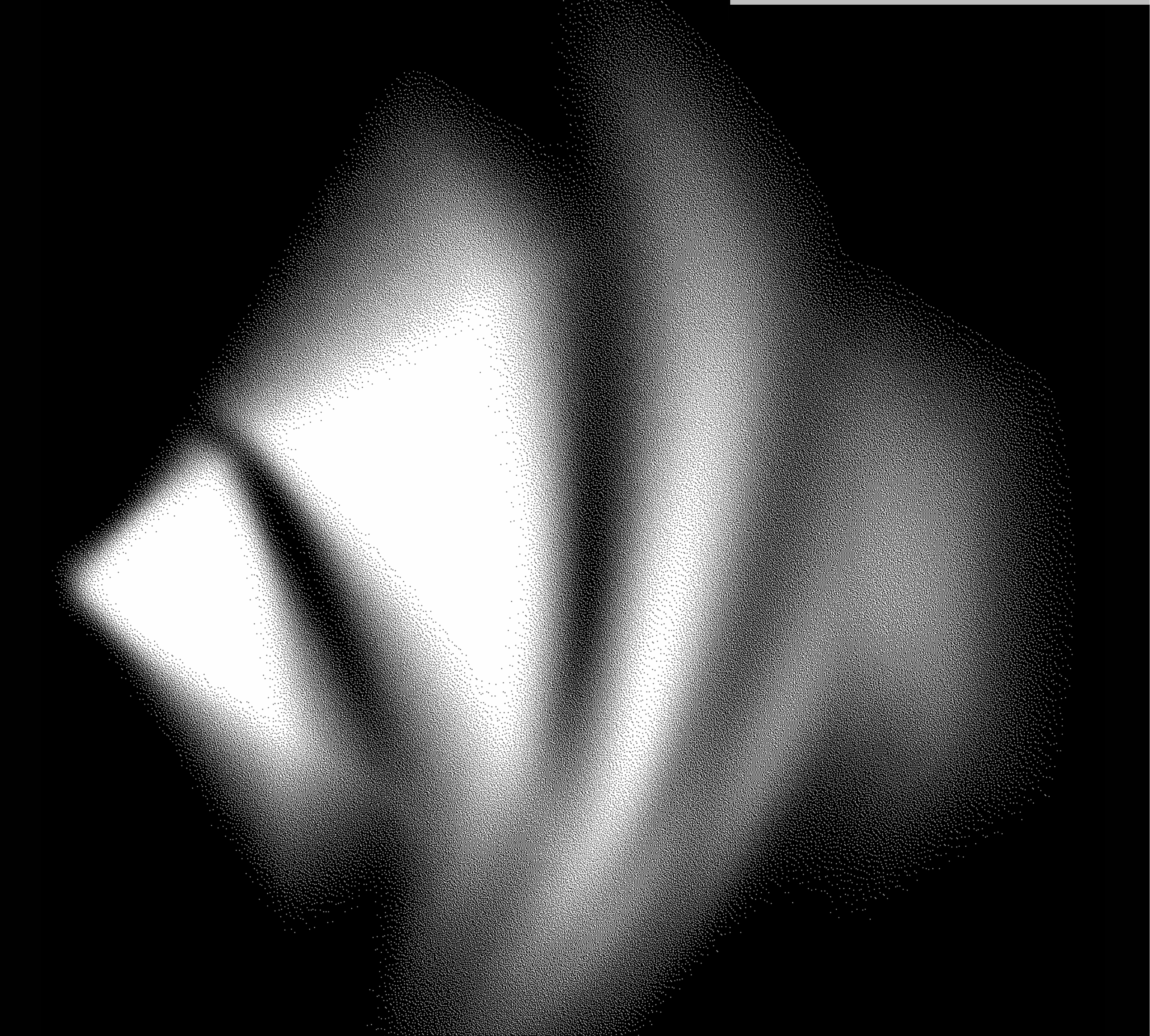
Australian Government
Productivity Commission

The Private Cost Effectiveness of Improving Energy Efficiency

Productivity Commission Inquiry Report

No. 36, 31 August 2005



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<u>The Productivity Commission</u>

The Productivity Commission, an independent agency, is the Australian Government's principal review and advisory body on microeconomic policy and regulation. It conducts public inquiries and research into a broad range of economic and social issues affecting the welfare of Australians.

The Commission's independence is underpinned by an Act of Parliament. Its processes and outputs are open to public scrutiny and are driven by concern for the wellbeing of the community as a whole.

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Terms of reference

INQUIRY INTO THE ECONOMIC AND ENVIRONMENTAL POTENTIAL OFFERED BY ENERGY EFFICIENCY

Productivity Commission Act 1998

I, ROSS CAMERON, Parliamentary Secretary to the Treasurer, pursuant to Parts 2 and 3 of the *Productivity Commission Act 1998*, hereby request that the Productivity Commission undertake an inquiry into the economic and environmental potential offered by energy efficiency and report within 12 months of receipt of this reference. The Commission is to hold hearings for the purpose of the inquiry.

Background

Australia's access to low cost, reliable energy is a source of competitive advantage for Australia. However, Australia's historic energy efficiency performance has been weak in comparison with other OECD countries. In this context, improvements in energy use which are cost-effective for individual producers and consumers have the potential to enhance Australia's economic prosperity and at the same time lower Australia's greenhouse signature.

Energy efficiency in this context refers to maintaining or increasing the level of useful output or outcome delivered, while reducing energy consumption, and encompasses both supply side and demand side efficiency.

Scope of the Inquiry

The Commission is to examine and report on the economic and environmental potential offered by energy efficiency improvements which are cost-effective for individual producers and consumers, including through consideration of:

1. the economic and environmental costs and benefits arising from energy efficiency improvements, including, but not limited to, research undertaken in the context of the National Framework for Energy Efficiency and international studies;
2. existing and recent Australian and state government energy efficiency programmes, including consideration of the level of coordination between these programmes and comparison with international experiences;
3. barriers and impediments to improved energy efficiency, including, but not limited to, information asymmetries and implementation costs;
4. the potential for energy efficiency improvements which are cost-effective for individual producers and consumers arising from actions including:
    - energy market reform to facilitate improved demand and supply management, including, but not limited to, more efficient cost-reflective price signalling in the market, particularly at peak times;

- improved financial information on energy efficiency, including, but not limited to, provision of additional financial information on energy efficiency to firms' internal and external investors and decision makers;
- improved energy efficiency information, including, but not limited to, provision of additional energy efficiency information in relation to plant and equipment, appliances, vehicles and fuels, and residential and non-residential buildings;
- minimum energy efficiency standards, including, but not limited to, minimum standards for plant and equipment, appliances, vehicles and fuels, and residential and non-residential buildings;
- new and improved technologies and equipment, including, but not limited to, improved technologies in relation to plant and equipment, appliances, vehicles and fuels, and residential and non-residential buildings;
- financial incentives for improving energy efficiency, including, but not limited to subsidies, private sector rebates or discounts and levies on energy use; and
- improved operational practices at the level of consumers and households, governments, and the industrial and commercial sectors.

5. policy options for energy efficiency improvements which are cost-effective for individual producers and consumers, including:
   - improving industrial and commercial energy efficiency, including, but not limited to, energy efficiency agreements, and increased disclosure through public energy efficiency reporting;
   - improving consumer and household energy efficiency;
   - improving the efficiency of government energy use;
   - improving transport related energy efficiency, including, but not limited to, urban planning, congestion pricing, intelligent transport systems, travel demand management, and increased efficiencies in the business and freight sectors (including opportunities for better matching of transport choices with transport tasks undertaken); and
   - introducing a national energy efficiency target, including, but not limited to, the establishment of an annual requirement for major users of stationary energy to generate, or otherwise acquire, a target level of efficiency related energy savings.

The Commission is to provide both a draft and a final report. The Government will consider the Commission's recommendations, and its response will be announced as soon as possible after the receipt of the Commission's report.

ROSS CAMERON

31 August 2004

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Abbreviations and explanations

Abbreviations

ABARE	Australian Bureau of Agricultural and Resource Economics
ABCB	Australian Building Codes Board
ABGR	Australian Building Greenhouse Rating
ABS	Australian Bureau of Statistics
ACA	Australian Consumers' Association
ACCC	Australian Competition and Consumer Commission
ACF	Australian Conservation Foundation
ACTHERS	ACT House Energy Rating Scheme
AEEMA	Australian Electrical and Electronic Manufacturers' Association
AER	Australian Energy Regulator
AEMC	Australian Energy Market Commission
AEPCA	Australasian Energy Performance Contracting Association
AGA	Australian Gas Association
AGO	Australian Greenhouse Office
ANZSIC	Australian and New Zealand Standard Industrial Classification
ATA	Australian Trucking Association
BASIX	NSW Building Sustainability Index
BAU	business-as-usual
BDP	Australian Council of Building Design Professions Ltd
Building Code	Building Code of Australia
BERS	Building Energy Rating Scheme
BTCE	Bureau of Transport and Communications Economics

BTRE	Bureau of Transport and Regional Economics
CAFE	Corporate Average Fuel Economy
CAPM	Capital Asset Pricing Model
CEFG	Clean Energy Future Group
CESA	Consumer Electronic Suppliers Association
COAG	Council of Australian Governments
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEH	Australian Government Department of the Environment and Heritage
DEUS	NSW Department of Energy, Utilities and Sustainability
DITR	Australian Government Department of Industry, Tourism and Resources
EEAP	Enterprise Energy Audit Program
EEBP	Energy Efficiency Best Practice Program
EEC	United Kingdom Energy Efficiency Commitment
EEOA	Energy Efficiency Opportunities Assessment
EEWG	Energy Efficiency Working Group
EPA	Victorian Environment Protection Authority
EPC	energy performance contract
ERAA	Energy Retailers Association of Australia
ESAA	Energy Supply Association of Australia
ESC	Victorian Essential Services Commission
ESCO	energy services company
ESCOSA	Essential Services Commission of South Australia
EWON	Energy and Water Ombudsman NSW
FBT	fringe benefits tax
FCAI	Federal Chamber of Automotive Industries
FRT	full retail contestability
GAEEEP	Gas Appliance and Equipment Energy Efficiency Program
GBCA	Green Building Council of Australia

HIA	Housing Industry Association Ltd
IC	Industry Commission
IEA	International Energy Agency
IPART	Independent Pricing and Regulatory Tribunal of NSW
IRR	internal rate of return
ITS	Intelligent Transport Systems
kWh	kilowatt hour
MBA	Master Builders Australia
MCE	Ministerial Council on Energy
MEFL	Moreland Energy Foundation Ltd
MEPS	minimum energy performance standard(s)
MRET	Mandatory Renewable Energy Target
Mt CO_2	megatonnes of carbon dioxide
NABERS	National Australian Built Environment Rating System
NAEEEC	National Appliance and Equipment Energy Efficiency Committee
NAEEEP	National Appliance and Equipment Energy Efficiency Program
NATA	National Association of Testing Authorities
NatHERS	Nationwide House Energy Rating Scheme
NCP	National Competition Policy
NEET	national energy efficiency target
NEM	National Electricity Market
NFEE	National Framework for Energy Efficiency
NGAC	NSW Greenhouse Gas Abatement Certificate
NGAS	NSW Greenhouse Gas Abatement Scheme
NGF	National Generators' Forum
NGO	non-government organisation
NGS	National Greenhouse Strategy
NPV	net present value
NRTC	National Road Transport Commission

NTC	National Transport Commission
OCC	opportunity cost of capital
OECD	Organisation for Economic Cooperation and Development
ORER	Office of the Renewable Energy Regulator
ORR	Office of Regulation Review
PC	Productivity Commission
PIA	Planning Institute of Australia
PVA	product verification audit
R&D	research and development
REC	Renewable Energy Certificate
RIS	regulatory impact statement
RTP	rate of time preference
SEAV	Sustainable Energy Authority of Victoria
SUV	sports utility vehicle
TWh	terawatt hour
US EPA	US Environmental Protection Agency

Explanations

Findings	*Findings in the body of the report are paragraphs highlighted using italics, as this is.*
Recommendations	***Recommendations in the body of the report are highlighted using bold italics, as this is.***

OVERVIEW

Key points

- Firms and households generally do not deliberately waste energy. But energy has been cheap and is only a small percentage of total outlays for most Australian firms and households. Energy efficiency has not been a high priority for them.
- Compared to other OECD countries, Australia has a relatively high level of energy consumption per unit of output. However, such comparisons can be misleading because of significant differences between countries in climate, energy prices and the size of energy-intensive industries. Australia must achieve the right level of energy efficiency for its own circumstances.
- Many governments see energy efficiency improvements as a low-cost means of reducing emissions of greenhouse gases. However, the scope for achieving environmental gains through increasing the uptake of only those energy efficiency improvements that are privately cost effective appears to be modest at current and expected energy prices.
- The most important barriers to the adoption of privately cost-effective energy efficiency improvements appear to be:
  - a failure in the provision of information; and
  - the different incentives facing those who take decisions about installing energy-efficient products and those who might benefit from using them.
- Some government intervention to address these problems is appropriate. The Commission favours light-handed regulatory responses and information provision, rather than more prescriptive and intrusive approaches:
  - mandatory labelling can be an appropriate way of providing information, but
  - other mandatory measures — such as minimum performance standards — may not be privately cost effective; and
  - a sufficient case has not been made for the imposition of a national energy efficiency target and tradeable obligations.
- The Ministerial Council on Energy has improved the coordination of energy efficiency programs. Elements of the National Framework for Energy Efficiency Stage One could result in further improvement, particularly if there is:
  - greater clarity as to the objectives of government intervention;
  - more emphasis on priority setting; and
  - rigorous evaluation of past policies and programs including in particular the energy efficiency regulations in the Building Code of Australia.
- The various educative, suasive and regulatory approaches to encourage or mandate greater energy efficiency continue to conflict with the signals given to energy users by Australia's relatively low energy prices.
- Some energy efficiency measures may not be privately cost effective, and yet may generate net public benefits because of their environmental outcomes. Those measures may prove to be sound public policy, but they should be considered against other means of achieving those environmental objectives.

Overview

Energy efficiency has long been a policy issue, first because of concerns about energy scarcity and depletion of energy reserves, exacerbated by the oil shocks of the 1970s, and more recently, because of links between fossil-fuel use and climate change. Policy interest has been heightened by the diverse positions of governments over the ratification of the Kyoto Protocol, emissions trading and carbon taxes. Governments around the world have been seeking low-cost opportunities to reduce greenhouse gas emissions. The combustion of fossil fuels is a key source of greenhouse gas emissions, so reducing their consumption (or of electricity derived from them) seems like an obvious focus.

Energy efficiency measures, unlike energy conservation, aim to reduce energy consumption while at the same time maintaining or increasing the level of useful output or outcome delivered. Put simply, on hot days, electricity consumption could be reduced through:

- an *efficiency* measure, for example, installing insulation (which reduces the amount (and cost) of electricity used to maintain a cool home); or
- a *conservation* measure, for example, turning up the thermostat (and tolerating a hotter house) or by turning off the air conditioner and going to the pool or the movies.

Achieving greater energy efficiency is understandably attractive to many governments and environmental organisations concerned about climate change. It offers the prospect of significant reductions in emissions — at low or negligible costs to energy users. It may even save users considerable amounts of money.

The pursuit of energy efficiency would also seem to be in the interests of any rational producer or consumer, firm or household. And yet the issue at the heart of this inquiry is why producers and consumers do not always seek greater energy efficiency, even when it seems cost effective for them to do so. Why isn't the market working — or is it? Answering these questions is important in framing a policy response that will provide net benefits for the community. In part, the answer is one of perspective — individual producers and consumers seek to economise on the use of all inputs, not just energy.

What did the inquiry cover?

The subject of this inquiry is ‘the economic and environmental potential offered by energy efficiency improvements which are cost-effective for individual producers and consumers’ (inquiry terms of reference). It has both narrow and broad perspectives.

The narrower focus has been on identifying: energy efficiency improvements where the private benefits exceed the costs to individual producers or consumers; the barriers and impediments to the adoption of such improvements; and the case for government intervention. Policy options have been canvassed for various sectors of the economy: commercial and industrial; consumers and householders; government (as a user); and transport. Different policy instruments and government programs have been examined: labelling and the provision of other information; standard setting; financial incentives; energy market reforms, such as how electricity prices are regulated; and the introduction of a national energy efficiency target.

Private cost effectiveness is a much narrower focus than the more commonly adopted public perspective that underpins the Commission’s economywide charter. That the Commission was required to take this narrower approach was a matter of great concern to many participants in this inquiry.

The Commission recognises that many energy efficiency measures can yield environmental benefits. It also recognises that governments should be motivated by the broader public interest (including effects on the environment), not by private cost effectiveness. Yet energy efficiency policies have been frequently rationalised by their alleged private benefits. This is understandable because it is harder to quantify environmental benefits and costs than it is to quantify private benefits and costs, and the latter have been frequently viewed by policy makers as sufficient to justify government intervention. But it is important that this basic principle be tested: are such policies truly ‘no regrets’ measures in the sense that they are good for energy users and good for the environment? If it is difficult to overcome the barriers to the adoption of privately cost-effective improvements in energy efficiency, then it will be even more difficult to drive the adoption of measures that will require private sacrifices for the greater public good. As governments push beyond ‘costless’ or ‘no regrets’ policies, it becomes increasingly important that net social benefit (including environmental benefits) is substantiated, not just asserted.

Furthermore, the inquiry terms of reference direct the Commission to examine and report on the broader economic and environmental costs and benefits arising from privately cost-effective energy efficiency improvements. Thus, although the Commission is constrained to look at only a subset of all possible energy efficiency measures, it is required to have regard to the public benefits of those measures.

It is appropriate for governments to evaluate the social impacts of all energy efficiency proposals, whatever their underlying rationale. But the first task is to examine why measures that appear to be privately cost effective are not being adopted.

Policy interest in energy efficiency

All levels of government in Australia are involved in various, and changing, energy efficiency programs. Some effort is being devoted to developing a more coordinated approach as a means of adopting best practice nationally, of achieving economies of scale in the development of programs and of reducing costs of compliance for national firms. However, there can also be benefits from so-called ‘regulatory competition’, where different approaches by different governments provide opportunities for exploring and piloting innovative policies. These tradeoffs come into play at various points in this report.

In June 2001, the Council of Australian Governments established the Ministerial Council on Energy (MCE) to oversee energy market reform and related issues. The MCE subsequently established the Energy Efficiency Working Group to develop a National Framework for Energy Efficiency (NFEE). Following public consultation, the MCE has adopted an extensive nine point plan for promoting energy efficiency (NFEE Stage One). It involves:

- tightening *residential* building energy efficiency regulation;
- introducing *commercial* building energy efficiency regulation;
- extending *labelling and standards* for electrical appliances and applying the same approach to gas appliances;
- various awareness-raising programs targeted at *consumers*, the *financial sector* and the *private sector* (the latter including through mandatory audits for large energy users);
- developing *commercial and industrial sector capability* (for example, through establishing best-practice networks);
- imposing additional reporting requirements on *governments*; and
- trade and professional *training and accreditation*.

In its August 2004 White Paper, *Securing Australia’s Energy Future*, the Australian Government announced its commitment to ‘energy prosperity, security and sustainability’. Measures which were endorsed included: mandatory audits for large energy users; the extension of minimum energy performance standards (MEPS) for appliances and buildings (both as set out in NFEE Stage One); and a ‘solar cities’ demonstration trial.

Other more ambitious initiatives proposed during the drafting of the White Paper, such as a national energy efficiency target (NEET), were not included but were to be referred to the Commission for inquiry. This led to the perception among some people that this inquiry would be constrained to only consider policies additional to the NFEE Stage One policies. However, the terms of reference quite clearly stipulate that the Commission should look at all *existing and recent* policy considerations, including a NEET.

Is there an energy efficiency gap?

Throughout these processes, much attention has been given to the ‘energy efficiency gap’, defined as the gap between actual energy efficiency and the level of energy efficiency believed to be achievable and affordable. Evidence of a gap (or gaps) can be found in cross-country comparisons and case study results.

Australia’s aggregate energy intensity, and rate of improvement in aggregate energy intensity, are below OECD norms. This is sometimes taken as sufficient evidence of a problem that needs to be fixed by government action. The terms of reference for this inquiry include this notion. But for each country the economically efficient level of energy use, intensity or efficiency depends on such factors as the price of energy, any comparative advantage in energy-intensive industry, the climate, and the cost of other inputs. The costs of making the necessary changes and other options for investment must also be considered.

The second body of evidence comes from micro studies of individual firms, factories and households, or even individual machines and appliances. Claims made during the early phases of the NFEE process suggested that, even using pessimistic assumptions, energy efficiency improvements could achieve reductions in energy consumption of between 20 per cent and 34 per cent in different sectors of the economy. The implication was that these measures would not only be cost effective for energy users but also highly effective at reducing greenhouse gas emissions.

More recent modelling undertaken for the NFEE suggests that the economic and environmental potential of closing these gaps might be considerably less than was first thought. Using a bottoms-up approach, the modelling has estimated that energy efficiency gains of between 5 and 14 per cent of current energy usage could be achieved, depending on the industry sector. It was estimated that, relative to a business-as-usual scenario, implementing 50 per cent of the identifiable gains would increase GDP by 0.09 per cent (or about $1 billion) and reduce greenhouse gas emissions by 2.8 per cent in 2016.

The Commission has reviewed such claims and considers that there is such uncertainty about the size of the gains to be made (and so many unknowns), that it is impossible to say just how big they are. Rather than debate the size of these gaps, the Commission considers it more productive to accept that they exist, and then ask why they exist, and how government intervention could help increase uptake of energy efficiency improvements in a way that is best for the Australian community. The first step is to understand the barriers and impediments that explain the existence of these gaps.

What are the barriers and impediments?

Inquiry participants identified different reasons for the behaviour of individual producers and consumers where investing in energy efficiency improvements is concerned (box 1). This behaviour reveals that many different barriers and impediments can be at work. This report has grouped these into three broad categories: market failures; organisational failures, and behavioural and cultural norms; and other barriers and impediments.

Box 1 **Some attitudes to energy efficiency**

The attitudes of a number of producers and consumers to improving their levels of energy efficiency can be summarised as follows:

- *My production decisions are driven by the combined costs of all inputs, and not just the most efficient use of energy* — energy efficiency does not fully equate with marketplace economic efficiency.
- *I'm not across all of the options* — there are information gaps, asymmetries and costs.
- *I can't afford the extra costs of the latest or most efficient machinery or appliance* — producers and consumers are generally capital constrained.
- *For the savings it will give me, it's not worth my effort* — satisficing behaviour is a fact of business and household life, especially if energy costs are low.
- *What might be cost effective for some people is not cost effective for me* — producers and consumers are heterogeneous, and the potential costs and benefits of one individual's actions to increase energy efficiency will be different from the benefits and costs in a 'model' energy-efficient firm or household.
- *From my experience, making the changes won't be straightforward* — there are implementation costs and risks, some of which may be uncertain.

Market failures

There are well-known circumstances in which markets will not achieve the best returns for the community. In terms of the uptake of privately cost-effective energy efficiency improvements, the market failures of most policy relevance are caused by information failures. *Lack of information* may account for many such opportunities being forgone. Some information may not be provided at all, or will be underprovided, if firms and households can *free-ride* on the efforts of others. And *information asymmetries* can put buyers of energy-using products at a disadvantage to sellers.

Split incentives might also be important. Split incentives can exist where, for example, the incentives facing a builder (to choose a technology with low capital costs) diverge from the incentives facing the user (to choose the technology with lower running costs). While these problems may be worse where information asymmetries are present, they may exist even where both parties have the same information. For example, both landlord and tenant could benefit from installing insulation or a solar hot water system, if they could agree on a rent adjustment that makes both better off. Yet frequently this does not happen because of difficulties and risks in negotiating the rental adjustment. However, the importance of split incentives as a market failure needs to be kept in perspective. To the extent that energy costs are important, it will become worthwhile for both parties to sort out a new contract.

The presence of market failure does not of itself warrant government intervention. Government intervention can be costly and introduces its own distortions, especially if the intervention is poorly targeted to achieving the relevant objective. Government intervention is only warranted when it produces net economic, social or environmental benefits to the community.

Organisational failures and behavioural norms

A second set of barriers and impediments include behavioural norms and organisational constraints. The difficulties faced by individuals in obtaining and processing complex information can lead to *satisficing* ('close enough is good enough') rather than *optimising* behaviour. However, to the extent that this behaviour has lower information costs (including cognitive effort), it might itself be a realistic, cost-effective outcome.

Constrained or defective internal communications within organisations might also account for some of the energy efficiency gap. Even within households there are communications gaps ('turn the lights off, kids!'). But the extent to which this set of barriers should influence policy is doubtful. For firms, encouraging a competitive environment is a better approach, as this will exert pressure on them to be as efficient as possible, in all areas, including their use of energy.

Other barriers and impediments

A final set of barriers and impediments are associated with a range of costs that are difficult to capture in the 'engineering–accounting' models typically used to estimate the cost effectiveness of energy efficiency improvements. The limited resources of management, the costs of implementing new technologies, risk and uncertainty, access to (and the cost of) capital, and the sunk nature of many investments provide a reminder that many energy-efficient technologies may not be sufficiently cost effective, once all of the costs are considered. Generally speaking, these are not barriers that warrant policy intervention.

Furthermore, energy costs are often quite a small component of total costs. In the face of competing demands, households and firms may not consider that it is worth the time or effort to obtain information about energy used and then undertake the consequent investment, for relatively small (private) benefit. For example, in 2003-04, households only spent on average around $24 per week on non-transport energy. Thus, even if a 10 per cent saving were achieved, it would amount to only about $2.40 per week. Energy costs are similarly quite small for the commercial sector, amounting to 1.6 per cent of total expenditure. Energy costs in manufacturing and transport are somewhat higher at levels of 6.8 per cent and 4.5 per cent of total expenditure respectively.

The influence of energy prices

The Commission has separately considered the price of energy. Changes in energy prices would clearly influence what energy efficiency measures individual consumers or producers would be prepared to adopt. For example, higher prices would encourage more investment in energy-efficient technologies as people and firms think of creative new ways for economising on the input that has become more expensive. Higher prices would not, however, change the intrinsic nature of the barriers and impediments in the market for energy-efficient technologies, just their relative importance. Even in Europe, where energy prices are much higher than in Australia (and energy efficiency appears also to be somewhat higher as a result), the same sorts of barriers and impediments still persist. This is not to imply that energy prices should be artificially increased just for the purpose of promoting energy efficiency. Access to low-cost energy is important for economic and social reasons. What is more appropriate is that prices be fully cost reflective so that they promote overall economic efficiency in the production and use of energy.

Table 1 **Governments' responses to identified barriers and impediments to adopting energy efficiency improvements**

Barrier and impediment	*Typical government responses*	*Australian examples*
Market failure		
Asymmetric information	Help buyer discover relevant information or require seller to disclose	Labelling appliances ACT house energy efficiency rating scheme
Split incentives	Mandate installation of chosen technology	Minimum energy performance standards for appliances; Building Code of Aust; Building star ratings
Public good information	Provide or subsidise provision of relevant information	AGO Green Vehicle Guide; TravelSmart; Smart Housing; brochures; energy efficiency shopfronts
Positive externalities	Provide or subsidise research and development and demonstration projects	General R&D tax concessions and grants; cooperative research centres
	Encourage business networks	Energy Efficiency Best Practice program
Behavioural and cultural		
Bounded rationality	Reduce choice; eliminate 'inferior' products; mandate certain equipment	Minimum energy performance standards for appliances; Building Code of Aust; Building star ratings
Organisational barriers	Mandatory audits & disclosure	Energy Efficiency Opportunity Assessments; Victorian EPA licensing requirements; NSW Energy Savings Action Plans
Other barriers and impediments		
Implementation costs	Subsidies for audits, consultancies and equipment	SEAV/DEUS programs
Risk and uncertainty	Subsidise use of energy-service consultants	NSW Energy Smart Business program
Capital constraints	Special funds for energy efficiency	Energy Efficiency Program for Low Income Households (SA)
Asset replacement costs	Subsidies	Greenhouse Gas Abatement program (DEH); subsidies for solar hot water systems

Responding to barriers and impediments

The Commission has summarised how governments have typically responded to the various barriers and impediments to adopting energy efficiency improvements (table 1). Some existing policies and programs arguably address several perceived barriers and impediments at the same time. But the existence of others that do not address a source of market failure should be questioned. Many such policies and programs may be quite effective in increasing energy efficiency and/or reducing emissions of greenhouse gases, but they are unlikely to be privately cost effective for producers and consumers, and should not be justified on such grounds.

Policy responses

A key policy question this inquiry has been asked to address is: what is the case for government intervention to promote the uptake of energy efficiency improvements that are ostensibly cost effective for individual producers or consumers but are not being taken up? If there is a case for intervention, a supporting question is: how should governments intervene?

The case for intervention varies according to the sector of the economy. The market failures of most policy relevance are more profound in the residential/consumer segment than elsewhere, typically relating to information asymmetries and split incentives. In the commercial and industrial area, information problems are less significant, particularly for larger firms, and especially for those who face large energy bills and/or have strong links to like firms around the world. However, for many small businesses, the issues are similar to those confronting householders.

Governments have used various policy instruments to address barriers and impediments. These can be grouped in an order of increasing intrusion:

- providing information directly;
- voluntary partnership programs (for example, Greenhouse Challenge Plus);
- subsidies and other financial incentives;
- requiring disclosure of information by sellers/producers;
- preventing access to less energy-efficient products (for example, MEPS and the energy efficiency standards in the Building Code of Australia (Building Code));
- setting a NEET; and
- mandating investment in more energy-efficient equipment and technologies.

The Commission's assessment of the case for using each of these classes of policy instruments is presented below.

Providing information

Information programs are provided by all jurisdictions and are pitched mostly at the householder level. For example, the Queensland Government provides a general energy efficiency advisory service and a more specific Smart Housing service that provides information on how to build homes that are more energy efficient.

Governments have a role to play in providing such information directly where the information has public good characteristics (or positive spillovers) that would result in it being otherwise underprovided. Government provision might also achieve economies of scale and scope, and thus lower costs to users; and it might be justified for social reasons if it aids accessibility or provides credibility by deriving from a neutral source.

However, judgements are required about how much information governments should provide directly. For example, the Australian Greenhouse Office's Green Vehicle Guide provides fuel consumption information that largely replicates what is available from private sources. And some advice on home energy efficiency options can be obtained from commercial and other non-government sources. To some extent, the most productive role for government is to be the facilitator that draws together this information and packages it in a form that ensures that relevant and trusted information gets to those who would otherwise not get it.

The case for governments providing general information is weakest where the users are larger commercial and industrial organisations. The information needs of such firms are usually very specific and, to the extent that energy costs are significant, firms have strong incentives to obtain that information and the resources to do so.

Where there is sufficient private incentive, markets can be expected to provide information. Producers of energy-efficient goods and services (for example, insulation, solar hot water systems, and more efficient motors) vigorously advertise the merits of their products. Energy services companies (ESCOs) are widespread in North America and are rapidly emerging in Australia, with business propositions that guarantee energy savings for their clients.

Governments very clearly have a role to provide information on energy efficiency regulations where they exist. In the interests of maximising regulatory compliance, no fees should be charged for access to the regulations themselves. In this respect, the Commission reiterates its concern over the high costs of accessing the Building Code and affiliated standards.

Voluntary partnership programs

Most jurisdictions operate partnership programs in which participating firms voluntarily commit to invest in agreed measures, usually targeted at achieving greenhouse objectives. In return, the firm receives some assistance (though not usually cash subsidies) and the right to promote itself as an 'eco friendly' company. The most prominent of these is the *Challenge Plus — Enhanced Industry Partnerships* program operated by the Australian Government. This program has attracted the participation of a large proportion of manufacturing industry, particularly the larger firms.

The Commission considers that voluntary agreement programs can be effective policy tools for promoting energy efficiency improvements as a means of achieving greenhouse gas abatement objectives. Voluntary agreements give organisations the flexibility to self-select as well as to choose the level and nature of their undertaking. There is, therefore, a lower risk of firms being forced into adopting practices which are not privately cost effective for them.

However, at least in the case of Greenhouse Challenge Plus, it is likely that firms are motivated partly to prove their green credentials and as a precaution against the possibility of more intrusive measures being adopted. Furthermore, despite their neutral overtones, a certain amount of financial coercion or incentive is present in these schemes. The Commission notes that from 1 July 2006 participation in the Challenge Plus program will be a requirement for Australian companies receiving fuel excise credits of more than $3 million. The presence of financial incentives (or sanctions) may increase the probability of such companies undertaking projects that are not privately cost effective (though they may have net social benefits overall).

Subsidies and other financial incentives

Subsidies and rebates are used by governments to encourage energy efficiency improvements in various ways. Most jurisdictions have provided or currently provide subsidies to encourage firms to undertake audits, invest in research and development or participate in demonstration projects. Residential users may also receive rebates to take up energy-efficient practices, technologies and/or appliances (such as solar water heating), and subsidised house energy audits.

There may be good public policy reasons for using financial incentives in some or all of these cases. An incentive to encourage the uptake of energy-efficient practices may be justifiable on the grounds of reducing environmental damage associated with energy use, or because the practices generate positive spillover effects, like demonstration effects. But in the absence of these spillovers, the role of financial incentives is questionable.

Financial incentives do not directly address the market failures preventing the uptake of privately cost-effective energy efficiency improvements. They might make cost effective what is not otherwise, and they might help address internal organisational issues within firms (for example, by inducing involvement of different managers within the firm), but the Commission considers that these are not sufficient reasons for policy intervention.

Levies

The Commission was also asked to consider the role of levies, and has presumed this to mean a way of raising revenue for subsidising the uptake of energy efficiency improvements. That is, the income of the levy is hypothecated to a particular purpose. Levies have been used in some overseas countries in this way, and such a levy has recently been announced in New South Wales. That levy will be used to raise a $40 million annual fund over 5 years to support energy saving initiatives.

Levies can be an important revenue-raising tool where there is some connection between the payment and the services received, and are sometimes likened to benefit taxes. The use of the fuel excise paid by truck operators to fund the repair of road damages is an example.

A levy on energy users to pay for energy efficiency improvements has some appeal on equity grounds — all users of energy derived from fossil fuels contribute to environmental externalities and hence might be asked to contribute to their amelioration. However, such a levy would have some serious drawbacks because there is no necessary nexus between the appropriate level of taxes and funding needs. It would be more distortionary and have higher administration and compliance costs than existing broad-based taxes. The Commission considers that the case for government subsidies for promoting energy efficiency should be separated from the means of funding those subsidies.

Requiring disclosure of information

Governments can pass regulations that require information to be provided. Examples include compulsory labelling schemes (such as apply to electrical appliances and passenger motor vehicles), requiring that energy efficiency ratings be provided when selling or leasing a house, and compulsory auditing and reporting for large energy users. Governments typically also require that their own agencies provide information on energy consumption or intensity.

Appliance and vehicle labelling

Labelling is used to indicate the energy efficiency of electrical and gas appliances and cars. Mandatory labelling directly addresses a source of market failure — the asymmetry of information between buyers and sellers of energy-using products. By providing information in a readily-accessible and easily-understandable format, labelling can help consumers to make better-informed choices about energy efficiency.

Previous research had suggested that energy efficiency labels were not a prime consideration in choosing appliances or motor vehicles, but may have come into play once consumers had short listed products on the basis of price, performance, capacity and style. However, there is some evidence to suggest that consumers are now paying more attention to labels than they have in the past. A positive characteristic of labelling is that it does not directly limit consumer choice. Suppliers might chose to withdraw low-ranking appliances from sale, but that is essentially a commercial decision on their part.

However, labelling involves both administration and compliance costs, such as those incurred by suppliers in having their products tested. Even so, the Commission has concluded that, at least in the case of electrical and gas appliances, labelling has probably produced net social benefits. The Commission has also concluded that labelling should be more actively considered as an alternative to minimum performance standards. Other forms of labelling, such as disendorsement labels (for example, 'this product is not recommended for frequent usage'), and positive labelling (where suppliers are permitted, but not compelled, to display labels on appliances that exceed a minimum standard) might also be considered.

This is not to say that labelling should extend to all appliances. It is most suited where there is a wide spread in the range of energy efficiency performances of comparable appliances, where energy-rating tests bear some resemblance to the way appliances are used, and where information failures are most pronounced.

House energy performance rating

The ACT Government currently requires anyone selling or leasing a house to obtain an energy-performance rating that must be disclosed in advertisements and in the contract of sale. The NFEE Stage One proposals include the extension of this scheme to all other States and the Northern Territory. These sorts of schemes address market failures arising from information asymmetry and split incentives between vendors and purchasers, and can be broadly likened to appliance labelling.

However, the Commission is not convinced that in its current form the ACT scheme produces net social benefits and considers that there are fundamental problems with such schemes. They add to transaction costs and may not be very effective in encouraging the uptake of energy efficiency improvements. This is because energy operating costs are a very small cost of home ownership and other features will most likely have a far more important impact on house-purchasing decisions. Furthermore, there are serious problems in using rating tools to assess the energy efficiency of different homes.

The Commission welcomes the intention to undertake an independent evaluation of the ACT scheme before it is extended to other jurisdictions. The evaluation should assess how well house ratings predict actual energy performance, and the costs, benefits and effectiveness of the scheme, including the extent to which the information disclosed has influenced purchasing decisions.

Mandated audits for large energy users

The recently announced Energy Efficiency Opportunity Assessment (EEOA) program will make it mandatory for firms using more than 0.5 petajoules of energy per annum, to undertake energy audits and report the results publicly. The program is the culmination of a long history of governments trying to persuade firms to invest in energy efficiency improvements that external auditors consider to be cost effective but which are not being adopted. The public-reporting requirement is a significant development that is presumably intended to encourage management to adopt cost-saving opportunities that others (both within and outside the firm) might identify. The features of the EEOA suggest that it is designed to address perceived organisational and behavioural weaknesses within firms.

The proposition that large energy users are forgoing cost-effective energy efficiency improvements is questionable. These users, particularly those who use energy intensively, have strong incentives to use energy prudently within the total mix of all inputs. Unnecessarily wasting energy will cost them money, and damage their competitiveness.

It is also questionable whether mandatory assessments and reporting will lead to appropriate changes in behaviour. Publicly-listed firms are already answerable to shareholders and the capital market generally. And as has been seen with earlier audit programs, many energy efficiency opportunities are not taken up by management because they are perceived to be uneconomic when all costs of implementation are considered. A common criticism of external auditors is that it is difficult for them to fully appreciate the way their clients operate and hence to anticipate the implications of their recommendations. This can lead to unacceptable operating and personnel changes, risk or inconvenience to personnel, disruptions to production and changes in product quality. To the extent that mandatory assessments influence behaviour, there is the risk that managers will be pressured into investing in lower-return projects.

As noted previously, the Commission considers that organisational and behavioural limitations/barriers are not a sufficient reason for government intervention. Governments' attention would be better focused on continuing to promote a competitive environment within which firms focus on cost control as part of maximising shareholder value.

It is doubtful too that the EEOA scheme could be justified on environmental grounds. It contains no incentives to address environmental objectives other than to avoid the possible embarrassment associated with publishing audit results. On the basis of the evidence currently before it, the Commission is not able to support this program. Furthermore, the Commission notes the inconsistencies that are now emerging between the EEOA and the recently announced (and similarly flawed) commitment by the New South Wales Government that requires large energy users in that state to separately undertake energy audits.

Preventing access to energy-inefficient products

Governments can prevent the sale of energy-inefficient products by using minimum standards. These standards apply to gas and electrical products through the MEPS program, and for residential buildings (and shortly, other buildings) through the Building Code (and State and Territory-specific standards).

Minimum Energy Performance Standards

MEPS apply to appliances such as refrigerators and freezers, air conditioners, electric water heaters, electric motors, lamp ballasts and so on. If appliances do not meet the minimum standard they cannot be sold in Australia. Some appliances are covered by both MEPS and by labelling (for example, refrigerators). These instruments can be complementary, with MEPS penalising the worst energy performers, and labelling rewarding the better performers. In practice, MEPS have sometimes been used quite aggressively to remove whole swathes of product from the market (albeit with advance notice), to achieve a step change in average energy efficiency.

Appliance standards have most relevance where products are purchased infrequently, consumers rarely inspect the appliances in the showroom, and split incentive problems are significant. These conditions may apply for appliances such as electric water heaters (where householders may have little influence on choice), but are less relevant for most other household appliances, such as refrigerators and freezers, and equipment used by commercial and industrial consumers. But it does not necessarily follow that minimum standards will achieve privately cost-effective outcomes for consumers purchasing such appliances. Indeed, it seems counterintuitive that a measure that denies consumers choice and can increase purchase prices could be in their interests.

Notwithstanding these reservations, many *ex ante* assessments have alleged that MEPS can generate substantial savings in operating costs and net benefits overall for appliance users. But these assessments depend on what would have happened in the absence of MEPS, and this is largely unknowable. Clearly MEPS will have a dramatic effect when first introduced, but to the extent that they bring forward technological developments that would have occurred anyway, their effectiveness is limited.

Furthermore, higher levels of energy efficiency may only be sustained through trading off other features that consumers value, cost cutting that affects quality, or increases in price. Many of these effects will go unnoticed because most consumers will be unaware of the (now unavailable) options. But that does not decrease their importance.

Some participants argued that minimum standards are privately cost effective because they decrease the search costs associated with purchasing energy-efficient appliances. The presumption is that if consumers had the time and ability to search out the most energy-efficient appliance they would come to the same conclusion as the regulator. However, if information failures are the main problems, providing information — including through labelling — would be a less intrusive alternative.

MEPS may also have adverse distributional effects. Consumers with limited capital may prefer to purchase a less-efficient but cheaper appliance even if it would cost them more to operate over its lifetime.

A more practical problem with MEPS (and labelling), is in relating measures of energy efficiency to actual use. For ‘set and forget’ appliances (such as freezers and refrigerators), laboratory measurements of energy consumption are likely to relate reasonably closely to actual use. But where energy consumption is influenced more by the user than by the design of the appliance, this connection is more tenuous.

Although net social benefit should be the criterion by which such interventions are judged, the Commission considers that to the extent that private cost effectiveness is to continue to be an evaluation criterion, future MEPS need more rigorous analysis. Greater consideration also needs to be given to other policy instruments, including labelling. Furthermore, since abatement of greenhouse gases is the primary objective of MEPS, it would seem appropriate to give more emphasis to how well they achieve this objective. This is becoming more important as the opportunities for new privately cost-effective MEPS appear to be diminishing. The practice of always selecting standards on the basis of world's best practice (or leading the world) also needs to be reconsidered as it can lead to over-engineered standards that excessively reduce private cost effectiveness.

Building energy efficiency regulations

The explicit objective of the energy efficiency regulations in the Building Code (and variations on these adopted by particular states and territories) is to achieve greenhouse gas abatement. But they have also been promoted as cost effective for householders and building owners to implement. In the Commission's view, these regulations suffer from many of the same problems as appliance standards: they limit consumer choice (and innovation in design); add to costs; and may have adverse distributional effects.

Assessments of building energy efficiency standards have invariably suggested that the standards will be cost effective for individual producers and consumers. Yet evidence is now appearing of compliance costs being much higher than expected. For example, the Victorian Government predicted that the cost of a new house would rise by 0.7–1.9 per cent, but a recent survey shows that the average cost increase has been 6 per cent. And a survey by Master Builders Australia of its members revealed that the cost of a three-bedroom brick-veneer dwelling had increased by between $13 000 and $18 000, depending on design and location. In comparison, the Victorian Government had predicted an average cost increase of $3300.

In addition, there appear to be serious doubts about the effectiveness of these regulations in improving energy efficiency in a systematic way. Buildings and their occupants are heterogeneous in nature and, other things being the same, no two occupants will use energy, or their buildings, in the same way. Assessments of building standards have largely overlooked the consequences of this heterogeneity by simulating energy savings for a limited number of building designs and types of occupant behaviour. Energy savings are also uncertain because standards can be difficult to enforce; there are various compliance methods and they lead to different energy savings for a given building and occupant; and standards are not specified in terms of energy consumption.

The Commission is concerned that the analytical basis for these regulations (computer simulations of energy loads within buildings in each climatic zone) may be flawed. When added to the emerging evidence on costs of compliance, the Commission considers that there is a compelling case for existing standards to be fully evaluated as a matter of urgency.

The Commission also considers that it is vital to achieve national uniformity (but with appropriate allowance for climatic variation) with respect to the energy efficiency regulations in the Building Code. In this respect, it welcomes the recent commitment by the jurisdictions to a new intergovernmental agreement, and the expressed intention of the states and territories to implement measures to prevent local governments undermining the Building Code.

A national energy efficiency target

Another recent idea to promote energy efficiency is to implement a NEET. While no formal policy proposal is available, one general idea is that a NEET would require large energy users or retailers to achieve efficiency-related energy savings (compared to projected energy use under business-as-usual assumptions). While such targets could be voluntary, energy efficiency targets and related schemes implemented in Australia and internationally generally impose mandatory requirements on individual firms. A firm that failed to meet its mandatory target would be penalised. If trading was allowed, firms would be able to sell or purchase credits in a market for energy efficiency certificates (sometimes called white certificates).

A NEET would not directly address the market failures that may account for the energy efficiency gap. There would also seem to be many practical difficulties involved with establishing business-as-usual baselines for each regulated entity, and with measuring improvements in energy efficiency against these baselines:

- There is the potential that firms that were already energy efficient could be the most disadvantaged by the introduction of a NEET.
- A NEET is likely to encourage gaming by firms — they would have a strong incentive to artificially inflate business-as-usual projections and delay energy efficiency improvements that are already in the pipeline. Certification of activities that would have occurred anyway (in the absence of a NEET) is likely to be prevalent.

- Isolating energy savings resulting from energy efficiency measures from other influences on energy use — such as market and technological changes — is likely to be difficult. Consequently, verification of white certificates is likely to be time consuming and incur significant administration costs.

Due to these difficulties, trading in white certificates would not allocate energy-saving obligations in an economically-efficient way. A NEET would alter investment patterns and encourage energy efficiency projects that are not privately cost effective under current expectations about energy prices.

It is also unlikely that a NEET would be an appropriate policy to capture the wider social benefits (avoided costs) of greenhouse gas abatement. A NEET would not be the most directly-targeted instrument to address emissions, and is therefore unlikely to be the most efficient or cost-effective option. Notwithstanding European experiments with trade in energy efficiency (white), renewable energy (green) and greenhouse gas emissions (black) certificates, it is unlikely that a white certificate scheme would be a cost-effective complement to other measures to address greenhouse gas abatement objectives.

Mandating investment

At its most interventionist, government policy might require compulsory investment in technologies to achieve greater energy efficiency. This is a feature of the regulatory framework covering Victorian firms licensed by the Environment Protection Authority (EPA). Similarly, allowance has been made for mandating investment in a recently introduced NSW scheme that will require 'designated' energy users to undertake energy audits. Under the EPA scheme, firms seeking works approval for proposals involving energy use of 500 gigajoules per annum or more must undertake an audit, and are required to invest in projects that meet specified investment criteria (a three-year payback is the norm).

Such requirements could distort firms' investment decisions. Even if the audit assessment is accurate — and the proposed investment passes normal profitability criteria — the regulator is not required to assess whether the firm has access to the capital required or if the project represents the best use of that capital.

Although justified primarily for their environmental objectives, these schemes also illustrate the preparedness of governments to force firms to supposedly 'help themselves'. The Commission does not support this approach. A better approach might be to attach (explicitly justified) environmental-performance conditions to the licences of such firms and allow them to choose the means of achieving those objectives.

Energy market and transport reforms

The Commission has been asked to examine energy efficiency in the context of other important reform agendas: the influence of energy market reforms; and transport. In both cases, there appear to be compelling economic reasons for building on the pro-competitive reforms introduced in these areas in the past. The direction of those reforms is fundamentally about getting the prices of energy and transport right, so that producers and consumers face appropriate signals that will lead to better resource allocation in the economy. This will influence energy efficiency, but energy efficiency is *not* the prime policy objective. Indeed, while many reforms in these areas will enhance overall community wellbeing, their impacts on energy efficiency may be small, zero or even negative.

Energy market reforms

Significant microeconomic reforms of electricity and gas markets have occurred under the aegis of the Council of Australian Governments (COAG) and various State and Territory Governments. Of most interest in this inquiry is the electricity industry, and the potential for achieving even more cost-reflective pricing in the future. Past reforms have driven down costs but little attention has been given to demand-side measures. A number of obstacles to more cost-reflective pricing of electricity remain.

Retail price regulation

Retail electricity prices are regulated in one form or another in all States and Territories (typically through price or revenue caps on tariffs for residential and small business users or though price-equalisation schemes). Without a price mechanism to moderate demand during periods of congestion and high wholesale prices for electricity, many consumers have little or no incentive to conserve electricity, invest in energy efficiency, or reschedule their use to off-peak times. The result is the overinvestment in infrastructure needed to meet the needs of the community for those relatively few hours in the year when demand peaks, and an undue dependence on non-price means of rationing demand.

Many participants advocated the deregulation of retail pricing to allow more cost-reflective tariff arrangements to be introduced. There was a great deal of interest in time-of-use pricing and variations on this theme. While consumer demand is likely to be quite inelastic to increases (and decreases) in prices in the short term, there is potential for more significant medium to longer-term adjustment as behaviour changes. The early results of trials being conducted in New South Wales illustrate that savings are being achieved.

Some participants were concerned that competition might not yet be sufficiently robust to contain price rises. Others were concerned that adverse distributional effects would follow from unravelling the cross subsidies that exist in current tariff structures (for example, between small and large users and between urban and rural users). Distributional issues are clearly a concern for governments but, where hardship occurs, may be better addressed by more direct policy intervention, such as through explicitly funded community service obligations.

The Commission strongly supports the deregulation of retail pricing of electricity, as soon as there is effective competition in retail and generation markets.

However, the Commission notes that it will then largely be up to network operators and electricity retailers to decide how to translate wholesale prices into retail tariffs. To put time-of-day pricing into practice will require a substantial investment in metering technologies, and it is by no means clear that this will be worthwhile for all small customers. Ordinarily, this might seem to be a commercial decision for network operators, retailers and their customers to contemplate. However, it might be difficult for any one party to capture sufficient benefits to warrant making the investment unilaterally. There may be a case for government intervention to speed up the rate of adoption and address free-rider problems. Regulatory initiatives are already occurring in some States. For example, Victoria has mandated the roll out of interval meters in all new dwellings.

'Postage-stamp pricing' of networks disguises location-based costs

Price regulation of distribution and transmission networks generally involves cost averaging over classes of customers, including 'postage-stamp' pricing where the transmission charge is the same irrespective of the distance the electricity is transported. This can mean that users do not face the full (location-based) costs of delivering electricity to them. This may encourage the inefficient consumption of energy in some areas, while also discouraging distributed generation (that is, smaller-scale generators located close to local users).

It is not straightforward what effect distributed generation could have on energy efficiency. Energy losses during transmission would be reduced, but for a given primary fuel type, the smaller generators involved are likely to have lower generation efficiencies than the traditional and much larger centralised generators. Energy efficiency may be enhanced where cogeneration opportunities allow the joint production of process steam and electricity. On the down side, distributed generation can potentially lead to localised pollution impacts, which must be compared with the impacts of centralised generation.

Disincentives to invest in demand-side management measures

Some participants were concerned about regulatory disincentives for network operators to invest in demand-side management (for example, voluntary cuts in energy consumption, greater energy efficiency, or peak-load shifting) as an alternative to expanding their networks. There can be more incentive for network operators to invest in poles and wires than to invest the time and effort in demand-side measures that will lose them sales revenue, particularly if regulated prices make allowances for such capital expenditures. The Commission supports the actions of some regulators to address this bias through measures that attempt to recognise revenues forgone as a result of demand-side management measures. Peak-load congestion in the distribution systems might be more cost effectively addressed through demand-side management than through expanding the network, especially where the new capacity will only be utilised for a few hours per year.

Does transport reform improve energy efficiency?

Most important energy efficiency improvements in transport flow from policies which have major objectives other than energy efficiency. For example, the primary rationale for congestion pricing of road usage is that it will achieve valuable time savings, but it will also have some fuel efficiency benefits. Similarly, improved regulatory environments for road freight and the rail industry offer significant productivity gains and are also likely to provide energy efficiency improvements within each sector as well.

Efficient road pricing to alleviate congestion, at least in some cities at some times, could deliver significant net benefits (including improved fuel efficiency). Analysis by the Bureau of Transport and Regional Economics suggests that substantial net social benefits could be achieved from implementing congestion pricing at least in Sydney, Melbourne and Brisbane. Continued reform and improvements in passenger public transport should accompany any road pricing initiatives.

There is scope for further regulatory improvements in road transport, although the road agenda has progressed much further than rail. These additional reforms may permit the more flexible and efficient use of larger trucks (B-doubles and triples), which would increase the average fuel efficiency of road freight. But whether such changes should be made will depend on many other factors as well (road safety, road damage, noise, etc) — energy efficiency is but one consideration.

Improvements in the economic efficiency of the rail sector would improve energy efficiency directly and, by shifting demand from road to rail, would be likely to increase national energy efficiency further. But again, other factors would need to be considered, in addition to energy efficiency.

The existing voluntary fuel target for the Australian vehicle fleet seems a fairly innocuous policy. And the compulsory fuel and greenhouse gas label scheme gives consumers low-cost information that might not have been provided so extensively or in such a reliable, comparable and easy-to-access form by the market. As these schemes do not compel consumers and producers to move to more energy-efficient vehicles, any improvements they encourage should be privately cost effective. Both schemes are part of the environmental strategy for the motor vehicle industry and hence have broader objectives than financial benefits to consumers.

The way the fringe benefits tax on company cars and parking is calculated provides encouragement to overuse those vehicles. However, any change to this arrangement would require balancing any reductions in the administrative efficiency of the tax system against the benefits of removing this distortion, including increased energy efficiency, and greenhouse gas and air pollution abatement.

The influence of urban planning on transport-related energy efficiency is included in the terms of reference for the inquiry. Planning is a very broad and complex process that should be focused on optimising outcomes (including transport) for individuals and firms (within the constraints of the private and social costs of meeting desired locational decisions). Energy-efficient transport solutions should be only one of the many considerations in urban planning.

Greater use of ‘intelligent transport systems’ (for example, coordinating traffic lights on major roads, traffic lights responding to traffic flows, more sophisticated scheduling of public transport) might offer some energy efficiency gains as well as other vehicle cost savings and reduced travel times. However, where government funding is involved, these investments need to meet benefit–cost criteria.

The Commission’s recent review of national competition policy recommended as national priorities further separate inquiries into freight and passenger transport. These would be useful forums within which the issues raised in this inquiry with respect to transport could be further explored.

Concluding comments

Energy efficiency improvements that are privately cost effective are true ‘no regrets’ measures — the individual producer or consumer concerned saves costs and the (global) community benefits from reduced pollution, including greenhouse gas abatement. There is no doubt that such opportunities exist. But the potential for making such improvements, and the scope for governments to efficiently intervene to address barriers and impediments preventing their uptake, appears to be modest. In many cases, the improvements are not as cost effective for individual producers and consumers as they might seem, once all of the costs (including the opportunity cost of using those funds elsewhere) are considered. And few of the many perceived barriers and impediments are areas where government intervention is justified.

There is nevertheless a reasonable case to be made for governments to address information failures. Supplying information directly, or requiring market participants to provide information indirectly, is warranted in some cases. But it is more contentious to argue that mandatory measures (such as the EEOAs) should be introduced to force producers and consumers to take up opportunities that are ostensibly in their own interests. Mandatory measures not only override consumer and producer sovereignty but are inconsistent with the proposition that energy efficiency improvements are privately cost effective. They should be used with some caution and only where broader benefits are clearly demonstrable.

None of this is to deny that firms and individuals are sometimes not acting as rationally as they might. Energy efficiency opportunities are sometimes overlooked, but so too are other income-raising or cost-saving measures. There is nothing intrinsically different about energy in this regard; nor does failure to take up such opportunities necessarily warrant policy intervention.

In a policy environment where emissions trading or carbon tax options are struggling to gain widespread acceptance, energy efficiency policies and programs have been pursued with some vigour. Building on the presumption that many energy efficiency improvements are privately cost effective and that the many existing programs are well founded, the MCE and the various Australian jurisdictions have been pushing ahead with new policy proposals. The nine-point plan endorsed by the MCE as NFEE Stage One would appear to be just the beginning. Although some existing and proposed programs appear to be well founded, others do not.

The Commission considers that the NFEE is a promising framework for developing a sound, coordinated approach to energy efficiency policy. However, neither the MCE nor the jurisdictions involved appear to have an adequate information or analytical base on which to make good policy choices at present. Indeed, few programs in this area seem to have been rigorously evaluated.

Formal, independent evaluation of key programs would help establish the knowledge base needed for considering the way ahead. These should all be made publicly available. The Commission recommends that Stage One proposals of the NFEE that expand the scope of existing programs (to new jurisdictions or products) should only proceed after the net social benefit of those programs has been established and a convincing case can be made for their expansion. The enthusiasm for tightening the energy efficiency regulations in the Building Code without having first tested the effectiveness of existing regulations, is a case in point.

An alternative perspective can be brought to bear on energy efficiency policy — namely that government intervention might be warranted for its pollution-abatement benefits. Even if some measures are not cost effective for individual producers and consumers, they might result in a net social benefit (after considering the costs of government intervention) and hence warrant action by governments. However, it is not clear that directly targeting energy efficiency is the best, or only, response that should be made to address greenhouse gas and other environmental externalities. A consideration of other approaches is outside the scope of this inquiry.

What is apparent from this inquiry, however, is that the objectives of energy efficiency policy need to be clarified and private cost effectiveness placed in a more realistic light. The temptation has been to overstate the private cost-effectiveness aspect of energy efficiency programs when public benefits from greenhouse gas abatement often seem to be the real policy target. Clarifying objectives will also influence the instruments that are chosen. As the Commission has argued in this report and elsewhere, piecemeal responses to greenhouse gas externalities have the potential to be costly and ineffective. A coherent, soundly-based national response is required.

Findings and recommendations

General

FINDING 3.1

Cross-country comparisons of energy intensity must be used with caution, given that the observed levels of energy intensity of any economy reflect local circumstances, including climate, energy prices and economic structure.

FINDING 4.1

Failures in markets for energy efficiency technologies can inhibit the adoption of energy efficiency improvements at current (and expected) energy prices:

- *imperfect information (including asymmetries of information) and split incentive problems can lead to the non-adoption of energy efficiency improvements that are privately cost effective; and*
- *positive externalities associated with research and development and demonstration projects can limit the adoption of energy efficiency improvements that are socially but not privately cost effective.*

Government intervention may be warranted on these grounds if the social benefits of intervention exceed the social costs.

The case for government intervention rests primarily on the benefits of reducing harmful environmental externalities.

FINDING 4.2

Behavioural, cultural and organisational barriers do not of themselves provide a rationale for government intervention. Understanding these barriers may, however, be helpful in designing efficiency programs that address environmental externalities, information failures and other sources of market failure.

FINDING 4.3

Barriers and impediments, such as risk and uncertainty, asset replacement costs and implementation costs, increase the costs to energy users of adopting energy efficiency improvements. However, the role of governments in addressing these issues may be quite limited.

FINDING 5.1

Numerous case studies have found that producers and consumers fail to adopt some energy efficiency improvements that appear to be cost effective for them. However, there is considerable uncertainty about the estimated potential savings, because the case studies use many questionable assumptions, including the:

- *criterion used to determine cost effectiveness (such as a simple payback period);*
- *use of a social discount rate rather than private discount rates that reflect the range of individuals' circumstances;*
- *level of business-as-usual improvements in energy efficiency;*
- *costs associated with energy efficiency improvements;*
- *extrapolation of audit and best-practice study results to a whole sector; and*
- *representativeness of simulated producers and consumers.*

Appliance labels and standards

FINDING 9.1

Appliance energy-performance labels have some influence on consumers after they have short-listed products on the basis of characteristics such as price, performance, capacity and style. While the benefits of labelling may have been overstated in regulation impact assessments, it is likely to have produced net benefits for consumers.

RECOMMENDATION 9.1

Future regulation impact assessments of appliance minimum energy performance standards (MEPS) should include a more comprehensive analysis of:

- ***whether MEPS reduce competition and how this affects prices and service quality;***
- ***why individuals — with guidance from an energy-performance label — are not best placed to judge what is in their best interests;***
- ***whether a disendorsement label and/or voluntary standard would be a more cost-effective policy; and***

- ***the distributional impacts, including the extent to which MEPS are regressive and prevent consumers from buying products that are more cost effective for them.***

The extent to which individuals are forced to forgo product features they value more highly than energy efficiency should also be reported in regulation impact assessments if MEPS are to continue to be promoted as privately cost effective.

Building ratings and standards

FINDING 10.1

The Australian Greenhouse Office plans to commission an ex post *evaluation of the ACT home energy-rating scheme on behalf of all Australian governments. The results should inform the Ministerial Council on Energy decision to mandate building energy ratings across Australia.*

FINDING 10.2

There is considerable uncertainty about the extent to which building standards have reduced energy consumption and emissions. In addition, it is doubtful that the net financial benefits predicted in regulation impact assessments have been achieved in practice. The limited available evidence suggests that the costs of current standards have been much higher than were predicted.

RECOMMENDATION 10.1

The Australian Building Codes Board should, as a matter of urgency, commission an independent* ex post *evaluation of building energy efficiency standards to determine:

- ***how effective the standards have been in reducing actual (not simulated) energy consumption; and***
- ***whether the financial benefits to individual producers and consumers have outweighed the associated costs.***

This evaluation should include the standards for residential buildings in New South Wales (BASIX), Victoria (5 star) and the ACT (ACTHERS), as well as the national standards in the Building Code of Australia.

Commercial and industrial

FINDING 7.1

Government should not become directly involved in accreditation of energy consultants and energy service companies because this function can be adequately performed by an industry or professional association.

FINDING 7.2

The need for special energy efficiency research and development funds has not been substantiated. Sourcing funds from existing more general research and development programs enables contestability between proposals and selection of those yielding the greatest net benefit.

FINDING 7.3

The Commission does not support the provision of direct subsidies to firms to undertake energy efficiency improvements that would be privately cost effective for those firms. Subsidies may, however, have a role in encouraging the uptake of improvements that have important spillover effects. In such cases this policy mechanism should be evaluated against other policies pursuing the same objective.

FINDING 7.4

The case for government subsidies to encourage energy efficiency improvements should be separated from the means of funding those subsidies, such as by hypothecated levies.

FINDING 7.5

The policy of mandating assessments of energy efficiency opportunities is not warranted on private cost-effectiveness grounds. The demonstration effects that might be achieved by this policy could be pursued more effectively and at less cost by voluntary programs.

RECOMMENDATION 7.1

Private cost effectiveness should not be a rationale for requiring firms to implement any recommendations arising from the Energy Efficiency Opportunities Assessments.

Governments as energy users

FINDING 8.1

Addressing cost-effective energy efficiency in procurement policies, provided there is sufficient flexibility, could lead to environmental benefits and a small increase in the overall efficiency and effectiveness of government operations. There may be some additional benefits through demonstration effects and market development, but these are unlikely to justify procurement decisions that are not cost effective for government operations. Moving beyond cost-effectiveness criteria may be justified on other grounds (such as greenhouse gas abatement), but this would require an evaluation that incorporated these broader considerations.

FINDING 8.2

Energy-intensity performance indicators, or targets, can help identify opportunities for cost-effective improvements in energy efficiency. Performance indicators are preferable because they provide less incentive to adopt measures that are not cost effective.

Transport

FINDING 11.1

Markets provide extensive information to consumers regarding fuel consumption of motor vehicles. Nonetheless, the Australian Government's Fuel Consumption Labelling Scheme and Green Vehicle Guide provide relatively low cost, accessible and comparable information to consumers, and may be justified as part of the more fundamental objective of encouraging consumers to reduce the adverse environmental impacts of motor vehicle use.

FINDING 11.2

Fleetwide fuel consumption targets for new motor vehicles sold in Australia are likely to have had only a limited impact on the fuel efficiency of the new vehicle fleet. Significantly tightening such targets and making them compulsory would be likely to impose additional costs on consumers.

FINDING 11.3

Efficient road congestion pricing would lead to communitywide, cost effective increases in energy efficiency. However, these gains will not be privately cost effective for all road users. Reductions in fuel consumption and cleaner burning of *fuel would also provide significant local environmental benefits and reductions in greenhouse gas emissions.*

RECOMMENDATION 11.1

Australian governments should investigate the feasibility of introducing congestion pricing where it is likely to improve the economic efficiency of road use (including greater energy efficiency). It may be appropriate for such a study to be incorporated in a wider examination of efficient road pricing or in a review of passenger transport reform as a whole.

FINDING 11.4

The TravelSmart program improves the energy efficiency of transport by providing consumers with information regarding less fuel-intensive travel options and means to reduce the need to travel. TravelSmart simultaneously addresses several policy issues — greenhouse gases, air pollution, and personal health and fitness — in a way that allows consumers to choose which options are most cost effective for them.

FINDING 11.5

There remains some scope for additional regulatory reform within both the road and rail sectors, that would improve overall efficiency and is likely to lead to some increase in energy efficiency within each sector. Some individual reforms may alter the competitive position of road freight compared to rail. This may change the energy efficiency of the overall freight task, in some cases reducing energy efficiency overall. However, this would not be an appropriate reason for delaying such reforms.

Role of energy market reform

FINDING 14.1

The real costs of supplying electricity to final users vary significantly in terms of both the time and location of its use. Regulatory arrangements governing the transmission, distribution and retail price of electricity insulate consumers from these variations and dampen demand-side responses.

FINDING 14.2

Removing retail price caps (as soon as effective competition has been established), and exploring opportunities to improve the efficacy of price setting arrangements for network operators will improve the economic efficiency of electricity markets.

FINDING 14.3

More cost-reflective pricing should improve energy efficiency in peak-load periods, particularly in the longer term when consumers have both more information, and the opportunity to modify their behaviour, and suppliers can respond to changed market conditions. This would be facilitated by a roll out of ‘smart’ meters.

RECOMMENDATION 14.1

Any mandated roll out of ‘smart’ metering devices should be subject to a comprehensive benefit–cost analysis. Mandated roll out of technologies should not preclude choice in the device or competition between service providers.

Coordination

FINDING 12.1

National uniformity has been achieved in the regulation of energy labelling and minimum energy performance standards for electrical appliances and the same is planned for gas appliances. To the extent that appliance regulation is justifiable, national uniformity is appropriate.

FINDING 12.2

The current State and Territory-based variations in energy efficiency standards for new houses increase costs for the building and building products industries. The case for such variations appears to be weak.

RECOMMENDATION 12.1

Australian, State and Territory Governments and the Australian Building Codes Board should examine ways to prevent local governments creating variations in minimum energy efficiency standards for buildings.

FINDING 12.3

A review of the requirements on firms to report on their energy use and greenhouse gas emissions has the potential to reduce compliance costs. The review should consider whether the information currently collected serves a useful purpose as well as examining opportunities to harmonise reporting formats and data definitions.

FINDING 12.4

The National Framework for Energy Efficiency will improve national coordination and guide the development of energy efficiency programs. It would be further *enhanced by greater clarity on the rationale for, and the objectives of, government intervention and by more rigorous evaluation of existing policies and programs.*

RECOMMENDATION 12.2

Stage One proposals of the National Framework for Energy Efficiency that expand the scope of existing programs (to new jurisdictions or products) should only proceed after the net social benefits of those programs has been established and a convincing case can be made for their expansion. Evaluations should also consider the impact on private cost effectiveness.

FINDING 13.1

A national energy efficiency target, based on an annual requirement for major users of stationary energy (or energy retailers) to generate or otherwise acquire a target level of energy efficiency related savings, can not be justified on the grounds of privately cost-effective energy efficiency. It may help to drive investment in energy efficiency, but this would be at the expense of economic efficiency. It would also be very difficult and costly to implement effectively.

FINDING 13.2

As a measure to address greenhouse gas abatement, a national energy efficiency target has serious disadvantages compared to other more directly-targeted policy options. It is unlikely to complement those options, and could reduce the overall economic efficiency with which a greenhouse gas abatement objective is met.

RECOMMENDATION 13.1

A national energy efficiency target, based on an annual requirement for major users of stationary energy (or energy retailers) to generate or otherwise acquire a target level of energy efficiency related savings, should not be implemented.

1 Introduction

Key points

- The Productivity Commission was asked to inquire into the economic and environmental potential offered by energy efficiency improvements that are ‘cost effective for individual producers and consumers’.
- Energy efficiency improvements have attracted considerable attention because of the perception that they can be win-win options: that is, they potentially achieve private cost savings for the producers or consumers concerned, improved economic performance, and environmental benefits through pollution abatement.
- The predominant focus of the inquiry is on the policy implications of the various barriers and impediments that are said to be preventing the adoption of these privately cost-effective improvements in energy efficiency.
- This is not an inquiry into global climate change or the least-cost options for greenhouse gas abatement.
- A National Framework for Energy Efficiency (NFEE) has been developed to increase energy efficiency and lower greenhouse gas emissions. Stage One of the NFEE focuses on further development and greater national coordination of a range of energy efficiency programs, to both reduce compliance costs and improve outcomes. Nonetheless, most jurisdictions have their own policy frameworks which at times create interjurisdictional inconsistencies.
- The Commission consulted widely during this inquiry. It held two rounds of public hearings at which there were 61 presentations and received 155 submissions as well as holding informal discussions with over 30 organisations.

Energy efficiency has long been a policy issue, first because of concerns about the depletion of fossil fuels leading to energy scarcity and, more recently, because of attributed links between fossil-fuel use and climate change. Policy interest has been heightened by the recent ratification of the Kyoto Protocol and attempts to negotiate more comprehensive longer-term international agreements to reduce greenhouse gas emissions.

In this context, certain energy efficiency improvements are perceived to offer a win-win or ‘no regrets’ solution to conserving energy: they are good for the environment and because they are privately cost effective they are good for the firms or households concerned. The paradox is that if energy efficiency improvements are privately cost effective, and hence in the interests of any rational producer or consumer, firm or household, why do they not spontaneously occur? Are there barriers or impediments preventing the market from working efficiently? What role is there for government? Answering these questions is important in framing a policy response that will provide net benefits for the community. The scope for appropriate policy intervention to encourage the greater uptake of cost-effective energy efficiency improvements is the focus of this inquiry.

1.1 Scope of inquiry

The Australian Government has asked the Productivity Commission (the Commission) to conduct an inquiry into the economic and environmental potential offered by energy efficiency improvements that are 'cost effective for individual producers and consumers'. The scope of this inquiry is set by the Government's terms of reference and the Commission's approach, as set out in its authorising legislation, the *Productivity Commission Act 1998* (Cwlth).

The terms of reference

The terms of reference are extensive and in effect constitute a series of mini inquiries. In summary, the Commission is required to consider:

- the impacts of barriers and impediments to improved energy efficiency;
- a range of different policy instruments including standards, labelling, information provision, financial incentives, energy-market reforms (for example, the development of better price signals) and a national energy efficiency target;
- existing and recent government energy efficiency programs, including the level of coordination between those programs; and
- policy options for improving energy efficiency within different sectors, including the commercial and industrial, consumers and householders, government (as a user), and transport sectors.

The scope of the inquiry is largely determined by the focus of the terms of reference on energy efficiency improvements that are 'cost effective for individual producers and consumers'. The terms of reference also require the Commission to comment on the economic and environmental costs and benefits of such privately cost-effective energy efficiency improvements.

A further consideration is that the Commission's enabling legislation requires it to take an economywide view that considers all costs and benefits, including the costs of government intervention. However, the terms of reference imply that this economywide framework should apply to only those energy efficiency improvements that appear to be privately worthwhile but are not being taken up because of barriers or impediments facing individual producers or consumers. There may well be a broader set of energy efficiency improvements that would be justified on the grounds of net social benefit (including environmental benefits) but these are not the principle policy focus of this inquiry. The most appropriate means of achieving such energy efficiency improvements would need to be examined afresh as part of the possible policy mix to best address these environmental issues.

Barriers and impediments

Many technical experts perceive a significant gap between current levels of energy efficiency and the levels that are privately cost effective. This energy efficiency gap is usually explained by barriers and impediments. However, it is plausible that the actual gap is, in reality, much smaller than some of the technical experts believe — they may have overestimated the benefits or underestimated the various costs of achieving the energy efficiency improvements they believe are warranted.

The pursuit of privately cost-effective energy efficiency improvements would seem to be consistent with the self interest of any rational producer or consumer. And yet the issue at the heart of this inquiry is why producers and consumers do not react in this manner. The presumption that various barriers and impediments must be at work, and further that these require government intervention to close the gap, requires careful consideration. Barriers can arise for different reasons, and not all barriers suggest the need for such intervention. Government intervention is not costless for producers, consumers or taxpayers. If inappropriately introduced or poorly implemented, it can also create unintended distortions in the marketplace. (Barriers and impediments are discussed in more detail chapter 4 and, where relevant, in chapters 6 to 11 dealing with particular sectors or programs.)

The influence of energy prices

The impact on energy efficiency of the various barriers and impediments considered in this report will depend partly on current energy prices and consumers' and producers' expectations regarding future prices. However, the Commission has also considered the impact of possible distortions in the pricing of energy on the potential for privately cost-effective energy efficiency improvements. The prices paid by energy users may not accurately reflect the costs of production and consumption of that energy due to factors such as the regulatory frameworks governing the energy industries, limited competition in some sectors of energy production and distribution or due to government ownership of some energy sector producers (chapter 14).

While changes to energy prices will influence the economically-efficient amount of investment in energy efficiency, they do not change the underlying nature of barriers and impediments that exist at currently-expected prices.

Unpriced externalities (such as greenhouse gas emissions) in energy production and use are likely to mean that privately cost-effective levels of energy use (including the level of energy efficiency) differ from socially desirable levels. Policies for dealing with such externalities are beyond the scope of this inquiry.

This is not an inquiry into climate change policies

This inquiry is occurring at a time of great interest in the environmental implications of greenhouse gas emissions. While decreasing Australia's 'greenhouse signature' is mentioned in the terms of reference, the Commission has not been asked to comment on the Australian Government's policy response to climate change. However, the role of privately cost-effective energy efficiency improvements in decreasing greenhouse gas emissions as well as other environmental effects, such as reducing urban air pollution, is recognised.

Apart from achieving currently privately cost-effective energy efficiency improvements, there are many other ways to achieve greenhouse gas abatement, including: reducing land clearing; storing carbon dioxide in geological strata; increasing the use of energy from renewable and/or nuclear sources; and increasing energy conservation and energy efficiency by increasing the prices of carbon fuels. Policies to encourage cost-effective energy efficiency improvements can play a role, but this inquiry does not address the appropriate mix of abatement options or what should be the overall abatement objective.

Influence of regulation impact statements on scope of inquiry

Many participants in this inquiry misunderstood the Commission's role in vetting regulation impact assessments though its Office of Regulation Review (ORR). Some felt that it was inappropriate for the Commission, in the course of this inquiry, to question or otherwise analyse the results of Regulation Impact Statements (RISs) that it had already assessed. However, RISs for initiatives such as MEPS and amendments to the Building Code contain a great deal of analysis and insight into how the government has approached the development of energy efficiency policy. They have been an important resource for this inquiry.

Just as importantly, what those RISs recommended has not in any way constrained the scope of this inquiry. This is because the ORR's role is to provide advice and assistance on the preparation of these RISs and to monitor compliance with COAG guidelines (COAG 2004, attachment A). While this involves assessing whether a RIS meets minimum adequacy standards, the ORR does not verify the data or methodology underlying a RIS nor does the ORR comment on the merits of the regulation being considered.

1.2 Policy background

This section briefly discusses some of the recent background to energy efficiency policy in Australia and the institutional framework for implementing those policies. Further detail is provided in appendix B.

Greenhouse policy

The increasing interest in energy efficiency policy in Australia has been closely linked to greenhouse gas abatement objectives. Various Australian, State and Territory Government greenhouse gas abatement programs were developed during the 1990s, culminating in the National Greenhouse Strategy (NGS) in 1998. Several components of the NGS involve improving energy efficiency in the government, industrial, power generation, commercial, residential and transport sectors. In this regard, the NGS focuses on:

> … cost-effective ways to reduce net greenhouse gas emissions in particular through 'no regrets' actions. The actions will deliver substantial non-greenhouse benefits to Australia. (AGO 1998, p. ix)

Since the inception of the NGS, all jurisdictions have separately developed their own greenhouse abatement strategies, including measures to increase energy efficiency. In June 2005, COAG agreed to set up a Senior Officials' group to examine the scope for national cooperation on climate change policy, particularly in areas of common ground between jurisdictions. The group will consider the scope for improving investment certainty for business, encouraging renewable energy and enhancing cooperation in areas such as technology development, energy efficiency and adaptation.

At the international level, greenhouse policy has been largely progressed under the 1997 Kyoto Protocol to the United Nations Framework Convention on Climate Change. The Protocol established individual country targets for industrialised countries to limit or reduce their greenhouse gas emissions by 2012. The Protocol formally came into force for ratifying countries in 2005, following its ratification by countries that produced 55 per cent of industrialised country emissions in 1990. Australia has signed but not ratified the Protocol, but nonetheless has committed to meeting its agreed emissions target of 8 per cent above 1990 levels by 2008–12.

In 2005, Australia joined with the United States, China, India, Japan and South Korea in establishing the Asia-Pacific Partnership on Clean Development and Climate. The partnership will collaborate to develop and deploy existing and emerging cost-effective, cleaner energy technology and practices. Energy efficiency is one of a wide range of possible areas for cooperation between the members.

Energy efficiency policy

In 2001, COAG established the Ministerial Council on Energy (MCE) to take responsibility for national energy policy including energy security, energy market reform and energy efficiency. In doing so, it considers both economic and environmental issues. The MCE established the Energy Efficiency Working Group (EEWG) to advise it on the performance of end-use energy efficiency policies and programs.

EEWG has developed a package of measures within a National Framework for Energy Efficiency (NFEE). These Stage One measures were announced by the MCE in August 2004 and consist of nine groups of measures designed to improve coordination among jurisdictions in delivering energy efficiency programs (box 1.1). Nonetheless, policy and implementation decisions remain at the discretion of individual jurisdictions.

A number of participants were of the view that measures in NFEE Stage One were not to be re-evaluated in the current inquiry. However, the terms of reference direct the Commission to consider *existing and recent* government energy efficiency programs, which clearly includes NFEE Stage One.

Further measures, including the possibility of incentives to encourage greater energy efficiency, are to be considered under a Stage Two NFEE (MCE 2004e).

The EEWG has also developed administrative guidelines for appliance labelling and performance. These are administered by the National Appliance and Equipment Energy Efficiency Committee (NAEEEC) which comprises officials from jurisdictional agencies responsible for administering energy-performance labelling and performance standards. It is responsible for managing Australian end-use energy efficiency programs including mandatory minimum energy performance standards (MEPS) and mandatory energy labelling (appendix E).

Box 1.1 National Framework for Energy Efficiency Stage One

There were nine packages included in NFEE Stage One:

- Tightening **residential** building energy efficiency regulation (including through nationally consistent standards for new buildings and major renovations, and the mandatory disclosure of energy performance at time of sale or lease).
- Introducing **commercial** building energy efficiency regulation (including nationally consistent standards for new and refurbished buildings, and the mandatory disclosure of energy performance at time of sale or lease).
- Raising awareness of senior management in the **commercial and industrial** sectors (including through mandatory audits for large energy users, and training and accreditation for energy auditors).
- Imposing additional requirements on **governments** (including through developing consistent measuring and reporting, establishing standards for government buildings and developing best practice models).
- Extending **labelling and standards** for electrical appliances and applying the same regulatory approach to gas appliances.
- Developing and integrating energy efficiency **training and accreditation** for key trades and professions that influence energy efficiency outcomes.
- Developing **commercial and industrial** sector capability building (for example, through establishing best practice networks and generating highly visible examples of energy efficient equipment or processes).
- Raising **consumer awareness** (for example, through requiring energy retailers to report data on energy bills, promotional campaigns and through curriculum development for schools).
- Increasing **finance sector awareness** (for example, through providing tools for the valuation and risk assessment of finance proposals).

Source: MCE (2004e).

In 2004, the Australian Government (2004) released a white paper on energy policy. This included energy efficiency issues covering a range of new and existing energy efficiency policies (subsequently incorporated in NFEE Stage One) and the Solar Cities trial incorporating energy efficiency measures and more effective signalling of energy market prices.

There have been significant changes in regulation and operation of Australian energy markets since 1990 which may impact on energy efficiency policy and outcomes. In both the gas and electricity sector the provision of services by vertically-integrated government monopolies has been dismantled. While details vary between jurisdictions, gas and electricity utilities have been structurally separated and corporatised or privatised and competitive neutrality reforms introduced where some government ownership was maintained. Pricing has become more cost reflective and some cross subsidies between regions and groups of users have been removed. Discriminatory entry barriers have been removed and wholesale, and in some cases retail, customers have been given greater freedom of choice of suppliers.

A national electricity market and a gas access regime have been established, promoting increased interstate trade and competition in energy. The development of these markets is ongoing with reviews of the national energy markets for gas and electricity (COAG 2002), the Gas Access Regime (PC 2004c) and the wholesale gas market (Allen Consulting 2005b) proposing further reforms to improve the efficiency of the markets.

1.3 Conduct of the inquiry

The Commission received the terms of reference for this inquiry on 31 August 2004. The inquiry has been completed within the scheduled 12 months, including both a draft and a final report. As required by the terms of reference, and in line with normal inquiry procedures, the Commission has encouraged public participation in this inquiry. The Commission:

- advertised the inquiry widely and sent a circular to individuals and organisations thought likely to be interested;
- released an issues paper in September 2004 to assist participants to prepare submissions to the inquiry;
- held informal discussions with a wide range of organisations and individuals;
- encouraged written submissions — a total of 155 submissions were received, 85 before the release of the draft report and 70 in response to the draft report;
- released a draft report for public comment in April 2005; and
- held two rounds of public hearings in Sydney, Brisbane, Canberra and Melbourne and by teleconference — initial hearings in November 2004 in which 39 participants took part and post draft report hearings in May and June 2005 in which 22 participants took part.

The Commission thanks all participants for their contributions to this inquiry. Those who attended informal discussions, made submissions and participated in hearings are listed in appendix A.

2 Energy efficiency and policy assessment

Key points

- The underlying goal of policy is to improve community wellbeing. Using resources in the most economically efficient way will contribute to this goal. Government intervention may be warranted to address market failures that prevent the economically efficient allocation of resources.
- A policy is generally described as 'cost effective' if it generates a net benefit. However, implementing a cost-effective policy will not necessarily improve overall economic efficiency.
- Energy efficiency improves if energy use decreases but the level of useful output or outcome stays the same, or increases. An energy efficiency improvement is 'privately cost effective' if it generates a net benefit for the individual undertaking the improvement. Not all energy efficiency improvements are privately cost effective, nor are they necessarily economically efficient.
- Individuals face tradeoffs between using resources to improve energy efficiency, and using those resources to undertake other activities, some of which may generate *greater* private benefits.
- Some energy efficiency improvements may generate net social benefits but do not result in net benefits for the individual.
- Private cost effectiveness is not a sufficient basis for making policy decisions. However, understanding the various barriers to privately cost-effective energy efficiency improvements — and where it is appropriate for government to intervene — is an important step in designing policies that would capture the wider social benefits of energy efficiency.

The Commission recognises that government intervention should aim to improve community wellbeing, and not necessarily be limited by private cost effectiveness. However, as discussed in chapter 1, the terms of reference for this particular inquiry explicitly direct the Commission to consider energy efficiency improvements that are privately cost-effective — they being a subset of all possible energy efficiency improvements.

In this chapter, the Commission outlines how the policies to address *privately* cost-effective energy efficiency improvements are assessed within the broader process of policy design and assessment.

2.1 Economic efficiency and the role of government intervention

In this inquiry, the Commission has applied its economywide charter to the assessment of privately cost-effective energy efficiency improvements. Underpinning this approach is a wide public perspective and an underlying goal of improving the wellbeing of the community. The framework for assessing the overall impacts of policy interventions on society — and where it is appropriate to intervene — are described in this section.

Economic efficiency and cost effectiveness

'Economic efficiency' and 'cost effectiveness' are concepts used extensively to evaluate the overall effect of policies and programs on the economy. However, these concepts are not interchangeable.

Essentially, the concept of *overall economic efficiency* is about ensuring individuals in society maximise their utility, given all resources (including, but not limited to, energy) available in the economy. Increasing economic efficiency is necessary to achieve the ultimate goal of policy or regulatory endeavours — which is to improve the wellbeing and living standards of the community.

Overall economic efficiency requires satisfaction of *productive, allocative* and *dynamic* efficiency (box 2.1):

- Maximum productive efficiency requires that goods and services be produced at the lowest possible cost. This is a question of the input mix used to produce the output of any good or service.
- Maximum allocative efficiency requires the production of the set of goods and services that consumers value most, from a given set of resources. This is a question of the output mix of the economy.
- Greater dynamic efficiency means that consumers are offered, over time, new and better products, and existing products at lower cost.

An activity is economically efficient if there is no other use of the resources that would yield a higher value or net benefit. More commonly, an activity is said to be economically inefficient if its costs (including all costs associated with social and environmental externalities) exceed its benefits; or if it can be shown that the resources could be used to produce something with a higher net benefit.

Box 2.1 Components of economic efficiency

Economic efficiency is about maximising the wellbeing of the members of the community. Economic efficiency requires satisfaction of three components.

Productive efficiency is achieved when output is produced at minimum cost. It incorporates technical efficiency, which refers to the extent to which, in the production of any good or service, it is technically feasible to reduce any input without decreasing the output, and without increasing any other input. If waste is avoided in this way, improvements in productive efficiency can generate more income and improve living standards.

Allocative efficiency is about ensuring that the community gets the greatest return (very broadly defined) from its scarce resources. A nation's resources can be used in many different ways. The best or 'most efficient' allocation of resources is the one that contributes most to community wellbeing. Improvements in allocative efficiency bring improvements in living standards because resources are used to generate more income and satisfy more needs and desires.

Dynamic efficiency refers to the allocation of resources over time, including allocations designed to improve economic efficiency and to generate more resources. This can mean finding better products and better ways of producing goods and services. Investments in education, research, development and innovation are involved. Dynamic efficiency can also refer to the ability to adapt efficiently to changed economic conditions, a capacity for optimally modifying output and productivity performance in the face of economic 'shocks'. Improvements in dynamic efficiency bring growth in living standards over time.

Source: Adapted from PC (1999a).

The term *cost effectiveness* is sometimes defined as achieving a stated objective or outcome using the lowest-cost mix of inputs. Cost effectiveness can also be used to describe the achievement of the best outcome for a stated level of inputs or cost. Cost-effectiveness analysis can be used to assess options where it is easier to identify benefits than to value them. However, if it is not possible to value all outcomes, it may be difficult to compare options which differ in both outcomes and costs.

Cost effectiveness is sometimes used as shorthand for asserting that there is a net benefit — that is, the total benefits of an activity exceed its total costs. A policy option that generates net benefits will not necessarily be the preferred option, because other options could generate greater net benefits, and be *more* cost effective. Moreover, even if a policy option is the most cost effective one available to achieve a particular policy objective, employing it will not necessarily improve overall economic efficiency. Consideration must be given to whether greater net benefits could be generated by abolishing the program and using the resources to produce something else entirely. Achieving the best input mixes to achieve stated outcomes does not guarantee that the mix of outcomes will be preferred over other feasible options.

The role of government intervention

If all individuals act to maximise their utility, in ideal circumstances perfectly competitive markets will, of themselves, allocate resources in an economically efficient way, maximising net benefits to society. However, in reality there are various sources of market failure that prevent markets from allocating resources in this way.

Government intervention could be warranted to address market failures such as imperfect competition, imperfect information, public goods, and externalities. In this inquiry, the Commission has examined market failures in energy markets (such as imperfect competition in electricity generation) as well as market failures in the market for energy efficiency technologies, such as:

- information asymmetries in the markets for energy-efficient appliances, buildings and industrial equipment;
- public good characteristics of information about energy efficiency;
- split incentives arising from a divergence in incentives (typically those faced by landlords and tenants); and
- positive externalities resulting from research, development and the demonstration of energy efficiency technologies.

Several participants suggested that government intervention might also be warranted to address the negative externalities associated with energy use — particularly greenhouse gas emissions. However, it is beyond the terms of reference to assess policy options to address this type of market failure.

Regardless of the nature or extent of market failures, government intervention is not appropriate if the costs of intervention outweigh the benefits. The costs of intervention often take several forms, including administration costs to government; distortions associated with revenue raising to cover these administration costs; and compliance costs incurred by regulated firms, other organisations and households. An unintended consequence of a policy intervention might be that it imposes costs on participants in markets other than that originally targeted by the intervention.

Governments also intervene on social grounds — such as to redistribute the gains from improvements in economic efficiency. Furthermore, as there are many ways to improve economic efficiency (each with different distributional consequences), decision makers also use other criteria — especially equity — to help determine which approaches are appropriate.

2.2 Energy efficiency and its benefits

Energy efficiency is generally described as output per unit of energy input, where output and energy input are measured in physical units. The pursuit of energy efficiency would seem to be in the interests of any rational producer or consumer, firm or household. However, energy efficiency measures do not capture the *value* of energy use to the individual — an individual will not necessarily benefit from improving energy efficiency.

Nevertheless, regardless of benefits accruing to individuals, some energy efficiency improvements may generate net benefits to society as a whole — such as by avoiding costs of environmental damage associated with energy generation and use.

Energy efficiency and related definitions

There are various ways to define energy efficiency, depending on how output is specified.

'Thermal efficiency' is a measure of energy efficiency in which output, as well as input, is measured in units of energy. This definition is commonly applied to the generation of electricity from primary energy sources — for example, ABS (2004b, n.p.) defined thermal efficiency as 'electricity generated (energy output) as a proportion of energy consumed to generate the electricity (energy inputs)'.

The terms of reference define (improving) energy efficiency as 'maintaining or increasing the level of useful output or outcome delivered, while reducing energy consumption'. Under this definition, output can be measured in units of any physical quantity — including, but not limited to, units of energy.

Energy intensity is commonly used to describe energy use per unit of GDP or income, or number of households. Energy intensities are often used to aggregate and compare levels of energy efficiency across individuals, organisations, regions or nations. However, as there are many factors that affect energy intensity, it is difficult to assess whether changes in energy intensity reflect technological advances in energy efficiency. Furthermore, even if outputs are measured in dollar terms, energy intensities do not reflect the *value* of energy use, or energy efficiency improvements, to individuals or the economy.

Seeking to maximise energy efficiency or minimise energy intensity in the economy would be analogous to pursuing an objective of maximising the value of output per unit of any one other resource — such as labour, capital or land. However, focusing on only one of the many scarce resources in the economy will not result in the most beneficial use of all these resources. Therefore, energy efficiency and energy intensity measures are not good proxy measures for economic efficiency:

> … differences in energy intensities between economies may simply reflect differences in the mix of more or less energy intensive sectors within each economy. Similarly, energy efficiency so defined tells us nothing about economic efficiency. For example, differences in energy efficiency in a given activity between economies may be due to differences in fuel prices and have no bearing on economic efficiency whatsoever. (ABS 2001, p. 102)

Energy conservation is commonly defined as a reduction in energy use that also causes a reduction in the level of useful output or outcome. The term is sometimes used to describe situations where energy use can be reduced supposedly at no additional cost and without any changes in the level of output. For example, Moreland Energy Foundation Ltd suggested:

> … the point behind energy conservation is that many of the current uses of energy have no value, they are simply wasted resources. For instance, lighting, heating and cooling spaces which do not have people using them has no value. Addressing the situation requires an individual to take action — for instance turning off a light switch … (sub. DR115, p. 5)

Energy conservation measures that do not require upfront capital expenditure (such as the example above) are not necessarily costless, as they may require changes in behaviour or additional time. Nevertheless, within this inquiry, opportunities to reduce energy use without changing the level of useful output or outcome are included under the definition of energy efficiency improvements.

Several inquiry participants suggested that the Commission should consider policies that target energy conservation, as well as energy efficiency (for example, Queensland Government, sub. 38, p. 3; South Australian Government, sub. 80, p. 4; Queensland Department of Energy, trans., p. 187). However, as defined by the terms of reference, energy conservation measures that require or cause a decrease in the level of outputs or outcomes are not the principal focus of this inquiry. Nevertheless, some policy instruments might lead to both energy efficiency improvements and energy conservation — such as cost-reflective pricing of energy (chapter 14).

Due to the *rebound effect*, the reduction in energy use resulting from an improvement in energy efficiency may be less than expected (box 2.2).

Box 2.2 **The rebound effect**

The expected effects of energy efficiency improvements on energy consumption can be reduced through so-called 'rebound effects'. In practice, when an energy efficiency improvement is implemented, some of the energy saved will subsequently be used by the individual undertaking the improvement. For example, Gottron (2001) estimated that for households, depending on the device concerned, rebound effects of between 10 to 50 per cent might be expected.

For an individual household, increasing energy efficiency makes energy appear cheaper, relative to other items — less money is required to purchase the same energy services. Consequently, the household will tend to use more energy, substituting away from other goods and services (the 'substitution effect'). For example, after installing a more energy-efficient air conditioner, a residential consumer may choose to set the operating temperature lower or be less diligent in the use of other energy-conserving devices such as shades. Furthermore, increasing energy efficiency 'frees up' part of household income. The household might use all or part of the money they save to buy other goods and services that also use energy (the 'income effect').

Firms are also likely to be affected by rebound effects because energy is only one of many costs of production. Increasing energy efficiency means that firms could (if possible) substitute away from other inputs towards energy, and could also respond to lower unit costs of production by expanding overall production.

The potential for rebound effects could be difficult to estimate but should be taken into account when calculating the effects of energy efficiency programs on energy consumption — for example, to estimate anticipated demand for energy-related infrastructure, or to project reductions in greenhouse gas emissions.

Privately cost-effective energy efficiency improvements

The Commission defines 'privately cost-effective energy efficiency improvements' as actions that (a) reduce energy use per unit of useful output or outcome delivered, and (b) deliver a net benefit (at current and expected energy prices) to the individual producer or consumer undertaking the action.

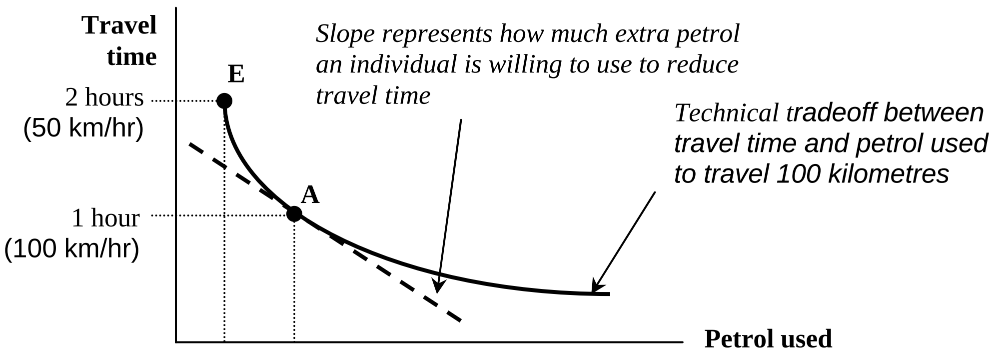
An individual household or firm could undertake many possible energy efficiency improvements, but not all of these improvements will be beneficial. In some situations, improving energy efficiency could impose a net cost on an individual — depending on the costs of other resources, and the extent of substitutability between energy and these resources (box 2.3).

Box 2.3 **Not all energy efficiency improvements generate net benefits for the individual — an example**

Consider an individual who wants to drive 100 km. His car is most fuel efficient (uses the least amount of petrol per distance travelled) at a speed of 50 km/hr. At faster speeds, more petrol will be used to complete the 100 km journey. To maximise energy efficiency, the individual would choose to drive at 50 km/hr (point E), with a total travel time of 2 hours.

However, at faster speeds the individual can complete the journey in a shorter period of time. The technical tradeoff between fuel consumption and travel time is illustrated by the curved line in the diagram below. Depending on how much the individual values time, relative to the cost of petrol (illustrated by the slope of the dashed line), he might prefer to complete the journey at a higher speed — for example, 100 km/hr (point A), which would result in a travel time of 1 hour.

Reducing his speed from 100 km/hr to 50 km/hr reduces the amount of petrol required and represents an increase in energy efficiency. However, for this individual, the cost of extra travelling time would outweigh the money saved through lower fuel consumption — and so the energy efficiency improvement would not generate net benefits.



Furthermore, an individual faces tradeoffs between using available resources to improve energy efficiency, and using those resources to undertake *other* activities. An energy efficiency improvement could generate net benefits for the individual but in some situations, could mean that the individual had to forgo opportunities that would have generated *greater* net benefits. Therefore, depending on the circumstances of the individual, undertaking energy efficiency improvements that *seem* to be privately cost effective will not always be consistent with utility- or profit-maximising behaviour. For example:

- Consider an individual who has to choose which of two appliances to purchase. Information about the energy efficiency performance of the appliances is readily available, and the individual determines that the lower energy bills would, over time, outweigh the higher upfront purchase cost of the more energy efficient model. However, by purchasing the more expensive appliance, the individual would forgo other opportunities to use that money in ways (such as on other purchases or investments) that could generate a *higher* level of overall utility.

- A firm almost invariably incurs upfront capital costs and/or requires increased management time to implement energy efficiency improvements. An individual firm may assess that an energy efficiency investment will create net benefits. For example, the net present value (NPV) of the investment might be positive (see chapter 5 for discussion of firm investment criteria). However, as the firm has limited capital funds and management time, it must choose between undertaking the energy efficiency investment, or undertaking other investments. A project might also be a mutually exclusive alternative to an energy efficiency improvement. If the firm assesses an alternative investment as yielding a higher NPV, undertaking this investment would contribute more to the overall market value of the firm than would improving energy efficiency.

Some energy efficiency improvements that seem to be worthwhile for the individual (for example, those that result in monetary savings) might not actually be privately cost effective, once the benefits of forgone opportunities are considered. Furthermore, if individual households and firms were to forgo more beneficial activities in the pursuit of energy efficiency improvements, the overall allocation of resources across the economy is unlikely to be economically efficient.

Environmental benefits of energy efficiency improvements

Some energy efficiency improvements, although not privately cost effective, could generate net social benefits. Several participants suggested that energy efficiency policies could be justified on the grounds that they help avoid the external costs of environmental damage associated with energy generation and use.

It is beyond the terms of reference to assess the wider social costs and benefits of all energy efficiency policies. It is also beyond the terms of reference to assess or design policies to address a greenhouse gas abatement objective. However, the Commission recognises that many privately cost-effective energy efficiency improvements are also likely to benefit the environment. These benefits could include:

- greenhouse gas abatement;
- improved air quality from avoided transport, stationary sector and electricity generation emissions; and

- reduced environmental impacts from exploration and processing activities of resource development projects (Australian Government 2004).

Other external costs, however, could be imposed on the environment through the resources required and processes undertaken to implement energy efficiency improvements (such as the manufacture of new appliances or industrial equipment). Life-cycle assessments, rather than partial assessments based only on operational energy requirements, will provide a more accurate indication of net environmental impacts associated with an energy efficiency improvement (for example, see chapter 10).

The possible environmental benefits of improving energy efficiency are mainly related to reducing energy use. However, the majority of opportunities for overcoming the market failures that inhibit privately cost-effective energy efficiency improvements are likely to be in the household sector — which accounts for a relatively small proportion of total final energy consumption. Therefore, the overall potential for capturing environmental benefits through addressing these market failures appears to be modest.

2.3 Assessing energy efficiency policies

Private cost effectiveness is not a sufficient basis for making decisions about energy efficiency policies. As discussed in the previous section, the pursuit of all energy efficiency improvements that generate net benefits for individuals will not necessarily result in the most economically-efficient allocation of resources. Furthermore, some energy efficiency improvements that are not privately cost effective could improve community wellbeing, by avoiding external costs of environmental damages associated with energy generation and use.

Nevertheless, many energy efficiency policies are promoted as ‘no regrets’ measures, implying that individual energy users (as well as the environment) will benefit. A policy that benefits the environment could be described as ‘no regrets’ if it addresses relevant market failures (such as those in the markets for energy efficiency technology), and if its costs (such as those associated with government administration, distortions or other unintended impacts) do not outweigh the resulting private benefits.

Policies that result in privately cost-effective outcomes are likely to be more widely accepted than measures that are not privately beneficial. However, careful evaluation of benefits and costs is required to determine whether an energy efficiency policy is truly ‘no regrets’. If opportunities for implementing ‘no regrets’ policies become limited, it will become increasingly important to assess the extent to which a policy results in a net social benefit (including environmental benefits).

General guidelines for developing policy are described in box 2.4. These are adapted from the best practice processes for regulation described by the Office of Regulation Review (ORR 1998), and are intended to ensure that government intervention has the best outcomes for society in terms of welfare. In the rest of this chapter, some of the key principles are discussed in relation to policies to address privately cost-effective energy efficiency improvements.

Box 2.4 **General principles for designing and assessing policies**

1. *Clearly specify the problem* — Specification of the problem should include detailing its nature, estimating the size of impacts, and identifying the risks and consequences of not acting to address the problem.

2. *Justify the need for government intervention* — As government intervention is not costless, it is important to describe why it is required. The existence of market failure indicates that there may be a role for government action.

3. *Clearly describe the objectives of government action* — The objective should be clear, concise and as specific as possible, but specified broadly enough to allow consideration of all relevant solutions.

4. *Identify any regulation/policy currently in place to address the problem* — The characteristics of existing regulations, responsible regulatory organisation(s) and any authoritative basis for review or amendment of regulations should be identified.

5. *Identify the most feasible options for achieving the stated objectives* — The measures should target the problem, to minimise unintended impacts. The reasons for rejecting options without detailed analysis should also be clearly stated.

6. *Comprehensively assess the benefits and costs of each option* — An economywide perspective must be taken, which means that all groups directly and indirectly affected by the problem and its proposed solution must be identified. The impact of the proposed option on existing regulations and the roles of existing regulatory authorities should also be assessed.

7. *Consider how the option will be implemented and enforced, and establish a review strategy* — The option should be assessed for clarity, consistency, flexibility and accessibility. The impact on firms and compliance costs should also be minimised.

Source: Adapted from ORR (1998).

Justifying the need for government intervention

Government intervention may be warranted to address market failures. If governments intervene in ways that do not address market failures, it could impose costs on other markets and individuals, and decrease the overall efficiency with which resources are allocated in the economy.

As discussed in this chapter, one reason why individuals might not undertake energy efficiency improvements that generate net benefits is that the cost savings are too small — the improvement is not *sufficiently* cost effective for the individual, given other possible uses of capital and other inputs.

The various barriers and impediments inhibiting the uptake of energy efficiency improvements (including those improvements that would seem to be privately cost effective) are discussed in chapter 4. However, as discussed in section 2.1, government intervention — which aims to maximise community wellbeing — is only justified to address the barriers posed by market failures.

Clearly describing policy objectives

One of the key steps involved with assessing and designing policy is to clearly define the objectives of the government intervention. Common errors that occur when describing policy objectives are to confuse the desired final outcome of the proposal with the means of obtaining it, or to pre-justify a preferred solution (ORR 1998). Improving energy efficiency is not a policy objective *per se*, but could be one possible means to an end — for example, to address the external costs of greenhouse gas emissions, or to improve energy security.

Many energy efficiency policies are often introduced to meet a broad policy objective such as greenhouse gas abatement, but are also promoted as being privately cost effective. However, it is sometimes uncertain whether some individuals might actually be worse off under the policy (for example, see the discussion of mandatory building ratings and standards in chapter 10). It is also sometimes uncertain whether the underlying objective is actually being achieved. For example, an assessment of the impacts of an energy efficiency policy might attempt to capture some of the social costs of energy use by using shadow prices for energy that are greater than market prices. However, if the assessment does not explicitly include greenhouse gas abatement benefits, it will be uncertain whether the greenhouse gas abatement objective will be met.

Assessing the benefits and costs of different policy options

Identifying different policy options is a key step to designing or assessing policy. As discussed in section 2.1, a policy option that is cost effective is not necessarily the best way to achieve an objective, because there may be *other* policy options that could be *more* cost effective and generate *greater* net social benefits — for instance, if they result in fewer unintended or distortionary impacts.

Sometimes one policy option might be suitable for meeting multiple policy objectives. For example, it is possible that policy options that target energy consumption could contribute to meeting both energy security and greenhouse gas abatement objectives. More commonly, however, there will be tradeoffs between meeting different policy objectives — such as improving economic efficiency, whilst ensuring that equity objectives are not compromised. To enable decision makers to weigh up the equity implications of different policy options, a key step of policy assessment is to evaluate the *distribution* of benefits and costs across all affected parties.

There could also be trade-offs between meeting objectives that target different sources of market failure. For example, Origin Energy identified imperfect information and environmental externalities as two market failures that warrant government intervention, but suggested:

> … it does not follow that the most effective and efficient overall policy response is to use energy efficiency policy to target both sources of market failure … it would be a coincidence if the same policy tool happened to be the most appropriate for targeting both sources of market failure. (sub. DR129, p. 5)

Such tradeoffs are accounted for by examining the wider economywide impacts of policy options — including the effects on competition, distortionary impacts of revenue raising, compliance costs on firms and unintended third-party impacts (such as the external costs of environmental damages).

This economywide policy assessment approach — justifying policy intervention, clarifying objectives and assessing the impacts of different policy options — has been applied throughout this inquiry to evaluate existing and proposed energy efficiency policies that claim to be privately cost effective.

3 How is energy used in Australia?

Key points

- Total primary energy consumption in Australia is dominated by fossil fuels — crude oil, black coal, natural gas and brown coal.
- Although some primary fuels can be used directly by end users, many need to be converted to a form which is more convenient for the end user, like electricity or petroleum. The electricity generation sector is the largest consumer of primary energy in Australia.
- Conversion processes consume significant amounts of energy. Around 70 per cent of the primary energy consumed to supply electricity to end users is lost in conversion, transmission and distribution. The losses represent 30 per cent of total primary energy used.
- Energy accounts for a small proportion of expenditure across most sectors (from 1.6 per cent in the commercial sector to 6.8 per cent in the industrial sector) and accounts for around 3 per cent of total expenditure in the economy as a whole.
- Energy consumption has grown significantly over the last 30 years, because of growth in output. But primary energy consumption per dollar of output is estimated to have fallen, due largely to structural shifts away from energy intensive sectors of the economy.
- Compared to other OECD countries, Australia has a relatively high level of energy consumption per unit of output. However, such comparisons can be misleading because of significant differences between countries in climate, energy prices and the size of energy-intensive industries.
- Australian energy prices are low by international standards.
- Consumption of fossil fuels contributes to greenhouse gas emissions. Around 48 per cent of Australia’s greenhouse gas emissions have been attributed to stationary energy users (70 per cent of these are attributable to electricity generation). Around 14 per cent of emissions have been attributed to the transport sector.
- Australia’s greenhouse gas emissions from energy consumption have grown over the last 30 years as output has grown. However, emissions per unit of output fell by 17 per cent between 1973-74 and 2000-01.

Energy is an important input into all the goods and services we consume; it underpins many aspects of our high standard of living. Most household activities, such as heating, cooling, cooking, lighting and transport, require energy in some form. Firms also use energy in virtually all of their activities, like processing and manufacturing materials, transporting goods, heating and cooling premises, providing telecommunication services or powering computers.

Over time, the amount of energy used in Australia, the types of energy used and use by individual sectors have changed. This chapter examines these changes, within Australia and in comparison with other countries. It also examines changes in energy intensity (as an indicator of energy efficiency) and greenhouse gas emissions.

3.1 Energy availability and use in Australia

Descriptions of the energy system usually refer to energy being consumed. However, in physical terms, energy cannot be 'consumed' — rather, it is converted from one form (such as the chemical energy contained in fossil fuels) to other forms (box 3.1). Ultimately, most energy used by final consumers is dissipated as low-grade heat (Saddler, Diesendorf and Denniss 2004).

Box 3.1 **Summary of the energy system**

Primary conversion

The energy system starts with the extraction or harvesting of what are termed primary fuels. These include fossil fuels such as coal, crude oil and natural gas, which are extracted from the earth, and renewable energy sources such as wind, hydro, biomass and solar-thermal energy, which are harvested from the atmosphere, from rivers, from the sea or directly from solar radiation.

Some sources of energy can be used directly by final consumers (for example, burning firewood or coal), but many sources of energy undergo conversion or transformation to end-use fuels, which are more convenient or efficient for final consumers to use. The most important energy conversion processes are thermal electricity generation and oil refining. Each of these processes uses considerable amounts of energy. In addition, some energy is used or lost in the process of delivering energy to final customers.

(Continued next page)

Box 3.1 (continued)

Consumption

The final stage is consumption by end users of energy (that is, the use of energy for all activities other than the production of energy in another form). As a result of losses in primary conversion and distribution, the total quantity of energy available for use by final consumers is often significantly less than the quantity of primary energy supplied to the economy.

Renewable energy sources

Electricity obtained from renewable sources, such as hydro and wind, is treated as a form of primary energy, that is supplied directly to final consumers with no intermediate conversion step. Therefore, there are assumed to be no conversion losses, although there are losses in transmission and distribution.

Source: Saddler, Diesendorf and Denniss (2004).

At the primary conversion stage, primary sources of energy (for example, oil, gas and coal) are converted into more useful or convenient forms of energy (for example, petrol and electricity). The conversion sector comprises mainly electricity generation, electricity and gas transport and distribution, and oil refining and distribution.

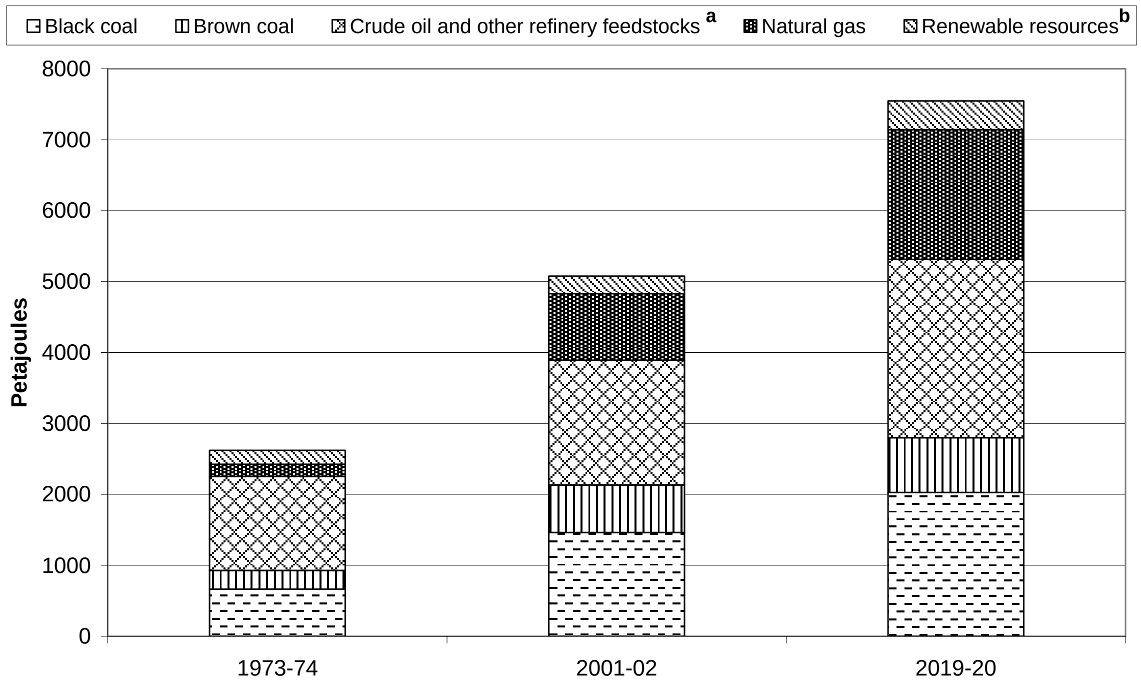
This section examines Australia's energy supply and use in terms of:

- total primary energy consumption (also known as total domestic availability), which comprises domestic production less net exports;
- electricity generation; and
- total final consumption, which comprises total primary energy consumption less energy lost in conversion and distribution.

Primary energy consumption

Total primary energy consumption in Australia is dominated by fossil fuels. For example, crude oil and other refinery feedstocks accounted for 34.8 per cent (or 1748 petajoules) of the 5055 petajoules of primary energy consumption in 2001-02. This was followed by black coal (comprising 28.9 per cent or 1463 petajoules) and natural gas (comprising 18.6 per cent or 941 petajoules). Renewables accounted for only small proportions of the total, ranging from 1.8 per cent for wood to 0.1 per cent for solar energy (figure 3.1).

Figure 3.1 **Trends in primary energy consumption, by fuel type**



a Includes petroleum products and liquid petroleum gas. **b** Comprises wood, bagasse, hydro electricity, solar energy and biofuels. **c** Projected figures.

Data source: ABARE (2004).

Total primary energy consumption grew at an average annual rate of 2.4 per cent between 1973-74 and 2001-02, almost doubling from 2615 petajoules to 5055 petajoules.[1] Although most of the growth is attributable to increasing use of coal (black and brown), natural gas consumption has become relatively more pronounced. Consumption of natural gas grew at 6.5 per cent per annum over the period, increasing its share of the total from 6.6 per cent in 1973-74 to 18.6 per cent in 2001-02. Solar energy recorded the strongest annual average growth between 1973-74 and 2001-02 (14.5 per cent per annum on average), but from a very low base. As a consequence, it still comprised only 0.1 per cent of primary energy consumption in 2000-01.

ABARE forecasts suggest that Australia will remain reliant on fossil fuels in the near to mid-term future. Total primary energy consumption is projected to grow by 2.2 per cent each year between 2001-02 and 2019-20 (Akmal et al. 2004). The greatest contribution to this growth is expected to come from natural gas, growing at an average of 3.7 per cent per annum and accounting for 35.6 per cent of the total

1 There was a break in the series between 2000-01 and 2001-02. The data indicate that total primary energy consumption grew by 1 per cent over that year. However, this may reflect changes in how data were collected, as well as changes in consumption levels.

change. Renewable energy resources, such as wind energy and biogas, are projected to record the strongest growth over the period (16.1 per cent and 7.5 per cent each year respectively), but from very low bases. These sources are still expected to account for only very small proportions of total primary energy consumption in 2019-20 (0.2 per cent and 0.4 per cent respectively). By comparison, solar energy consumption is projected to grow more slowly at 2.6 per cent per year, and is expected to account for only 0.1 per cent of total primary energy consumption in 2019-20.

Electricity generation and transmission

The electricity generation and transmission sector is the largest consumer of primary energy in Australia and creates more greenhouse gas emissions than any other sector.

Fuel sources

Approximately 83 per cent of the energy consumed in producing Australia's electricity is sourced from coal. The overall share of coal in electricity generation has remained relatively constant in the period 1973-74 to 2001-02, although the relative contributions of brown and black coal have changed. The share of black coal has grown from 49 to 53 per cent, and the share of brown coal has fallen from 33 to 29 per cent. Another important development in that period was the growth of the relative importance of natural gas for electricity generation — from 5 per cent in 1973-74 to 11 per cent in 2001-02. The widespread use of coal in Australia reflects the low variable cost associated with coal-fired generators and the proximity of large recoverable coal reserves to electricity consumers (Allen Consulting Group and McLennan Magasanik Associates 1999).

ABARE researchers (Akmal et al. 2004) have predicted that Australia's preference for coal-fired generation will continue in the period between 2001-02 and 2019-20. However, natural gas-fired generation is expected to record strong growth, more than doubling its total output over the forecast period and overtaking brown coal in terms of electricity generation by 2019-20 (table 3.1).

Table 3.1 **Electricity generation by fuel**

	Generation level			Annual growth in generation	
	2001-02	*2008-09*	*2019-20*	*2001-02 to 2008-09*	*2001-02 to 2019-20*
	TWh[a]	TWh[a]	TWh[a]	%	%
Black coal	125.7	142.4	185.3	1.8	2.2
Brown coal	48.3	52.4	59.4	1.2	1.2
Oil	2.3	2.3	2.4	0.3	0.3
Natural gas	30.5	46.5	69.3	6.2	4.7
Renewables	17.2	25.3	27.5	5.7	2.6
hydro	15.9	17.3	17.8	1.3	0.6
biomass	0.7	4.1	4.1	28.1	10.1
biogas	0.3	1.5	1.5	24.1	8.8
wind	0.3	2.4	4.1	35.3	15.9
Total	**224.1**	**269.0**	**343.9**	**2.6**	**2.4**

a 1terawatt hour = 1012 watt hours = 3.6 petajoules.

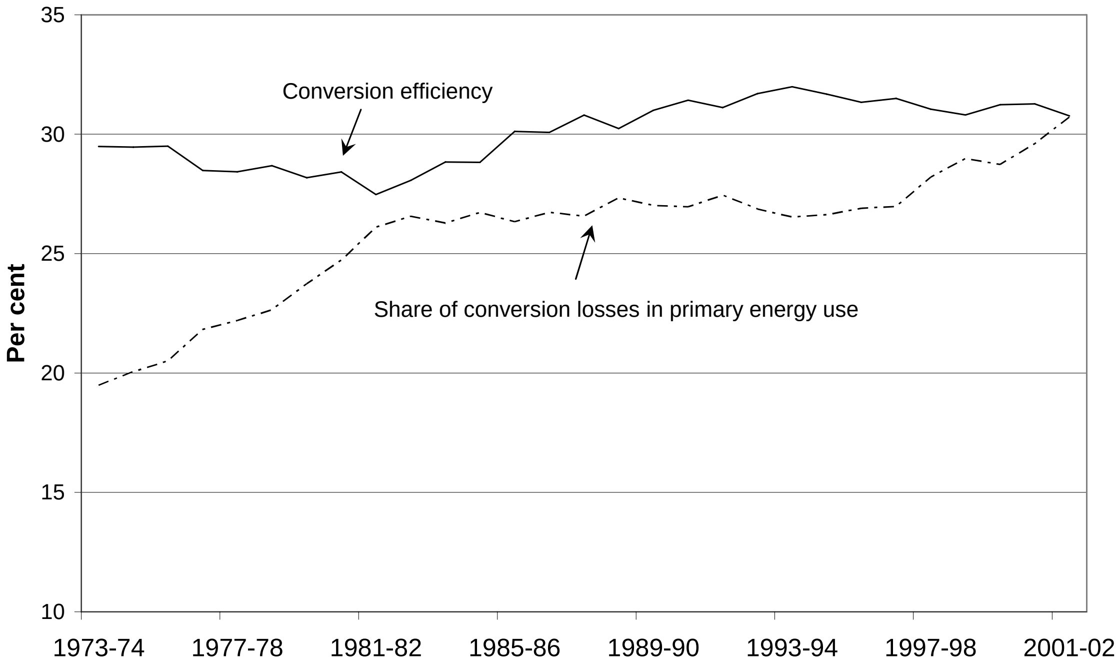
Source: Akmal et al. (2004).

Conversion losses

The conversion sector includes losses from the transport and distribution of natural gas and from refining and distribution of oil, as well as losses from electricity generation, transmission and distribution. Electricity generation is by far the largest source of conversion losses, with most of the primary energy used to generate electricity being lost during that process. Conversion losses from electricity generation represent a significant (and growing) proportion of energy use in Australia (figure 3.2).

Conversion efficiency (defined here as the ratio of electrical energy supplied to energy used in generation) is determined to a large extent by the fuel used in generation. The conversion efficiency of coal-fired generation, in particular, is low compared to other fuel sources and only about 30 per cent of energy used in generation reaches the end users in the form of electricity. A modest improvement in conversion efficiency in the period 1973-74 to 2001-02 (figure 3.2) may be due to a shift in the generation fuel mix away from (the less efficient) brown coal towards (the more efficient) black coal and natural gas.

Figure 3.2 **Conversion efficiency and losses in electricity generation, 1973-74 to 2001-02[a]**



[a] Conversion efficiency and losses are shown as a share of total primary energy consumption.

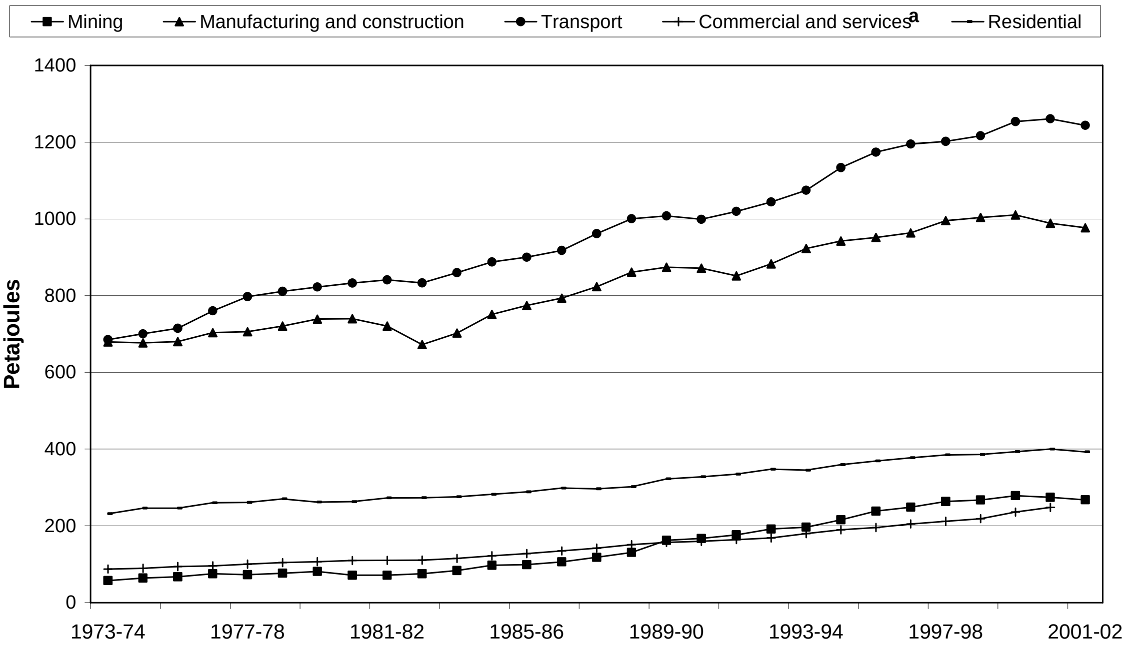
Data source: ABARE (2004).

Final energy consumption

Total final energy consumption is the amount of energy consumed by end users. It is calculated as total primary energy consumption less energy used or lost in conversion, transmission and distribution (Akmal et al. 2004).

Final energy consumption in Australia grew from 1852 petajoules in 1973-74 to 3308 petajoules in 2001-02, with all final energy-using sectors increasing their energy consumption (figure 3.3). The greatest contribution to the overall change came from the transport sector, which accounted for 39 per cent of the absolute change. The manufacturing (21 per cent), mining (15 per cent) and residential sectors (11 per cent) also made significant contributions to the change.

Figure 3.3 **Final energy consumption, by sector, 1973-74 to 2001-02**



[a] Includes ANZSIC Divisions F, G, H, J, K, L, M, N, O, P, Q and the water, sewerage and drainage industries.
Data source: ABARE (2004).

Projections developed by ABARE (Akmal et al. 2004) show that total final energy consumption is expected to continue to grow at roughly the same rate over time. Growth is projected to average 2.3 per cent each year between 2001-02 and 2019-20, taking total final energy consumption to 4714 petajoules in 2019-20. The transport sector is forecast to continue to dominate final energy consumption, accounting for 39 per cent of the total in 2019-20.

Final energy consumption by sector and fuel source

The importance of particular fuel sources varies across different industry sectors (table 3.2).

Table 3.2 **Consumption by sector and fuel source, 2001-02**

	Mining	*Manufacturing and construction*	*Commercial*	*Residential*	*Transport*
	Petajoules	Petajoules	Petajoules	Petajoules	Petajoules
Black coal	7	119	< 1	< 1	4
Petroleum products	77	137	20	15	1237
Natural gas	19	322	43	125	25
Biomass	< 1	81	< 1	66	< 1
Electricity	57	261	174	185	7
Total consumption	**161**	**919**	**238**	**393**	**1272**

Source: Akmal et al. (2004).

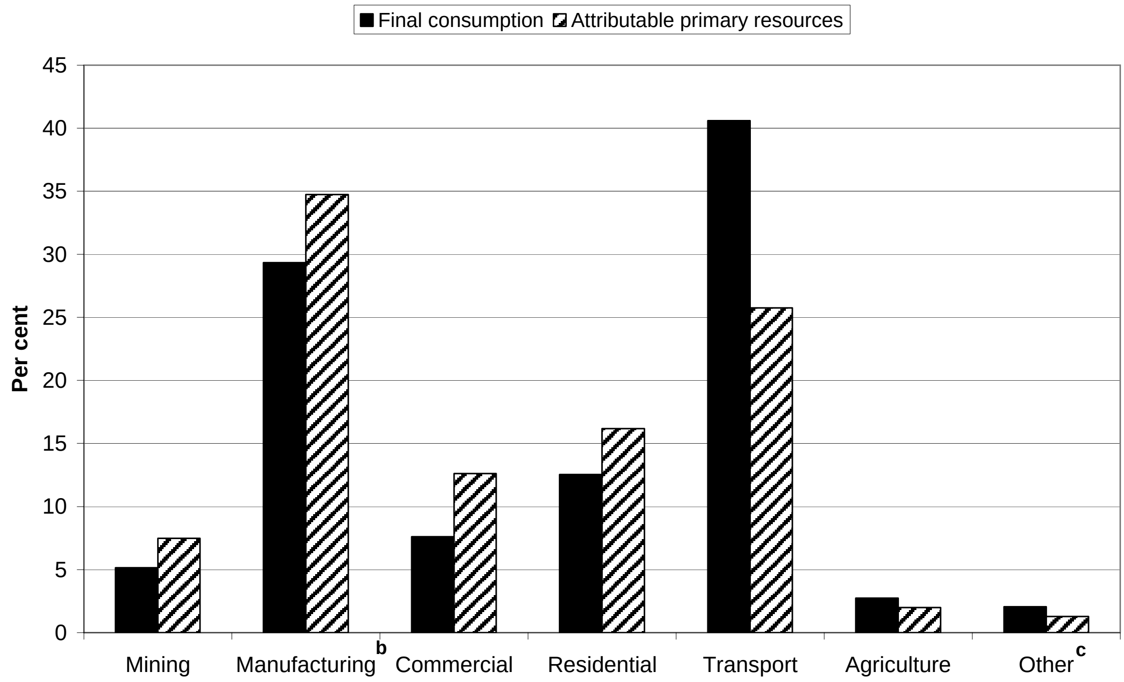
Unsurprisingly, petroleum products are a dominant source of energy in the transport sector. Petroleum is also a major fuel source in the mining sector. The manufacturing and construction sector is a significant user of a range of fuels, but natural gas consumption is the largest contributor to final energy consumption.

Electricity is a major energy source in the residential and commercial sectors because most of the energy consumed in those sectors is building and appliance-related. Electricity is also used extensively in the manufacturing and mining sectors.

Attributing primary energy resources to sectors

In view of the large conversion losses in electricity generation, a better idea of the relative magnitudes of total energy consumption by sector can be obtained by apportioning the resources required to generate electricity to the different sectors. A broad estimate can be made by calculating each sector’s share of total electricity use and applying these shares to the total primary energy used in electricity generation. When energy resources used in electricity generation are apportioned, the share in energy resource demand of electricity-intensive sectors, like the residential and commercial sectors, increases significantly (figure 3.4). The manufacturing and construction sector also overtakes the transport sector as the largest consumer of energy resources because of its large electricity usage.

Figure 3.4 **Percentages of final energy consumption and primary energy resources attributable to sectors, 2001-02[a]**



[a] Resource consumption is apportioned on the assumption of uniform electricity conversion losses across sectors. [b] Includes construction. [c] Includes consumption of lubricants and greases, bitumen and solvents.

Data source: PC estimates using data from Akmal et al. (2004).

Importance of energy costs in different sectors

Energy is generally a small item of expenditure in all of the final energy-using sectors of the Australian economy (table 3.3). Overall, in 1998-99, energy accounted for around 3 per cent of total expenditure in Australia, ranging from 6.8 per cent for the industrial sector to only 2.5 per cent for residential and 1.6 per cent for the commercial sector.

Table 3.3 **Share of energy costs in total expenditure, 1998-99**

Sector	*Share of energy costs in total expenditure*
	%
Residential	2.5
Industrial	6.8
Commercial	1.6
Transport	4.5
Total for Australia	**3.1**

Source: PC estimates from ABS (2004a).

These broad sector-wide averages hide the variability of energy costs that would be evident if comparing different subsectors or different producers and consumers within those subsectors. For some businesses or individuals, energy costs represent a significantly greater proportion of expenditure than their sector average. For example, the Australian Aluminium Council (sub. 29, p. 4) submitted that energy accounted for 23 per cent of the costs in alumina production and 22 per cent of aluminium smelting costs. Conversely, there will be many businesses and individuals for whom energy expenditure would constitute a lower share of total costs than the sector average.

3.2 Energy intensity

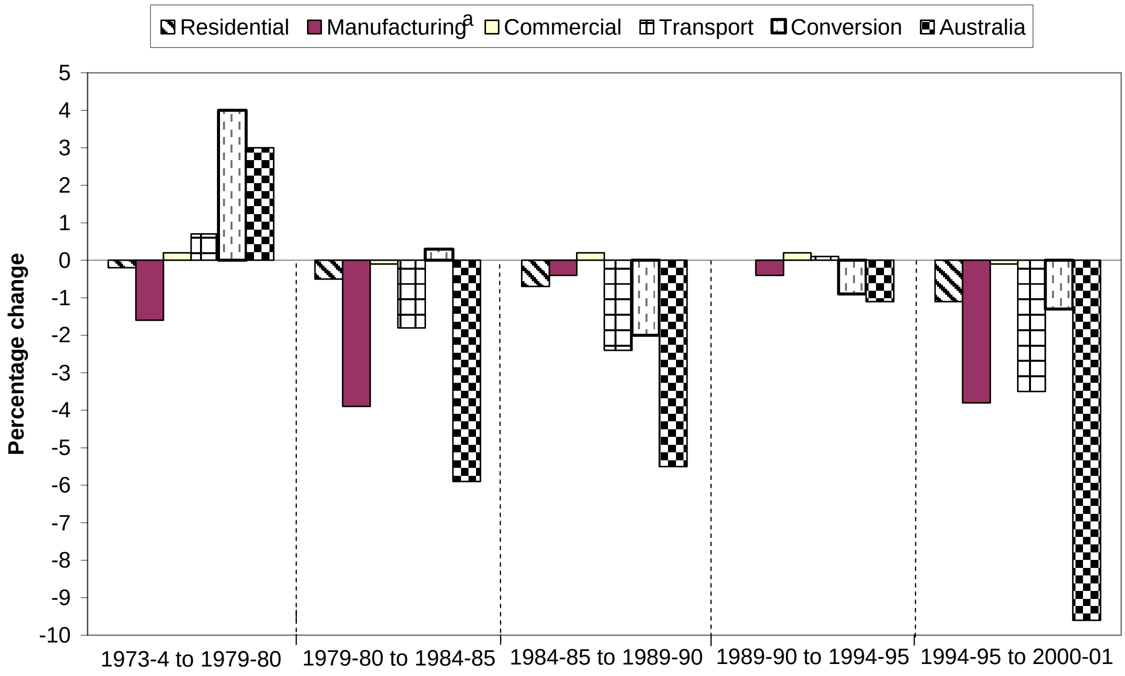
The energy efficiency of a specific process or piece of equipment can be evaluated by comparing the output of useful services to the energy input. It is much more difficult to measure energy efficiency at aggregate levels, such as for industry sectors, geographic regions or nations, because of the heterogeneity of circumstances and outputs. Energy intensity is one simple measure that can give some limited insights into energy efficiency at sectoral or economywide level.

Aggregate energy intensity

Aggregate energy intensities are calculated for sectors of the economy and the economy as a whole. Typically, energy intensity is defined as energy consumption per unit of gross domestic product. But it could also be measured in other ways. For example, residential sector energy intensity could be calculated as energy consumption per household or per square metre, or as energy expenditure per dollar of total household expenditure. Manufacturing and commercial sector intensity could also be calculated as energy consumption per unit of output.

ABARE researchers conducted an analysis of trends in Australia's energy intensity between 1973-74 and 2000-01 (Tedesco and Thorpe 2003). They estimated that aggregate energy intensity fell in most sectors and in the Australian economy as a whole (figure 3.5).

Figure 3.5 **Sectoral contributions to changes in Australian energy intensity, 1973-74 to 2000-01**



a Includes mining and construction.
Data source: Tedesco and Thorpe (2003).

Overall, in the period 1973-74 to 2000-01, economywide aggregate energy intensity fell by 18.2 per cent or an average of 0.6 per cent per year.

According to Akmal et al. (2004), aggregate energy intensity is forecast to decline by a further 1.1 per cent a year until 2019-20, suggesting that 18 per cent less energy will be needed to produce a unit of economic output in 2019-20.

Factorising energy intensity

Trends in energy consumption can be decomposed into the factors that underlie changes in energy use. ABARE identified three categories of effects (Tedesco and Thorpe 2003):

- Production effect — the effect of changes in the level of output on energy consumption. The production effect is excluded when calculating energy intensity.
- Structural mix effect — the first component of aggregate intensity that reflects the effect on energy consumption of changes in the mix of industries (such as a contraction in energy-intensive industries relative to other industries).

- Real energy intensity effect — the second component of aggregate intensity. It reflects the effect of changes in the mix of fuels, and the technical effect which accounts for all remaining changes (such as changes in industrial processes and input mix).

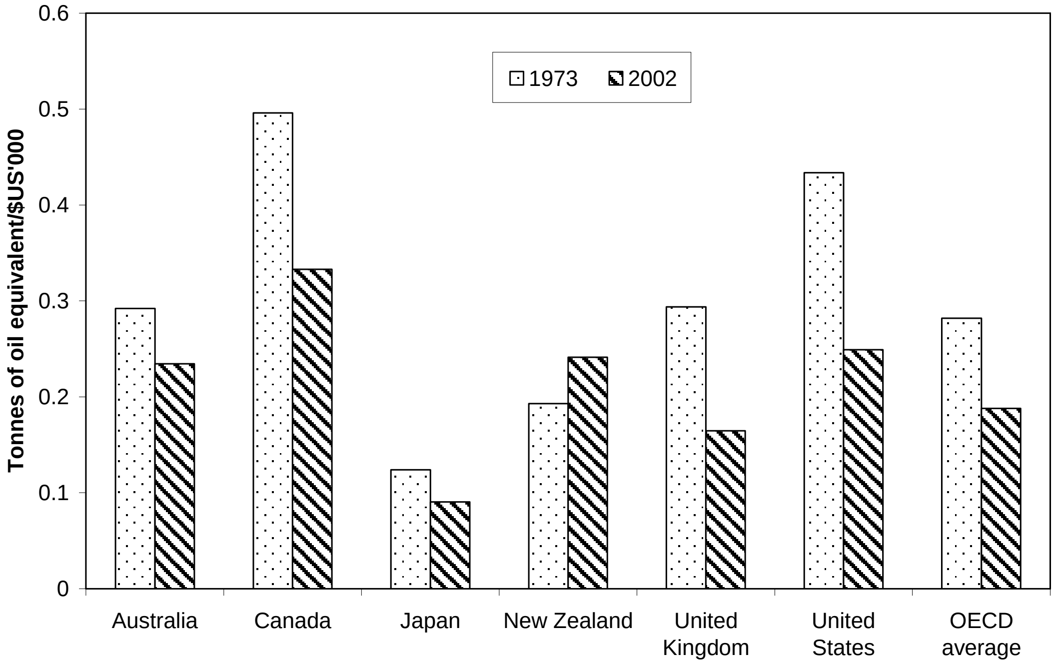
Tedesco and Thorpe (2003) found that, if aggregate energy intensity had remained constant, the increase in production that had occurred would have raised total energy consumption by 136 per cent from 1973-74 to 2000-01. However, the fall in economywide aggregate energy intensity meant that final energy consumption only grew by 93 per cent. Two thirds of the change in energy intensity was attributed to structural shifts away from energy-intensive sectors of the economy, whereas fuel-mix effects accounted for the remainder. The estimate of the technical effect, showed that energy consumption would have increased by 0.5 per cent in the absence of structural or fuel-mix effects.

The above findings appear to indicate that the reduction in Australia's energy intensity was caused by structural and fuel-mix changes rather than improvements in energy efficiency. However, such economywide estimates hide the variability in energy consumption trends across the different sectors of the Australian economy. As discussed in chapters 6 and 7, between 1973-4 and 2000-01, energy efficiency is likely to have improved substantially in the residential sector but declined across most industrial and commercial subsectors.

International comparisons of energy intensity

According to the IEA (2004a), Australia's energy intensity in 2002 (measured in terms of primary energy supply per dollar of gross domestic product) is higher than the OECD average, as was the energy intensity of Canada, United States and New Zealand (figure 3.6).

Figure 3.6 **Total primary energy supply per dollar of gross domestic product[a]**



[a] Gross domestic product is expressed in 1995 US dollars.

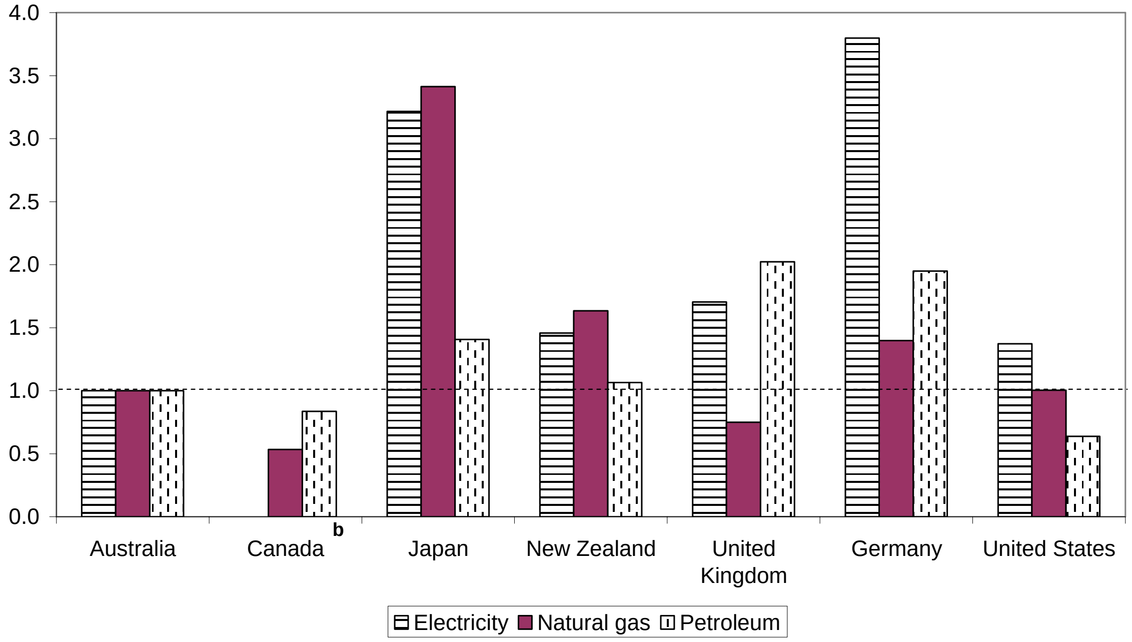
Data source: IEA (2004a).

Further, Australia's energy intensity reduction over the period 1973–2002 has been smaller than in most of the OECD countries.

Chapter 2 outlined why energy intensity does not necessarily reflect energy efficiency or economic efficiency. The ABS (2001) argued that Australia's high energy intensity reflects its economic structure and the fact that Australia has relatively more energy-intensive industries (such as the aluminium industry) than the OECD average. The ABS also attributed Australia's relatively high energy intensity to the significant role that coal plays as a fuel source in these industries, and particularly for power generation (and coal's relatively poor thermal efficiency).

Australia's relatively high level of energy intensity can also be explained in part by the fact that its energy prices are lower than in most other countries (figure 3.7).

Figure 3.7 **Index of international energy prices for industry[a]**
Australia = 1



[a] Electricity and petroleum prices are for first quarter 2004. Natural gas prices are for 1997. Electricity prices for Australia and the United States exclude taxes. [b] Data on Canadian electricity prices were not available.

Data sources: IEA (2003; 2004b).

Australian electricity prices are among the lowest in the OECD. Similarly, Australian petrol prices are fourth lowest in the OECD (IEA 2004b). Natural gas prices are also relatively low by OECD standards. The influence of energy prices, economic structure and other differences on consumption and energy intensity is crucial. In the absence of such consideration, it would not be appropriate to draw conclusions about Australia's energy efficiency performance based solely on comparisons of its energy intensity to the rest of the world. Ultimately, Australia's energy efficiency performance needs to be assessed in the context of the barriers and failures hindering the operation of Australian markets, rather than through comparisons with the performance of other countries.

FINDING 3.1

Cross-country comparisons of energy intensity must be used with caution, given that the observed levels of energy intensity of any economy reflect local circumstances, including climate, energy prices and economic structure.

3.3 Energy prices

As mentioned in the previous section, Australia's energy prices are low by world standards. This section analyses the changes in Australia's energy prices over the last 10 years.

Electricity prices

The average electricity retail price in Australia was estimated to be 9.77 cents per kWh in 2003-04. The price for residential customers was 13.38 cents per kWh, while the price for non-residential customers was 8.23 cents per kWh. Electricity prices vary between states (box 3.2).

Box 3.2 **How average retail electricity prices are estimated**

Retail electricity prices (that is, what customers pay for their electricity) comprise wholesale electricity prices, network service charges, market (pool) fees and the retailers' fees.

Over 87 per cent of electricity users in Australia receive their electricity from the national electricity market (NEM), which operates in New South Wales, Victoria, Queensland, South Australia and the ACT. Wholesale prices are set via a competitive bidding process. The Energy Supply Association of Australia (ESAA) estimates retail prices for customers in NEM jurisdictions based on these wholesale prices.

Retail electricity prices in Western Australia, Tasmania and the Northern Territory are set within ranges regulated by the relevant State or Territory Government.

The ESAA estimated that network service charges (transmission use of system and distribution use of system) can be between 30 per cent and more than 50 per cent of the end price to customers. They can be a significant factor in explaining differences in retail prices between and within states and territories.

Source: ESAA (2004).

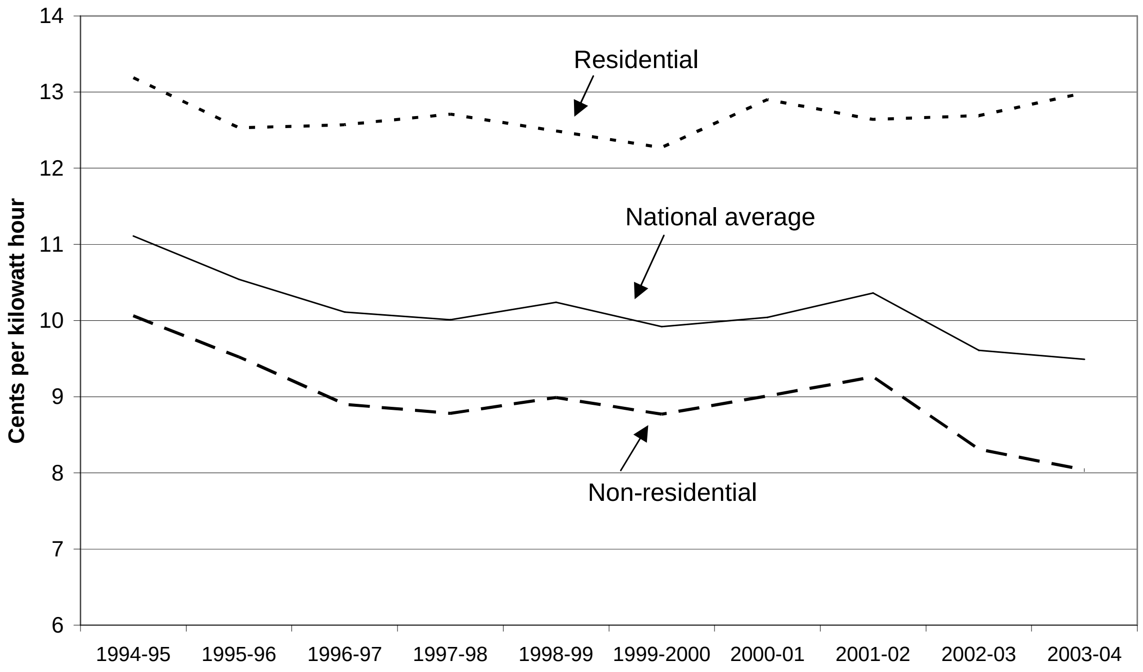
Average retail electricity prices in Australia fell by 14.6 per cent (in real terms) between 1994-95 and 2003-04, an average fall of 1.7 per cent each year (figure 3.8). The fall was greatest in Queensland, where average retail prices fell by 23.1 per cent overall (or 2.9 per cent each year). By contrast, average retail prices rose in South Australia, up 20.8 per cent since 1994-95 (average growth of 2.1 per cent each year).

For residential customers, retail prices fell overall by 1.5 per cent over the period. Falls were recorded in New South Wales, Queensland, Western Australia and the

Northern Territory, with residential retail prices rising in Victoria, South Australia, Tasmania and the ACT.

Non-residential retail prices fell by 20.1 per cent. At the state/territory level, falls were recorded in all jurisdictions except South Australia, where prices rose by 11.1 per cent (or 1.2 per cent each year) over the period. Some of the relative movements in electricity tariffs can be explained by retailers rebalancing tariff structures following the general deregulation of electricity markets.

Figure 3.8 **Average retail electricity prices, Australia**
2002-03 prices



Data source: ESAA (2004).

Petroleum prices

Petroleum products are internationally-traded commodities and their prices are influenced by world prices. Caltex (2005) identified the following major determinants of retail petrol prices in Australia:

- price of petrol from Singapore refineries (these being the major source of Australia's imported petroleum) in US dollars;
- exchange rate;
- taxation regime; and

- profit margins in Australia for storage, distribution, wholesaling and retailing.

Caltex (2005) data show that average city retail prices for unleaded petrol at Ampol and Caltex stations grew in all states between December 1997 and May 2005. In real terms, prices increased by 12 per cent in Western Australia; 14 per cent in Tasmania; 16 per cent in Victoria; 19 per cent in New South Wales and Queensland; 20 per cent in South Australia and 26 per cent in the ACT. Caltex attributes these increases to the increase in international crude oil prices. In addition, Singapore refinery prices have been increasing due to the reduction of excess refinery capacity.

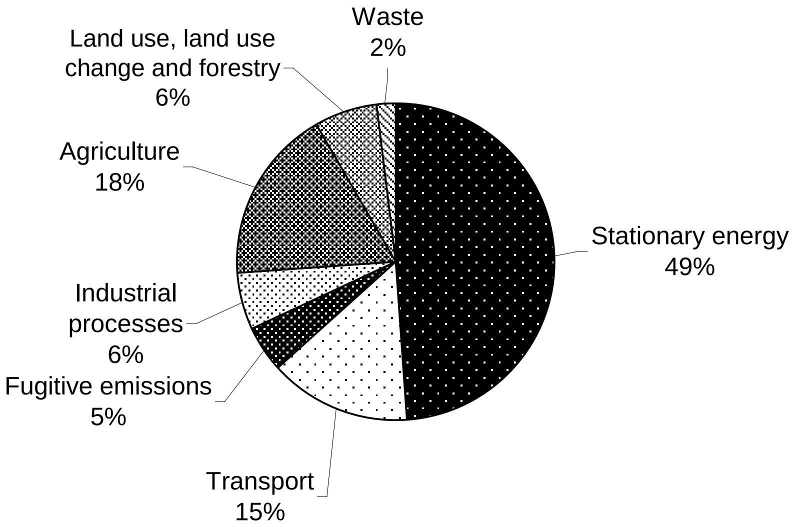
Gas prices

Data on gas prices are quite sparse. The PC (2005) has estimated that between 1990-91 and 2003-04, average real gas prices for households in state capital cities rose by approximately 13 per cent. On the other hand, real gas prices for manufacturers fell by around 12 per cent over the same period.

3.4 Greenhouse gas emissions

Greenhouse gases include carbon dioxide, methane, nitrous oxide and chlorofluorocarbons. The production and use of fossil fuel-based energy is a large source of greenhouse gas emissions. For example, stationary energy use (comprising electricity generation, and non-transport fuel combustion in the industrial, commercial and residential sectors) accounted for almost half (49 per cent) of the 550 megatonnes of carbon dioxide equivalent gases emitted by Australia in 2003 (figure 3.9). Other large contributors were the agriculture and transport sectors (respectively accounting for 18 and 15 per cent of the total).

Figure 3.9 **Greenhouse gas emissions by source, 2003**[a]



[a] Calculated in terms of carbon dioxide equivalents.

Data source: AGO (2005f).

Among stationary energy users, electricity generation made the largest contribution, accounting for 71 per cent of stationary energy emissions in 2003. Within the transport sector, road transport accounted for 90 per cent of carbon dioxide equivalent emissions from that sector in 2003.

Overall, Australia's greenhouse gas emissions rose by 1.1 per cent between 1990 and 2003, growing on average by 0.1 per cent each year. However, significant but largely one-off falls in emissions from land use, land-use change and forestry have partially offset large increases in emissions from the stationary energy and transport sectors (which grew by 37 per cent and 29 per cent respectively).

Tedesco and Thorpe (2003) analysed trends in carbon dioxide emissions per unit of economic output — carbon dioxide emission intensity — in Australia for the period 1973-74 to 2000-01. Their analysis showed that, if there had been no growth in output during 1973-74 to 2000-01, Australia's carbon dioxide emissions would have fallen by 17 per cent (table 3.4). All of the primary energy-using sectors of the Australian economy registered significant reductions in their emission intensity, except the mining and conversion sectors whose emission intensity increased markedly.

Table 3.4 **Changes in carbon dioxide emission intensity during 1973-74 to 2000-01 — total energy use[a]**

Sector	*Change in carbon dioxide emission intensity*
	%
Residential	-42
Manufacturing	-60
Construction	-17
Mining	99
Commercial	-46
Transport	-24
Conversion	10
Total for Australia	**-17**

a The numbers given in the table were derived by recalculating the results reported by Tedesco and Thorpe (2003). The sectoral numbers provided in that study estimated the percentage impact of the change in emission intensity of particular sectors on Australia's total emissions. To derive the emission intensity change for individual sectors, the absolute value of the change in emissions for the sector was calculated and then divided by the 1973-74 level of emissions for that sector.

Source: PC estimates based on Tedesco and Thorpe (2003).

The Australian Greenhouse Office (AGO 2004o) estimated that greenhouse gas emissions during 2008–12 will on average be 8 per cent above 1990 levels (accounting for emission reduction programs). This means that Australia is on track to achieve its commitment under the Kyoto Protocol of 108 per cent of the 1990 level of emissions in 2008–12. The largest contribution to the rise in emissions is predicted to come from stationary energy users (approximately 70 per cent of which will originate from electricity generation). These are forecasted to increase by 46 per cent over the period. Transport emissions (over half of which are from cars) are also expected to make a significant contribution to the rise in emissions, growing by 43 per cent between 1990 and 2008–12. Despite these significant increases, the overall emissions target will be met due to substantial reductions in emissions resulting from reduced land clearing and the expected emergence of carbon sequestration in Kyoto-compliant forest plantations. In the longer term, AGO (2004o) forecasted that greenhouse gas emissions will increase by 23 per cent between 1990 and 2020 with the largest contributions coming from the growth of stationary and transport energy use.

As noted earlier, since the 1970s, growth in energy consumption has been driven primarily by growth in the level of output. Ongoing economic growth suggests that foreseeable improvements in energy efficiency may only marginally reduce production-related growth in energy consumption. Improvements in end-use energy efficiency must, therefore, be seen as just one of the many drivers for reducing greenhouse gas emissions from the use of energy. In announcing the Asia-Pacific Partnership on Clean Development and Climate, the Australian Government

(Howard 2005b) stated that fundamental technological advances in areas such as the use of low-emission fuels; efficiency of conversion of primary energy to final energy; and carbon capture and storage, will be required to achieve a significant reduction in greenhouse gas emissions.

4 What are the barriers and impediments?

Key points

- Barriers and impediments to the adoption of energy-efficient investments result in an energy efficiency gap. At issue is whether government intervention is warranted to reduce or remove such barriers and impediments so as to benefit individual energy users and/or society.
- The various barriers and impediments to the adoption of energy efficiency improvements can be categorised as:
  - market failures
  - behavioural and organisational barriers
  - other barriers and impediments that increase the costs of energy efficiency investments.
- Market failures provide the strongest rationale for government intervention at current (and expected) prices:
  - imperfect information (including asymmetries of information) and split incentive problems can lead to the non-adoption of energy efficiency improvements that are *privately* cost effective; and
  - positive externalities associated with research and development and demonstration projects can lead to the non-adoption of energy efficiency improvements that are *socially but not privately* cost effective.
- Government intervention may be warranted to address market failures provided the social benefits of intervention exceed the social costs.
- Behavioural, cultural and organisational barriers do not of themselves provide a rationale for government intervention. Understanding these barriers may, however, be helpful in designing efficiency programs that address environmental externalities, information failures and other sources of market failure.
- Other barriers and impediments, such as risk and uncertainty, asset replacement costs and implementation costs, may increase the costs to energy users but do not represent failures in markets for energy efficiency investments. The role of governments in addressing these issues may be quite small.

Many participants in this inquiry have pointed to the existence of a variety of barriers and impediments that increase the costs to energy users of adopting energy efficiency investments and which result in an energy efficiency gap. It has also been argued that government intervention is warranted to reduce or remove such barriers and impediments as this will benefit both individual energy users and/or society.

This chapter provides a framework for assessing those barriers and impediments. In so doing, the Commission recognises the widespread use of the terms *barriers* and *impediments* in this policy area. Whereas a barrier might prevent the adoption of an energy efficiency improvement altogether, an impediment might mean the improvement is taken up but not as fully as it otherwise might. In practice, the terms are used more or less interchangeably, depending on the circumstances.

4.1 Introduction

Understanding the nature of the barriers and impediments facing individual consumers and producers is important in devising policy responses that will improve energy efficiency in a way that maximises economic efficiency (and thereby brings net benefits to the Australian community as a whole). Drawing on some of the features of a taxonomy adopted by Jaffe and Stavins (1994) and Sorrell et al. (2000), and which was also used by the Allen Consulting Group (2004c), three classes of barriers and impediments are considered in the subsequent discussion:

- *market failures* — which arise where the market fails to provide or allocate goods and services to their most efficient use (that is, the allocation of goods and services is not one that maximises overall wellbeing of the community);
- *behavioural, cultural and organisational barriers* — which arise because of limits on the decision-making abilities of individuals and organisations; and
- *other barriers and impediments* — such as the additional costs of adopting energy-efficient investments or the impact of those investments on output.

This framework can be broadened to consider how the case for policy intervention would change if there was a change in the price of energy. That is, if energy was priced at its true economic cost, by which it is meant that the price includes all of the costs of resources used in its production and any associated externalities (such as pollution or greenhouse gas emissions).

There are several reasons why energy is not priced at its true economic cost: there are natural monopoly influences in the transmission and distribution of energy (such as gas and electricity), there is imperfect competition in the generation of electricity in some jurisdictions, and environmental externalities are not included in the price of energy. A related issue concerns the regulatory failures that could follow from imperfectly addressing natural monopoly (such that prices are not as cost reflective as they might be) or as the result of the inadvertent side effects of other policies (such as the effects of taxation on the incentives to consume energy).

Addressing such distortions to the price of energy in turn would influence what energy efficiency measures might be privately cost effective for individual consumers or producers to adopt. These issues are discussed in chapter 14. What is important to note here is that, while changing energy prices would alter the size of the perceived energy efficiency gap (for example, higher prices would encourage more investment in energy-efficient technologies), they do not change the intrinsic nature of the barriers and impediments in the market for energy-efficient technologies. For example, European policy literature also refers to barriers and impediments to energy efficiency even though prices for electricity, gas and oil in many European countries are often substantially higher than in Australia, and levels of energy efficiency are also higher than in Australia (Sorrell et al. 2004).

4.2 Failures in markets for energy-efficient technologies

Failures in markets for energy-efficient technologies have the potential to impede the adoption of energy-efficient investments whether privately cost effective or not. Three broad types of market failure are considered:

- *imperfect information* — markets may undersupply energy-efficient technologies and services because consumers (and sometimes vendors) do not have access to sufficient or accurate information about their energy efficiency options;
- *split incentives* — markets may undersupply technologies and services because the person purchasing an energy-using technology is different from the person who benefits from its use, and the incentives facing the purchaser differ from those of the user; and
- *positive externalities* — markets may undersupply investment in new technologies and processes because market participants are unable to fully capture the benefits from undertaking an activity.

Imperfect information

Markets work best when consumers and producers have sufficient information about energy-using technologies and services to make choices that will maximise their welfare and profit respectively. However, consumers might not be able to access the necessary information on the energy efficiency of a product, or the price and performance of competing products. Similarly, producers might not have sufficient information about their competitors or their consumers' preferences. Consequently, consumers and producers may make choices that they later regret when they become better informed.

Some commentators have drawn attention to information deficiencies in the market for energy-efficient technologies. For example, the Institute for Sustainable Futures (2004, p. 74) commented:

> … in general, participants identified a lack of knowledge about the actual functioning of appliances …
>
> Participants also lacked information to inform purchasing decisions … Without knowledge, householders are unable to make informed choices about energy-reduction actions available to them.

And as the Moreland Energy Foundation Ltd pointed out '… you can't implement something if you don't know it exists' (sub. 18, p. 5).

Some of the reasons why market information may be imperfect include:

- information can be costly to obtain
- information can have public good characteristics
- information is available to some parties in a transaction but not others.

Costs of obtaining information

In some ways, information is like any other commodity in that it can be costly to obtain. Consumers would be acting rationally by incurring costs to obtain information up to the point where the additional cost of an extra piece of information just equals the additional benefit. The costs of obtaining information are not just financial — they may include the opportunity costs of devoting time and effort that could be spent elsewhere. For consumers, this might mean less leisure time, and for firms it might mean less attention is given to other business activities and obligations. Moreland Energy Foundation Ltd implied that the opportunity cost of time can be significant, referring to the:

> Lack of time or resources to look at all the options prior to making a decision — renovators often complain about choices they made under stress that they have become

unhappy with; sole business operators rarely have the time to look at non-core business issues, even if it would be to their advantage. (sub. 18, p. 5)

Transaction costs

The costs of obtaining information are part of overall transaction costs. For instance, they are part of the costs a producer might incur in purchasing and installing more energy-efficient equipment. As well as gathering, assessing and applying information, transaction costs can also include the costs of negotiating, drawing up, monitoring and enforcing contracts.

In some cases, transaction costs may prevent individual producers and consumers from undertaking investments that might be otherwise economically efficient. Where economies of scale and scope are present, other arrangements may make such investment feasible. For example, market intermediaries such as energy efficiency auditors and energy-performance contractors might be able to meet a firm's information needs at a lower unit cost. Similarly, for consumers, governments or other intermediaries might be able to supply general information on energy efficiency, through, for example, appliance labelling (see also the discussion below on public goods and chapter 9).

Transaction cost theory can also be useful in explaining the way people behave (section 4.3).

Public goods

Information can have some of the characteristics of a public good. Information can be used many times over without reducing what is available to others, and it can be difficult to exclude its use by others, even if they do not pay for it. This decreases markedly the incentives for private providers to supply such information. The extent to which this is an issue in energy efficiency is debatable and requires a distinction to be made between product-specific information and general information. Vendors in markets for energy-efficient technologies have incentives to provide information that is specific to their particular product. For example:

- To the extent that it may give them a marketing advantage, suppliers of energy-efficient appliances could be expected to provide information on the energy efficiency features of their products.
- Builders and vendors of properties and landlords may draw the energy efficiency features of their properties to the attention of potential buyers and renters where such features will save money on energy bills or significantly enhance comfort or productivity.

However, other suppliers, builders or vendors may not provide comparable product-specific information when it is not to their advantage, such as if their products or properties were less efficient. In these circumstances the consumers do not have a readily-available comparable information base.

Where information is less product specific and offers less opportunity for cost recovery, producers will have little incentive to provide it. For example, information on general energy-saving techniques or practices, such as how to incorporate passive design principles into house design, might not be readily supplied. However, possibly motivated by social and environmental concerns and the spinoffs that might be generated by being seen to be ‘eco friendly’, some energy and product suppliers are supplying some general information on energy efficiency. For example, on their respective websites, CSR Bradford provides some basic information about passive solar design for houses and AGL provides advice on the typical energy consumption costs of various household appliances. Furthermore, these matters are often referred in specialist journals and magazines and are often promoted by enthusiasts through the internet.

In the Commission’s view, the public good nature of general information about energy efficiency may provide some rationale for government intervention. However, the method and extent to which governments actually intervene will depend in part on the material nature of this problem and the relative cost effectiveness of the various policy options.

Asymmetry of information

Imperfect information includes cases where the information is not available equally to all participants in the market. Such information asymmetries abound in energy efficiency and other markets. They can lead to policy problems where there are incentives not to share information or information is difficult to verify. Typically, information asymmetries occur where producers (or vendors) have more information about the energy efficiency of their products than their consumers.

Market participants nevertheless have incentives to obtain information or to verify the credibility of information supplied by other parties. For example, motor-vehicle buyers often subject second-hand cars to independent vehicle inspections. And prospective building owners and tenants may assess the quality and likely repair and maintenance requirements of a building as well as its energy costs. Yet the transaction cost of obtaining and verifying the claims of other parties can at times be prohibitive. If the problem of verification is sufficiently widespread, the problems of *adverse selection* and *moral hazard* can arise (Jaffe and Stavins 1994; Phlips 1988).

Adverse selection

Adverse selection can occur if sellers are much better informed than buyers about a product's energy efficiency. This information asymmetry could persist because sellers have an incentive to promote products as energy efficient even when they are not. If consumers think this is the case, then they will be unwilling to pay a premium for actual higher energy efficiency. This will in turn lead to a 'lemons effect' in which only poorer quality (less efficient) products are supplied to the market (the logic of the lemons effect was detailed by Akerlof 1970). As a result, markets may undersupply cost-effective energy-efficient technologies (Howarth and Sanstad 1995).

Moral hazard

In some situations, the buyer can possess more information than the seller. If after a contract is agreed, the seller is unable to verify the behaviour of the buyer, the buyer may act in an opportunistic manner to the detriment of the seller (Sorrell et al. 2000; Phlips 1988). This is known as the *moral hazard* problem.

Known primarily for its presence in insurance markets (where insured parties may become less risk averse after taking out insurance), moral hazard may also be relevant to energy efficiency. For example, Origin Energy described the difficulties facing energy efficiency auditors in verifying energy savings made by their clients after contracts for energy efficiency audits were signed:

> … there is less incentive for the client, after undergoing an energy audit, to recognise fully (and attempt to measure) the benefits that are possible from the consultant's advice. Where the contract involves implementation of the consultant's advice, there is less incentive for the client to attribute fully the actual benefits accruing from that advice. One would expect the party with less information *ex post* (the consultant) to design a contract upfront to minimise the client's incentive in this regard, but the costs are likely to be prohibitive relative to the size of auditing fees (especially if the consultant is a small operator). (sub. 25, p. 7)

Repeat purchasing

One way in which consumers can address information asymmetries is through the experience gained from repeat purchasing. For example, repeat purchasing of grocery items allows consumers to compare and contrast the performance of different competing products quite quickly and inexpensively. But where transactions are large and infrequent (such as with major appliances, cars and houses), consumers might have little past experience to draw on, creating the potential for poor decisions. If disgruntled customers have little or no influence on future sales, producers (or vendors) have little incentive to provide full and accurate information. Examples can be found in one-off sales of real estate in private markets, although this form of market failure might be less severe in the new property market, where the reputation of a builder or property developer can be established and made known in the marketplace.

Split incentives

Split incentives arise when the person purchasing an energy-consuming product is different from the person who benefits from it and the incentives facing the purchaser differ from those of users.

This problem can occur in real estate markets, where it is sometimes called the *landlord–tenant* problem. Landlords, it is argued, do not have strong incentives to install more energy-efficient appliances because they might not be able to recoup the additional capital costs through increased rent. Tenants on the other hand might be prohibited from replacing appliances, or might not be confident that they will be able to recoup the savings (through lower energy bills), when the term of their lease is uncertain.

Rheem Australia noted that split incentives is potentially a large issue:

> Approximately 30 per cent of Australian households are in rented accommodation rather than owner occupied. In this market segment the decision maker is primarily concerned about minimising capital cost and is less concerned about the running cost of the water heater. (sub. 46, p. 1)

Alternatively, it might be argued that landlords want to maximise the net returns on their investment and if tenants were willing to pay the higher rent (while still saving overall), the more energy-efficient appliances would be installed. But in many cases the benefits are not sufficient to warrant renegotiating leases. As Sanstad and Howarth (1994, pp. 814–5) noted:

> In the absence of transaction costs, landlords and tenants would presumably enter into contracts to share the costs and benefits of energy efficiency. But structuring efficient contracts is by no means a simple task, and the net gains achievable through improved energy efficiency might be swamped by the associated transaction costs.

The Commission notes that split incentives can occur where there is an information asymmetry, but this is not essential. Even where the buyer and seller have the same access to information, the transaction costs of overcoming their different incentives may result in the non-adoption of what would otherwise have been a worthwhile investment. The case for government intervention would be strongest where it lessens these transaction costs.

Positive externalities

Positive externalities (or spillovers) occur where the actions of one person have beneficial spillover effects for others that are not reflected in market prices. If the person making the investment is unable to capture all of the benefits, they might not provide as much of the good or service as would be appropriate from the broader community perspective.[1]

The positive externalities of greatest relevance in terms of market failures in the supply of energy-efficient technologies concern research and development (R&D) and the demonstration effects of firms adopting energy efficiency improvements.

R&D is an important determinant of technological advances in energy efficiency in the long term. It tends to push out the technical frontier, but because of the need to commercialise new technologies and the inevitable lags in turning over the capital stock, can take time to diffuse through the economy. Addressing barriers to undertaking R&D would contribute to the supply of (potentially cost effective) energy-efficient technologies and potentially increase Australia's energy efficiency and overall economic efficiency. Where R&D externalities are strong, a firm's incentive to undertake R&D is weakened (IC 1995; Banks 2000).

The incentives for adopting new and innovative technologies and services may also be weakened because of demonstration effects. A firm that adopts a new technology demonstrates the net benefits of the investment to its competitors. In doing so, it reduces the risk to the competitor of adopting the same technology. If firms are unable to appropriate all of the benefits from being the first mover, there will be an underadoption of new technologies (Sorrell et al. 2000; Jaffe and Stavins 1994).

Australian governments currently support R&D in energy efficiency technology and other areas in many ways. These include the provision of a patent system and other intellectual property laws, and the direct funding of government bodies (such as cooperative research centres, the Commonwealth Scientific and Industrial Research Organisation, universities and government agencies), and the provision of general and selective R&D incentives (such as the R&D tax concession, competitive grants, and concessional loans). The extent to which it is appropriate for governments to provide incentives specifically for energy efficiency is addressed in chapter 7.

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[1] Positive externalities and public goods are similar in nature — both involve free riders. The difference is largely one of degree. With public goods, the private benefits are assumed to be so small (that is, the private costs of addressing the market failure are so large) that no private investment takes place. With positive externalities, sufficient private benefit can be captured to ensure some provision of the product but not as much as would be appropriate from a broader community perspective.

Market failure and government intervention

The presence of market failure does not of itself warrant government intervention. Such intervention can be costly and introduces its own distortions, especially if the intervention is poorly targeted (chapter 2). Intervention is only warranted when it produces net benefits to the community (including economic, social or environmental benefits and the public and private costs). One way that this might be achieved would be to target the market failure as directly as possible. For example, some information asymmetries may be virtually insurmountable for most consumers at any reasonable cost. Government intervention that provided such information directly or that required that it be provided (through labelling, for example) could reduce the search costs of obtaining information.

The reduction of harmful greenhouse gas emissions is a stated policy objective for many energy efficiency measures — even though such benefits are frequently not quantified in their regulatory impact assessments. Since government intervention is warranted only when it produces net social benefits, the case for energy efficiency measures is likely to be strengthened if such net benefits are included and if they are significant.

FINDING 4.1

Failures in markets for energy efficiency technologies can inhibit the adoption of energy efficiency improvements at current (and expected) energy prices:

- *imperfect information (including asymmetries of information) and split incentive problems can lead to the non-adoption of energy efficiency improvements that are privately cost effective; and*
- *positive externalities associated with research and development and demonstration projects can limit the adoption of energy efficiency improvements that are socially but not privately cost effective.*

Government intervention may be warranted on these grounds if the social benefits of intervention exceed the social costs.

The case for government intervention rests primarily on the benefits of reducing harmful environmental externalities.

4.3 Behavioural, cultural and organisational barriers

There are times when individuals, small businesses and larger organisations appear (to an outsider) not to choose privately cost-effective energy-efficient technologies even when market information is available to them. This can be because of behavioural, cultural and organisational barriers that limit their decision making.

Behavioural and cultural norms

Behavioural and cultural norms are the values and attitudes of individuals towards energy use. According to the Institute of Sustainable Futures (2004, p. xvi):

> These factors reflect the interaction between past experiences, socially established norms and expectations, present living conditions and social contexts. They represent long standing and deeply held convictions and understandings that play out in behaviour.

The Australian Consumers' Association argued that consumers 'do choose, and are likely to continue to choose, an energy intensive lifestyle' (sub. 52, p. 1).

Several inquiry participants argued that behavioural and cultural norms are influenced by economic factors, such as the opportunity cost of management time:

> Behavioural norms are clearly a factor influencing the way energy is used. These norms are likely to reflect many commercial and non-commercial factors operating and evolving in the economy and the community more broadly. (Origin Energy, sub. 25, p. 8; Electricity Retailers Association of Australia, sub. 26, p. 31)

Behavioural and cultural norms can also bear on the decision-making processes of individuals:

> Another important aspect to behavioural norms is that they may in many instances, for example small business decisions, be driven by time-poor managers. (Building Products Innovation Council, sub. 44, p. 4)

Bounded rationality

In an ideal world, individual consumers and producers would have sufficient information and the ability to process that information, to make the most appropriate decisions. But individuals are limited in their ability to obtain and process complex information and to handle the uncertainties that invariably arise in a dynamic and evolving operating environment. In this sense, their rationality is said to be bounded.

In response to such constraints, individuals adopt several decision-making strategies. One is to follow *satisficing*, rather than *optimising*, behaviour. Satisficing individuals may downgrade the standard of their goals, and settle for outcomes that are less than ideal but which are reasonable in the circumstances.

Individuals can also follow a rule-of-thumb routine (sometimes called a heuristic) when arriving at a decision. Routines can include:

- Purchasing the same make or brand of equipment that a competitor, family member or friend purchases (following the pack).
- Purchasing the same make or brand of equipment as previously (relying on past experience). In this respect the Australian Conservation Foundation noted that 'some organisations find it easier to continue using the same technologies and processes that they already have in place' (sub. 24, p. 6).
- Using simplified selection criteria that focus on key features and overlook more technical and (to them) less seemingly-important considerations such as energy efficiency.

In a study of the electric motor market in France, de Almeida (1998) reported that managers of small companies adopted rule-of-thumb routines, such as continuing to purchase the same type and brand of low energy efficiency electric motor. When required to replace electric motors in an emergency, they were principally concerned with minimising delivery time and price. As a result, they frequently purchased the same type and brand as the failed motor.

In a further example of bounded rationality, DeCanio (1994) also found that many senior executives economised on management time and resources by following simple payback rules to determine the cost effectiveness of competing investments. This was despite the deficiencies of the payback rule as a decision-making tool, particularly given its inherent inaccuracy and potential to contribute to poor decision making (chapter 5). The payback rule was popular because it is easy to communicate, intuitive and saves managerial effort.

The effect of satisficing behaviour and rules-of-thumb routines is that individuals do not arrive at the same decisions as they would if they were able to costlessly process all the available information.

The concept of bounded rationality has some potentially important policy implications. First, it helps to explain that, in some cases, supplying information might not be sufficient — decision makers might not be able to process it. This suggests that different ways of providing information might need to be explored. Second, given that information is costly to obtain and process, there might be a role for governments to minimise transaction costs.

However, while individuals might not make ideal choices from the perspective of an outside observer, they may well be optimising something else that is just as important to them — such as the value of their time — which might be better spent on core projects or leisure activities. As Conlisk (1996, p. 671) said:

> … heuristics often provide an adequate solution cheaply whereas more elaborate approaches would be unduly expensive.

In other words, concepts of bounded rationality help explain how firms and individuals achieve entirely appropriate, if somewhat constrained, approximations of economically-efficient outcomes. They might not be ideal outcomes, but given the limits on cognitive abilities, and the transaction costs involved in seeking out the ideal solution (which may include the opportunity cost of management time), they are as economically efficient as it is practical to contemplate achieving.

Although bounded rationality helps explain decision making generally, it is not immediately apparent that there is much that governments can or should do to address it. Some participants and commentators have advocated that intervention is warranted. For example, noting that bounded rationality will limit the benefits of policy measures such as providing improved information, Sorrell et al. (2000, p. 176) observed:

> … individual and organisational routines can be overridden through the use of regulatory standards, such as minimum levels of performance. Such market transformation initiatives focus on the *supply* of energy services, rather than attempting to modify the behaviour of customers who are preoccupied with other priorities.

They went on to argue that bounded rationality (and organisational failure) can provide a rationale for intervention: 'governments can help individuals and organisations to help themselves' (Sorrell et al. 2000, p. xxvi). This work is also cited by the Insulation Council of Australia and New Zealand, the Australian Glass and Glazing Association and the Australian Business Council for Sustainable Energy (sub. DR144) and by the Allen Consulting Group (2004c) in defence of the case for government intervention.

The Commission considers that the bounded rationality of consumers is an insufficient ground for justifying intrusive measures such as minimum standards. The case for intervention relies on notions of omniscient regulators who are capable of making decisions that are in the best interests of energy users. If those users were capable of collecting and digesting the relevant information, the presumption is that they would come to the same conclusion as the regulator, that is, to not purchase the energy-inefficient appliance. This might decrease search costs but, given the diverse preferences of energy users, must inevitably leave some consumers worse off. Where bounded rationality is on stronger grounds is in its application to labelling systems that help consumers to cut through the information haze without curtailing choice. Even then, the argument for intervention can be mounted more strongly from the grounds of information asymmetries. These issues are taken up in more detail in chapter 9.

Understanding the bounded nature of decision-making processes may nevertheless be useful in regard to how information is packaged and to whom it is targeted. Such information should be specific and personalised, vivid, clear and simple, and available close in time to the decision (Sorrell et al. 2000). Governments may have a role in ensuring that general and specific product information is provided in a manner that is readily used and understood.

Organisational barriers

Barriers and impediments to the adoption of cost-effective energy-efficient technologies also occur within organisations — including larger firms and government agencies (Sorrell et al. 2000; DeCanio 1993). Larger organisations may not adopt cost-effective energy-efficient technologies even if such technologies can improve their profitability or help meet the objectives of the organisation (Sorrell et al. 2000).

This may be because they face *principal–agent* problems. In many organisations, the owners (the principals) are faced with a problem of how to ensure that its employees (the agents) act in the owners' interests, given that the interests of the owners and employees are not always aligned. A range of management tools (such as task allocation and incentives) may be employed to enhance the alignment. However, the complexity of designing incentives and allocating tasks is compounded by the difficulties posed by imperfect information within the organisation and by the bounded rationality of owners and employees (DeCanio 1993; Button and Weyman-Jones 1992; and Sorrell et al. 2000).

Overseas research on this topic has demonstrated a number of examples of how principal–agent (and related) problems can impede the adoption of energy-efficient technologies in organisations:

- *Risk aversion* — Managers have an incentive to avoid risky projects and actions in areas like energy efficiency if they are more risk averse than the owners of firms. Managers are likely to be risk averse if the personal consequences of failure are larger than the payoff from success (DeCanio 1993).
- *Short time horizons* — Managers might operate with a shorter time horizon than the owners of a firm. Sorrell et al. (2000) claimed that this is an example of split incentives operating inside a firm. Short time horizons might result from policies of rotating managers or of linking managers' compensation to recent performance (short-term profitability) rather than longer-term performance (long-term profitability) (DeCanio 1993). In this environment, projects with short paybacks will be preferred over those with longer paybacks, even if they have lower net present values.

- *Lack of cooperation* — Managers within different parts of an organisation might not cooperate if their incentives have not been appropriately aligned by the owners. DeCanio (1994, p. 114) observed that managers make decisions in response to incentives that are established to 'get the best possible effort' from each unit rather than maximising the firm's overall profits.
- *Decentralisation* — Organisations with decentralised management were shown to be poorly equipped and less likely to pursue large-scale projects spanning the entire organisation. On the other hand, organisations with centralised management were constrained in adopting small-scale localised initiatives which required the active cooperation of their employees (Cebon 1992).

Some inquiry participants cited the role of organisational barriers in inhibiting the uptake of energy efficiency improvements. For example, the Department of the Environment and Heritage, paraphrasing EEWG (2004), argued:

- [senior management can have a] … poor understanding … of the potential for improved energy efficiency to increase productivity;
- companies, particularly small manufacturers, often see any change to working processes and practices as a significant risk; and
- finite resources within companies, both staff and financial, to focus on a limited number of issues. This means that energy efficiency falls off the priority list. (sub. 30, p. 7)

The Australian Industry Greenhouse Network noted:

> The pursuit of energy efficiency improvements may be influenced by factors such as: the firm's size and corporate structure; information asymmetries within the firm; alignment of management incentives with company objectives; decision making authority of management and rules of procedure; and management acumen.
>
> These things are all symptoms of poor management and no doubt energy efficiency is prejudiced when it is prevalent. (sub. 57, pp. 7–8)

A number of inquiry participants have also suggested that the relatively low attention given to energy efficiency by many organisations could also reflect the low priority given by managers to energy use. For example, the Australian Conservation Foundation said:

> … the relatively low cost of energy, the effort required to contemplate energy efficiency options and the risks in implementing them means decisions are often driven by other priorities. (sub. 24, p. 6)

In contrast, the Australian Aluminium Council (sub. 29, p. 9) said that for relatively intensive energy users in the aluminium industry, 'energy efficiency is a priority' for continual improvement because of its effect on costs.

As the Australian Industry Greenhouse Network implied, many of the organisational issues cited above could be used to explain inefficiency in many firms' activities, not just energy use (sub. 57). Poor management, and therefore inefficiency, in some aspects of business some of the time is not unusual in many industries. For example, in a review of the empirical evidence of the incidence of inefficiency among firms, Button and Weyman-Jones (1992) found that the minimum possible operating costs ranged between 61 and 97 per cent of the actual costs of the firms surveyed.

Button and Weyman-Jones (1992) and Conlisk (1996) both observed that competitive market forces serve to place a discipline on the extent to which such inefficiencies can occur. As Conlisk (1996, p. 671) argued:

> … market discipline, through repeated transactions with significant stakes, can be potent in attenuating discrepancies between optimising and observed behaviour ...

In the Commission's view, there is no clear case for government intervention to address internal organisational issues. The most important policy implication is that governments should strive to provide a competitive environment within which firms operate. Attention may be needed to encourage incentive structures in non-competitive firms (such as natural monopoly utilities and government agencies), but the case for additional measures beyond those already applied would need to be established. This is taken up in later chapters. Another policy implication is that, in conjunction with the lessons to be learned from understanding bounded rationality, information asymmetries within firms might provide some rationale for targeting information programs to both technical staff and senior managers within firms — to the extent that such programs can be separately justified on the grounds of market failure.

FINDING 4.2

Behavioural, cultural and organisational barriers do not of themselves provide a rationale for government intervention. Understanding these barriers may, however, be helpful in designing efficiency programs that address environmental externalities, information failures and other sources of market failure.

4.4 Other barriers and impediments

Barriers and impediments other than market failures and the influence of organisational, cultural and behavioural factors may also be at work. Failure to consider all of the costs associated with adopting energy efficiency investments or the impact of those investments on output, can make energy efficiency investments less attractive to households and firms than they might appear to an outsider. Some of these include:

- *Implementation costs* — some energy efficiency technologies and processes entail additional costs when implementing an investment.
- *Risk and uncertainty* — some energy-efficient investments are inherently risky, financially and/or technically. The presence of such risks may reduce the level of investment, or even restrict access to finance.
- *Asset replacement costs* — upgrading plant and equipment to the latest energy-efficient technologies may require the premature scrapping of existing assets.

A further factor to consider is the heterogenous nature of consumers and producers. Although not a barrier as such, heterogeneity can account for differences in the uptake of energy efficiency. Estimates of the cost effectiveness of a particular energy-efficient technology or service are often based on characteristics of an average user within a particular class, or based on assumptions of the performance of the technology or process under specific or average conditions. If cost-effectiveness studies do not reflect these variations, they will overstate the potential for the uptake of energy efficiency improvements (Jaffe and Stavins 1994; Sorrell et al. 2000).

Implementation costs

Households and organisations may not invest in apparently worthwhile energy-efficient technologies because of additional costs that can be involved in the implementation phase (that is, additional to the direct capital and operating costs of the energy efficiency improvement). Estimates of the size of the energy efficiency gap may be overstated if the models do not take all such costs in to account, given that those costs would be considered by individual firms and households.

Implementation costs can arise for a variety of reasons. Costs can be incurred when the workplace or household must change its behaviour to accommodate the new investment before the new technology can reach its peak performance. Such costs include retraining the workforce or hiring new staff, and adopting new workplace or household practices.

Alternatively, benefits may be forgone when the new replacement technology is not perfectly substitutable for the old technology. In these instances, the firm or household may either incur additional costs to maintain productivity or functionality, or forgo benefits from the new technology (Jaffe and Stavins 1994). The new technology might also pose problems with safety, noise, working conditions or require extra maintenance and service quality. As a result, either the cost effectiveness of the technology might be diminished because of decreased returns, or additional costs might be incurred to ensure that it performs at the same level as the old technology (Sorrell et al. 2000).

Risk and uncertainty

Investment in a new appliance or plant and equipment involves some degree of risk or uncertainty.[2] If the degree of risk and uncertainty facing producers and consumers is not adequately recognised, estimates of the potential for taking up energy efficiency related investments will be overstated.

Three sources of risk and uncertainty associated with energy efficiency investments are:

- *technical* — those associated with the management of the energy efficiency investment, such as the irreversibility of many energy efficiency investments or its effects on production processes;
- *external* — those over which the household or firm has little direct control, such as sovereign risk; and
- *financial* — those associated with the household's or firm's capacity to respond to changes in costs and prices, including the costs and availability of capital and energy prices (Sorrell et al. 2000; Hassett and Metcalf 1993).

Origin Energy identified technical risks as being important for new investments:

> Risks include operational difficulties associated with changing to new processes and opportunity loss of management time and effort as it is diverted away from higher priority areas of the business and toward[s] energy efficiency. (sub. 25, p. 5)

Technical risks can be very high when investments are irreversible. Even where the *prima facie* evidence suggests that an investment is capable of generating high returns, it may be rational for firms and households to delay making such investments until more information is obtained that would help resolve its uncertainties (Dixit and Pindyck 1994).

The Australian Aluminium Council pointed to sovereign risk as an important issue for long-term investments:

> Equally rational is the decision not to proceed with energy efficiency investments where policy certainty is not adequate to support the investment required; this is

2 Risk refers to those possible future outcomes of an investment for which the probabilities of possible outcomes are known, and uncertainty refers to those possible outcomes for which the probabilities are not known.

> exacerbated by the large capital requirements and by the length of time required to recover the new capital investment; the involvement of state governments often causes further uncertainty within the market, with policy activity directly and indirectly (eg greenhouse policy actions). (sub. 29, p. 10)

Financial risk also includes the uncertainty about the cost and availability of capital. Faced with uncertainty, constraints can be externally imposed by the capital market or internally imposed within a household or firm. In the presence of such constraints, households and managers may ascribe a hurdle rate of return that is higher than the prevailing market rate, reflecting the need to allocate limited financial resources between competing investments.

Sorrell et al. (2004) observed that firms apply high discount rates to energy efficiency projects when internal finance is constrained. For example, senior managers in larger firms will impose high hurdle rates on non-core projects being administered by more junior staff.

Sanstad and Howarth (1994, p. 815) noted that financial institutions similarly place borrowing limits on low-income households for energy-efficient investments because such investments are perceived to be risky:

> … [Households] frequently must pay substantial premia to obtain loans from lending institutions; indeed, they may be unable to obtain credit at any price. Under these conditions, the poor might rationally use high discount rates in evaluating the merits of energy efficiency improvements.

In effect, capital constraints encourage households and firms to purchase cheaper and less energy efficient appliances and investments:

> In many cases consumers do not have ready access to capital to purchase more efficient equipment (more expensive). This is particularly so in the residential end use sector. Here, initial investment in energy efficiency can be seen to be large compared with significantly lower purchase costs, but higher operating costs of less-efficient alternatives. (TransGrid, sub. 62, p. 3)

Similarly, Origin Energy observed that capital constraints effectively reduce the attractiveness of energy efficiency investments:

> Even if risk-adjusted IRRs [internal rates of return] are substantial, it may be that the net present value of energy efficiency investments are small relative to alternative investment projects, and not pursued as a result (given the practical limits on the availability of capital that often apply). This is likely to be a rational explanation of the reluctance of businesses (and financial institutions) to underwrite investment in energy efficiency improvement in some cases. (sub. 25, p. 5)

However, some financial intermediaries are actively courting business in this area. For example, the Bendigo Bank provides home loan mortgages with reduced interest rates for borrowers prepared to invest in energy-efficient technologies.

Are risk premiums for energy efficiency investments unreasonably high?

A number of inquiry participants and commentators have argued that the high risk premiums accorded to energy efficiency investments act as barriers to their adoption. For example:

> The South Australian Government believes there is a strong case for government intervention to encourage energy efficiency … Key barriers to energy efficiency include the high risk premiums businesses often apply when evaluating energy-efficiency investments… (South Australian Government, sub. 80, p. 2)

The Energy Efficiency Working Group (EEWG 2004, p. 8) reported that:

> Uncertainty within organisations on the success of energy efficiency projects, has often resulted in higher investment return hurdle rates being applicable to these investments relative to others.

Similarly, the Total Environment Centre argued:

> … that a very high effective discount rate is applied to energy efficiency opportunities for both households and industrial customers, when capital is available at all. … In effect, energy efficiency opportunities developed by consumers [households and industrial customers] typically must meet far more demanding requirements for financial performance than do other projects. (sub. 81, pp. 4–5)

To some extent, the use of high discount rates is a reflection by the household or firm of the additional but not readily identifiable costs that the investment might entail. It might also be explained by senior managers using high hurdle rates as a discipline on more junior staff and as a substitute for the cost of their time.

Though high risk premiums can reduce the estimated cost effectiveness of energy efficiency investments, it is not clear that they warrant government intervention. Risk and uncertainty *per se* do not represent a source of market failure. As Jaffe and Stavins (1994, p. 805) noted:

> It is reasonable and appropriate for individuals to take uncertainty into account in making investment decisions, and to apply relatively high discount rates to irreversible investments whose returns are uncertain. To the extent that consumers' true discount rates were high for these reasons, this would not represent a market failure.

It is also not clear to what extent households and firms are attaching higher risk premiums to energy efficiency investments than to other comparably risky investments. The Atech Group (2003) argued that energy efficiency investments in commercial applications represent a relatively low risk investment and, as a result, should attract lower risk premiums than for the average commercial sector investment.

Yet other authors have argued that energy efficiency investments were risky and justified their high discount rates. Greely et al. (1989), in a study of actual energy savings obtained from commercial building retrofits, found that actual savings varied significantly from the predicted energy savings. Very few predictions of actual energy savings came within 20 per cent of the expected savings.

Nor is it clear that government intervention is justified on the basis of incorrect perceptions of risk — apart from providing information. The Commission notes that market intermediaries, such as energy service companies, can play an important role in helping their customers to manage risk and uncertainty. Such contractors operate by undertaking to develop, install, and manage projects that will improve the energy efficiency and maintenance costs of their customers, in exchange for an agreed portion of the energy savings (chapter 7).

Although risk and uncertainty are not the sources of market failure in themselves, there are important lessons for policy if the source of uncertainty stems from sovereign risk. Minimising sovereign risk is always important, but clearly governments will need to change policy settings from time to time as circumstances change, so some risk is inevitable. As this report notes, there is considerable uncertainty in the current policy framework, particularly in relation to a national response to greenhouse policy.

Asset replacement costs

Many energy-using technologies have long asset lives. Since the adoption of more energy-efficient technologies can require either the replacement or the refurbishment of existing assets, new investments will usually occur relatively infrequently and will be governed by a variety of economic considerations, energy efficiency being only one of them.

For example, the Electricity Supply Association of Australia said that large electricity customers would only change their energy use if their capital stock changed:

> For large electricity customers, the level of consumption tends to be embedded in existing plant and equipment and only replacement investment can effect a substantial change in the efficiency of their energy use. (sub. 68, p. 8)

In some cases, very large improvements in energy efficiency may be needed to bring forward asset replacement, other things being the same. This issue is taken up in more detail in chapter 7.

In the Commission's view, these other barriers and impediments to the adoption of energy-efficient investments are rational explanations for their non-adoption by the private investor. Though some energy efficiency investments will not be privately cost effective because of them, they are not necessarily problems that need to be, or can be, addressed by government intervention. As a result, these issues are not considered to be barriers and impediments to privately cost effective increases in energy efficiency, later in the report. There is, however, always a role for governments to reduce sovereign risk, such as that which arises from the involvement of governments in energy efficiency investment markets.

FINDING 4.3

Barriers and impediments, such as risk and uncertainty, asset replacement costs and implementation costs, increase the costs to energy users of adopting energy efficiency improvements. However, the role of governments in addressing these issues may be quite limited.

5 How big is the energy efficiency gap?

Key points

- An energy efficiency gap is the difference between actual energy efficiency and what is considered to be the most energy-efficient processes and technologies that are achievable.
- Defining the highest achievable energy efficiency is not straightforward. A common approach, and the one set out in the terms of reference for this inquiry, is to only include energy efficiency improvements that would be cost effective for individual producers and consumers.
- To the Commission’s knowledge, nobody has quantified the full extent of the energy efficiency gap in Australia. Many researchers have, however, undertaken case studies of selected energy efficiency improvements.
- The case studies typically find that producers and consumers have failed to adopt energy efficiency improvements that appear to be cost effective for them. However, there is considerable uncertainty about the estimated potential savings, because the case studies use many questionable assumptions, including the:
  - criterion used to determine cost effectiveness (such as a simple payback period);
  - use of a social discount rate rather than private discount rates that reflect the range of individuals’ circumstances;
  - level of business-as-usual improvements in energy efficiency;
  - costs associated with energy efficiency improvements;
  - extrapolation of audit and best-practice study results to a whole sector; and
  - representativeness of simulated producers and consumers.

Various studies have identified energy efficiency improvements that seem to be cost effective for individual producers and consumers, but for some reason are not adopted. This apparent underinvestment in energy efficiency improvement is often said to result in an ‘energy efficiency gap’.

This chapter clarifies what is meant by the term energy efficiency gap, and reviews recent case studies of potential energy efficiency improvements in Australia.

5.1 What is an energy efficiency gap?

An energy efficiency gap describes the difference between actual energy efficiency and what is considered to be the most energy-efficient processes and technologies that are achievable. Such a gap could be assessed at a national level, for particular industries, or for individual producers or consumers.

Defining what are the most energy-efficient processes and technologies that are achievable is not straightforward. At the extreme is the technologist or pure engineering view that any technically feasible improvement in energy efficiency is achievable (regardless of its cost). Few would claim that this is practical or economically efficient.

The approach set out in the terms of reference for this inquiry is to only assess the economic and environmental benefits of those energy efficiency improvements which are privately cost effective. As noted in chapter 2, the Commission defines 'privately cost-effective energy efficiency improvements' as actions that (a) reduce energy use per unit of useful output or outcome delivered, and (b) deliver a net benefit (at current and expected energy prices) to the individual producer or consumer undertaking the action. The discussion in chapter 2 also explains why cost effectiveness is not synonymous with economic efficiency.

Whether there is currently an energy efficiency gap is best assessed on the basis of current price expectations and output because they are the conditions under which present energy consumption occurs. To do otherwise is to 'compare apples and oranges' and so produce a misleading measure of an energy efficiency gap. Similarly, when forecasting a future energy efficiency gap, predictions of actual and maximum achievable energy efficiency should be based on the same price and output expectations.

5.2 Case studies of energy efficiency potential

The true extent of the energy efficiency gap in Australia, or any other country, is largely immeasurable. Quantification of the energy efficiency gap could, in theory, be achieved by using production frontier techniques that benchmark individual producers and consumers against best practice. However, this would require data on the many possible technologies and management practices available to producers and consumers, and how current practices compare with the 'best-practice' frontier.

Numerous researchers have, however, used case studies of a subset of all possible energy efficiency improvements to demonstrate that Australian producers and consumers have failed to adopt energy efficiency improvements that are cost effective for them. Such case studies are reviewed in this section, with an emphasis on those that estimate the combined impact of energy efficiency improvements in several sectors.

General methodological issues

In broad terms, the case studies examined in this section use an 'engineering–accounting' approach. An engineering estimate of how far energy efficiency can be increased is converted into predicted savings in running costs. An accounting or financial equation is then used to assess whether it is cost effective to incur the costs of investing in the energy efficiency improvement, in return for lower running costs in the future.

There are various criteria that can be used to assess cost effectiveness, even within the definition specified in this inquiry's terms of reference (box 5.1). This can, in turn, lead to different estimates of what is cost effective.

Box 5.1 **Possible cost-effectiveness criteria**

Various criteria can be used to determine cost effectiveness. The following are three possible options.

Net present value (NPV) is positive — the present value of expected future savings in running costs exceeds the present value of expected additional capital costs. Present values are determined by applying a discount rate to future costs and benefits.

Internal rate of return (IRR) is above a minimum threshold — the discount rate at which the present value of expected future savings in running costs equals the present value of the expected additional costs is above a certain level.

Payback period is below a certain time period — the number of years it takes for cumulative savings in running costs to match the increase in capital costs is below a certain level. It is assumed that the benefit from having a dollar today is the same as having a dollar in the future, and so a discount rate is not applied to future cost savings.

If an investment meets the selected criterion, but is not being adopted, this is regarded as evidence that producers or consumers are not adopting cost-effective energy efficiency improvements.

Another reason why estimates may differ concerns whose costs are considered when assessing cost effectiveness. The terms of reference for this inquiry require the Commission to consider changes in the costs of individual energy users. A broader approach would be to also consider changes in the costs that energy users impose on others (such as from pollution), as would be done in a social (societywide) benefit–cost analysis.

SEAV-NFEE estimates

The Sustainable Energy Authority of Victoria (SEAV), with assistance from several consultants, produced estimates of Australia's energy efficiency potential for the National Framework for Energy Efficiency (NFEE).

The SEAV-NFEE estimates were produced in two phases. The first phase used readily available data to generate preliminary results. In the second phase, sectoral studies were undertaken to produce revised estimates of energy efficiency potential.

Preliminary (phase one) estimates

The preliminary SEAV-NFEE estimates were generated for two scenarios — low and high energy efficiency improvement (figure 5.1). The results suggested that there was significant scope for producers and consumers to adopt improvements in their energy efficiency that would be cost effective for them.

The authors stressed the preliminary nature of their results:

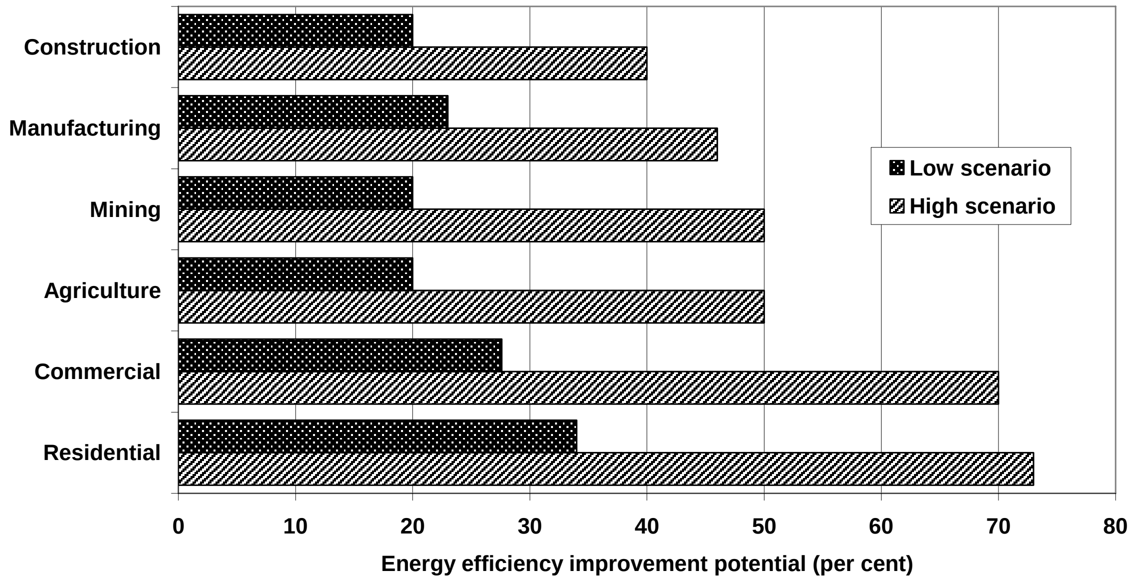
> This work does not purport to be a definitive study on energy efficiency improvement potential in Australia, and its inherent limitations are recognised. (SEAV, Armstrong and Saturn Corporate Resources 2003, p. ii)

They also listed various limitations of their study, including that the estimates were based on national averages and did not take account of the 'rebound' effect or future technological improvements that would lower the cost of adopting energy efficiency improvements.

Although many claimed that the preliminary estimates of energy efficiency improvements were overly optimistic, Alan Pears (sub. DR113) commented that the estimates were revised downwards in order to reach a compromise with critics, not because the phase one results were too optimistic. Similarly, Moreland Energy Foundation Ltd noted:

> There was nothing wrong with the first set of estimates, except some of the industry stakeholders were kicking up a stink about them. In order to silence the critics and enable the process to move forward, the most conservative estimates were used. On the other side of the debate were many credible people who felt that the initial estimates were more conservative than they needed to be, but those in favour of NFEE had to accept the pragmatic position taken in order to see something happen. (sub. DR115, p. 7)

Figure 5.1 **Preliminary (phase one) SEAV-NFEE estimates of potential energy efficiency improvements[a]**



[a] Energy efficiency improvement potential is expressed as a percentage of current energy use. The low energy efficiency improvement scenario was based on current commercially available technologies with an average 4 year payback period. The high energy efficiency improvement scenario was based on existing or developing technologies potentially available during a 12 year projection period with an average 8 year payback period.

Data sources: EEWG (2003); SEAV, Armstrong and Saturn Corporate Resources (2003).

Phase two SEAV-NFEE estimates

For the second phase of the SEAV-NFEE assessment, more detailed studies were commissioned on potential energy efficiency improvements in the residential, commercial and industrial sectors. Different estimation approaches were used for each of these sectors, as outlined below.

Residential sector

For the residential sector, the SEAV commissioned two studies:

- George Wilkenfeld and Associates (2004b) analysed potential improvements in the efficiency of water heating; and
- EMET Consultants (2004b) examined 15 potential energy efficiency improvements for lighting, cooking, refrigeration, dishwashers, clothes washers, building thermal performance and heating/cooling systems.

Both of these studies used spreadsheet models to quantify the benefit to householders from investing in specific energy efficiency improvements. The simulated investments were in addition to those that householders were expected to undertake under a business-as-usual scenario of continuing energy efficiency improvements and expected future increases in mandatory efficiency standards for residential buildings and appliances.

In summary, the residential sector estimates suggested that, by 2014, householders will have overlooked additional cost-effective actions that could have reduced their energy consumption by at least 13 per cent in that year (table 5.1). The majority of these gains were from changes to heating and cooling appliances. This result is significantly lower than the 34 per cent improvement estimated under the 'low scenario' in phase one (figure 5.1).

Table 5.1 **SEAV-NFEE estimates of potential energy efficiency improvements for the residential sector[a]**

Relative to a business-as-usual projection for 2014/2015

Energy efficiency measure	*Reduction in energy use*[b]	*Proportionate reduction in energy use*[b]	*Reduction in running costs*[b]	*Increase in capital costs*[b]
	Petajoules	%	$m	$m
Building shell, heating & cooling	37.7	16.4	459	2 175
Lighting	2.7	12.4	98	384
Refrigeration	3.5	10.9	126	439
Cooking	3.9	17.7	100	330
Dishwashers	0.3	8.0	11	63
Clothes washers	0.2	13.5	9	35
Water heating	21.2	14.9	427	1 038
Total	**69.5**	**13.0**	**1 230**	**4 464**

[a] Estimates in the table show changes relative to a business-as-usual projection for 2015 (water heating) or 2014 (other measures). Water heating estimates are for measures with a payback period of no more than four years, as estimated by George Wilkenfeld and Associates (2004b, p. 15). Estimates for other energy efficiency measures have a payback period of no more than 6.5 years, as estimated by EMET Consultants (2004b). [b] Compared to annual energy use and costs in the final year of the business-as-usual projection (2014/2015).

Sources: EMET Consultants (2004b); George Wilkenfeld and Associates (2004b); McNicol (2004).

Commercial sector (buildings)

The SEAV-NFEE analysis of the commercial sector focused on measures that could be implemented in existing buildings, refurbishments or new buildings. Estimates were generated by EMET Consultants (2004a) by using a database of 80 potential energy efficiency improvements, which covered:

- thermal performance of building fabric

- heating, ventilation and air conditioning
- lighting
- hot water services
- lifts and other services and plant.

Individual energy efficiency improvements were ranked according to their estimated payback period. Measures that had a payback period of no more than four years were then combined to produce an overall estimate of energy efficiency potential in six subsectors (after taking account of any interactions between the energy efficiency measures). The results were compared to business-as-usual scenarios for 2010 (derived from ABARE sectoral forecasts and EMET Consultants' assessment of future adoption rates for energy efficiency measures due to improvements in the cost effectiveness of technologies and their availability).

In summary, it was estimated that, by 2010, the commercial sector will have overlooked cost-effective actions that could have reduced its energy consumption by a further 10.4 per cent in that year (table 5.2).

Table 5.2 **SEAV-NFEE estimates of potential energy efficiency improvements for commercial buildings[a]**

Subsector	*Reduction in energy use*[b]	*Proportionate reduction in energy use*[b]	*Reduction in running costs*[c]	*Implementation cost*[c]
	Petajoules	%	$m	$m
Wholesale and retail trade	15.2	11.9	920.8	846.9
Accommodation, cafes and restaurants	2.8	14.1	121.4	144.0
Communication services	0.5	7.6	25.6	27.3
Finance, insurance, property and business services	4.1	11.1	196.1	203.6
Government administration, education, health and community services	6.0	7.3	430.0	276.6
Culture and recreation, personal and other services	1.7	9.9	73.6	74.0
Total	**30.2**	**10.4**	**1 767.5**	**1 572.4**

[a] Estimates in the table are for energy efficiency improvements (beyond those under the business-as-usual scenario) that have a payback period of no more than four years. The average payback period was much less than four years for all subsectors because most of the energy efficiency improvements examined had a payback period well below four years. [b] Compared to annual energy use in the final year of the business-as-usual projection (2010). [c] Before taking account of business-as-usual changes in running and capital costs. This has the effect of overstating the increase in capital costs and fall in running costs.

Source: EMET Consultants (2004a).

Around half of the estimated potential energy savings were from initiatives to improve lighting and management of hot water systems and processes (such as cooking and heating) in the wholesale and retail trade. Again, this estimate (10 per cent improvement by 2010) is substantially less than the phase one estimates of 28 to 70 per cent (figure 5.1).

Industrial sector (mining and manufacturing)

The SEAV-NFEE estimates for the industrial sector were produced by Energetics (2004). There were some key differences from the assumptions used for the residential and commercial studies, including that:

- there is no change in the size of the industrial sector over the projection period;
- there are no energy efficiency improvements under the business-as-usual scenario for some industries (mining, ceramics, bakery products, flour milling and cereal products); and
- there is no interaction between different energy efficiency measures when they are combined to estimate overall energy efficiency potential.

Energetics (2004) compared the energy that individual subsectors used for specific processes — such as use of a blast furnace — with that found in best practice studies and site audits. The results were used to estimate how far the energy efficiency of a specific process in a subsector could be improved. ‘Implementation rate factors’ were used to recognise that not every firm in a subsector could achieve the energy efficiency improvement. Process-specific energy efficiency measures were then ranked according to their payback period. Measures that had a payback period of no more than four years were combined to produce estimates of energy efficiency potential in each subsector. The results were compared to a twelve year business-as-usual projection that, for some sectors, included energy efficiency improvements.

In summary, the estimates suggested that, in the final year of the projection period, the industrial sector will have overlooked additional cost-effective actions that could have reduced its energy consumption by at least 6.2 per cent in that year (table 5.3). This is smaller than the percentage improvements estimated for the residential and commercial sectors (13.0 and 10.4 per cent respectively) and can be attributed to a number of reasons. Unlike the commercial sector study, the industrial sector analysis excluded greenfield projects and did not take account of reductions in non-energy costs, such as lower maintenance.

Table 5.3 **SEAV-NFEE estimates of potential energy efficiency improvements for the industrial sector[a]**

Subsector	*Reduction in energy use[b]*	*Proportionate reduction in energy use[b]*	*Reduction in running costs[c]*	*Cumulative increase in capital costs[c]*
	Petajoules	%	$m	$m
Mining (excluding oil, gas and bauxite)	8.0	8.8	100.0	212.0
Meat and meat products	1.0	8.3	24.1	63.6
Dairy product manufacturing	1.7	11.9	23.9	81.8
Bakery products, flour milling and cereal products	1.5	13.5	19.2	58.1
Pulp and paper manufacturing	3.5	7.4	54.2	149.3
Chemical products manufacturing	9.3	8.9	89.0	211.0
Ceramic products manufacturing	2.1	8.6	13.2	44.8
Cement manufacturing	2.8	9.6	28.3	42.9
Iron and steel manufacturing	6.6	4.0	117.0	160.0
Bauxite mining and alumina refining	1.0	0.6	45.7	111.6
Aluminium smelting and semi-fabrication	11.4	8.8	143.7	438.2
Total	**48.9**	**6.2**	**659.0**	**1 574.0**

[a] Estimates in the table are for energy efficiency improvements that have a payback period of no more than 4 years when implemented over a 12 year period starting from 1999. [b] Compared to annual energy use in the final year of the business-as-usual projection. [c] Before taking account of business-as-usual changes in running and capital costs. This has the effect of overstating the increase in capital costs and fall in running costs.

Source: Energetics (2004).

The potential reduction in energy consumption was estimated to be similar in percentage terms in most subsectors (around 7 to 9 per cent in the final year of the projection period). The exceptions were bauxite mining and alumina refining, and iron and steel manufacturing, where energy efficiency potential was found to be relatively small; and dairy product manufacturing and bakery products, which had a high energy efficiency potential. In terms of the amount of energy that could be saved, aluminium smelting and semi-fabrication was estimated to have the greatest potential.

The relatively small energy efficiency potential (in percentage terms) for bauxite mining and alumina refining, and iron and steel manufacturing, can be partly attributed to the strong incentive for those industries to adopt cost-effective energy efficiency improvements under the business-as-usual scenario. That is, energy accounts for a large proportion of their costs and so there is a strong incentive to reduce energy costs.

Such an incentive also applies to aluminium smelting and semi-fabrication, and so it is surprising that an above-average energy efficiency potential was estimated for that subsector (8.8 per cent versus 6.2 per cent for all industrial subsectors). Energetics (2004) did not explain the reason for the difference, but it did note that the information it had on energy efficiency opportunities in those industries was more limited than what it had for other industries. Alan Pears (sub. DR113) advised that the estimated potential saving in aluminium smelting and semi-fabrication is large because uncertainty about greenhouse policy has caused many firms to hold back from implementing energy efficiency improvements, and that long-term research and development has led to a potential for large savings.

Input to SEAV-NFEE general equilibrium modelling

The Victorian Government cautioned that the phase two SEAV-NFEE estimates do not provide a definitive measure of the energy efficiency gap. Rather:

> The work was undertaken to provide an estimate of the potential, costs of and savings of beyond BAU [business-as-usual] energy efficiency improvement across the Australian economy as the input data into macroeconomic modelling of the impact of implementing these over a 12-year period. (sub. DR125, p. 21)

The results of the above-mentioned sectoral studies were integrated by the SEAV into a dataset that was provided to the Allen Consulting Group (2004a) in order to estimate the economywide impacts of adopting potential energy efficiency improvements (table 5.4). Estimates for agriculture, construction and some manufacturing industries were also provided to the Allen Consulting Group. These were based on the preliminary (phase one) SEAV-NFEE results (SEAV, Armstrong and Saturn Corporate Resources 2003) and an extrapolation of the industrial sector case study results (Energetics 2004).

In its modelling of economywide effects, the Allen Consulting Group (2004a) assumed that 50 per cent of the potential energy efficiency improvements shown in table 5.4 would be achieved over a 12 year period from 2005 to 2016:

> For this modelling it was assumed that 50 per cent of the EEI [energy efficiency improvement] measures with a payback up to and including 4 years were introduced over the 12 year modelling period 2005 to 2016. The EEI potential was introduced uniformly over the modelling period, that is, 1/12 was introduced in each year so that the full potential had been applied by year 12 [2016]. (Allen Consulting Group 2004a, pp. 41–2)

The ABCSE (sub. DR121, p. 11) stressed that the input to the economywide simulations was 'extremely conservative' because of the assumption that only half of the potential energy efficiency improvements estimated in the sectoral studies was achieved.

Table 5.4 **Comparison of SEAV-NFEE estimates of potential energy efficiency improvements**

	Energy efficiency potential	
Sector	*SEAV-NFEE sectoral case studies*[a]	*SEAV-NFEE general equilibrium study*[b]
	%	%
Agriculture	**ne**	**5.0**
Industrial sector	**6.2**	**6.4**
Mining	8.8	3.4
Manufacturing	na	6.9
Dairy Products	*11.9*	
Meat Products	*8.3*	*11.2*
Milling & Baking	*13.5*	
Textiles, Clothing & Footwear	*ne*	*6.3*
Pulp & Paper Manufacturing	*7.4*	*7.4*
Chemicals (ex petroleum) – Basic chemicals	*8.9*	*8.9*
Non-Metallic Minerals – Ceramics	*8.6*	*9.1*
Non-Metallic Minerals – Cement	*9.6*	
Iron & Steel	*4.0*	*4.0*
Alumina	*0.6*	*4.3*
Aluminium	*8.8*	
Other Metals	*ne*	*4.3*
Machinery & Equipment	*ne*	*6.3*
Other Manufacturing	*ne*	*6.3*
Construction	ne	6.3
Commercial sector	**10.4**	**10.4**
Wholesale & Retail Trade	11.9	11.9
Accommodation, Cafes & Restaurants	14.1	14.1
Communication Services	7.6	7.6
Finance & Insurance, Property & Business Services	11.1	11.1
Government Administration, Education, Health & Community Services	7.3	7.3
Culture & Recreation, Personal Services	9.9	9.9
Residential sector	**13.0**	**13.0**

a EMET Consultants (2004a, 2004b); Energetics (2004); George Wilkenfeld and Associates (2004b). **b** Allen Consulting Group (2004a). **ne** Not estimated. **na** Not available.

The Allen Consulting Group (2004a) estimated that, in 2016, its assumed increase in energy efficiency would, relative to a business-as-usual scenario for that year:

- increase gross domestic product by 0.09 per cent ($975 million);
- increase real private consumption by 0.12 per cent ($724 million);
- increase employment by 0.02 per cent (2600 people); and

- reduce greenhouse gas emissions by 2.8 per cent (9.5 megatonnes of carbon dioxide equivalent).

It therefore appears that, even if all of the potential energy savings identified in the sectoral studies were achieved, it would have a relatively minor impact on economic activity and greenhouse gas emissions.

CEFG estimates

The Clean Energy Future Group[1] (CEFG) commissioned a study by Saddler, Diesendorf and Denniss (2004) to examine whether it was possible to achieve a 50 per cent reduction in carbon dioxide emissions from stationary sources by 2040 with only minor improvements in existing technologies.

A long projection period (36 years) was chosen so that most of the current capital stock could be retired or refurbished cost effectively. Importantly, and in a major departure from the approach adopted for this inquiry, it was assumed that there would be a future constraint on greenhouse gas emissions and this would lead to a significant increase in energy prices. The prices of primary fossil fuels were assumed to increase in real terms by between 25 and 50 per cent above current levels. As the study's authors noted, their price assumptions would also increase the number of energy efficiency improvements that are cost effective.

An assessment of the achievable energy efficiency improvements beyond a 'baseline' scenario was made by drawing on other studies and data sources, such as information from the Energy Efficiency Best Practice program. One example of the resulting energy efficiency scenario was the assumption that solar hot water systems would displace 75 per cent of existing electrical hot water heaters and 90 per cent of gas hot water heaters.

In summary, the CEFG study estimated that, in 2040, it would be cost effective (assuming the higher energy prices) to reduce energy consumption by 590 petajoules (20 per cent) below the baseline scenario in that year (table 5.5). The largest percentage savings in energy consumption were estimated to be in sectors where energy accounts for a relatively small share of total costs (residential; commercial; agriculture, forestry and fisheries; and food, beverages and tobacco). Only modest savings were estimated for sectors where energy accounts for a large

[1] The Clean Energy Future Group comprises the Australasian Energy Performance Contracting Association, Australian Business Council for Sustainable Energy, Australian Wind Energy Association, Bioenergy Australia, Renewable Energy Generators of Australia, and the Worldwide Fund for Nature.

share of total costs (nonferrous metals; iron and steel; and wood, paper and printing).

Table 5.5 **CEFG estimates of potential energy efficiency improvements**
Relative to a baseline projection for 2040

Industry	*Reduction in energy use*	
	Petajoules	%
Agriculture, forestry and fishing	21	20
Mining	66	16
Manufacturing	138	11
Iron and steel	*17*	*8*
Food, beverages and tobacco	*86*	*42*
Basic chemicals	*12*	*16*
Cement, lime, plaster and concrete	*10*	*16*
All other non-metallic mineral products	*8*	*11*
Non-ferrous metals	*0*	*0*
Wood, paper and printing	*0*	*0*
All other manufacturing	*5*	*5*
Construction	20	17
Commercial services	197	39
Residential	148	27
Total final stationary energy consumption	**590**	**20**

Source: Saddler, Diesendorf and Denniss (2004).

The CEFG estimates are much higher than the SEAV-NFEE estimates because of the longer projection period and the assumed significant increase in energy prices. The SEAV-NFEE studies assumed that real energy prices would not change over the projection period to 2014. Nevertheless, it is remarkable that the long projection period and assumed large increases in real energy prices in the CEFG study did not lead to an overall energy saving of more than 20 per cent.

Regulation impact assessments

Numerous regulation impact assessments have predicted that a proposed mandatory energy efficiency standard or label would benefit individual producers and consumers. The estimation approach typically used in these assessments is to calculate the net present value (NPV) of benefits and costs. The resulting net benefit is often large, implying that many individuals would fail, without mandatory labelling or the removal of less efficient products from the market, to adopt energy efficiency improvements that would have been cost effective for them (table 5.6).

That is, in the absence of government intervention, it is predicted that there would be a substantial energy efficiency gap. Further discussion of the results of regulation impact assessments for appliances and buildings is provided in later chapters.

Table 5.6 **Predicted benefits and costs of mandatory energy efficiency labels and standards[a]**

Source/year assessment undertaken	*Regulation that was assessed*	*Benefit*[b]	*Cost*[b]	*Net benefit*[b]	*Benefit –cost ratio*
		$m	$m	$m	ratio
Australian Building Codes Board					
2002	Houses (current standards)	1 150	665	485	1.7
2004	Commercial & industrial buildings (class 2–4)	46[c]	32	13	1.4
2005	Commercial & industrial buildings (class 5–9)	3 370	723	2 647	4.7
2005	Houses (proposed 5 star upgrade)	558	364	194	1.5
Energy Efficient Strategies					
2002	Houses (Victoria) (5 star, simulation method)	159	107	52	1.5
Allen Consulting Group					
2003[d]	Houses (NSW) (BASIX)	na	na	339	1.2
George Wilkenfeld and Associates					
1999[e]	Labels & MEPS (household appliances)	2 287	996	1 291	2.3
2000	MEPS electric motors	165	92	73	1.8
2000	MEPS air conditioners & heat pumps	480	78	402	6.2
2001	MEPS upgrade household fridges & freezers	462	170	292	2.7
2001	MEPS fluorescent lamp ballasts	623	152	471	4.1
2002	MEPS electric distribution transformers	497	343	154	1.4
2003	MEPS small electric water heaters	249	60	200	5.1
2005	Labels & MEPS (2005–20 projections)	11 357	6 568	4 788	1.7
Mark Ellis & Associates					
2003	MEPS linear fluorescent lamps	344	70	274[f]	4.9
2004[g]	MEPS commercial fridge cabinets	182	93	89	2.0
Syneca Consulting[h]					
2003	MEPS air conditioners	363	59	304	6.2
2003	MEPS electric motors	201	72	130	2.8
2004	MEPS miscellaneous electric water heaters	19	9	10	2.1
2005	MEPS upgrade for room air conditioners & single & three phase units	209	127	82	1.6
Queensland Government					
2004	Changes to building & plumbing regulations	1 009	689	320	1.5

[a] Unless otherwise indicated, the reported estimates are social benefits and costs. [b] Benefits and costs are expressed in present value terms. [c] A predicted $8.2 million benefit from lower greenhouse gas emissions is not included in order to ensure consistency with the other studies in the table. [d] Includes the effects of BASIX water efficiency requirements. [e] Undertaken in conjunction with Energy Efficient Strategies. [f] Net benefit as advised by S. Beletich (Steven Beletich Associates, pers. comm., 22 July 2005). [g] Undertaken in conjunction with Steven Beletich Associates. [h] Benefits and costs are those estimated from a private user perspective. **na** Not available.

5.3 Assessment of case study results

The case studies described in the previous section appear to support the hypothesis that producers and consumers often fail to adopt energy efficiency improvements that are cost effective for them. However, the case studies need to be interpreted with caution because they are based on many questionable assumptions, including the definition of cost effectiveness. This section considers how such assumptions lead to a high degree of uncertainty about case study estimates of potential energy savings.

Cost-effectiveness criterion

The criterion used to determine cost effectiveness can have a large bearing on the number and type of energy efficiency improvements that are deemed to be cost effective.

Defining cost effectiveness in terms of a maximum payback period (as the SEAV-NFEE sectoral studies did) could give undue emphasis to investments with short-term returns. This may cause analysts to overlook projects that have relatively large upfront capital costs, but nevertheless are worthwhile because they generate significant benefits over the longer term. These benefits could be far larger than those available from short-term projects. Projects with longer-term significant benefits are more likely to be deemed cost effective when using an NPV or internal rate of return (IRR) criterion (as was the case for the regulation impact assessments discussed in section 5.2).

Despite the sensitivity of case study results to which cost-effectiveness criterion is used, few studies justify their selected criterion or examine the sensitivity of their results to a change in the criterion.

The Victorian Government noted that the phase one SEAV-NFEE study would ideally have used an IRR criterion, but in practice used a payback criterion because of data limitations:

> While IRR is recognised by Armstrong/SEAV [the phase one SEAV-NFEE study] as the superior criterion (and is generally used for major business investments) it was noted that most available EEI [energy efficiency improvement] data in the commercial and industrial sectors is based on simple paybacks and that investment lives are rarely given. A simple payback approach was selected to suit the data available. This report also notes that this approach ultimately may lead to a conservative estimate of the EEI potential, as the total energy savings of many larger projects with long investment lives will not all be included under a simple payback criterion, especially with a relatively short payback time of 4-years … (sub. DR125, p. 22)

A related issue is whether the cost-effectiveness criterion used in a case study is the same as that used by the producers and/or consumers being studied. An ABARE survey of participants in the Australian Government's Enterprise Energy Audit Program (EEAP) found that 80 per cent of firms used a payback rule to evaluate energy efficiency investments, 53 per cent used an IRR criterion, and 30 per cent used an NPV criterion (Harris, Anderson and Shafron 1998). Some firms used more than one criterion. Where a payback criterion was adopted, the average requirement was a maximum 3.5 year payback.

A survey of about 400 companies in the United States found that small firms used a payback period criterion to evaluate investments almost as frequently as they used an NPV or IRR criterion (Graham and Harvey 2002). Large firms were significantly more likely to use an NPV criterion than were small firms.

What discount rate should be used in assessing cost effectiveness?

The NPV criterion typically used in regulation impact assessments deems an energy efficiency investment to be cost effective if, after applying a discount rate to future cash flows, the expected benefits exceed the expected costs.[2] Discounting recognises that individuals value a dollar today more highly than a dollar next year, which in turn is valued more than a dollar in the year after. Discounting is also used in order to recognise the opportunity cost of forgoing potential returns from investments other than energy efficiency improvements.

Table 5.7 summarises the discount rates that have been used in assessments of energy efficiency regulations. It can be seen that most assessments undertook sensitivity analyses using a range of discount rates from as low as 0 per cent to as high as 10 per cent. However, the range of discount rates used was sometimes small. For example, the Australian Building Codes Board (ABCB 2002) used discount rates of 4, 5 and 6 per cent in its assessment of the current energy efficiency standards for housing. In contrast, a discount rate of 10 per cent was used by George Wilkenfeld and Associates (2005b) to predict the impacts of mandatory energy performance labels and standards for appliances over the period 2005–20.

The discount rates used in the regulation impact assessments listed in table 5.7 were typically based on an estimate of the social opportunity cost of capital (OCC), which is the rate of return that society forgoes from the next best investment. This is

2 The payback period criterion used in the SEAV-NFEE case studies could be re-expressed as the discount rate required to equate the present value of benefits and costs (the internal rate of return). For example, if a project costs $100, has a life of 10 years, and delivers a net benefit of $25 in each of those years, then it will be deemed cost effective using either a required payback period of no more than 4 years or a required rate of return of at least 21 per cent.

an appropriate discount rate to use when assessing the societywide impact of an energy efficiency measure. It is not appropriate when considering cost effectiveness from the perspective of particular individuals. The relevant individual's private OCC should be used instead.

Table 5.1 **Discount rates used in selected regulation impact assessments**

Source/year that assessment was undertaken	*Regulation that was assessed*	*Lowest rate*	*Base rate*	*Highest rate*
		%	%	%
Australian Building Codes Board				
2002	Houses (current standards)	4	5	6
2004	Commercial and industrial buildings (class 2–4)	3	5	7
2005	Commercial & industrial buildings (class 5–9)	3	5	7
2005	Houses (proposed 5 star upgrade)	4.5	6	9
Energy Efficient Strategies				
2002	Houses (Victoria) (5 star, simulation method)	0	4	10
George Wilkenfeld and Associates				
1999[a]	Labels & MEPS (household appliances)	0	4	8
2000	MEPS electric motors	0	10	–
2000	MEPS air conditioners & heat pumps	0	5	10[b]
2001	MEPS upgrade household fridges & freezers	0	5	10[b]
2001	MEPS fluorescent lamp ballasts	–	10	–
2002	MEPS electric distribution transformers	0	5	10[b]
2003	MEPS small electric water heaters	0	5	10[b]
2005	Labels & MEPS (2005–20 projections)	–	10	–
Mark Ellis & Associates				
2003	MEPS linear fluorescent lamps	0	5	–
2004[c]	MEPS commercial fridge cabinets	5	7	10
Syneca Consulting				
2003	MEPS air conditioners	0	5	10
2003	MEPS electric motors	0	7	10
2004	MEPS miscellaneous electric water heaters	0	5	10
2005	MEPS upgrade for room air conditioners & single & three phase units	–	10[d]	–
Queensland Government				
2004	Changes to building & plumbing regulations	3	4	5

[a] Undertaken in conjunction with Energy Efficient Strategies. [b] These discount rates were the 'base case' scenario. [c] Undertaken in conjunction with Steven Beletich Associates. [d] Syneca Consulting (pers. comm., 18 July 2005) advised that a discount rate of 10 per cent had been used, rather than the 6.3 per cent mentioned in the draft regulation impact statement (Syneca Consulting 2005b, p. 63).

It could be argued that regulation impact assessments evaluate private cost effectiveness for the 'average individual', and their cost of capital — the average private OCC across all members of society — will equal the social OCC.[3]

However, the social OCC used in regulation impact assessments is not derived by calculating an average private OCC across all individuals. Instead, it is usually a general-purpose rate that is loosely based on an application of a financial model to a limited number of individuals. That model is based on assumptions that are not valid for many individuals and this tends to lead to an underestimate of the private OCC for such individuals (appendix F).

The average private OCC could therefore be much higher than the estimated social discount rates normally used in regulation impact assessments. If this is the case, then many of the energy efficiency measures examined in regulation impact assessments may not be privately cost effective. This is because the assessment results are often very sensitive to small changes in the discount rate used. For example:

> … the discount rate has a major effect on the estimated value of energy savings that accrue in the medium to longer term. (Syneca Consulting 2003a, p. 18)

> The discount rates applied … are very sensitive. Every one percentage point increase in the discount rate decreases the net benefit by 20 per cent. (Queensland Government 2004a, p. 62)

A further problem is that the average private OCC (even if accurately measured) would not be sufficient to reflect the rate for all individuals above the average (and be higher than that of all those below the average rate), given the diverse circumstances of producers and consumers. At the extreme, poor households may have to forgo basic needs (such as for food and clothing) if they are to invest in an energy efficiency measure. The private OCCs for such households are probably much higher than the social OCC estimates used in regulation impact assessments.

One way to take account of diversity among individuals would be to carry out a disaggregated analysis that assessed private cost effectiveness for different groups and tested the sensitivity of the disaggregated results to a wider range of discount rates than those shown in table 5.7. A study commissioned by the Australian Greenhouse Office noted that US regulation impact assessments have tended to involve more comprehensive distributional analysis than their Australian equivalents, possibly due to the availability of more disaggregated data:

> Australia uses average values, while the US uses full distributions. If data and resources permit, … [distributional analysis] will provide more information about the benefits

3 Assuming there are no 'externalities' that would lead to differences in the costs and benefits borne by particular individuals versus society as a whole.

> and costs of the program, in particular identifying who benefits and who bears net costs so that programs can be designed to offset unintended negative consequences, and may assist the government in convincing affected parties of the justification for some MEPS [minimum energy performance standards]. However, without a detailed and statistically representative national survey, such an approach may not be practical for Australia at this time. (McMahon 2004, p. ii)

In conclusion, the Commission considers that, while the discount rates used in regulation impact assessments and case studies may be appropriate for the purposes of assessing cost effectiveness from a societywide perspective, they are probably too low to make definitive conclusions about private cost effectiveness. The case for private cost effectiveness is weakened by the inadequate consideration of distributional effects in the studies.

Business-as-usual projections

The potential for energy efficiency improvement is typically assessed by comparing the modelled scenario to a business-as-usual projection many years into the future. This requires judgements about many aspects of the future that are highly uncertain, such as future changes in the cost of energy saving technologies, relative prices (between different forms of energy, and relative to other goods and services), rate of capital turnover, and the impact of government energy efficiency programs. Examples are provided in box 5.2 from the SEAV-NFEE residential sector case studies. For the SEAV-NFEE industrial sector study, the business-as-usual projection assumed no increase in the size of the sector and, for some industries, no future improvements in energy efficiency.

Sutherland (2003) concluded that US policy makers often overstate the potential for cost-effective improvements in energy efficiency because their assumed business-as-usual improvements in energy efficiency are too pessimistic and fail to anticipate the responsiveness of consumers to future reductions in the prices of energy-efficient products. His conclusion was based partly on the results of an econometric analysis by Newell, Jaffe and Stavins (1999) of innovation by suppliers of energy-using consumer appliances offered for sale in the United States. The econometric analysis showed that the direction of innovation was in some cases responsive to changes in energy prices, but a sizeable proportion of efficiency improvements occurred independently of changes in energy prices and regulations. While some participants in this inquiry questioned Sutherland's method and findings (for example, ABCSE, sub. DR121; Alan Pears, sub. DR113), his analysis nevertheless illustrates the point that case study results are sensitive to the many assumptions used on matters where there is no unambiguously correct answer.

Box 5.2 **A sample of the assumptions used for the SEAV-NFEE residential case studies**

The estimates produced for the SEAV and NFEE by George Wilkenfeld and Associates (2004b) and EMET Consultants (2004b) relied on a wide range of assumptions. These included:

- the prices that householders across Australia face for different forms of energy (electricity, gas and wood), including differences between peak and off-peak tariffs;
- business-as-usual projections ten years into the future for:
  - the number of households and their distribution between different household types;
  - the distribution of residential buildings between different climatic regions and building types (such as floor area, whether brick veneer or double brick, and whether a detached dwelling);
  - purchases of specific types of appliances (such as top loading washing machines of a certain capacity and reverse cycle air conditioners with a particular capacity) and their distribution between different levels of energy efficiency;
  - investment in specific energy efficiency improvements, such as insulation and weather stripping and sealing;
  - detailed usage patterns for specific appliances (such as number of times a clothes washer is used each week and proportion of washes done at less than full capacity);
  - amount of energy used for specific purposes (such as space heating, cooking, air conditioning, hot water for showering and hot water for clothes washing);
- no change over the next ten years in the prices of different forms of energy relative to each other, or relative to other goods and services;
- detailed characteristics of specific energy efficiency improvements, including:
  - purchase and installation costs;
  - reductions in energy used; and
  - the rate at which the measure could be adopted by households, and the upper limit on the level of adoption, given household characteristics, usage patterns and the stock of buildings and appliances.

Despite the uncertainty of business-as-usual projections and their importance to estimated energy efficiency potential, some case studies did not detail how they were constructed. For example, the SEAV-NFEE industrial sector study (Energetics 2004) gave limited detail about its assumed business-as-usual energy efficiency improvements. The basis for the assumed growth rates included recent performance of the industry (pulp and paper manufacturing) and the experience of companies involved in the relevant industry (meat and dairy). For bakery products, flour milling and cereal products, Energetics (2004, p. 32) assumed no energy efficiency improvements under the business-as-usual scenario because it had ‘observed no overall decrease in energy usage within the industry over the last number of years’. Energetics (2004, p. 47) also assumed no energy efficiency improvements under the business-as-usual scenario for ceramic products manufacturing because it was ‘unaware of data that supports a BAU [business-as-usual] decrease in energy usage in the future’. For other subsectors (cement, iron and steel, aluminium, and alumina), no justification for the assumed energy efficiency improvements under the business-as-usual scenario was provided. The Victorian Government defended the approach used by Energetics:

> For the industrial sector case studies an estimate of the BAU [business-as-usual] uptake of energy efficiency was provided by Energetics based on their experience working in a wide range of various industry sectors. Clearly this is not an exact measurement of the BAU uptake of energy efficiency, but the [Productivity] Commission does not put forward a better methodology. (sub. DR125, p. 23)

Other case studies were more transparent about the assumptions underpinning their business-as-usual projections. For example, the CEFG study (Saddler, Diesendorf and Denniss 2004) detailed its future energy demand scenario, which is based on current energy intensity trends. However, the CEFG estimates are probably the most speculative among the studies examined in this report. The study projected almost four decades into the future and assumed that energy prices will increase by between 25 and 50 per cent (in real terms) by 2040. This has the effect of producing a much larger, and also much more uncertain, estimate of energy efficiency potential than that found in the other case studies.

Extrapolation of audit results and best-practice studies

A key input to a case study is the engineering prediction of what is the technically feasible reduction in energy use from adopting a particular measure. Such predictions are often derived by extrapolating to a whole sector the results of a trial or audit for a small number of producers or consumers.

For example, the CEFG study relied on case study material from the Energy Efficiency Best Practice (EEBP) program, which targeted specific companies that could achieve energy efficiency improvements. Similarly, the SEAV-NFEE industrial sector study (Energetics 2004) was based on a number of energy audits, some of which were from overseas.

Jaffe, Newell and Stavins (1999) noted that past attempts to extrapolate case study results to a whole sector have led to significant overestimates of achievable energy savings:

> … there is evidence that analysts have substantially overestimated the energy savings that higher efficiency levels will bring, partly because projections often are based on highly controlled studies that do not necessarily apply to actual realised savings in a particular situation. For example, studies by Sebold and Fox, Hirst, and others have found that actual savings from utility sponsored programs typically achieve 50 to 80 per cent of predicted savings. Metcalf and Hassett draw a similar conclusion based on an analysis of residential energy consumption data in which they found that the actual internal rate of return to energy conservation investments in insulation was about 10 per cent, which is substantially below typical engineering estimates that the returns for such investments were 50 per cent or more. (Jaffe, Newell and Stavins 1999, pp. 7–8)

With respect to audits, the ABARE survey of EEAP participants found that 81 per cent of all audit recommendations were implemented. However, the authors of that study noted that a lower implementation rate could occur if audits were made compulsory for all firms (Harris, Anderson and Shafron 1998). This is because EEAP participants had a strong commitment to achieving energy efficiency improvements, and hence their pecuniary and non-pecuniary benefits may be higher than for the typical firm. ICANZ, AGGA and ABCSE (sub. DR144, p. 37) contested ABARE's assessment by arguing that 'it is equally plausible, if not more likely, that firms that are not interested in energy efficiency (and hence do not self select for energy audits) have greater opportunities for energy savings, rather than less'. This again illustrates the degree of debate about the assumptions used in case studies of energy efficiency potential.

A related issue is how case studies tend to simulate impacts for a representative producer or consumer (or several producer or consumer types). This is done because it is not practical to evaluate the cost effectiveness of energy efficiency improvements for every individual producer and consumer. ICANZ, AGGA and ABCSE noted:

> … the use of sectoral averages in modelling is reasonable, even in the presence of variance, provided that there is no significant skew in the target population. Even then, the sensitivity of the results is likely to be small, provided that sample sizes are adequate. There is no evidence to suggest that diversity in the use of energy is significantly skewed one way or the other. (sub. DR144, p. 37)

However, Jaffe, Newell and Stavins (1999) observed:

> Heterogeneity … leads to differences in the expected value that individual purchasers will attach to more energy-efficient or carbon-efficient products. As a result, only purchasers for whom it is especially valuable may purchase a product. For example, it may not make sense for someone who will only rarely use an air conditioner to spend significantly more purchasing an energy-efficient model — they simply may not have

> adequate opportunity to recoup their investment through energy savings. (Jaffe, Newell and Stavins 1999, p. 7)

It appears that energy use is most heterogenous in the commercial and residential sectors. Assessments of the benefits and costs for these sectors typically depend on many assumptions. For example, in its evaluation of energy efficiency measures in the residential sector, EMET Consultants (2004b) had to make assumptions regarding the performance of existing technology, costs of implementing the improvements and the potential energy savings (boxes 5.2 and 5.3).

Even if most of the assumptions seem plausible, such an approach still raises questions about whether the results provide a representative guide, under real world conditions, of the potential for cost-effective energy efficiency improvements across a sector (Jaffe and Stavins 1994; Sorrell et al. 2000).

As noted in chapter 4, there is a range of barriers and impediments that can make it sensible for producers and consumers to refrain from adopting a proposed energy efficiency improvement. They include:

- the opportunity cost of decision makers' time
- implementation costs
- risk and uncertainty
- capital constraints
- tradeoffs between energy efficiency and other performance features.

An indication of the relative importance of the various barriers and impediments faced by firms is given by the ABARE study of EEAP participants. It found that, where an audit recommendation was not implemented, the most likely cause was that the rate of return was too low (table 5.8). Other important constraints were investment risk, expertise of staff, and availability of finance.

The ABARE findings are supported by overseas studies. For example, Anderson and Newell (2002) conducted an evaluation of why half of the recommendations from 9000 government-sponsored energy audits of US manufacturing plants were not taken up. From follow-up surveys, it was found that the recommendations were not adopted primarily because important implementation costs had not been recognised in the audits.

Box 5.3 Selected measures examined in the SEAV-NFEE residential case studies

Increased use of insulation in existing homes

Energy efficiency improvements were estimated for a typical home in each State. Key assumptions included:

- 60 per cent of households nationally were currently insulated (based on ABS data);
- the proportion of non-insulated buildings was assumed to be the same across all states;
- an upper limit of 70 per cent adoption could be achieved at a rate of an additional 1 per cent a year; and
- the average cost of insulating a dwelling was assumed to be $750.

Increased energy efficiency of reverse cycle heating and cooling

Energy efficiency improvements were estimated for a typical household across all States. Key assumptions included:

- all existing air conditioners are replaced over a period of 10 years with units that have a coefficient of performance level of 0.5 better than the minimum specified by the relevant energy performance standard;
- electricity use for existing air conditioners is estimated assuming an average coefficient of performance of 2.0; and
- the additional cost of purchasing a more energy-efficient appliance is $400, based on an assumed 25 per cent price premium over a typical air conditioner.

More energy-efficient lighting

Energy efficiency improvements were estimated for a typical household across all States. Key assumptions included:

- 30 per cent of kitchen lights, 30 per cent of lounge room lights and 50 per cent of bedroom lights are converted to fluorescent at a rate of 7 per cent a year; and
- the average cost of making the change is $130 per household.

Source: EMET Consultants (2004b).

With respect to capital constraints, case studies typically assume that producers and consumers are always able to finance an energy efficiency investment if the upfront capital cost is outweighed by future returns. In reality, there is usually a limit to what producers and consumers are able to finance and so they will tend to ration their scarce capital resources to the most highly valued uses, which may not include energy efficiency improvements.

Table 5.2 **Reasons why EEAP audit recommendations were not adopted**[a]

Reason for not implementing recommendation	*Proportion agreeing or strongly agreeing with reason*
	%
Rate of return too low	53
Payback period too long	45
Auditor’s assessment inaccurate	38
Energy efficiency often overlooked	35
Unclear how to implement	28
Investment irreversible	28
Finance unavailable	20
Investment too risky	20
Lack of staff with expertise	17
Not our decision	13

a Based on a survey of participants of the Enterprise Energy Audit Program.

Source: Harris, Anderson and Shafron (1998).

In summary, there are many difficulties in extrapolating case study results to derive sectoral estimates of potential energy efficiency improvements. With considerable heterogeneity between producers and consumers in the way energy is used, case study results could be unrepresentative. Other influences, such as unaccounted costs (including managers’ time) and competing uses for scarce capital, could also limit the sectorwide application of case study results.

Interaction between different measures

Another issue arising from the analysis of case study methodology is how to account for the interdependence between the benefits that some energy efficiency improvements generate. For example, the energy savings from upgrading residential heating and cooling systems depends on whether or not measures are put in place to improve residential thermal insulation. All else being equal, if thermal insulation is undertaken first, energy consumption will fall and, hence, the energy savings from upgrading cooling and heating systems will be reduced.

Where interdependence is present, but energy efficiency measures are analysed independently and are added, the overall energy efficiency potential will tend to be overstated. The SEAV-NFEE study of the industrial sector (Energetics 2004) did not take account of any interaction between different energy efficiency measures when they are combined to estimate overall energy efficiency potential. The other SEAV-NFEE studies did take account of interaction effects.

Changes in non-energy costs

Energy efficiency improvements can change not only energy costs, but also other expenditure items. In many case studies, these changes in non-energy costs are ignored.

For example, the SEAV-NFEE industrial sector study omitted changes in non-energy costs. It was claimed that this led to an understatement of what is cost effective:

> This study considers energy cost savings … In some cases other factors will be significant, including operating and maintenance savings and increased throughput. While some actions will entail new or ongoing maintenance …, most will involve lower maintenance requirements … The non-inclusion of additional benefits will tend to present a conservative view of potential paybacks. (Energetics 2004, p. 8)

Whether the omission of changes in non-energy costs leads to an overstatement or understatement of what is cost effective can only be judged on a case-by-case basis.

Feedback effects

The case studies do not consider how 'feedback effects' could change the cost and energy savings that result from a given energy efficiency improvement.

One possible example of feedback is an energy price effect — if lower energy demand due to greater efficiency led to a fall in energy prices. This would reduce the value of energy savings and so make it less likely that a given energy efficiency improvement is cost effective, *ex post*.

Another example of feedback is known as the 'rebound effect' — some of the benefits of greater energy efficiency are used to purchase more energy-consuming goods and services. This would reduce the overall energy savings from an energy efficiency improvement. The Victorian Government (sub. DR125) noted that the SEAV-NFEE sectoral studies did not take account of rebound effects, suggesting that the studies may have overstated the likely reduction in energy use. However, rebound effects were simulated in the subsequent general equilibrium analysis by the Allen Consulting Group (2004a).

Finally, greater use of an energy-efficient technology could enable economies of scale to be achieved in producing that technology and so lower its unit cost. This would tend to make the technology cost effective for more producers and consumers than otherwise.

The net impact of feedback effects is uncertain and is likely to vary between energy efficiency technologies, depending on a range of factors.

FINDING 5.1

Numerous case studies have found that producers and consumers fail to adopt some energy efficiency improvements that appear to be cost effective for them. However, there is considerable uncertainty about the estimated potential savings, because the case studies use many questionable assumptions, including the:

- *criterion used to determine cost effectiveness (such as a simple payback period);*
- *use of a social discount rate rather than private discount rates that reflect the range of individuals' circumstances;*
- *level of business-as-usual improvements in energy efficiency;*
- *costs associated with energy efficiency improvements;*
- *extrapolation of audit and best-practice study results to a whole sector; and*
- *representativeness of simulated producers and consumers.*

6 Residential sector

Key points

- On a per capita basis, energy efficiency has been increasing and carbon dioxide emission intensity has been falling in the residential sector since at least the early 1970s. However, total residential energy use and emissions have grown because of the increasing number of householders and their rising per capita consumption of goods and services.
- Householders have not implemented the full range of potential energy efficiency improvements that may be cost effective for them. This could be due to information barriers and split incentives.
- The most significant government interventions to encourage greater adoption of energy efficiency improvements by householders are labelling and standards for appliances and buildings (dealt with in specific chapters on appliances and buildings).
- Governments also provide subsidies and advisory services. They appear to have a small, but positive, impact on energy efficiency.
- Subsidising people to take actions that are already cost effective for them is difficult to justify, unless the real policy goal is to reduce 'negative externalities' — such as pollution — rather than to increase energy efficiency *per se*.

Around 12 per cent of Australia's final (end use) energy consumption is attributable to the residential sector (ABARE 2004). Despite this relatively small share, the residential sector has been a major focus for energy efficiency policies.

This chapter considers the rationale for such policy intervention in the residential sector and assesses the effects of current policies. The analysis is structured as follows:

- key features of residential energy use (section 6.1);
- why householders might fail to adopt energy efficiency improvements that are (or appear to be) cost effective for them (section 6.2); and
- assessment of residential energy efficiency policies (section 6.3).

6.1 Key features of residential energy use

Household expenditure on energy

At current prices, energy is a relatively minor component of household expenditure. In 2003-04, Australian households spent, on average, 2.7 per cent of their total expenditure on domestic fuel and power (exclusive of motor vehicle fuels) (table 6.1). This amounted to around $24 per week. Thus, a 10 per cent increase in the energy efficiency of the average household would lead to a cost saving of about $2.40 per week.

Table 6.1 **Share of household expenditure on domestic fuel and power by state, 2003-04**

	NSW	*Vic*	*Qld*	*SA*	*WA*	*Tas*	*Australia*
	%	%	%	%	%	%	%
Electricity	1.8	1.9	2.0	2.6	1.8	3.2	1.9
Mains gas	0.4	1.1	0.1	0.7	0.6	0.0	0.5
Bottled gas[a]	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Other	0.1	0.1	0.1	0.2	0.1	0.4	0.1
Total domestic fuel and power expenditure[b]	**2.3**	**3.2**	**2.2**	**3.5**	**2.6**	**3.7**	**2.7**

[a] Excludes gas for barbeques. [b] Excludes expenditure on motor vehicle fuels, which accounted for 3.7 per cent of household expenditure at the national level in 2003-04. Totals may not add up due to rounding.

Data source: ABS (2005b) and unpublished ABS data.

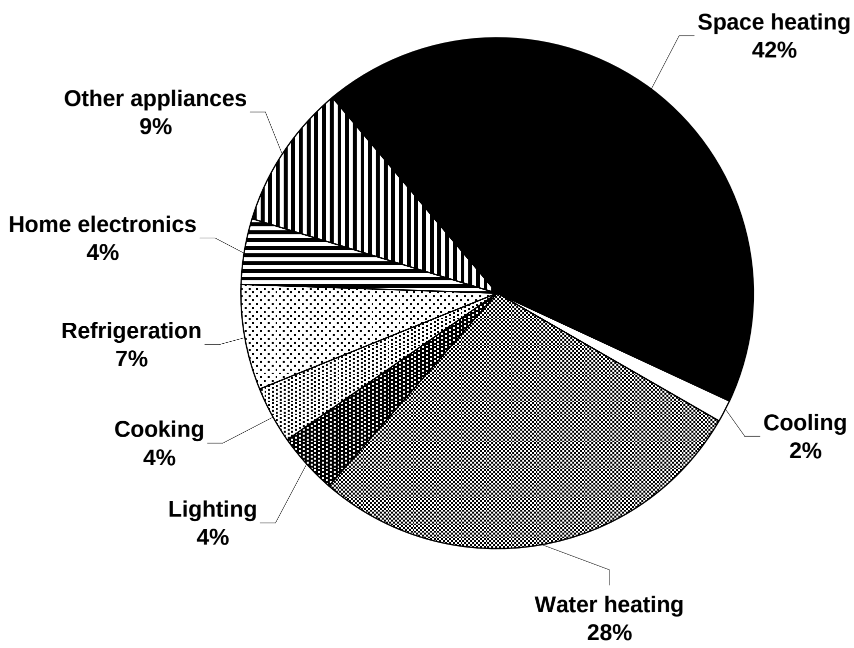
For households whose gross income was in the bottom 20 per cent of all households in 2003-04, domestic fuel and power still accounted, on average, for only 4 per cent of their total expenditure (ABS 2005b). This does not mean that energy is an insignificant expenditure item for all householders. There will be a small group of households for whom energy is a significant expense. The Consumer Utilities Advocacy Centre (sub. DR107) noted that nearly a quarter of households in the lowest income quintile — that is, around 5 per cent of all Australian households — are unable to pay their utility bills on time due to a shortage of money. Nevertheless, it is evident from the ABS data that, for the vast majority of Australian households, domestic fuel and power accounts for only a small proportion of their total expenditure.

What households use energy for

The purposes for which households use energy are not reported on a regular and comprehensive basis in publicly available statistics. Rather, such information tends to be contained in one-off and irregular studies (for example, State Electricity Commission of Victoria 1984; Fiebig and Woodland 1991; State Energy Commission of Western Australia 1991; Pacific Power et al. 1994; Harrington and Foster 1999; EMET Consultants 2004b). The results of these studies vary and some have become dated by changes in the prevalence and use of appliances.

Among the more recent estimates of energy use are those prepared by EMET Consultants (2004b) as part of the modelling work undertaken for the National Framework for Energy Efficiency (NFEE). EMET Consultants projected that, in 2005, most of the energy consumed by the residential sector would be for space heating and water heating (figure 6.1). Cooling was projected to account for only a small proportion (2 per cent) of average annual residential energy consumption, but it is a major source of peak electricity loads on a small number of hot days each year (chapter 14).

Figure 6.1 **Projected residential energy use by purpose, 2005[a]**



a Purchased energy only. Solar energy is excluded.

Data source: EMET Consultants (2004b).

Caution should be exercised in interpreting such aggregate data because the residential sector comprises a large number of small and very diverse energy users.

Factors such as differences in climate, income and household size can lead to marked differences in consumption patterns between households.

Has residential energy efficiency been increasing or decreasing?

The total amount of energy used by the residential sector grew by 70 per cent from 1973-74 to 2000-01. This does not necessarily imply that the energy efficiency of individual householders has fallen. Much of the increase in residential energy consumption can be attributed to a growing population and standard of living. That is, there are more householders and their growing affluence has enabled them to enjoy more goods and services that use energy as an input.

In per capita terms, to correct for population growth, residential energy use grew by 19 per cent from 1973-74 to 2000-01. But the average householder's consumption of all goods and services grew much faster over the same period (real per capita household final consumption expenditure grew by 64 per cent), suggesting that householders have become more energy efficient. It should be noted that this finding applies to the energy consumed directly by householders. The energy efficiency of industries that supply goods and services to households — including electricity — is examined in other chapters of this report.

ICANZ, AGGA and ABCSE (sub. DR144) cautioned that comparing the growth rates for energy consumption and real expenditure could provide a misleading impression of how energy efficiency has changed. They noted that real expenditure is a proxy — rather than a direct measure — for the utility that householders gain from energy use. They also observed that real expenditure might have grown at a faster rate than household energy use because of a shift by householders toward consuming goods and services that do not require energy use within their homes, rather than improvements in the energy efficiency of specific activities. ABARE has undertaken a more comprehensive analysis of trends in residential energy efficiency.

ABARE researchers (Tedesco and Thorpe 2003) have confirmed that residential energy efficiency has increased. They found that changes in householders' energy use during 1973-74 to 2000-01 would have reduced residential energy consumption by 28 per cent if there had not been an increase in the number of householders and in their consumption of goods and services.[1] About half of this reduction was attributed to a substitution toward fuels with a higher conversion efficiency. The remaining half was largely due to so-called technical effects, which include more energy-efficient use patterns, the use of appliances that are designed and built to be more energy efficient, price-induced substitution of energy for other inputs, and improvements in the conversion efficiency of particular fuels.

Potential for cost-effective improvements in energy efficiency

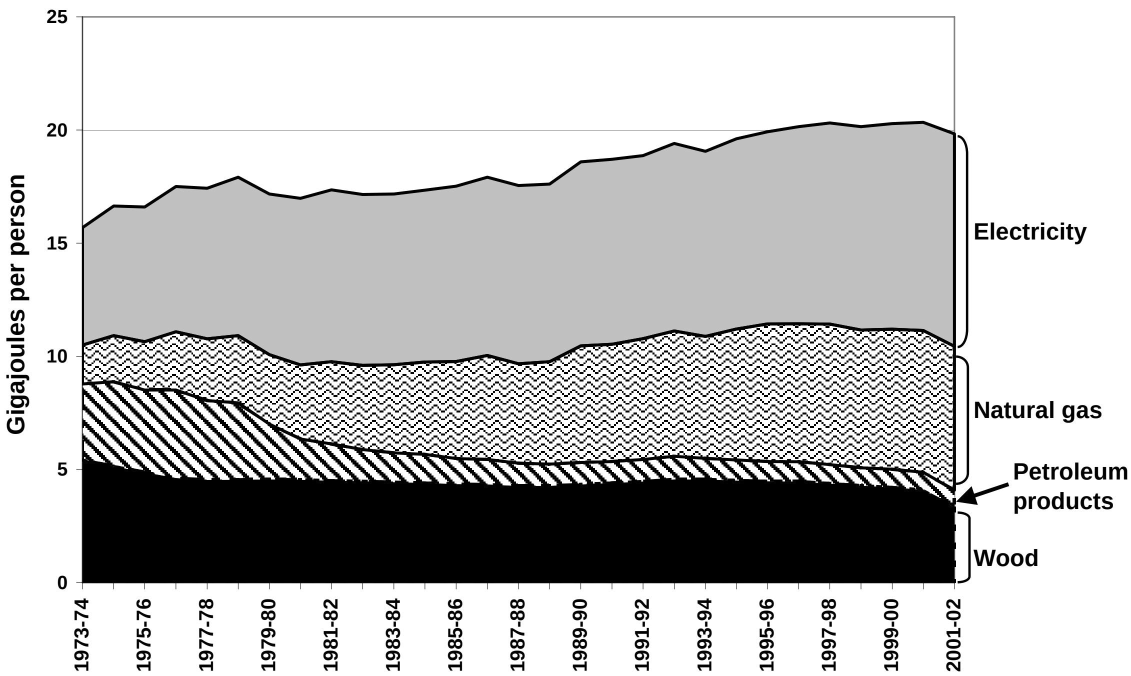
Despite the long-term trend of improving energy efficiency in the residential sector, case studies often find that householders have overlooked energy efficiency improvements that are thought to be cost effective for them. For example, case studies commissioned by the Sustainable Energy Authority of Victoria indicate that, by 2014, householders will have overlooked cost-effective actions that could have reduced their energy consumption by at least 13 per cent in that year (chapter 5). It was estimated that failure to adopt the relevant energy efficiency improvements would, in 2014, lead to the consumption of an additional 69.5 petajoules of energy. This was greater than the potential energy efficiency improvements estimated for the commercial and industrial sectors (30.2 and 48.9 petajoules respectively), even though those sectors use more energy than the residential sector. Despite its relatively small share of Australia's energy consumption, the residential sector has been a major focus for energy efficiency policies.

Shift between different forms of energy

Since the early 1970s, householders have made a significant substitution between different forms of energy. The relative importance of electricity and natural gas in per capita residential energy consumption has been growing since at least the early 1970s, primarily at the expense of wood and petroleum products (figure 6.2). This could be due to a range of factors, including changes in the relative prices of different forms of energy, increased availability of reticulated gas, and air pollution controls on the burning of wood for space heating.

[1] Tedesco and Thorpe (2003, p. 20) reported that changes in residential energy use during 1973-74 to 2000-01 would have reduced *Australia's* total energy consumption by 2.5 per cent if there had not been an increase in the number of householders and their consumption of goods and services. In 1973-74, Australia's total energy consumption was 2615 PJ, with 231 PJ of this attributable to the residential sector (Tedesco and Thorpe 2003, p. 9). Thus, a fall of 2.5 per cent in *Australia's* total energy consumption amounted to a decline of 65 PJ (0.025 x 2615). A fall of 65 PJ in residential energy consumption was a decrease of 28 per cent (65/231).

Figure 6.2 **Per capita residential energy consumption by fuel, 1973-74 to 2001-02[a]**



[a] Fuels not shown on the diagram (such as coal briquettes and solar) accounted collectively for an annual average of 0.5 GJ per person during the period 1973-74 to 2001-02.

Data sources: ABARE (2004); dX Database.

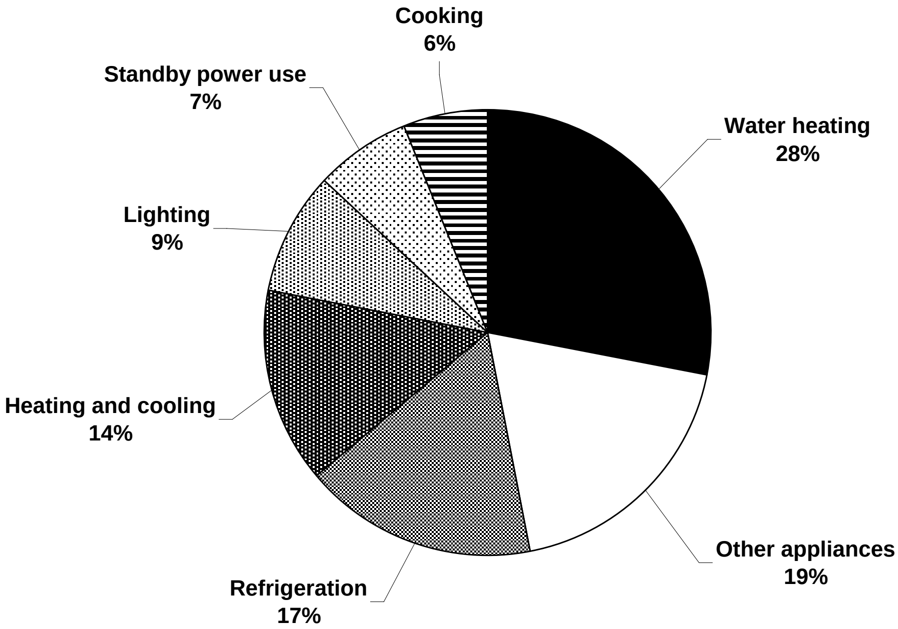
In aggregate terms, almost half of the energy used by the residential sector was in the form of electricity in 2001-02, and about another one-third came from natural gas. This was the result of a long-term decline in energy consumed from wood (down 13 per cent during 1973-74 to 2000-01) and petroleum products (down 67 per cent), and increased use of energy from natural gas (up 429 per cent) and electricity (up 159 per cent).

From the 1950s until the oil price shocks of the 1970s, many households in southern Australia used oil heaters. Following the second oil price shock in 1979, there was a rapid and substantial decline in residential consumption of petroleum products (from 18 per cent of residential energy consumption in 1978-79 to 10 per cent in 1980-81). Thus, householders generally demonstrated that they are capable of quickly changing their energy use when it is cost effective for them to do so, even if it means replacing appliances before they have worn out.

Emissions

Using data assembled for the Australian Greenhouse Office, Reardon (2001) reported that the largest single residential activity contributing to household greenhouse gas emissions was water heating (figure 6.3).

Figure 6.3 **Household greenhouse gas emissions by purpose, 1998[a]**



a The data in this figure are not comparable with the decomposition of energy use in figure 6.1 because they are not for the same year (1998 versus 2005) and the respective authors used different methods to disaggregate the purposes of household energy use.

Data source: Reardon (2001).

Fuel combustion in the residential sector accounted for 1.6 per cent of Australia's greenhouse gas emissions in 2002 (AGO 2004i). Between 1990 and 2002, residential greenhouse gas emissions from fuel combustion increased by 14.3 per cent. Most of these emissions arose from the burning of natural gas by householders. These data do not include the greenhouse gases that were emitted in converting primary fuels into electricity for residential users.

Analysis by ABARE researchers (Tedesco and Thorpe 2003) shows that there has been a significant decline in the residential sector's carbon dioxide emission intensity since the early 1970s.[2] They estimated that residential carbon dioxide

2 Carbon dioxide emission intensity is the amount of carbon dioxide emitted as a result of energy consumption per unit of output.

emissions from the use of energy would have fallen by 42 per cent during 1973-74 to 2000-01, if there had not been an increase in the number of householders and in their consumption of goods and services.[3]

Tedesco and Thorpe (2003) estimated that about two-thirds of the fall in residential carbon dioxide emission intensity during 1973-74 to 2000-01 was due to technical effects, which includes increased energy efficiency. The remaining one-third was attributed to a shift to less emission-intensive fuels, reflecting the previously noted shift by householders between different forms of energy. In particular, burning less wood and petroleum products reduced emissions at individual residences. This ignores householders' increased reliance on electricity and natural gas, which raises the conversion sector's total emissions. However, further analysis by Tedesco and Thorpe (2003, pp. 63 and 70) showed that emission intensity fell in the residential sector even after taking account of emissions from energy conversion. Thus, the analysis indicates that, since the early 1970s, householders have not only raised their energy efficiency, but also reduced their carbon dioxide emission intensity.

Electricity use and relative importance of the residential sector

As noted previously, the residential sector accounts for around 12 per cent of final (end use) energy consumption. However, this does not include the energy lost in converting fuels into electricity for residential users and in transmitting and distributing that electricity to individual residences. Accordingly, the Commission has broadly estimated the extent of this loss. The broad estimates were calculated by multiplying the energy used to generate all electricity by the share of electricity supplied to households (based on data from ABARE 2004).

It is estimated that, in 2001-02, the energy lost in electricity conversion, transmission and distribution for households accounted for around 8 per cent of Australia's total energy consumption. The energy consumed by householders in end-use applications (including electricity) was equivalent to an additional 8 per cent of Australia's total energy consumption. Thus, a total of about 16 per cent of

[3] Tedesco and Thorpe (2003, p. 67) reported that changes in residential energy use during 1973-74 to 2000-01 would have reduced *Australia's* total carbon dioxide emissions from the production and use of energy by 1.2 per cent, if there had been no increase in the number of householders and their consumption of goods and services. In 1973-74, Australia's total carbon dioxide emissions from the production and use of energy was 174 Mt of carbon dioxide, with 5 Mt of this attributable to the residential sector (Tedesco and Thorpe 2003, p. 57). Thus, a fall of 1.2 per cent in *Australia's* total carbon dioxide emissions from the production and use of energy amounted to a decline of 2.1 Mt (0.012 x 174). A fall of 2.1 Mt in residential carbon dioxide emissions was a decrease of 42 per cent (2.1/5).

Australia's total energy use could be attributed to households in 2001-02. Similar shares were estimated for earlier years from 1973-74 onwards.

6.2 Why would householders overlook cost-effective energy efficiency improvements?

The trend of rising energy efficiency in the residential sector since at least the early 1970s suggests that householders have a history of adopting energy efficiency improvements when it is *sufficiently* cost effective for them to do so. Nevertheless, it is possible that various sources of market failure cause householders to overlook some energy efficiency improvements that are cost effective for them. In addition, ICANZ, AGGA and ABCSE (sub. DR144) cautioned that the observed improvement in residential energy efficiency since about 1991 could be at least partly due to the introduction of widespread government interventions — such as mandatory insulation requirements for houses — rather than being solely due to improvements initiated by householders. Moreland Energy Foundation Ltd (sub. DR115) claimed that government policies were a key reason why residential energy efficiency has been increasing.

The many potential barriers to increased energy efficiency were outlined in the general review in chapter 4. Not all of those barriers are relevant to the residential sector, or lead to market failures that may justify policy intervention.

There appear to be two broad reasons why householders might fail to adopt energy efficiency improvements that are cost effective for them:

- *imperfect information* — there are information asymmetries (sellers are much better informed than buyers about the energy efficiency of their products) and energy efficiency information has public good characteristics (there is little incentive for the market to supply information because it is difficult to exclude householders who do not pay for it); and
- *split incentives* — energy-consuming products are purchased on behalf of householders by other parties (such as landlords and builders) who do not benefit from greater energy efficiency.

Another constraint is the small potential benefits in monetary terms (table 6.1). In many cases, what appears to be marginally rewarding in monetary terms probably does not pass the cost effectiveness test after individuals take account of the time and effort required.

The information and split incentive barriers that householders might face are described below.

Imperfect information

It can be difficult for householders to determine the energy efficiency of an appliance or dwelling prior to using it. Physical inspection may not reveal much about energy efficiency because householders do not have the relevant technical expertise and/or ability to undertake comprehensive tests. For example, Rheem Australia noted:

> There is widespread ignorance and misconception amongst purchasers regarding the costs and benefits of solar water heaters and heat pump water heaters ... (sub. 46, p. 3)

In principle, suppliers have an incentive to provide information about the energy efficiency of their products, especially when such information makes the product more attractive to consumers. In practice, such information is not always provided to consumers.

Buyers tend to select products on the basis of qualities such as price, performance, capacity and style, and energy efficiency may not be an equally visible attribute:

> Marketing sources report that energy efficiency is often not a primary or even a significant consideration in consumer purchases. The apparent lack of concern is at odds with the fact that energy costs contribute significantly to the 'whole of life' costs of using an appliance. (Syneca Consulting 2003a, p. 4)

In a free market, consumers may not have sufficient information to make rational decisions about energy efficiency. Where sellers are much better informed about a product's energy efficiency than buyers, adverse selection can occur (chapter 4). This is more likely when the frequency of purchase is low, search costs are high relative to the purchase price, and the product is heterogeneous in price and quality (Sorrell et al. 2004). For householders, these conditions are most likely to apply when searching for a home.

Household appliances are often homogeneous and so the unit cost of providing information on their energy efficiency can be quite low. However, as it can be difficult to exclude householders who do not pay for it, there is little incentive for market participants to provide information that could assist householders in selecting cost-effective products. As noted by the Energy Retailers Association of Australia:

> The information asymmetry between buyers and suppliers of appliances, equipment and building services is potentially significant (particularly for infrequent purchases). The cost associated with small consumers attempting to become informed, individually, is clearly prohibitive in most cases. While provision of this information on a larger scale may lower the cost, standard public good/free-rider problems associated with the provision of information may inhibit such provision by private providers. (sub. 26, p. 32)

Another information issue is that the energy consumption of a dwelling or an appliance (and the consequences of different usage patterns) can be difficult to determine, given that electricity bills are issued well after consumption has occurred, and individual appliances are not metered:

> Most customers act as if they have no control over their electricity bill. What limited feedback they get (a bill every three months, and limited information on that bill) is too late for them to respond. (Jeff Beal, sub. 64, p. 12)

One means of addressing this problem is to install more informative electricity meters (chapter 14).

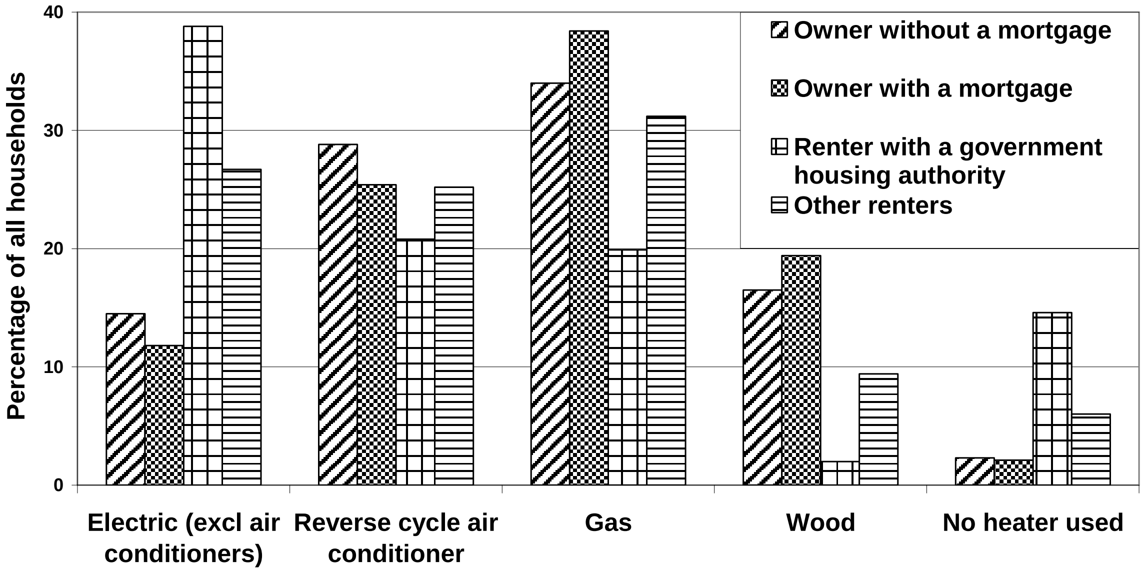
Split incentives

For the residential sector, split incentives are usually associated with dwellings. Energy-consuming fixtures — such as water heaters — are often selected by a builder or landlord who is primarily concerned about the capital cost, whereas users also have an incentive to reduce running costs. This was identified as a problem by many participants in this inquiry (for example, Rheem Australia, sub. 46; Energy and Water Ombudsman NSW, sub. 48; Government of Western Australia, sub. 58; TransGrid, sub. 62; AGL, sub. 66).

A recent survey by the ABS (2005a) of South Australian householders confirms that there are marked differences in the appliances used by tenants and owner occupiers. For example, the survey found that tenants were more likely to use an electric heater (38 per cent of renters with a government housing authority and 27 per cent of other renters) than owner occupiers (15 per cent of owners without a mortgage and 12 per cent of other owners) (figure 6.4). The use of electric heaters was also more prevalent for low-income households (figure 6.5).

As noted in chapter 4, landlords/builders and tenants/home buyers could address split incentive problems by entering into a contract to share the costs and benefits of more energy-efficient products, or to separately negotiate contract prices of appliances. In practice, information barriers and transaction costs limit the instances of this happening. The Energy Consumers Council (sub. DR103, p. 5) expressed a concern that, even if information barriers and transaction costs were overcome, in ‘many cases landlords hold the power, and tenants have little choice but to accept inefficient premises’.

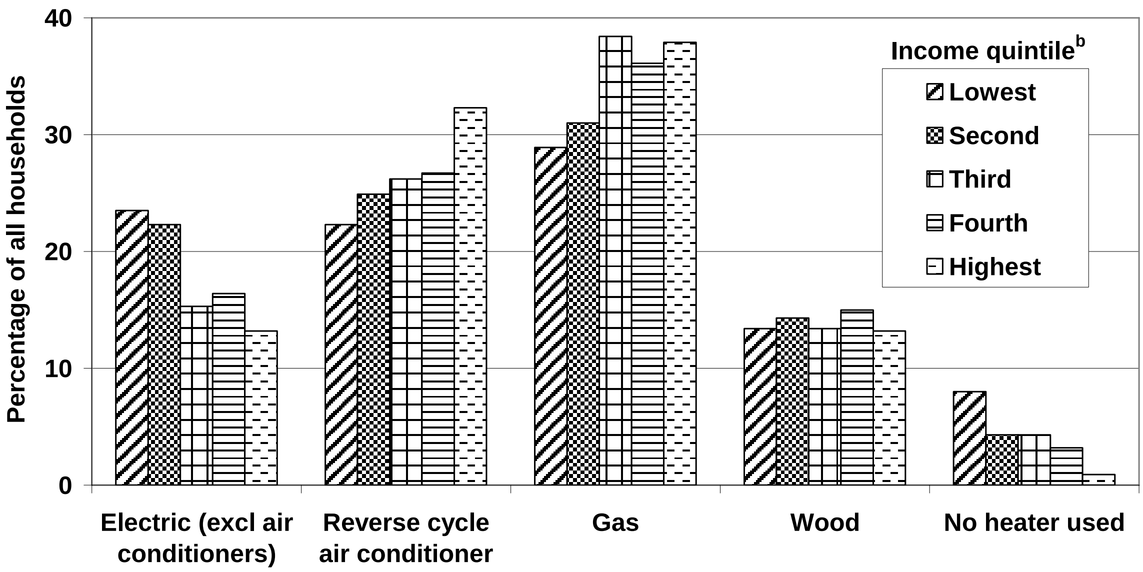
Figure 6.4 **Main type of heater used in South Australian dwellings, by tenure type[a]**



[a] Data are for October 2004.

Data source: ABS (2005a).

Figure 6.5 **Main type of heater used in South Australian dwellings, by income[a]**



[a] Data are for October 2004 and exclude households for which income data were not collected. [b] An income quintile comprises 20 per cent of households that reported their income. Quintiles were ranked from lowest to highest according to gross household income, after adjusting for the number and age of each household's occupants.

Data source: ABS (2005a).

6.3 Residential policies

Governments intervene in various ways to encourage householders to adopt energy efficiency improvements. The most significant interventions are labelling and standards for appliances and buildings. These are examined in specific chapters on appliances and buildings later in this report because the policies apply to more than just the residential sector.

Governments also intervene in the residential sector by providing subsidies and advisory services to householders. The remainder of this chapter considers whether such interventions are effective in lowering the three barriers to energy efficiency improvements mentioned above, and if the associated benefits outweigh the costs.

Subsidies

Subsidies do not directly address information barriers and split incentives, but they may lead to cost savings for householders that can be achieved by adopting energy efficiency improvements, or even increase the level of savings from improvements that are already cost effective for them. Subsidies may also be justified for policy goals such as lowering greenhouse gas emissions.

Some participants in this inquiry advocated the use of financial incentives to encourage greater energy efficiency in the residential sector. For example, the Insulation Council of Australia and New Zealand stated:

> There are a range of areas where financial incentives or the removal of disincentives can assist in removing barriers to the implementation of energy efficiency in the regulation of building energy efficiency:
>
> - The amount of the first home buyers grant could be tied to the energy efficiency of the home, and could decline as house size increased above the average.
> - Infrastructure connection costs could be scaled to reflect the lower impacts of energy-efficient development.
> - The current rebate schemes for solar hot water, photo voltaic systems and water tanks could be consolidated into one grant and broadened to include further aspects of sustainability such as building fabric and appliance efficiency.
> - Rebates for the installation of insulation in existing homes where costs are higher and are therefore a greater barrier to implementation ... (sub. 14, p. 14)

Rheem Australia (sub. 46) supported subsidies for the purchase of solar hot water heaters. It noted that the higher capital cost of solar water heaters acts as a deterrent to their purchase.

The Queensland Government (sub. 38) noted that it already provides rebates to install renewable energy systems, including solar hot water systems. Queensland subsequently ceased its solar hot water rebate scheme on 30 June 2005. Similarly, the ACT had a rebate scheme for solar hot water systems that ceased on 30 June 2005. Other jurisdictions still provide subsidies for solar hot water systems and other energy efficiency investments (box 6.1 and appendix C).

Box 6.1 **Subsidies for photovoltaic and solar hot water systems**

The Photovoltaic Rebate Program is funded by the Australian Government and administered by State and Territory Governments. This program provides rebates to householders who install photovoltaic systems with a peak output of at least 450 watts. For new systems, the rebate is $4 per peak watt up to a maximum total rebate of $4000 (1 kilowatt) for each installation. Extensions to existing systems are eligible for a rebate of $2.50 per peak watt up to a maximum total rebate of $2500 (1 kilowatt).

In addition, the following jurisdictions have their own rebate programs for solar hot water systems:

- Victoria — rebates of up to $1500 to replace an existing gas or solid fuel hot water system, or convert an existing hot water system, to solar power;
- South Australia — rebates of up to $700 for new solar hot water systems installed at a person's principal place of residence; and
- Western Australia — rebates of up to $1000.

Householders can also obtain a cash back amount from manufacturers by signing over or 'trading' Renewable Energy Certificates they are entitled to receive under the Australian Government's mandatory renewable energy target. The cash back amount is based upon the performance of the solar hot water system purchased.

It appears that subsidies for residential energy efficiency investments are relatively inexpensive. The impact on residential sector energy use is also probably minor, since few householders have been paid subsidies for energy efficiency measures. For example, in 2003-04, the South Australian Government approved 2526 rebate applications for solar hot water systems (Energy SA nd).

The impact of subsidies on household energy efficiency is probably even lower than is suggested by the modest participation rates. This is because subsidies are often paid to householders that would have made the relevant energy efficiency investment anyway. This was evident for an ACT Government program that subsidised 25 per cent of the market price of cavity wall insulation. A survey found that at least 32 per cent of households that received the subsidy would have installed cavity wall insulation regardless of the subsidy (Beckman and Associates 2003).

The Consumer Utilities Advocacy Centre claimed that subsidy programs would be more effective if they focused on improving the energy efficiency of low quality housing:

> We believe that uptake and impact [of financial incentives] could be increased if rebate schemes focused on improving low quality housing through insulation and the installation of high rating gas hot water tanks. These schemes may appear somewhat mediocre or mainstream but the reality for many households are that these are unaffordable improvements that could reduce non-discretionary energy consumption substantially. These rebates should be substantial enough to attract applicants (however eligibility could be restricted). (sub. DR107, pp. 3–4)

The Centre also noted that governments currently spend far more on assisting householders with paying their energy bills than they do on capital grants that would reduce those energy bills:

> In 2002-03 the Victorian Government spent over 800 times more on utilities concessions and relief grants than they did on capital grants. The capital grants scheme delivers once-off assistance with the repair or replacement of an essential household appliance that is causing high utility costs. (Consumer Utilities Advocacy Centre, sub. DR107, p. 4)

It cited policy experience in the United Kingdom as an example of what could be achieved by giving greater emphasis to capital grants:

> In the UK the Warm Front program assisted over 300 000 households with an average grant of £445 (in 2002). The improvements undertaken to the grant recipients' homes had the potential to reduce the fuel bill by £150 per annum (on average). The initial grant cost of insulation and heating is thus recouped in just three years by fuel savings. (Consumer Utilities Advocacy Centre, sub. DR107, p. 4)

While a capital grants program would benefit recipient households, it is unclear whether it is the most cost-effective means of achieving the policy goal that motivates energy bill assistance. Energy bill assistance is provided primarily for equity reasons, rather than to increase energy efficiency *per se*. It is possible that many households receive energy bill assistance today because of temporary circumstances (such as loss of employment) which are overcome in the longer term and so make them ineligible for future assistance. If this is the case, it may be more cost effective to achieve the equity goal by maintaining the current emphasis on energy bill assistance for households that are experiencing short-term financial stress. This is an empirical issue that individual governments will have to assess on the basis of the detailed information they have about participation in current assistance programs.

More generally, the Commission considers that it is difficult to justify subsidising people to adopt energy efficiency measures that are already cost effective for them, unless the real policy goal is to reduce ‘negative externalities’ — such as pollution — rather than to increase energy efficiency *per se*.

Advisory services

Governments have established advisory services to help householders overcome information barriers that limit householders’ ability to identify energy efficiency improvements that are cost effective for them (appendix C). For example, the Queensland Government (sub. 38) noted that it provides two such services:

- The Energy Advisory Service provides free advice on energy efficiency and renewable energy, and distributes information brochures and fact sheets.
- The Smart Housing initiative provides information on how to build homes that are more energy efficient.

Similar services are offered in other jurisdictions, including Energy Smart (New South Wales and Western Australia), Energy SA Advisory Service (South Australia) and Home Energy Advice Team (ACT):

> The Western Australian Government … provides information to the community through the energy smart community program. Information is in the form of public seminars and community forums, a free telephone advisory service and attendance at trade exhibitions, brochures and a website that addresses key areas of energy use in the home. The community program also covers house energy-ratings programs in the State and promotes awareness of equipment energy ratings. (Government of Western Australia, sub. 58, p. 10)

These programs often include internet-based advice. For example, the NSW Energy Smart website has an online calculator that enables householders to compare the cost of purchasing and operating different types of hot water heaters (SEDA nd). Some jurisdictions also have programs that provide energy efficiency audits of individual homes.

Government advisory services could be useful in cases where information about cost-effective energy efficiency improvements has public good characteristics, and so would not necessarily be supplied by the private sector. Government-provided information may also have greater credibility than that provided by private-sector parties with a financial interest in promoting particular energy efficiency investments. But information provided by private parties without a vested interest — such as the Australian Consumers’ Association — could also be just as credible, if not more so, than government-provided information.

Government provision might also achieve economies of scale and scope, and thus lower costs to users; and it might be justified for social reasons if it aids accessibility or provides credibility by deriving from a neutral source.

The public good rationale for government advisory services is more likely to apply to general advice than to information that is specific to an individual home. This is because there is greater scope for private-sector providers to exclude people who do not pay for home-specific information.

Nevertheless, the private sector does provide general advice on energy efficiency improvements. For example, CSR Bradford provides information on its website about the cost effectiveness of building insulation and other energy efficiency investments. Similarly, AGL has an energy advice website:

> Interactive capabilities have recently been introduced that enable householders to visit a virtual home online to see how simple energy housekeeping techniques will reduce energy bills and help save the environment. By clicking on the appliances in each room — ovens, air conditioners, washing machines etc — users can calculate the costs of running different appliances, and discover tips to realise cost savings for each appliance. The site provides advice on a broad range of environmental issues and offers energy saving tips and advice on energy star ratings for different appliances. The site also contains an interactive energy efficiency calculator that provides quick reference information about how much energy appliances typically consume around the home. (sub. 66, p. 7)

In summary, government advisory services can be justified on public good, credibility and accessibility grounds, but it does not follow that such services should always be provided by governments. The rationale for government provision is strongest in the case of general advice about energy efficiency. But even in that case, private sector providers — such as the Australian Consumers' Association — have demonstrated that they can provide useful general information about energy efficiency.

7 Industrial and commercial sectors

Key points

- Improving energy efficiency is often not a major priority for Australian firms. This is a reflection of the fact that energy accounts for a small proportion of most firms' costs.
- Information gaps, 'split incentives', and organisational and behavioural characteristics of firms have prevented some firms from undertaking cost-effective energy efficiency improvements.
- The energy services industry could provide a market solution to some of the barriers faced by firms. However, provision of government assistance to the energy services industry does not seem warranted.
- Voluntary agreements between governments and firms can encourage privately cost-effective energy efficiency improvements, so long as they are well designed. To the extent that privately cost-effective outcomes are a policy objective, the agreements should not be compromised by incentive or coercive elements.
- General information provision can increase the uptake of privately cost-effective energy efficiency improvements, but the usefulness of such programs for firms is limited.
- Provision of incentives for firms to undertake energy audits and research, development and innovation may be warranted if it generates spillover benefits from information diffusion.
- Provision of direct subsidies to firms to undertake privately cost-effective energy efficiency improvements is not justified. Subsidies may have a role in encouraging energy efficiency improvements that generate broader positive environmental externalities. However, before this policy mechanism is applied on those grounds, it should be evaluated against other policy options for achieving the same objective.
- The mandatory energy audit and disclosure approach for large energy users — which is currently being implemented by the Australian Government — is likely to distort firms' behaviour and investment patterns and is not warranted on private cost-effectiveness grounds.
- A policy of mandating implementation of audit results to achieve privately cost-effective energy efficiency improvements is not justified.

This chapter examines the issues surrounding privately cost-effective energy efficiency improvements in the industrial and commercial sectors. The industrial sector has been defined to include all firms in the manufacturing, construction and mining industries. The commercial sector is comprised of firms which specialise in providing services, including hotels, motels, restaurants, wholesale firms, retail stores, and health, social, educational and financial institutions.

A number of current and proposed policies for energy efficiency improvements in the industrial and commercial sectors are analysed in terms of their potential for achieving their objectives.

The chapter is structured as follows:

- energy consumption and greenhouse gas emissions (section 7.1);
- why firms might fail to adopt energy efficiency improvements that are cost effective for them (section 7.2); and
- assessment of policies (sections 7.3 to 7.9).

7.1 Energy consumption and greenhouse gas emissions

Energy is an important resource in the industrial and commercial sectors. It provides a great range of services including driving manufacturing processes; heating; cooling and lighting firms' premises; powering office appliances; and providing communication services. This section examines key features of energy consumption in these sectors.

Energy consumption

The commercial sector is a relatively minor energy consumer, accounting for 8 per cent of final (end use) energy consumption (table 7.1). However, over 73 per cent of final energy use is in the form of electricity. When the conversion, transmission and distribution losses are taken into account, around 13 per cent of Australia's total (primary) energy consumption was attributable to the commercial sector in 2001-02. Average annual growth between 1973-74 and 2001-02 was 3.9 per cent, compared to annual growth in national final energy use of 2.2 per cent (ABARE 2004). ABARE projections (Akmal et al. 2004) suggest that final energy consumption in the commercial sector is expected to continue to grow at a relatively high rate over the next 15 years.

Table 7.1 **Energy consumption in industrial and commercial sectors, 2001-02**

	Final energy consumption		*Primary energy resources attributable to sector*[a]	
	petajoules	% of total	petajoules	% of total
Commercial	**238**	**8**	**644**	**13**
Mining	**161**	**5**	**379**	**7**
Manufacturing and construction	**919**	**29**	**1 759**	**35**
Basic non-ferrous metals	319	10	670	13
Other manufacturing[b]	192	6	289	6
Chemicals	156	5	191	4
Iron and steel	101	3	261	5
Non-metallic mineral products	96	3	128	3
Wood, paper and printing	56	2	96	2

a Resource consumption is apportioned on the basis of uniform electricity conversion, distribution and transmission losses across sectors. **b** Includes the food, beverages and tobacco sector; the textiles, clothing, footwear and leather sector; the machinery and equipment sector; and the construction sector.

Sources: Akmal et al. (2004); PC estimates.

The mining sector is also a relatively small user of energy, accounting for 5 per cent of final energy use in 2001-02. The mining sector relies more on petroleum products than electricity. When its electricity consumption is taken into account, however, around 7 per cent of primary energy consumption was attributable to mining in 2001-02. The sector registered the strongest growth in final energy use in the past 30 years (5.9 per cent per annum between 1973-74 and 2001-02) and is projected to maintain that growth up to 2020 (Akmal et al. 2004).

In contrast to the commercial and mining sectors, the manufacturing and construction sector is a major consumer of energy. Although no longer the largest final energy user in Australia, and registering a relatively low growth in final energy use between 1973-74 and 2001-02 (1.4 per cent per annum), the manufacturing and construction sector still accounted for over 29 per cent of final energy use in 2001-02. When the sector’s electricity consumption is taken into account, it overtakes the transport sector as the largest consumer of primary energy resources at around 35 per cent of the total energy consumed in 2001-02.

Within the manufacturing and construction sector, some subsectors are particularly reliant on energy as an input into their production. The non-ferrous metals subsector is the largest final energy user in manufacturing, consuming about 10 per cent of final energy in 2001-02, followed by chemicals producers with 5 per cent of total final energy use.

Business expenditure on energy

Energy costs amounted to less than 2 per cent of the total costs faced by firms in the commercial sector in 1998-99 (table 7.2). In the mining sector, energy is a larger (but still relatively small) contributor to costs, accounting for around 9 per cent of total expenditure. In the manufacturing sector, the importance of energy varies across sectors from 1.8 per cent of total expenditure in the food, beverages and tobacco sector to 11.5 per cent in the non-metallic mineral products sector.

Table 7.2 **Share of energy costs in total expenditure, 1998-99**

Sector	*Energy costs as a share of total expenditure*
	%
Commercial	**1.6**
Mining	**8.9**
Manufacturing and construction	**6.8**
Non-metallic mineral products	11.5
Iron and steel	10.9
Basic non-ferrous metals	8.5
Chemicals	3.6
Wood, paper and printing	2.4
Food, beverages and tobacco	1.8

Source: PC estimates from ABS (2004a).

Changes in energy efficiency

The amount of energy used by the commercial and industrial sector has increased since the early 1970s, due mainly to an increase in the commercial and industrial sector's output, although changes in energy efficiency have also had an impact.

A quantitative analysis by ABARE researchers (Tedesco and Thorpe 2003) has separated the impact of energy efficiency changes from those of output growth. Their results show that movements in energy efficiency have differed markedly between industries within the commercial and industrial sector.

In the mining industry, changes in energy use during the period 1973-74 to 2000-01 would have increased the sector's energy consumption by 104 per cent if there had been no change in the mining sector's output.[1] However, most of the sector's increase in energy intensity was due to structural change — a shift within the mining industry to subsectors that used more energy per unit of output— rather than a drop in the energy efficiency of particular mines. The remainder was due to technical changes that increased energy use per unit of output. These technical changes could have included less energy-efficient usage patterns, the use of equipment that was less energy efficient, price-induced substitution of energy for other inputs, and a shift to fuels with a lower conversion efficiency. ABARE analysis shows that the trend of falling energy efficiency in the mining sector was largely reversed in the period 1994-95 to 2000-01. In that period, technological change reduced energy use per unit of output by approximately 5 per cent.

In contrast, changes in manufacturing energy use during the period 1973-74 to 2000-01 would have reduced the sector's energy consumption by 44 per cent if there had not been an increase in that sector's output. Most of the sector's reduction in energy intensity was due to structural change. There was also a widespread shift by manufacturers toward fuels with a higher conversion efficiency which was partially offset by technical changes that increased the amount of energy used per unit of output.

In the construction sector, energy use would have fallen by 20 per cent between 1973-74 and 2000-01 if the level of output had stayed the same. This was largely due to a structural shift to less energy intensive parts of the industry. Energy efficiency declined in the services (commercial) sector with energy use per unit of output rising by approximately 16 per cent. This could be attributed to a structural shift to parts of the industry that used more energy per unit of output, and technical changes that raised energy use per unit of output. There was, however, a shift to fuels with a higher conversion efficiency in the services sector.

Table 7.3 shows how the changes in energy intensity of the above sectors would have affected Australia's total energy consumption at 1973-74 levels of output.

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1 Tedesco and Thorpe (2003, p. 18) reported that changes in energy intensity of the mining sector would have increased Australia's total energy consumption by 2.4 per cent between 1973-74 and 2000-01 if the level of output did not change. In 1973-74, Australia's total energy consumption was 2615 PJ, with 59 PJ attributable to mining (Tedesco and Thorpe 2003, p. 9). A 2.4 per cent increase of 2615 PJ is equal to a 104 per cent increase of 59 PJ (0.024 x 2615/59). The same method was used to calculate the changes in energy intensity of other sectors.

Table 7.3 Impact of energy efficiency changes on national energy consumption, 1973-74 to 2000-01

Subsector	*Impact of subsector energy efficiency change on national energy consumption*[a]	*Decomposition of impact*[b] *Structural change*[c]	*Fuel substitution*[d]	*Technical change*[e]
	%	%	%	%
Mining	**2.4**	**1.4**	**0.0**	**1.0**
Manufacturing	**–11.9**	**–10.4**	**–4.0**	**2.5**
Food, beverages and tobacco	–1.7	–1.0	–0.1	–0.7
Textiles, clothing, footwear and leather	–0.4	–0.5	–0.1	0.2
Wood, paper and printing products	–0.9	–0.8	–0.3	0.2
Non-metallic products	–2.3	–1.7	–0.3	–0.3
Metal products	–6.8	–6.5	–3.2	3.0
Other manufacturing	–0.3	–0.3	–0.1	0.0
Construction	**–0.2**	**–0.3**	**0.0**	**0.1**
Services	**0.5**	**0.5**	**–0.5**	**0.6**

[a] Change in Australian energy consumption due to change in the energy efficiency of the relevant subsector. [b] May not add exactly to overall impact of energy efficiency changes (first column of numbers in the table) due to rounding. [c] Portion of the overall impact of energy efficiency changes that is due to a shift within the relevant subsector between industries that use different amounts of energy per unit of output. [d] Portion of the overall impact of energy efficiency changes that is due to a shift in the relevant subsector between fuels with different conversion efficiencies. [e] Portion of the overall impact of energy efficiency changes that is not due to structural or technical change in the relevant subsector.

Source: Tedesco and Thorpe (2003).

In summary, much of the changes in energy use in the industrial and commercial sectors since the early 1970s can be attributed to the structural shifts within these sectors between more and less energy-reliant subsectors, rather than changes in the energy efficiency of particular industries. Most producers in the industrial and commercial sectors appear to have shifted to fuels with a higher conversion efficiency. However, this has been at least partially offset by technical changes that have increased energy use per unit of output in some cases.

Emissions

The commercial sector is a minor source of greenhouse gas emissions. According to the Australian Greenhouse Office (AGO 2005e), emissions from fuel combustion in the commercial sector were 4.3 megatonnes of carbon dioxide equivalent, which accounted for 0.8 per cent of total emissions in 2003. This figure, however, does not include emissions from the generation of electricity consumed by the sector. If electricity generation, transmission and distribution emissions are allocated to the commercial sector on the basis of the sector’s share of electricity supplied, the commercial sector's contribution to greenhouse gas emissions rises to 52 megatonnes or 9.5 per cent of total emissions in 2003. Emissions from fuel combustion in the mining, manufacturing and construction sectors were 39.4 megatonnes of carbon dioxide equivalent in 2003, accounting for 7.2 per cent of total emissions. If emissions from electricity generation, transmission and distribution are included, the sectors' emissions rise to 127 megatonnes or 23 per cent of total greenhouse gas emissions.

ABARE researchers (Tedesco and Thorpe 2003) analysed changes in the carbon dioxide emission intensity from the end use of energy by the commercial and industrial sectors between 1973-74 and 2000-01. They estimated that, if there had been no change in the structure or level of output of the commercial sector, the sector would have reduced its carbon dioxide emissions from using energy by 53 per cent.[2] Similarly, the manufacturing sector would have decreased its emissions by 28 per cent between 1973-74 and 2000-01, if the level of output and structure of the sector had remained the same.

On the other hand, the mining sector would have increased its emissions by 50 per cent between 1973-74 and 2000-01, if it had not increased its level of output and had maintained the same industry structure. The construction sector also would have increased its emissions by 10 per cent between 1973-74 and 2000-01, if the level of output and the structure of the sector had remained the same.

The above estimates ignore the commercial and industrial sectors' contribution to emissions in the energy conversion sector, whose emission intensity rose significantly during the period. If emissions from energy conversion were allocated to the sectors, ABARE concluded that all of the above sectors would have significantly increased their emissions for 1973-74 levels of output and economy structure.

In summary, the carbon dioxide emission intensity in the industrial and commercial sectors has increased since the early 1970's. However, this increase is largely attributable to the significant increase in the carbon dioxide emission intensity of the energy conversion sector, especially in the generation, transmission and distribution of electricity.

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2 Tedesco and Thorpe (2003, p. 69) reported that changes in the emission intensity of the commercial sector between 1973-74 and 2000-01 would have reduced Australia's total carbon dioxide emissions from energy production and use by 0.9 per cent if the level of output and economy structure did not change from 1973-74. In 1973-74, Australia's total carbon dioxide emissions from energy production and use were 174 Mt, of which 3 Mt were attributed to the commercial sector (Tedesco and Thorpe 2003, p. 57). A 0.9 per cent decrease of 174 Mt is equal to a 28 per cent decrease of 3 Mt (0.009 x 174/3). The same method was used to calculate changes in emission intensity of other sectors.

7.2 Why would firms overlook cost-effective energy efficiency improvements?

The previous section demonstrated that much of the observed changes in energy intensity in the commercial and industrial sectors could be explained by structural effects and not by improvements in energy efficiency *per se*. It is possible that Australian firms do not always take up energy efficiency improvements that are privately cost effective because of various barriers and impediments. These can be broadly categorised as follows:

- imperfect information arising from the public good nature of some information about energy efficiency and information asymmetries between firms acquiring a product (buildings, appliances and industrial equipment) and the seller of the product;
- split incentives arising from the fact that energy efficiency investment decisions in commercial buildings are made by people who are unlikely to bear the costs and benefits of those decisions; and
- organisational and behavioural issues within firms.

The apparent lack of improvement in energy efficiency might also reflect the fact that, with energy being a minor component of most firms' costs, Australian firms may have decided that their priorities lie elsewhere. Firms must have regard to many other considerations — product quality, marketing, competitors' actions, other production inputs, occupational health and safety, to name a few — not just the benefits and costs of greater energy efficiency. If improving energy efficiency comes at the cost of forgoing other more cost-effective opportunities (because of capital or labour constraints or because the projects are mutually exclusive alternatives), it would be rational for the firm to give energy efficiency a low priority.

The information and split incentives barriers, as well as the organisational and behavioural issues within firms, are discussed below.

Imperfect information

A number of inquiry participants argued that imperfect information prevented the full take-up of energy efficiency opportunities by firms. Information gaps for energy users were identified in the following areas:

- information about the various commercial building options and their cost (Royal Australian Institute of Architects, trans., p. 277);

- information asymmetries about construction and design characteristics of commercial buildings (ABCB, sub. 7; Exergy Australia Pty Ltd, sub. 40; Insulation Council of Australia and New Zealand, sub. 14); and
- information asymmetries in the market for energy services (Origin Energy, sub. 25).

Some information gaps can be attributed to the public good nature of some information. For example, information on the best currently available technologies or consolidated lists of energy consultants may be underprovided in a private market if providers cannot capture the benefits. Sometimes information can be in the public domain but not in a form useful to a particular firm. For example, the Australian Meat Processor Corporation (sub. 12) submitted that general information on improving boiler energy efficiency was available but not in a consolidated and readily usable form. And Norske Skog (2004) observed that firms may have difficulty engaging the most appropriate energy services consultant in the absence of a consolidated register of consultants.

Information-related market failure may also arise from information asymmetries. For example, the problem of adverse selection may exist in the markets for commercial buildings where the purchasers/renters are poorly informed about the characteristics of the building relative to sellers/landlords. The Insulation Council of Australia and New Zealand (sub. 14) argued that information asymmetries regarding the quality of insulation in buildings resulted in adverse selection and stated that this was a significant barrier to energy efficiency.

When the tenants and purchasers of commercial buildings are large corporations with significant resources and good access to technological expertise to assess the characteristics of the building, the likelihood of adverse selection is low. Nevertheless, many firms are small and may be little, if any, better-informed about energy efficiency than householders. The adverse selection problem may also exist in commercial and industrial appliance and equipment markets, particularly for smaller manufacturing and commercial firms. However, high-cost (in dollar terms) purchases like commercial building leases or industrial appliances also create stronger incentives for the purchaser to investigate all relevant characteristics of the purchase.

Split incentives

A number of participants identified split incentives in the market for commercial building leases as a barrier to energy efficiency investments in buildings (ABCB, sub. 7; Lincolne Scott, trans., pp. 241–42). The Royal Australian Institute of

Architects observed that the split incentives barrier was less likely to be prevalent when the lessor or purchaser of the building was a large company:

> … a significant shift has occurred at the big end of town … in some of the major property trusts that are operating in Australia … They really know their stuff. They know about life-cycle costs because they end up being the primary facility manager, the owner long term … At the medium and the small end the frustrations … exist … because the developer has no other incentive other than to get the building up and fully leased out and then sold on possibly to the owner-occupier investors and they have to shoulder the ongoing costs. (trans., p. 277)

The split incentives problem is exacerbated by the different needs of potential future users of the building. Even if the incentives of the developer and the first tenant (or purchaser) of the building are aligned, future tenants may have different energy usage preferences. Nonetheless, future users of the building could be expected to take the cost of refitting the building in accordance with their preferences into account when deciding whether to buy or lease the building.

Organisational and behavioural issues

Organisational characteristics of firms, such as their divisional structures and decision-making processes, may influence the uptake of energy efficiency projects (chapter 4). These may include barriers to communication flows between technical staff and management within firms that may result in decision makers not receiving relevant information or not correctly processing the information. In this context, the Australasian Energy Performance Contracting Association observed:

> The issue is often whether or not the perception of such great benefits that is evident — self-evident even — to an organisation at the engineering level is very difficult to translate up to the decision-making level, and it is often the case that were an ESCO [energy services company] to approach an organisation at an engineering level, it can be very easily and very quickly demonstrated that there are great advantages to be achieved. (trans., p. 363)

Misalignment of staff incentives and business outcomes may also be a problem. Exergy gave an example of one of its clients — a firm managing a commercial building portfolio:

> … the chief executive officer commanded from above that there shall be a program of energy work and we’re going to do something and middle management killed it by saying basically, ‘We can’t be bothered.’ There’s a lack of connection to the result. (trans., p. 328)

The Australian Meat Processor Corporation (sub. 12) suggested that the flat organisational structure often found in smaller firms, with no consolidation of energy efficiency responsibilities in the hands of one person, hindered the uptake of energy efficiency improvements.

Energetics (sub. DR104) claimed that poor management was the main barrier preventing energy efficiency improvement in Australian firms. Energetics conducted a survey of management practices within its client firms using a self-diagnostic software tool. The results showed that 84 per cent of Energetics' clients that had operating expenses greater than five million dollars did not have a dedicated energy management system. Twenty per cent of the firms had no management system in place to manage energy waste.

Energetics also observed that other organisational barriers could include:

> … shortages of internal skilled labour, engineering focus of services in this area which has discouraged companies from integrating energy into business practices … (sub. DR104, p. 4)

Organisational characteristics of firms may combine with behavioural factors to inhibit energy efficiency improvement. Chapter 4 gave examples of economising behaviour in decision making caused by the bounded rationality of individual firms. Scarcity of staff resources within firms may contribute to constraints on the quality of decision making.

As noted in chapter 4, the Commission does not consider that organisational and behavioural issues are sufficient grounds in their own right to warrant government intervention. However, these issues might be relevant in the design and delivery of government programs that are otherwise justifiable, for example as a response to environmental externalities or other market failure.

The following sections analyse the policies for the industrial and commercial sectors, that have been introduced by governments purportedly to address the barriers and market failures identified above. The discussion starts by looking at less interventionist policies and proceeds to analyse the case for increasingly stronger intervention by governments.

7.3 Promoting the energy services industry

The Australasian Energy Performance Contracting Association (sub. 47) submitted that governments could promote the energy services industry in order to achieve greater adoption of privately cost-effective energy efficiency improvements. Such government involvement could take the form of running an accreditation scheme for energy service providers or playing a facilitating role in transactions between energy service providers and firms.

Advantages offered by the energy services industry

In the absence of government intervention, some energy efficiency improvements will take place as part of business-as-usual strategies. The energy services industry can provide market solutions to some of the barriers faced by firms in improving their energy efficiency.

A number of participants suggested that the energy service industry could play a significant role in achieving energy efficiency improvement for firms (AGL, sub. 66; ESAA, sub. 68; Insulation Council of Australia and New Zealand, sub. 14).

The Energy Retailers' Association of Australia observed that market demand for energy efficiency services could generate the supply of such services from energy retailers:

> In competitive energy markets customers looking to reduce their energy bill represent a commercial opportunity for energy retailers looking to differentiate their service offering (sub. 26, p. 23).

AGL (sub. 66, p. 6) submitted that its Business Energy Services division has helped customers reduce their energy use, resulting in a net benefit of $3 million.

Firms can engage energy consultants at a number of levels and can choose from a variety of services. These range from purchasing software which assists the maintenance and analysis of energy use records; to obtaining advice on energy-saving technologies; to hiring consultants to conduct energy audits; or entering into energy performance contracts.

Conducting energy-use audits to identify cost-effective efficiency improvements is one of the most commonly offered types of service by energy consultants. This may allow firms to achieve energy efficiency improvements at a lower cost than if the firm conducted its own assessments, due to specialisation and consequent economies of scale. Further, consolidation of the responsibilities involved in completing an energy efficiency audit in the hands of one agent (the consultant) can also reduce the organisational transaction costs of the firm.

An alternative approach to energy audits by a firm's staff or outside consultants is energy performance contracting. Under this approach, energy service companies (ESCOs) can enter into energy performance contracts with firms to supply an integrated package of services ranging from identification of energy-saving opportunities to design and implementation of projects and post-implementation maintenance of equipment. An ESCO usually guarantees a certain level of energy savings and its compensation is tied to the realisation of those savings (box 7.1).

Although energy performance contracting is relatively new in Australia, it has been used extensively in Europe and the United States for over 20 years. In the United States, projects worth over US$2 billion were commissioned to ESCOs in 2000 (Osborn et al. 2002). The US ESCO industry has experienced rapid growth with revenues growing at the rate of 24 per cent per annum in the decade 1990–2000. Analysis of the projects commissioned through energy performance contracts showed that the median payback time for industrial and commercial sector projects was three years and that these projects achieved a median benefit–cost ratio of 2.1 (Osborn et al. 2002).

Box 7.1 **Energy service companies and performance contracting**

An energy service company (ESCO) is a business that develops, installs, and manages projects designed to improve the energy efficiency and maintenance costs of facilities of a customer firm. Typically, ESCOs provide the following services:

- performing an energy audit of the firm;
- establishing baseline energy use for specific equipment, systems, or the facility as a whole;
- designing the energy efficiency project in consultation with the customer;
- supplying, installing and commissioning equipment;
- training customer personnel;
- operating and maintaining the equipment for the life of the contract; and
- conducting measurement and verification to determine the savings generated.

A distinguishing feature of ESCO operation is the energy performance contract (EPC). An EPC is an agreement entered into by a firm and an ESCO where the ESCO undertakes to provide specific services and guarantees some level of energy savings for the firm. The ESCO's compensation is usually paid from the savings generated by the EPC. Typical contract terms are between four and ten years.

Source: AEPCA (2004).

Energy performance contracting can reduce the information and organisational barriers identified in section 7.2. Further, since the ESCO guarantees a certain level of savings, there is a redistribution of implementation risk away from the firm to the ESCO, which would arguably face a lower risk of project failure due to its technical expertise.

Issues in using the energy services industry

In practice, the energy services industry faces some barriers. A significant difficulty that has been identified by industry is that energy consultants tend to focus on reducing one of the inputs to production and that this may result in an increase in other business costs. The Australian Aluminium Council noted:

> While there are opportunities for the engagement of consultants who offer the promise of sharing the benefits from reduced energy consumption, care needs to be taken in avoiding the use of a single metric (energy consumption) when the bottom line may be influenced by changes in the other inputs to the activity. There is little point in engaging the services of an 'energy efficiency specialist' who is focused on a single performance metric without reflecting the impact on the 'whole-of-business' outcome (sub. 29, p. 11).

As discussed in chapter 5, the dampening effect of implementation costs not observed by energy consultants is evident in survey results. A US survey of more than 9000 energy efficiency audits found that, while 50 per cent of audit recommendations were not implemented by firms, 75 per cent of those decisions were made for legitimate economic reasons (Anderson and Newell 2002). The most significant factor reported was costs to the firm in other areas of its operation which were not taken into account by the energy auditors. Firms reported costs like unacceptable operating and personnel changes, risk or inconvenience to personnel, costs of installing new equipment including production halts and changes in product quality.

A survey of the Enterprise Energy Audit Program that operated in Australia between 1991 and 1997 by offering subsidies for firms to conduct energy audits, revealed that the most common negative comment about the program was that auditors failed to understand the way the firm operated (Harris, Anderson and Shafron 1998).

Another major problem identified by Origin Energy (sub. 25) involves the information asymmetries between the service provider and customer. The actual savings that arise as a result of the consultant's advice will depend on many aspects of business operation. There is an inherent asymmetry of information between the consultant and the client about the client's business. This makes verification of actual energy savings difficult for the consultant. The problem is exacerbated when the consultant's remuneration is dependent on energy savings achieved, as in the case of EPCs.

Greater upfront contract specification by the energy service provider could reduce this moral hazard problem. However, this would add to the transaction costs.

Policies to promote the energy services industry

The Australasian Energy Performance Contracting Association (AEPCA, sub. 47) and the Moreland Energy Foundation (sub. DR115) suggested that the perceived risk of engaging a consultant may be reduced through government intervention in running a national training, accreditation and standards program for energy service providers. This would provide some independently-sourced information to firms about the reliability of the consultant.

The Australian Government committed to playing some role in providing this type of service as part of its policy of Mandatory Energy Efficiency Opportunities Assessment for large energy users (discussed in section 7.7). The program, which is currently in development, provides for government facilitation of capacity building in the energy services industry. This could involve training and accreditation of energy consultants.

Accreditation of energy service providers can reduce the risk associated with engaging consultants. However, this does not necessarily require government involvement. As in many other industries, accreditation could be undertaken by an industry or professional association. Indeed, AEPCA has developed an accreditation process for energy service companies. The Green Building Council of Australia also runs an accreditation course for its Green Star ratings scheme and maintains an online directory of Green Star Accredited Professionals. The Green Building Council stated that currently there are 265 Green Star Accredited Professionals, and that these have provided very positive feedback about the accreditation course (sub. DR137). The Commission considers that there is no particular case for government taking up this role for energy service consultants.

FINDING 7.1

Government should not become directly involved in accreditation of energy consultants and energy service companies because this function can be adequately performed by an industry or professional association.

AEPCA (sub. 47) also suggested that governments could reduce the high contracting costs (arising out of information asymmetries) by playing a facilitating role in transactions between energy service providers and firms. One example of such facilitation is the Energy Smart Business Program administered by the Department of Energy Utilities and Sustainability in New South Wales. Under this program, the New South Wales Government acted as an intermediary between energy service providers and large energy users in the commercial and industrial sectors.[3] The Energy Performance in Commercial Buildings program in the ACT (which started in 2002 and was subsequently discontinued) operated in a similar fashion but also provided firms with financial incentives to enter EPCs.

By acting as an intermediary between energy service providers and firms, governments could reduce the high transaction costs of selecting consultants and contract over-specification. Such involvement may provide an implicit guarantee to firms about the consultant, and hence might work in ways similar to a government-run accreditation scheme. However, such involvement is not costless and has some risks. The downside of being seen to endorse particular consultants is that governments implicitly take on the risks of those consultancies turning out less than satisfactorily. It also encourages favouritism and lobbying by consultants to gain an advantage over their competitors. To be able to provide firms with even the most basic advice on the capabilities of consultants, there is a need for a degree of expertise within government, and staff can be exposed to firm capture. If third parties are involved in the accreditation of consultants, governments could take a more neutral intermediary role by simply referring interested firms to the accrediting party or to any published list of consultants.

Other approaches to reducing transaction costs might be more productive. For example, the Australasian Energy Performance Contracting Association and the AGO have jointly developed a National Standard Energy Performance Contract which can be used as a template by ESCOs to cover most standard projects. The contract can also be used in combination with additional provisions to reflect the heterogeneity of clients and requirements.

7.4 Voluntary agreements

A number of programs facilitating voluntary initiatives by firms are currently run by governments. These tend to focus on reducing greenhouse gas emissions rather than on improving energy efficiency *per se*. Therefore, the market failure primarily addressed by these programs concerns the negative externalities associated with energy use, rather than market failures that might be preventing the uptake of privately cost-effective improvements in energy efficiency. Nevertheless, voluntary agreement programs can encourage such improvements. Voluntary agreements can

[3] The Commission has examined a summary of the evaluation of the New South Wales Energy Smart Business program that claims that the program achieved energy cost savings of $31 million. The evaluation provides no information on the administrative costs of the program or on the implementation costs borne by firms in realising the energy savings. The evaluation also does not state whether these savings are incremental to the business-as-usual scenario, in which some firms may have engaged the consultants independently of government facilitation.

address organisational barriers within firms by focusing a firm's attention on a specific issue. Voluntary programs can also address the information barriers faced by firms.

The two largest voluntary agreement programs are the Greenhouse Challenge and the Australian Building Greenhouse Rating scheme. Analysis of these programs provides a useful basis for assessing potential benefits available from voluntary energy efficiency improvement.

Greenhouse Challenge

The Greenhouse Challenge was launched in 1995 by the AGO as a joint voluntary initiative between the Australian Government and industry to abate greenhouse gas emissions. The program was discontinued in 2005 and replaced by the Challenge Plus — Enhanced Industry Partnerships program which is funded to run until 2007-08 and will operate in a broadly similar fashion to its precursor. One major change to the program is that participation in Challenge Plus will be compulsory from 2006 for recipients of fuel excise credits of more than $3 million. This would mean that the program would no longer be a purely voluntary one for some participants. For the purpose of this section, only the voluntary agreement aspect of the Greenhouse Challenge program is discussed here.

In 1999, the Greenhouse Challenge scheme had an annual budget of $6 million. Although the main focus of the program was on emission abatement, one element of Greenhouse Challenge — the Managing Energy for Profits scheme — was a recruitment scheme that involved consultants promoting energy savings to potential participants. Participating organisations made certain undertakings with the government and were provided with limited technical assistance in the development of their agreements. This was given in the form of template workbooks and advice from industry advisers. Participants were required to report annually on actions planned and undertaken, and on actual emissions. Reports had to be independently verified.

In 1999, the Greenhouse Challenge covered firms creating 26 per cent of Australia's total greenhouse emissions, including 100 per cent coverage of the aluminium and cement industries, 98 per cent of oil and gas extraction and 91 per cent of coal mining.

An evaluation of the program (AGO 1999a) listed some of the benefits and impediments to joining the Greenhouse Challenge, as identified by participants. The major benefits included reduced energy costs, improved corporate reputation as a responsible environmental manager, and improved relationships with the Australian

Government. Major impediments included the absence of financial benefits in participating, difficulties in developing a cooperative agreement and the uncertain policy environment. The report suggested that greater participation could be achieved if the link between energy cost savings and greenhouse gas abatement was better communicated.

Australian Building Greenhouse Rating Scheme

The Australian Building Greenhouse Rating (ABGR) scheme is a voluntary program aimed at reducing the greenhouse gas emissions attributable to commercial buildings (box 7.2). ABGR was developed in 1999 by the New South Wales Department of Energy, Utilities and Sustainability (DEUS) in New South Wales and was expanded to operate nationally in 2000.

Box 7.2 **Australian Building Greenhouse Ratings**

Australian Building Greenhouse Ratings is a performance based rating system for office buildings. It covers three categories:

- base building, covering the services supplied by a landlord under a gross lease (where the tenant only pays directly for the energy use of office lighting and other specifically tenant driven loads such as office equipment, and the landlord pays directly for the energy use of the air conditioning and other building services);
- tenancy rating, covering the tenant loads only; and
- whole building, covering the total operation for the building.

The rating is derived using the following process:

- building energy use is identified, based on actual bills;
- hours of occupancy are identified;
- for tenancy and whole-building ratings, the tenant load is characterised based on a count of computers;
- the climate region is identified; and
- the floor area is specified in terms of the net lettable area of productive office space.

These factors are fed into a calculation that converts the energy use into a greenhouse gas equivalent, divides by floor area and applies normalisation factors to compensate for hours of occupancy, climate, and (if assessed) tenant loads. The resultant figure is then compared against a scale set on the basis of the statistical distribution of energy use in office buildings in the same state as the building. This estimate is converted into a rating between one and five stars, where one star represents very poor performance and five stars exceptional performance.

Source: Exergy Australia Pty Ltd (sub. 40).

The scheme offers a performance-based rating system for office buildings. Office building owners and tenants can initiate an ABGR assessment at their expense — usually between $1000 and $3000 (NSW DEUS 2004b). Upon initiating the assessment, the firm is provided with a third-party accredited assessor who measures the building's energy use and assigns it a star rating, which indicates the building's relative energy efficiency. Ratings of one to five stars are given, with a three-star rating indicating current market standard practice (NSW DEUS 2004b). A database of building ratings derived using the ABGR methodology is maintained by DEUS. In December 2004, NSW DEUS (2004a) reported that 14 per cent of office space nationally and 20 per cent in New South Wales have been rated using the ABGR.

Originally, the ABGR underpinned a voluntary labelling scheme for commercial buildings. However, it has subsequently expanded to include other government initiatives. Currently, a number of information provision programs are run nationally as part of the ABGR scheme. These include the Star Performer diagnostic software that provides advice on reducing greenhouse emissions on the basis of building characteristics; and the Tenant Energy Management Handbook. At a state level, some voluntary agreement programs involve building owners or tenants committing to achieve certain levels of emission reductions after undergoing an ABGR assessment. Examples of such programs include the 3CBDS Greenhouse Initiative and the Parramatta Greenhouse Leaders Project in New South Wales. DEUS has also developed a standard commitment agreement to achieve a certain ABGR rating that developers of new buildings can choose to adopt.

Are voluntary agreements effective in improving energy efficiency?

A number of participants submitted that the capacity of voluntary programs to effect energy efficiency improvements was very limited. The Moreland Energy Foundation stated:

> Our primary concern with the voluntary agreement model is that a lot of resources can be invested and the results can be minimal. (sub. DR115, p. 14)

The Australian Business Council for Sustainable Energy (sub. DR121) argued that the current regulatory approach to energy consumption resulted from the prior failures of voluntary programs. The Victorian Government submitted that despite having already participated in voluntary programs, some firms were still able to identify opportunities with a three year payback as part of the Victorian Environment Protection Authority Greenhouse Program (sub. DR125).

International experience with voluntary agreement programs shows that they have led to some improvements in the energy efficiency of firms, although it is generally difficult to quantify those improvements. The World Energy Council (2004) concluded that many energy efficiency improvements that are attributed to voluntary agreement programs would have been undertaken by firms independently of government intervention. For example, it was found that the German voluntary agreement program resulted in relatively small improvements over the business-as-usual scenario. Nevertheless, studies of the Dutch program, which is considered to be one of the most successful industry voluntary agreement programs, showed that it drove participants to improve their energy efficiency. It was estimated that the program reduced energy intensity in the industrial sector by 0.8 per cent per annum between 1989 and 1999 (box 7.3), with improved energy efficiency being one of the major causes for this reduction. The program was deemed to have a number of effective features. These included:

- exploratory surveys to gauge the energy efficiency improvement potential of a participating sector prior to developing the agreement;
- annual monitoring of performance of participants; and
- government provision of general information to raise industry awareness of potential energy efficiency improvements.

Box 7.3 **Long-term voluntary agreements in the Netherlands**

The Dutch Voluntary Agreement Program ran between 1989 and 2000. The program involved energy intensive commercial and industrial subsectors entering into long-term agreements with the government to improve their energy efficiency by a specific percentage within an agreed period. The agreements included commitments by individual firms to adopt particular management practices, such as the preparation and implementation of energy conservation plans and annual monitoring of energy consumption. Subsector energy efficiency targets derived from initial government surveys of potential for improvement, underpinned the agreements.

Over the period of 1989–99 participating subsectors achieved an average energy efficiency improvement of 20.4 per cent. A study by University of Utrecht researchers utilised a combination of expert opinion and company surveys to analyse the direct effect of the program on industrial energy efficiency improvement. It was estimated that, between 25 and 50 per cent of the energy efficiency improvement in the industrial sector occurring during the program's operation was directly attributable to the voluntary agreements. Without the program, energy efficiency improvement in the industry would have been about 1 per cent per year instead of 1.8 per cent.

While developing the agreements in itself was not a costly process for the government, the program was accompanied by substantial government expenditure on information provision and awareness-raising initiatives. In total, between 1989 and 2000, the program cost the Dutch Government €159 million to run.

Source: World Energy Council (2004).

The main advantage of voluntary agreements is that they give organisations the flexibility to self-select as well as choose the level and nature of their undertaking. There is, therefore, a lower risk of firms being forced into adopting practices that are not privately cost effective for them.

However, the voluntary character of such programs is easily compromised. Some of the participation in the Challenge Plus and the ABGR programs may have been instigated by the presence in those programs of incentive or coercive elements. Participating may well be a precaution against the threat of other higher-cost policy measures being adopted by governments. Alternatively, participants may be motivated by government provision of technical support or the prospect of losing access to other government support (for example, participation in the Challenge Plus program is compulsory for recipients of fuel excise credits of over $3 million). To the extent that participation is not purely voluntary, there is a higher risk that firms would undertake projects that are not privately cost effective.

Furthermore, it is likely that firms would package some of their business-as-usual actions into their agreements, thus making it easier to achieve agreed targets. This proposition was not tested in the evaluation of the Greenhouse Challenge Program. The risk is likely to be lower for programs in which substantial government effort has been directed at collecting information about the participant and their industry prior to entering into an agreement with them. However, this may add significantly to government costs.

7.5 General information provision

As discussed in section 7.2, some of the information gaps faced by firms could be attributed to the public good characteristics of information. General information provision programs seek to address this market failure. Governments currently provide firms with a wide range of energy efficiency information using a variety of delivery mechanisms (box 7.4).

Box 7.4 **Examples of general information programs**

General information provision programs can take a number of forms. The following types of programs currently operate in Australia:

Educating firms about general aspects of energy efficiency

The ACT Ecobusiness program and the Western Australian Energy Smart Business program run workshops and seminars on general energy efficiency issues, in which small and medium sized firms are given information on various topics including lighting, air conditioning and energy audits.

Publicising current industry practice and success stories

Under the Australian Government's Energy Efficiency Best Practice Program, energy use case studies and benchmarking reports were prepared for a number of commercial and industrial subsectors. The New South Wales Energy and Water Green Globe Award scheme identifies and publicises the practices of energy efficient firms.

Providing information about products regulated for energy efficiency

The Australian Government publishes some information collected as part of the testing of appliances and equipment that are regulated for energy efficiency in the electronic Switched On newsletter and the Motor Solutions Online website.

Acting as a reference point for other sources of information

The Western Australian Government maintains an Energy Smart Directory of suppliers of 'sustainable' energy products and services. In South Australia, annual Energy Efficiency Conferences and Trade Fairs provide a forum for manufacturers of energy-efficient products and the energy services industry to advertise their products.

General information and education provision may address some of the information gaps faced by Australian firms. However, in some cases, the information will be available from the private sector. For example, the energy services industry can provide a wide range of advice including some of the information that is currently provided by governments through general information programs. Information gaps concerning the operation of the energy services industry can be addressed by industry associations like the Australian Business Council for Sustainable Energy and AEPCA. This includes maintaining consolidated registers of consultants and providing information on the services offered by the energy services industry.

In some cases, government provision of information may be warranted. Information provided by governments may be more credible than if it was supplied by private agents. If the information is relatively generic, a government agency may be able to provide it at a cost that is lower than that faced by individual firms due to economies of scale and scope. Government provision may also reduce search costs for users.

A frequent criticism of general information provision programs is that they do not guarantee outcomes, particularly if there are barriers within an organisation to the processing or implementation of the information. However, non-action on the basis of received information may also reflect rational decision making by the firms.

There is also usually a tradeoff between the generality of information and its relevance and usefulness to the recipient. Moreland Energy Foundation observed:

> Our experience indicates that firms prefer targeted information to general information … (sub. DR115, p. 14)

A review of the Energy Efficiency Best Practice program run by the Australian Government Department of Industry, Tourism and Resources (DITR) found that its original approach of general information provision was relatively ineffective in changing energy user behaviour in the industrial sector. General information provision '… did not directly assist companies in improving their energy efficiency …' (EnergyConsult 2002, p. E1).

The Australasian Energy Performance Contractors Association commented that, compared to energy audits, general information provision programs:

> … provide information on the benefits of energy efficiency, … provide information on specific technologies, but don't provide enough information for a consumer to actually exploit the opportunity. They may still not be certain how to specify a technology, how to be sure they are paying the right price for the technology. (trans., p. 359)

This illustrates the fine line between public and private goods and the dilemmas facing governments in pursuing anything but the most basic information provision. If information is specific enough to the needs of a particular firm, there should be sufficient incentives for others (consultants, performance contractors and ESCOs) to provide it. Generally speaking, the information failures in the commercial and industrial sectors are less significant than in the residential sector, suggesting a commensurately smaller role for governments in information provision.

7.6 Financial incentives

Financial incentives do not directly address the information barriers, split incentives and organisational barriers identified in section 7.2. Further, provision of financial incentives may simply improve the return on projects that are already privately cost effective. However, provision of financial incentives for actions that improve the energy efficiency of a firm increases the attractiveness of such actions to the firm, and thus can have a direct bearing on whether these actions are undertaken. Government financial assistance might be justified if it reduced the negative externalities associated with energy use or helped promote positive spillovers associated with research and development (R&D) and better practices.

This section examines the case for government provision of financial incentives to firms in the form of:

- subsidies for energy audits;
- assistance for research, development and innovation in energy efficiency; and
- subsidies for other energy efficiency related expenditure by firms.

The section concludes with a discussion of hypothecated levies as a means of financing the subsidies.

Subsidies for energy audits

The most common type of financial incentive program in the commercial and industrial sector involves governments assisting firms in conducting energy audits. A number of state programs adopted this approach, including the Energy Smart Business Program in Victoria; the Cleaner Production Partnerships and the Greenhouse Industry Partnerships programs in Queensland; and the Business Energy Efficiency Opportunity Identification program in South Australia (appendix C). However, the largest energy audit assistance programs of recent years were the Enterprise Energy Audit and Energy Efficiency Best Practice programs run by the Australian Government.

Enterprise Energy Audit and Energy Efficiency Best Practice programs

The Enterprise Energy Audit Program (EEAP) was run by the Australian Government Department of Primary Industries and Energy between 1991 and 1997. Under the EEAP, firms were provided with subsidies of 50 per cent of the cost of an energy audit up to a maximum of $5000. Approximately 1200 firms took part in the EEAP.

An evaluation by ABARE researchers (Harris, Anderson and Shafron 1998) concluded that the EEAP was very cost effective in generating cost savings for firms (box 7.5). However, the analysis showed that most of the improvements would have been initiated by firms in the absence of government subsidies. Harris, Anderson and Shafron (1998) argued that the role of government should be limited to promoting the private take-up of the EEAP auditing process by firms, but should not extend to providing firms with specific information or direct subsidies for audits.

Box 7.5 **Enterprise Energy Audit Program outcomes**

A survey of the EEAP participants conducted by ABARE researchers resulted in the following findings:

- The total net present value to firms of audit recommendations that were implemented was $189 million. The energy savings generated amounted to 8 per cent of previous energy costs.
- Total costs of program administration were $1 million and the total cost of audits was $8.7 million, of which the Government funded half.
- The average implementation rate of audit recommendations was 81 per cent (the implementation rate was lower for larger firms).
- Participation in the EEAP led to increased awareness of energy efficiency within the firm and acted as a 'springboard' for further actions.

Source: Harris, Anderson and Shafron (1998).

The EEAP was superseded by the Energy Efficiency Best Practice Program (EEBP) run by DITR during 1998–2002. The objective of the program was to assist firms to overcome the barriers to the adoption of privately cost-effective energy efficient practices. The EEBP commenced in 1998 as a general information provision program with funding of $10.3 million allocated over five years. From 2000, EEBP evolved to targeting specific firms and directly assisting them in improving their energy efficiency (box 7.6). Two approaches were developed under the program — the Big Energy Projects and the Best Practice, People and Processes. The Big Energy Projects involved DITR facilitating and subsidising a series of workshops that brought together representatives from different industries and external consultants. The objective was to foster exchange of knowledge and generate innovative solutions that would otherwise not be detected within the firm or the industry. The Best Practice, People and Processes component of the EEBP aimed to build capacity within organisations to deal with energy-use issues. The EEBP assisted firms in forming internal energy management teams and trained those teams to measure and monitor energy use in their organisations.

Box 7.6 Examples of firms that participated in the Energy Efficiency Best Practice Program

Amcor received approximately $25 000 from the Australian Government Department of Industry, Tourism and Resources (DITR) to engage an energy consultant to work part time for four months at the Amcor Botany Mill. The resulting energy audit identified potential energy savings of $654 800 per year. These came from efficiency improvements at operations level (including equipment maintenance issues, process optimisation and staff training) and the more fundamental improvements in underlying energy efficiency through replacement of equipment and significant changes to processes. Subsequently, Amcor implemented projects that resulted in annual savings of $240 000.

Carlton & United Beverages participated in the workshop organised by DITR as part of its Big Energy Project approach. Opportunities for optimisation of the refrigeration system at the company's Abbotsford plant were identified and implemented, resulting in net savings of $300 000 per year.

Sources: Amcor, pers. comm., 7 October 2004; DITR (2002).

A review of the EEBP program estimated that the program resulted in identification of opportunities to cut energy costs within participant firms by up to $74 million by 2010 (EnergyConsult 2002). By the end of 2002, savings of $21 million (cumulative to 2010) had been implemented (DITR 2003). These estimates, however, did not take any account of the impacts of the EEBP on other costs to the firm, including the capital and labour costs of achieving the savings. On the basis of available evidence it is, therefore, not possible to estimate the private cost effectiveness of the program, but, presumably, the firms only adopted measures that were privately cost effective.

Should firms be subsidised to identify specific energy efficiency improvements that are privately cost effective?

A policy of assisting firms to conduct energy audits is less likely to be justifiable on the grounds of correcting an information-related market failure than general information provision. Firms have an incentive to obtain and utilise information that would lead to cost savings, particularly where the net savings are as large as those identified in the EEAP and EEBP programs.

Subsidising firms to perform privately cost-effective actions may also encourage rent-seeking behaviour from firms. Some firms may seek funding to pay for energy audits that they intended to conduct in the absence of any government subsidy. On the other hand, governments are likely to face significant information asymmetries in trying to identify such firms. A study of the German energy audit assistance program (Gruber and Brand 1991) found that 67 per cent of the participating firms would still have used a consultant without the grant.

Although the Commission has reservations about subsidising firms to identify privately cost-effective opportunities, the long history of government involvement in audit programs appears to have led to considerable improvement in the programs' effectiveness. Some of the features of the EEBP program appear to have increased the uptake of privately cost-effective energy efficiency improvements. For example, many participants considered that the EEBP approach of sponsoring workshops, which combined internal staff with representatives from other industries and external consultants, helped to generate innovative ideas that would otherwise not be discovered by the firm. More generally, comments from EEBP participants published on the EEBP website (DITR 2004a) and made during private meetings with the Commission suggest that the program was successful at delivering actual energy efficiency gains in firms.

Assisting firms to obtain specific information on privately cost-effective opportunities for reducing their energy consumption may also be warranted if it results in significant spillover benefits to third parties. One potential externality is a positive demonstration effect for other firms in the industry. For example, the EEBP program published a number of case studies of program participants. This approach could diffuse the specific information obtained with government assistance across and within industries. It could also promote the uptake of energy auditing without government assistance if the private cost effectiveness of doing so can be demonstrated in the case studies. An examination of the EEBP case studies reveals, however, that most of them have tended to be relatively nonspecific summaries of the projects, lacking concrete details about the cost-saving opportunities that were identified and implemented.

The Australian Meat Processors Corporation argued that more could be done to diffuse the information generated by the EEBP program and provided an example of the UK Energy Efficiency Best Practice Program which:

> … had over 800 publications which covered energy consumption guides, best practice, good practice, future practice. The publications related to industry sectors and technologies, and were based on communicating actual case studies. (sub. DR95, p. 2)

If the policy of assisting firms to obtain specific information is to be pursued, it is important to try and diffuse the information that has been generated as much as possible. In order to be useful for other firms, the information would need to be concrete and relevant, providing details of the opportunities identified and the associated costs and benefits of implementation. However, governments may be constrained in doing this by the firms' unwillingness to disclose confidential information about their operations to their competitors.

Subsidies for research, development and innovation

Australian governments currently operate a framework of general policies supporting R&D that include maintaining an intellectual property rights system, tax concessions, competitive grants and concessional loans for R&D (chapter 4).

In addition, all jurisdictions operate a number of financial assistance programs aimed specifically at promoting research and innovation in energy use in the industrial and commercial sectors. Some programs take the form of a fund which distributes grants to research organisations and private firms (often on a competitive tender basis) to undertake research into energy efficiency technologies and practices. For example, the Sustainable Energy Research and Development Fund in New South Wales, the Sustainable Energy Research Grants scheme in South Australia and the Queensland Sustainable Energy Innovation Fund operate in this manner.

Other programs take a more applied approach, promoting the take-up by firms of existing new technologies and innovative solutions. Two examples are the Commercial Office Building Energy Innovation Initiative and the Business Energy Innovation Initiative schemes in Victoria (box 7.7). These programs are aimed at fostering the demonstration of new energy efficiency technologies in the commercial building and manufacturing sectors through subsidising the uptake of new technologies by individual firms.

Box 7.7 Commercial Office Building Energy Innovation Initiative and Business Energy Innovation Initiative

Commercial Office Building Energy Innovation Initiative

The program commenced in 2003 and is still in operation. The program aims to demonstrate innovation in the design and application of sustainable energy in new and existing office buildings. Financial incentives are provided to 'property industry leaders' to support the development of projects that demonstrate high quality and energy efficiency in commercial property. The Sustainable Energy Authority of Victoria (SEAV) estimates that, within 15 years, the demonstration projects will influence 30 per cent of office building activity.

(Continued next page)

Box 7.7 (continued)

Business Energy Innovation Initiative

The program provides support for projects that invest in new and innovative energy efficiency solutions, or in solutions that combine energy efficiency with sustainable industry practices. This can involve identifying and assessing new technology options; performing detailed technical and commercial appraisals; installing and commissioning new solutions and securing local and international expertise for energy efficiency initiatives. The focus is on productivity improvement through innovative demonstrations of sustainable energy supply, design and operation of state-of-the-art production facilities, and the development of new energy-efficient or renewable-energy products. The SEAV may contribute up to $150 000 matched dollar for dollar with the business partner.

Source: Victorian Government response to PC request for information (unpublished).

In addition, the Australian Government (2004) announced the establishment of the Low Emissions Technology Demonstration Fund, in 2006. The Fund will provide subsidies to firms for investment in new technologies that have significant greenhouse gas abatement potential, with the aim of demonstrating the commercial potential of those technologies to the wider industry. Among technologies listed as potentially eligible for subsidies are more energy-efficient manufacturing technologies. However, the Commission understands that such projects will account for only a small portion of the funds. The grants will be made on the basis of competitive funding rounds, with an eligibility prerequisite that the technology must have potential to reduce national energy-related emissions by at least two per cent. A total of $500 million has been allocated to the Fund for projects initiated between 2006 and 2020. It is anticipated that government funding will drive private R&D investment of $1 billion.

Should R&D into energy efficiency receive special treatment?

The Commission considers that a fundamental question to be answered is whether R&D and innovation programs focusing specifically on energy efficiency are required in addition to general R&D assistance already in operation.

In the EEWG consultation with stakeholders, one of the suggestions presented was that governments:

> Enhance levels of government support and partnerships with industry and research institutions to promote appropriate research, development and demonstration activities. (EEWG 2004, p. 32)

Similarly, the Australian Industry Greenhouse Network argued that the considerable public benefits from energy efficiency R&D justified further government support:

> … there is a case for additional incentives to induce private sector expenditure in this area. Energy efficiency improvement may provide unusual public benefit, in terms of enhanced energy security, reduced greenhouse gas emissions, etc. (sub. 57, p. 11)

Alan Pears made a similar point and added:

> … at present, research infrastructure for energy efficiency is sparse and fragmented: resources are needed to build it to a 'critical mass'. (sub. DR113, p. 19)

However, some inquiry participants doubted whether R&D into energy efficiency warranted special treatment compared to other forms of R&D. The Energy Retailers' Association of Australia argued:

> Positive externalities are likely to exist where research and development (R&D) in energy efficiency technology is undertaken. However it is not clear … that the social rate of return for this type of R&D should differ markedly from other types of R&D. Unless this difference can be demonstrated, general R&D policy should apply equally to energy efficiency technology as it does to other types of R&D activity in the economy. (ERAA, sub. 26, p. 38)

In outlining the principles of good R&D policy, the Industry Commission (1995) suggested (among other things):

- assistance levels should be broadly consistent
- contestability should have a major role in research funding.

Having an assistance policy that favours some fields of R&D and innovation over others may generate a number of costs. The major one is that such policy would have a distorting effect by encouraging R&D investment in one field at the expense of other (potentially greater benefit-yielding) fields. To the extent that there are economies of scale in administering a uniform R&D policy regime, having an additional R&D policy framework for energy efficiency is also likely to increase government administrative costs. Having energy-specific R&D programs in addition to general R&D assistance also creates coordination issues in preventing firms from exploiting the opportunity for additional funding through 'double dipping'.

The Commission considers that there is no special case to promote R&D into energy efficiency at the expense of other R&D solely on the basis of diffusion of technology, but there may be a case on the grounds of reducing negative externalities. However, while energy efficiency research may result in public benefits, this does not of itself justify energy-specific R&D assistance. In the

Commission's view, there is no reason why these public benefits cannot be considered in assessing project applications in a general competitive grants scheme.

FINDING 7.2

The need for special energy efficiency research and development funds has not been substantiated. Sourcing funds from existing more general research and development programs enables contestability between proposals and selection of those yielding the greatest net benefit.

Other financial incentives

A number of participants suggested that governments need to provide direct financial incentives for firms to undertake energy efficiency improvements (Green Building Council of Australia, sub. DR137; Alan Pears, sub. DR113; Energy Users Association of Australia, sub. DR150).

Moreland Energy Foundation (sub. 18) cited the results of a survey of small firm behaviour that it had commissioned, which found that 44 per cent of firms in the Moreland City area were interested in low or zero interest loans to finance energy efficiency improvements, while 58 per cent of firms would apply for grants if they were available.

The Green Building Council of Australia (GBCA) argued:

> Fiscal incentives are likely to be the most effective way to facilitate refurbishment that addresses efficiency or green building initiatives … The GBCA recommends fiscal incentives for existing buildings refurbishment or retrofits should include accelerated depreciation, land tax abatement, utility rate abatement, local government abatement. (sub. 41, p. 12)

The Aluminium Council of Australia (sub. 29) and the Energy Supply Association of Australia (sub. 68) suggested that incentives to hasten capital turnover, like accelerated depreciation, would improve energy efficiency.

Origin Energy had some reservations about subsidies. It stated that it:

> … does not consider financial incentives, generally, to be the most appropriate policy tool available. The basic premise of cost-effective energy efficiency improvements is that there are private benefits from undertaking the investment. Policy tools that rectify pricing distortions and information problems, which may be inhibiting this investment and the realisation of net private benefits, are more likely to be effective and efficient. (sub. 25, p. 13)

Direct subsidies to undertake energy efficiency improvements increase the attractiveness of such projects for firms. It is natural for firms and individuals to respond to incentives. However, there is also a risk that subsidies may distort business decision making by diverting resources away from other potentially more important areas. Therefore, the Commission considers that provision of subsidies to support investment into energy efficiency improvements that are privately cost effective for individual firms is not justified on these grounds alone.

However, while the Commission's focus is on barriers to the uptake of privately cost-effective energy efficiency investment, it notes that environmental externalities could justify a subsidy program even when the energy efficiency improvements are not cost effective. Subsidising firms to improve the energy efficiency of their operations would need to be considered among all policy options for achieving environmental goals.

FINDING 7.3

The Commission does not support the provision of direct subsidies to firms to undertake energy efficiency improvements that would be privately cost effective for those firms. Subsidies may, however, have a role in encouraging the uptake of improvements that have important spillover effects. In such cases this policy mechanism should be evaluated against other policies pursuing the same objective.

Hypothecated levies to fund subsidies

The terms of reference for this inquiry require the Commission to consider the role of levies. Levies could be used to ensure that energy users bear more of the full cost to society of their energy use. Such a rationale underpins arguments for imposing a carbon tax on greenhouse gas emissions. However, the terms of reference focus this inquiry on actions that would be cost effective for individual consumers and producers. Therefore, the Commission has interpreted the mention of levies as referring to the possibility of using 'hypothecated' levies to finance subsidies for energy efficiency improvements that are privately cost effective.

One example of a hypothecated levy is the Energy Savings Fund introduced in May 2005 in New South Wales through the *Energy Administration Amendment (Water and Energy Savings) Act 2005*. Under that scheme, DEUS will administer a $40 million annual fund over 5 years providing funding, primarily on a contestable basis, to support energy savings initiatives by large private sector users, government and the residential sector. The money will be raised from electricity distribution network service providers who have in turn been given a right to recover their contribution from retail customers. That is, the Energy Savings Fund will effectively be financed by taxing electricity consumers.

Hypothecated levies can be a useful revenue-raising tool when there is a close connection between the levy and services received. One example is the funding of road repairs and maintenance from the fuel excise paid by truck operators. A levy on fossil fuel use to finance subsidies for energy efficiency improvements also has some appeal on equity and environmental grounds, because all users of fossil fuels contribute to environmental externalities and would pay the levy in proportion to their environmental impact.

Climate Action Network Australia (CANA) favoured the use of levies:

> CANA supports the principle of using levies and/or taxes on fossil fuel generated energy to:
>
> - encourage a culture discouraging wasteful use of polluting energy forms;
> - provide funds for reinvestment into demand management, through the creation of demand management funds; and
> - ensure that the cost of pollution as a result of energy generation is reflected in the cost of electricity. (sub. 19, p. 6)

Moreland Energy Foundation supported the use of levies to finance a demand management fund:

> … MEFL [Moreland Energy Foundation] supports the creation of a demand management fund or funds, through the application of a levy on energy consumers, linked to consumption levels but also making allowances for social equity. Hypothecating a fund in this way is positive as it:
>
> - sends a signal to energy users that demand management in its broadest sense is a priority for the community;
> - creates a source of income to undertake much needed demand management work; and
> - is fair in that bigger energy consumers pay more than small energy consumers.
>
> It could also be possible to build in additional incentives for companies to act to reduce their energy consumption, by reducing the burden from those who have taken action under their own initiative.
>
> The demand management funds in the US are capable of undertaking very ambitious energy efficiency and demand-management work, because they have a real budget to work with. (sub. 18, pp. 36–37)

However, some participants expressed concerns about levies:

> The AAC [Australian Aluminium Council] is opposed to the use of levies (tax) to drive energy-efficiency improvements or to raise funds for energy-efficiency improvements. A levy would increase the cost of energy to the consumer and would distort/change resource allocation and competitiveness away from those sectors who use more energy to those who use less energy. This suggests that this policy option is based on the assumption that energy is incorrectly priced in the market. Economic growth will be

> reduced to the extent that the levy/tax and its subsequent redistribution results in a shift of resources away from more efficient or productive sectors of the economy. (sub. 29, p. 14)

The Australian Industry Greenhouse network argued:

> … any uniform levy on all energy users would penalise both energy-efficient and energy-inefficient users, and that targeting only those deemed to be inefficient would be difficult, arbitrary and discriminatory. Levies and other nonrebatable penalties risk affecting the competitiveness of Australian industry adversely and, in consequence, the jobs and living standards of many Australians. (sub. 57, p. 12)

The Commission considers that hypothecated levies have some major drawbacks. First, there is rarely, if ever, a nexus between the appropriate level of taxes and funding needs. The levy is therefore likely to raise too much or too little revenue. Second, existing broad-based taxes are likely to be less distortionary and have lower administration and compliance costs.

FINDING 7.4

The case for government subsidies to encourage energy efficiency improvements should be separated from the means of funding those subsidies, such as by hypothecated levies.

7.7 Mandatory energy audits

The policy of Mandatory Energy Efficiency Opportunities Assessment (EEOA) for large energy users was announced in the Australian Government's Energy White Paper (Australian Government 2004) and is currently being developed by DITR. The regulation is expected to come into operation in 2006.

The EEOA is a successor to the EEBP program that was discussed in the previous section, but is a much more coercive approach. This reflects a perception that large energy users are still overlooking privately cost-effective opportunities to improve their energy efficiency despite past and current information provision and financial incentive programs run by governments.

The EEOA will operate by mandating that energy users whose annual consumption is greater than 0.5 petajoules (at the moment around 250 firms, representing two-thirds of total business energy use) must conduct energy efficiency assessments every five years. Firms would be required to identify all opportunities to reduce their energy use with a payback period of four years or less, and to disclose this information to the public.

The EEOA seeks to address the perceived organisational failure by firms to focus on identifying and implementing privately cost-effective energy efficiency improvements. The disclosure element of the scheme appears to be aimed at exerting external pressure on firms from shareholders and other members of the public.

The EEOA approach appears similar to the policy introduced in New South Wales in May 2005 through the *Energy Administration Amendment (Water and Energy Savings) Act 2005* (box 7.8). It is unclear how this policy will interact with the EEOA framework (chapter 12).

Box 7.8 **Energy audits in New South Wales**

In May 2005, the *Energy Administration Amendment (Water and Energy Savings) Act 2005* was passed in New South Wales.

Under the Act, designated energy users (which include all government agencies and any other person or body that is designated by the Minister) are required to submit an energy savings action plan to the Minister every four years. The plan must include the following items:

- a description of the energy use of the reporting entity;
- a list of potential measures to reduce energy use, prioritised in terms of energy saved and private cost effectiveness, and
- a statement of the measures that the reporting entity proposes to implement in the next four years.

The Act does not require implementation of the measures identified in energy savings plans. However, the Minister has been given the power to introduce regulations under the Act to mandate the implementation of such measures.

The EEOA framework is still in development, and elements like the assessment, reporting and verification procedure have not been finalised. It is anticipated, however, that external consultants will play some role in assessing the energy efficiency opportunities of individual firms. One of the auxiliary elements of the framework involves capacity building in the energy services industry through training and accreditation.

As part of the policy development process, extensive consultation with interested parties has been undertaken. The subsequent draft consultation report (DITR 2004b) outlines the potential benefits and problems associated with the EEOA policy as identified by interested parties. Some of the identified benefits include:

- focusing management’s attention on cost-effective energy efficiency improvements;

- overcoming the organisational communication barriers between technical staff and management;
- improved access to external capital sources through a credible assessment process;
- public recognition for energy-efficient firms;
- demonstration and information diffusion effects through industry benchmarks and sector case studies; and
- strengthening of the energy services industry.

The potential problems identified by interested parties included:

- the small size of potential privately cost-effective energy efficiency improvement;
- difficulties in clearly specifying the boundaries and process of EEOA;
- difficulties of designing an EEOA process that reflected differences between firms;
- unsuitability of the four year payback as a benchmark for cost effectiveness;
- risk to corporate reputation of the firm from disclosing their energy using practices and the associated incentive to not conduct a thorough assessment;
- risk to corporate reputation if the firm did not implement the opportunities, even if the decision was taken for economically valid reasons; and
- disclosure of confidential information to the public.

No regulatory impact statements or any other evaluations of potential costs and benefits of the EEOA program have been completed yet, so it is difficult to assess it. However, the Commission has strong in principle reservations about this program. A number of potential problems can be identified.

First, the EEOA will apply to organisations on the basis of one criterion only — the amount of energy used (which appears to have been set at an arbitrary level). Under the EEOA scheme, companies are not targeted for their apparently energy-inefficient practices. Rather, they are targeted solely because they are large energy users. This conflicts with the implicit aim of improving the cost-effective take-up of energy efficiency improvements.

If anything, the targeting criterion is counter-intuitive and counter-evidentiary. Energy-intensive users, many of whom are likely to be captured in the selection process, already have a strong incentive to use energy efficiently, as well as having greater resources to identify and implement cost-effective energy efficiency improvements. In this regard, AGL noted:

> Many industrial and commercial energy customers already undertake energy efficiency audits. These audits are used to reduce energy costs because energy is often a higher proportion of their total structure. It is unclear why mandatory energy efficiency opportunity assessments are necessary given the commercial benefits from improving energy efficiency and the growing level of activity. (sub. DR119, p. 4)

It could be argued that focusing the EEOA program on large energy users was justified on the grounds of cost-effectiveness for government. The Moreland Energy Foundation stated:

> In terms of cost effectiveness for Government, it makes sense to focus resources on the 250 companies which use the lions share (60%) of business energy, rather than running diffuse programs. (sub. DR115, p. 14)

Focusing resources on a small number of large energy users may well reduce government administration costs. However, the point remains that if large energy using firms are already searching for ways to identify and implement energy efficiency improvements, the cost-effectiveness of the EEOA for government would be undermined.

Second, the EEOA is likely to create significant administrative costs and procedural difficulties. Several difficulties have already been identified in the consultation with interested parties (DITR 2004b). It is unclear how a uniform assessment and disclosure process could be designed to reflect the differences across and even within organisations. It would be difficult to set clear boundaries and standards for the assessment process. Origin Energy stated:

> … there is a concern about the technical focus of auditing standards currently used in Australia … They fail to provide decision-makers with practical solutions to achieve energy reductions in the context of their specific circumstances. Prior to the implementation of mandatory auditing by the Australian Government, auditing standards should be reviewed in consultation with industry to reflect a more holistic approach to identifying and assessing energy efficiency opportunities. (sub. DR129, pp. 12–13)

Some participants in the EEOA consultation process have also criticised the definition of cost effective as actions having a four-year payback because it excludes considerations of risk and profitability of other competing projects within a firm. And, as noted in chapter 5, using payback as an investment criterion may prejudice projects that have longer payback periods but higher net present values.

Verification of assessments is also likely to be problematic and costly. There would be information asymmetries between regulators and firms, and firms would have an incentive to withhold assessment results that might damage their corporate reputation.

However, the most significant weakness of the EEOA framework is the context in which it is to be applied. While the EEOA policy does not specify what barriers to energy efficiency it seeks to address, judging from the consultation report and the DITR presentation to stakeholders, it appears that the main issue is the perceived lack of managerial attention to energy efficiency matters.

The Commission reiterates its strongly held view that organisational barriers alone cannot justify regulatory intervention. To the extent that firms feel compelled by the EEOA process to invest in projects that they would otherwise reject, the EEOA would distort investment decisions and adversely affect the private cost effectiveness of firms' operations. Competitive pressures on firms give them strong incentives to maximise their efficiency. This is particularly true for industrial firms operating in export and import-competing markets, which make up a large proportion of the organisations targeted by the EEOA.

As Origin Energy stated:

> Policy should be based on the presumption that businesses are in the best position to allocate capital efficiently. Government involvement would be second best, except in cases where clear market failure (and minimal scope for government failure) can be demonstrated. The claim that managements' capital allocation decisions are ill informed with regard to energy efficiency investments is not sufficient, alone, to warrant government involvement. A sound approach to policy needs to ask why businesses and their shareholders would not seek and invest in information that maximises the long run value of the businesses' assets (as they are presumed to be able to do effectively in relation to other aspects of their operations). (sub. 25, p. 12)

The Australian Industry Greenhouse Network described organisational barriers to energy efficiency improvement as 'symptoms of poor management' and noted:

> Poor management might equally be responsible, of course, for over-investment in energy efficiency technologies and practices and this is a risk when governments intervene, especially with mandates. (sub. 57, p. 8)

Nevertheless, the EEOA framework does have some positive elements. Modest benefits might be achieved through demonstration and information diffusion effects. These effects would arise out of public disclosure of energy efficiency opportunities by firms and the resultant development of industry benchmarks and case studies. However, this benefit would need to be balanced against the disclosure costs for firms, including the cost of releasing potentially confidential information. Engaging firms in demonstration and information diffusion on a voluntary basis through schemes specifically targeted at achieving this aim (for example, through a program similar to the old EEBP) might be a better alternative.

A further benefit is that the scheme could enhance the development of the energy services industry. However, it would do so only at the expense of the participating firms and, as noted earlier, it is arguable whether these audits would be in their best interests.

More generally, the benefits arising out of the EEOA program appear likely to be modest and more easily achievable through a voluntary program. On the other hand, the compliance costs of this type of policy approach could be significant. In view of this, the Commission does not consider that introducing the EEOA program can be justified on the grounds of private cost effectiveness for individual firms.

FINDING 7.5

The policy of mandating assessments of energy efficiency opportunities is not warranted on private cost-effectiveness grounds. The demonstration effects that might be achieved by this policy could be pursued more effectively and at less cost by voluntary programs.

Mandating implementation of identified opportunities

It could be argued that a policy of mandatory energy efficiency opportunities assessments will not deliver substantial improvements in energy efficiency unless it is accompanied by a requirement to implement the opportunities identified.

Currently, there are no programs, at the State, Territory or Australian Government level which mandate implementation of energy efficiency improvements on the grounds of private cost-effectiveness, nor is the Commission aware of any international programs which adopt this approach. The Victorian Environment Protection Authority Greenhouse Program incorporates mandatory assessment and implementation of energy saving opportunities by large energy using firms.[4] However, the objective of that program is a reduction in greenhouse gas emissions, rather than achievement of cost-effective energy efficiency improvements.

The Commission considers that the policy of requiring firms to undertake particular energy efficiency improvements could not be justified on private cost effectiveness grounds.

4 Victorian Environment Protection Authority (EPA) licensees with an annual energy usage of 500 gigajoules or more (currently around 500 firms) are required to conduct an energy audit and to implement all energy efficiency improvements that have payback periods of up to three years. The same requirements apply to firms seeking an EPA works approval or applying for a new EPA license.

The approach is likely to face similar administrative and procedural difficulties to those identified in the discussion of EEOA. However to the extent that a higher degree of prescription is imposed on firms, the problems would be more severe. In particular, the cost to firms of identifying opportunities that they would not have voluntarily implemented would be higher than under the EEOA. Firms would, therefore, have an even stronger incentive to exploit their information advantage over the regulators and produce flawed assessments. In that respect, introducing an implementation requirement would undermine the effectiveness of the policy of mandatory assessment and disclosure.

More generally, forcing a firm to undertake energy efficiency improvements on the basis of external judge ments of what is in that firm's self interest creates a high risk of outcomes that are detrimental to the firm. Firms rather than governments are in the best position to make operational decisions that are consistent with their self interest.

Only if the broader environmental benefits of energy efficiency were included, might a case for mandating implementation of energy efficiency improvements by firms be considered. Even then, given the stated reservation about the potential effectiveness of this policy approach, it is imperative that the policy is evaluated against other means of achieving environmental objectives.

RECOMMENDATION 7.1

Private cost effectiveness should not be a rationale for requiring firms to implement any recommendations arising from the Energy Efficiency Opportunities Assessments.

8 Governments as energy users

Key points

- Governments account for a small proportion of final energy consumption in Australia and energy consumption accounts for a small proportion of total government expenditure.
- Government agencies are different from private-sector organisations in that they:
  – have different incentives for energy efficiency because the profit motive and competition are either absent or muted; and
  – consider the flow-on effects (for example, demonstration effects) that their energy use will have on the community at large.
- These differences may warrant government-specific energy efficiency policies, but these need to be consistent with other government activities.
- The Australian and most State and Territory Governments have programs that seek to improve the energy efficiency of their own operations. These typically include measures such as information provision, procurement policies and energy-use targets.
- To the extent that it is cost effective, governments should disseminate energy efficiency information to their own agencies.
- Procurement policies that encourage cost-effective energy efficiency could lead to a range of benefits to governments and the wider community. Moving beyond cost-effectiveness criteria for procurement may be warranted on environmental grounds, but evaluation is needed to avoid measures imposing high costs relative to environmental benefits.
- Energy-intensity targets have advantages over energy-use targets, but both risk placing undue emphasis on an input that only accounts for a small proportion of expenditure. The use of energy-intensity performance indicators can reduce this risk.
- Government agencies should be able to access capital for energy efficiency investments that can be demonstrated to be cost effective and are consistent with overall fiscal policy. This does not require governments to reserve part of their capital budget for energy efficiency projects.

Some of the energy used in the commercial and transport sectors is by government agencies. The findings of chapters 7 and 11, which deal with these sectors, generally apply to both government and private operations. The particular characteristics of government operations, however, may warrant and/or lend themselves to energy efficiency policy measures that specifically address governments as energy users. This chapter examines these characteristics and their implications for energy efficiency policy.

8.1 Characteristics of government energy use

Government agencies use energy in undertaking a range of activities, including administration, defence, service provision (for example, hospital services and school education) and more commercial activities (for example, water supply).[1] The available data show that the majority of government energy use is in buildings and transport (table 8.1). Buildings contribute a higher proportion of greenhouse gas emissions than would be suggested by their energy use. For example, buildings accounted for 50 per cent of the greenhouse gas emissions by New South Wales Government agencies, but only 38 per cent of energy use, in 2001-02 (table 8.1). This is because electricity, generated using coal, has a higher greenhouse gas emission intensity than other primary fuels, such as natural gas and petrol.

Table 8.1 **Energy use and greenhouse gas emissions for some Australian governments, 2001-02**

	NSW[a]	*SA*[b]	*ACT*[c]	*Australian Government*[d]
Energy use (Petajoules)				
Buildings	9.0	2.4	0.7	3.9
Transport	12.6	2.1	0.4	1.2
Other	1.9	0.1	0.1	3.1
Total	**23.5**	**4.7**	**1.2**	**8.3**
Greenhouse gas emissions (megatonnes carbon dioxide equivalent)				
Buildings	1.7	0.5	0.1	0.9
Transport	1.2	0.2	–	0.1
Other	0.5	–	–	0.6
Total	**3.4**	**0.7**	**0.2**	**1.6**

[a] Includes general government sector agencies and public trading enterprises. [b] Excludes commercial public trading enterprises. [c] Data are for 2002-03. Includes almost all ACT departments and statutory authorities. [d] Includes defence establishments but not defence operations. – Nil or rounded to zero.

Sources: AGO (2003b); Environment ACT (nd); NSW DEUS (2004c); SA Government (2003).

Governments account for a small proportion of final energy consumption in Australia. New South Wales Government agencies, for example, used about

[1] This chapter does not cover government as a supplier of energy. Supply of energy is covered in chapter 14.

2.3 per cent of total energy consumed in New South Wales in 2001-02 (NSW DEUS 2004c). Energy also accounts for a small proportion of government expenditure. For example, New South Wales Government agencies incurred energy costs of $416 million in 2001-02 (NSW DEUS 2004c). This compares to gross operating expenses for the New South Wales Government in the same year of $34 101 million (ABS 2003). On this basis, energy costs represented 1.2 per cent of gross operating expenses.

Despite this, it is worth focusing on government as an energy user in circumstances where there is:

- a significant potential for improving energy efficiency; and/or
- scope to encourage improvements by other energy users through demonstration and leadership.

8.2 Government-specific barriers and policy issues

Chapters 2 and 4 provide a framework for assessing where government intervention to increase energy efficiency may be warranted. This framework generally applies to government energy use, although there are some additional barriers and policy issues that need to be considered.

Government agencies are different from private-sector organisations in the following ways:

- the incentives for energy efficiency are different, and may be less pronounced;
- whole-of-government policy can be used to direct the energy-management practices of specific (or all) government agencies; and
- leadership, demonstration, market development and environmental objectives may be justified on the grounds of communitywide benefits.

As argued in chapters 4 and 7, the Commission considers that organisational barriers to energy efficiency in the private sector do not of themselves warrant government intervention. For the most part, firms manage their own affairs. The profit motive provides an incentive for them to pursue cost-effective energy efficiency opportunities. In most industries, competition provides a further incentive to minimise organisational barriers to the uptake of worthwhile energy efficiency opportunities (and other economic-efficiency opportunities).

For the public sector, however, the profit motive and competition are either absent or muted and so do not provide the same incentives, although there are pressures to minimise costs to meet output requirements within a constrained budget. Without the driving force of market incentives, organisational barriers in government agencies may require a stronger and more direct response. In addition, the large size and complex nature of some government operations increases the likelihood of organisational failures and this may add to the need for central agency coordination.

It is important to emphasise that this challenge is not confined to energy use — it applies more generally as governments seek to improve the overall efficiency and effectiveness of their operations. In response, a wide range of reforms have been undertaken, including:

- an increased focus on outputs and outcomes, rather than inputs and processes;
- increased decentralisation of decision making;
- a recognition that agencies are able to perform better if they are given objectives that are well defined, nonconflicting and few in number;
- the use of efficiency dividends and other cost-cutting initiatives to promote efficiency;
- improved accountability through performance reporting and other mechanisms; and
- government trading enterprises operating in an environment similar to the private sector, through corporatisation and the application of competitive-neutrality principles.

Policies aimed at overcoming organisational barriers to cost-effective energy efficiency need to be consistent with these broader reforms of government activities, particularly in relation to the respective governance and accountability roles of central and operational agencies.

8.3 Policy options

The Australian Government and all State and Territory Governments, with the exception of Tasmania, have programs which seek to improve the energy efficiency of their own operations. The Tasmanian Government is planning to introduce programs of this type, consistent with the National Framework for Energy Efficiency (NFEE) Stage One (box 8.1). In addition, the Australian, New South Wales, Victorian, Queensland and South Australian Governments run programs that aim to improve the energy efficiency of local government operations.

Box 8.1 NFEE Stage One measures for government energy efficiency

At its meeting on 27 August 2004, the Ministerial Council on Energy agreed to the implementation of nine policy packages constituting the first stage of NFEE. The measures relating to *government* energy efficiency are as follows.

To demonstrate leadership to the business sector and wider community, governments will:

- develop nationally consistent standards for measuring and reporting on government energy efficiency programs;
- introduce public annual reporting by all jurisdictions on energy use and progress towards achieving targets set for government agencies;
- establish minimum energy performance standards for government buildings; and
- develop best practice models for government departments to implement energy efficiency programs.

Ministers also agreed to develop a database of low standby power and high-efficiency appliances to guide government purchasing decisions.

Source: MCE (2004c).

The current programs generally have objectives that extend beyond improving the cost-effective energy efficiency of government operations. In this respect, some programs seek to demonstrate 'good practice' and thereby promote energy efficiency to firms and the wider community. Additional objectives of most programs are to reduce energy consumption and/or greenhouse gas emissions, and indeed, in some cases these are the primary goals. In its submission to this inquiry, the Australian Government Department of the Environment and Heritage (DEH) stated:

> The objectives of energy efficiency initiatives in the government sector are to lead by example and illustrate to others the economic and environmental benefits of improved energy efficiency. (sub. 30, p. 19)

Most inquiry participants that expressed views on government energy use felt that it was appropriate for governments to pursue a range of objectives through their energy management programs. The Australian Conservation Foundation (ACF) noted:

> Governments have a long yet mixed history of implementing energy management programs. These programs allow government to reduce its own energy consumption, associated costs and production of greenhouse gases, support a local sustainable energy services industry, and lead by example, thus both demonstrating the potential and providing valuable information on appropriate design and implementation of energy efficiency programs in the wider community. (sub. 24, p. 10)

Origin Energy stated:

> The government, as a significant user of energy and participant in the market for energy efficiency services, is well placed to affect cost-effective energy efficiency improvements simply by adopting them internally. Additionally, government tenders could emphasise energy efficiency as a way of motivating higher standards more generally. This would directly improve energy efficiency outcomes in the public sector and serve as a demonstration vehicle (reducing the risk) for the private sector. (sub. 25, p. 15)

The Commission's view is that it is appropriate for governments to consider flow-on effects (for example, demonstration effects) that their energy use will have on the wider community. It does not necessarily follow, however, that this justifies energy efficiency measures that are not cost effective for government operations.

Most governments combine a number of measures in a strategy or program, as has been done in the Queensland Government's Government Energy Management Strategy and the New South Wales Government's Energy Smart Government program. This section assesses the individual policy instruments (such as information provision, procurement policies and targets) that make up these programs. In doing so, impacts on the cost effectiveness of government operations and possible benefits to the wider community through demonstration and other means are considered. Other government policies that are not focused on energy efficiency but which may impact on it are also addressed.

Information provision

The provision of information on energy efficiency to government agencies forms part of some government programs. For example, energy awareness material is provided as part of the Northern Territory Government's Energy Management Services program, and awareness raising activities and training form part of the Western Australian Government's Energy Smart Government program.

The Commission supports governments disseminating information on energy efficiency to their own agencies, including:

- awareness raising regarding the potential to improve cost-effective energy efficiency;
- analytical tools that assist with managing energy use (for example, spreadsheet applications that estimate the return on energy efficiency investments);
- information to assist agencies to make effective use of external energy efficiency expertise; and
- examples of good energy efficiency practice.

This is analogous to large companies supplying information to their constituent parts. To the extent that it is cost effective, governments should be doing this as part of normal operations.

Currently, most government agencies are also required to provide information on their energy use to allow for monitoring of targets and performance indicators, and/or for inclusion in annual reports. As part of the NFEE Stage One measures, it is intended that nationally-consistent standards for reporting on energy efficiency programs for government operations will be developed and this may alter these information requirements. While governments need to be able to evaluate their programs, there are costs associated with providing and analysing data and this should be taken into account when deciding on what, if any, energy-use information is required.

Procurement policies and guidelines

Jurisdictions have a range of procurement policies and guidelines that relate to the energy efficiency of appliances, equipment, motor vehicles and buildings. Examples include the following:

- the New South Wales Government's procurement and purchasing guidelines, which aim to ensure that agencies achieve the objectives of the Government Energy Management Policy (NSW DPWS 1998);
- the ACT Government's procurement guidelines, which have requirements for environmental performance in areas such as waste, water and energy (ACT GPB 2004);
- the requirement that Australian Government departments and agencies purchase office equipment that complies with the US EPA Energy Star standard, where it is available and fit for purpose (DISR 2000);
- the Australian Government's Environmental Strategy for the Motor Vehicle Industry, which includes a target to increase the proportion of the Government's general pool vehicles with scores in the top half of the Green Vehicle Guide from 18 to 28 per cent by December 2005; and
- the ACT Government's policy of reaching a target number of fuel-efficient hybrid vehicles (powered by a combination of petrol and electric motors) in their fleet (Stanhope 2005).

Some inquiry participants support strengthening government procurement policies. The ACF stated that 'There is … a clear role for governments in pushing the frontier of efficiency in equipment through procurement strategies, and R&D [research and development] and demonstration support' (sub. 24, p. 8). With respect to passenger vehicles, Sara Gipton commented that 'by its own procurement practices and actions it [the Australian Government] can lead industry and consumers alike in adopting more fuel efficient practices' (sub. 34, p. 11).

Procurement policies can address energy efficiency with one or more of the following objectives:

- promoting cost-effective energy efficiencies within government operations;
- demonstrating good practice, in order to bring about a greater uptake of energy efficiency opportunities by others;
- changing market conditions in a way that results in a greater uptake of energy efficiency opportunities by others; and
- achieving environmental objectives, such as a reduction in greenhouse gas emissions.

Cost-effectiveness objective

Making cost-effective energy efficiency an explicit objective of procurement policies can increase the likelihood that decision makers consider factors such as the relative importance of initial costs and operating costs. This can help to address some of the organisational barriers to energy efficiency technologies discussed in chapter 4. Provided there is flexibility to select less energy-efficient options when this is necessary to obtain other desirable features, such policies could improve energy efficiency, provide environmental benefits associated with reduced energy use and contribute marginally to the overall efficiency and effectiveness of government operations.

Demonstration objective

Procurement policies that seek to demonstrate good practice are only effective if they result in a greater uptake of energy efficiency opportunities by firms and the wider community. For this to occur it is important that the energy efficiency measures advocated are genuinely cost effective. Measures that are not cost effective are likely to be ignored (and if not, will lead to net costs for those that implement them). In addition, consideration needs to be given to whether governments are necessarily in the best position to demonstrate good practice. A small manufacturing firm that achieves high energy efficiency would have a more powerful demonstration effect on other small manufacturers, than would a government department. In this respect there may be a role for energy efficiency awards and other mechanisms to publicise good practice in energy efficiency (chapter 7).

Objective to change market conditions

Procurement policies may go beyond cost-effectiveness criteria in order to change market conditions to the benefit of firms and the wider community. Some inquiry participants supported the view that governments could change markets in this way. For example, Origin Energy argued:

> Demand for energy efficiency services from the public sector (including skills and other inputs) provides a base of support for further development of the energy efficiency sector. In particular, large volume purchases (orders) from governments can assist emerging manufacturers in acquiring economies of scale and lower costs. (sub. 25, pp. 15–16)

However, Australia has little ability to influence global technological development, and Australian Governments, through their purchasing power, have even less influence. Accordingly, the Commission sees only limited potential for procurement policies to lower the costs of energy-efficient appliances, equipment and buildings. The potential that exists is likely to relate to importers and distributors achieving critical volumes.

The market for energy efficiency services is somewhat different in that it relies more heavily on local skills and industry capability. There is some potential for procurement policies to influence the development of this industry, leading to new and more cost-effective services being available to private firms and the wider community. If this occurs as a byproduct of government purchasing, then this can produce gains for all. However, it is the Commission's view that governments should not seek to promote development of any specific industry through purchases of services that are not cost effective. Nor is it immediately apparent that the performance of the energy services industry is so noticeably deficient that it is holding back the performance of the Australian economy to an extent that would warrant additional assistance. If governments determine that an industry requires assistance, for explicit reasons, then more direct policy options are available.

Environmental objectives

To achieve environmental objectives, procurement policies may mandate or encourage energy efficiency standards that are not cost effective for government operations. This may be socially beneficial if the resulting environmental benefits exceed the costs imposed on government operations. While a full assessment of this approach to procurement policy is beyond the scope of this inquiry, it is clear that measures that impose high costs relative to environmental benefits should be avoided. Box 8.2 provides an illustration of how costs and environmental considerations might influence a government's choice of which cars to purchase.

Box 8.2 How much more should governments be prepared to pay for more fuel efficient cars?

Governments could potentially increase the energy efficiency, and lower the environmental impacts, of their own operations by purchasing more fuel efficient cars. This box draws on the data below to analyse how purchase price, fuel costs and greenhouse gas emissions might influence a government's car purchasing decisions. The analysis is illustrative only, as not all relevant factors could be taken into account.

Of the four cars, the Corolla has the lowest total cost, based on purchase price and the net present value (NPV) of fuel costs over the life of each vehicle. Whether the Corolla would be the preferred car for governments also depends on other factors such as safety, maintenance costs and resale value. For example, Commodores might be preferred in some cases due to their larger size (and/or local manufacture). While the Peugeot 307 diesel and the Prius have lower fuel costs than the Corolla, these savings ($4597 and $5606 respectively, in NPV terms) are less than the extra purchase cost ($10 240 and $16 750 respectively). The Corolla remains the lowest-cost option even if a discount rate of zero is used to calculate the NPV of fuel savings. If a government considered the four cars to be equivalent in respects other than their purchase price and fuel costs, then the Corolla would be the most cost-effective choice.

It could be argued that governments should consider carbon dioxide emissions in deciding which cars to purchase. Under the assumptions explained above, choosing a Peugeot 307 diesel over a Corolla would reduce emissions at a net cost of over $400 per tonne of carbon dioxide saved. Choosing a Prius over a Peugeot 307 diesel would have a net cost of over $1200 per tonne of carbon dioxide emissions saved. For comparison, a review of the Mandatory Renewable Energy Target (MRET) found that the cost of abatement to the economy arising from the scheme is expected to be about $32 per tonne of carbon dioxide equivalent gases (AGO 2003e). The review panel considered that this made the MRET a relatively expensive abatement measure. Choosing a Prius over a Corolla (spending over $11 000 to save 1.2 tonnes of carbon dioxide emissions per year for 15 years) is an extraordinarily expensive strategy.

Selected passenger cars[a]	*Purchase cost ($)*[b]	*NPV of fuel costs ($)*[c]	*Total cost ($)*[d]	*CO_2 emissions (tonnes/year)*[e]
Toyota Corolla Ascent (1.8 litre, petrol)	19 750	12 272	32 022	2.9
Peugeot 307 XSR HDi (1.6 litre, diesel)	29 990	7 675	37 665	2.0
Toyota Prius (1.5 litre, petrol/electric hybrid)	36 500	6 666	43 166	1.7
Holden Commodore Executive (3.6 litre, petrol)	33 650	16 817	50 467	4.1

a The cars were selected to provide a wide spectrum of fuel consumption levels. The Peugeot is a manual, the other cars are automatics. **b** Recommended retail price (RRP) as reported on manufacturers web sites in August 2005. Note that governments often obtain a discount on RRPs and the extent of discount varies between models. **c** Calculated based on a travel distance of 15 000 kilometres per year, fuel consumption information sourced from the Green Vehicle Guide, a petrol price of $1.18 per litre and a diesel price of $1.22 per litre, a vehicle life of 15 years and a social discount rate of 8 per cent real. Note that actual fuel consumption will be influenced by road conditions, driver behaviour and the condition of the vehicle. **d** Purchase cost plus NPV of fuel costs (other costs, such as for maintenance, have not been included). **e** CO_2 = carbon dioxide. Calculated based on emissions data from the Green Vehicle Guide. Actual emissions will be influenced by similar factors that influence fuel consumption.

Sources: AGO (2005b); GM Holden (nd); Peugeot Australia (2005); Toyota Motor Corporation Australia (nd).

Specific types of procurement policies

Different types of procurement policies are being used by governments to promote energy efficiency. The preceding discussion on objectives provides a framework for their consideration.

Use of green leases

The DEH and the Australian Government Solicitor are developing a suite of Green Lease Schedules that can be attached to the Australian Government lease documents for leased and owned office property:

> The Green Lease Schedule has various features that take the duties of the tenant and building owner from the traditional static position of agreeing an energy intensity level in office building design, to a dynamic management process of monitoring, reporting and being accountable for energy and environmental issues annually. (DEH, sub. DR146, p. 2)

The development of green leases appears likely to be a relatively low-cost initiative that has the potential to improve the cost effectiveness of government operations. It may also have spillover benefits to the private sector.

The DEH reported that 'there is interest by the commercial property sector in actually picking up on green leases' (trans., p. 651). If this were to occur it would be an instance of government procurement having a demonstration effect. The commercial property sector would be unlikely to use green leases unless they were expected to be cost effective. This illustrates the general point that positive demonstration effects are only likely to occur where measures are genuinely cost effective.

Green leases may also change market conditions for the private sector by lowering transaction costs and thus helping to overcome the split incentives between landlords and tenants. There is a question, however, as to whether government development of these leases is likely to produce significant spillover benefits. Large firms that own or lease office space have an incentive to develop an efficient legal instrument for managing energy use under an office lease. The benefits of this can be shared between owner and tenant, so that each gains. While smaller firms may lack the capacity to do this, market intermediaries, such as legal and accounting firms can play a role in disseminating such instruments.

Government involvement could result in wider dissemination, but the benefits of this may be small. This is particularly the case as green leases require ongoing monitoring and reporting on energy use and this may be less worthwhile for small firms that have relatively low energy use.

Minimum energy performance standards for buildings

Consistent with NFEE Stage One, some governments have introduced, or plan to introduce, minimum energy performance standards for their office accommodation using the Australian Building Greenhouse Rating Scheme (ABGR) (DTF 2005; Exergy Australia, sub. 40). Under this scheme 'base buildings' and tenancies can be rated separately. More information about the scheme is included in chapter 7.

From July 2006, the Western Australian Government will only consider proposals to accommodate an agency in premises that achieve a 3.5 star rating for the base building, although this requirement may be waived where market conditions make it infeasible. In addition, all new fitouts shall achieve a minimum 4.5 star tenancy rating, where cost effective to do so (DHW 2004). These policies appear to appropriately address cost-effective energy efficiency. They require that energy efficiency be considered and set desired standards, but allow the costs of achieving these standards to be taken into account.

The Victorian Government introduced office accommodation guidelines in July 2005 that contain new minimum energy performance standards. The guidelines require that each new office leased or built by the Victorian Government has at least a 4.5 star energy rating for the base building and a 5 star rating for the tenancy. For existing offices, the requirements are similar, except that the stringency for base buildings is lower (4 stars) (DTF 2005). The guidelines also state that 'All projects carried out under the guidelines must deliver a value-for-money result for government and the people of Victoria' (DTF 2005, p. 8). The guidelines do not provide any assistance to agencies where achieving the energy efficiency standards is incompatible with the requirement for value-for-money. Unless the energy efficiency standards can be waived under these circumstances, the guidelines are likely to impose extra costs on government operations. The types of costs that could be incurred include:

- costs of occupying a building that, while more energy efficient, is otherwise less suitable than other buildings;
- relocation costs that exceed the net present value of the energy savings, where a move is required to meet the minimum standards; and
- higher construction or lease costs.

Basing procurement guidelines on Energy Allstars

Energy Allstars is a database and interactive website of the highest energy-efficient products available in Australia. It has been developed for all Australian governments, but will also be available for corporate purchasers and the public.

When fully developed, Energy Allstars will include details of the most energy-efficient household appliances, commercial equipment, lighting, office equipment, consumer electronics and other equipment. The National Appliance and Energy Efficiency Committee reported:

> [The] Ministerial Council on Energy has endorsed the idea that all future government procurement should use the website as the basis of energy efficient product purchasing guidelines that give preference to the listed products. (NAEEEC 2005a, p. 11)

Such guidelines are unlikely to be compatible with achieving cost effectiveness in government procurement because products are selected for listing based on energy efficiency and not cost effectiveness. A recent report found that the projected energy cost savings from government use of computers, office equipment and electronics listed on Energy Allstars (which were estimated to account for 95 per cent of government expenditure on products to be covered by the database) would only justify a maximum increase in purchase cost of 1 per cent. For all products the maximum increase in purchase cost justified by energy cost savings was 2.2 per cent (George Wilkenfeld and Associates 2005a).

Even if purchase cost outcomes within these narrow bounds could be achieved, this may change over time. Suppliers could seek to benefit from the preferential treatment of listed products by introducing models that are both high priced and energy efficient (the high prices might result from the additional costs of achieving increased energy efficiency or, if competition was inadequate, from suppliers increasing their profit margins). In addition, listed products may not always have the product features desired by government agencies. Accordingly, basing purchasing decisions on the Energy Allstars database could only be justified on other grounds, such as greenhouse gas abatement, but again only where there are net social benefits from doing so. In this respect, whether procurement guidelines based on the database would be consistent with greenhouse objectives depends in part on the extent to which other criteria, such as purchase price and product features, are taken into account. These other criteria need to be considered to avoid purchases which impose high costs relative to greenhouse gas abatement benefits.

FINDING 8.1

Addressing cost-effective energy efficiency in procurement policies, provided there is sufficient flexibility, could lead to environmental benefits and a small increase in the overall efficiency and effectiveness of government operations. There may be some additional benefits through demonstration effects and market development, but these are unlikely to justify procurement decisions that are not cost effective for government operations. Moving beyond cost-effectiveness criteria may be justified on other grounds (such as greenhouse gas abatement), but this would require an evaluation that incorporated these broader considerations.

Targets and performance indicators

The Australian Government and most State and Territory Governments have set targets to reduce energy consumption in government buildings. These targets vary with respect to:

- the percentage reduction in energy use required and the time period for its achievement (for example, one New South Wales Government target is a 25 per cent reduction of the 1995-96 level by 2005-06 (NSW DEUS 2004c) and the Western Australian Government target is for a 12 per cent reduction from the 2001-02 level by 2006-07 (appendix C));
- whether they are expressed in terms of energy intensity, energy use or energy cost (for example, the Australian Government targets relate to energy intensity levels; New South Wales, Western Australian and South Australian Government targets are for reductions in the quantity of energy used; and the Queensland Government target is for a reduction in energy cost); and
- whether penalties are imposed on government agencies that do not meet their targets (for example, the Western Australian Government's policy refers to penalties, while the New South Wales Government's policy does not).

The targets for individual agencies are often expressed in the same terms as the overall targets. For example, the Western Australian Government target of a 12 per cent reduction in stationary energy consumption applies to each participating agency. In New South Wales, however, each agency sets its own target, which must be aligned with the overall target. Some agencies have set energy-intensity rather than energy-use targets. The New South Wales Department of Education and Training, for example, has a target level for energy use per student per annum in schools (NSW DET 2004).

Progress toward meeting targets is mixed, as indicated below.

The DEH stated:

> … the Australian Government has reported, since 1997-98, falls in energy consumption of 15.4 per cent, reduction of greenhouse gas emissions by 12.7 per cent and an estimated fall in annual energy costs of $30 million. (sub. 30, p. 19)

In aggregate, the Australian Government has achieved some of its energy-intensity targets. For example, the target for energy use for tenant operations in office buildings was 10 000 megajoules per person per year by 2002-03 and the actual average use in that year was 8980 megajoules per person. The Department of Defence has not met its target for defence establishments (AGO 2003b). Being an Australian Government agency, the Commission also has an energy-intensity target, as discussed in box 8.3.

Box 8.3 **The Productivity Commission's energy use**

The Commission uses energy to light and power its two offices and provide passenger vehicle transport for staff. In 2003-04, 3876 gigajoules of energy was used for these purposes (approximately 60 per cent for offices and 40 per cent for passenger vehicles) (AGO 2005b). This energy accounted for 0.5 per cent of the Commission's total expenditure in 2003-04. In addition, energy is used for air conditioning offices and other central services provided by the building owners. Energy is also embedded in the various goods and services consumed by the Commission.

The Commission has obligations under the Australian Government's policy *Measures for Improving Energy Efficiency in Commonwealth Operations*. One of these is to report annually on its energy use, and this information is included in the Australian Greenhouse Office report *Energy Use in the Australian Government's Operations*. The reports show that the Commission's energy use per person declined by 15 per cent over the six years to 2003-04 (AGO 2003b; AGO 2005b). This was due to encouraging staff to better manage energy use (for example, turning off lights when they are not needed), purchase of more energy-efficient equipment and a range of other actions. However, for 2003-04 energy use was still above the target level of 10 000 megajoules per person.

To improve its energy management further, and as part of its Environmental Management System, the Commission engaged a consultant to conduct an energy review and audit of its Melbourne office in 2003. The initiatives identified mainly concerned lighting type and controls and these were implemented in 2004 and early 2005. While it is to too early to precisely evaluate the outcomes, based on electricity invoices to date it is estimated that energy use (excluding services provided by the building owner) has decreased by 18 per cent. The total cost for the consultancy, installation of new equipment and associated staff time has been approximately $29 000. While some of the initiatives have caused minor inconvenience to staff, and lighting is noticeably dimmer than it was before (but still above recommended minima), there appears to have been no significant impact on productivity. On this basis, the internal rate of return of the investment in energy efficiency will be 22 per cent (in real terms) over the life of the Commission's tenancy (assuming that electricity prices remain constant in real terms). This equates to a net present value of $11 200 (using a discount rate of 8 per cent real) and a payback period of 3.7 years. It is expected that once these initiatives — and similar measures being undertaken in the Canberra office — are fully reflected in annual energy use data, the Commission will be below the target level of 10 000 megajoules per person.

While undertaking the review and implementing the initiatives appears to have been cost effective for the Commission, the estimated financial gain is relatively small. Whether the broader policy of setting a target for the Commission has been cost effective is another question. Determining this would require an analysis of the costs and benefits of all activities motivated by the target, including monitoring and reporting undertaken by the Australian Greenhouse Office.

Building energy use in New South Wales Government buildings is estimated to have fallen by 2.3 per cent between 1995-96 and 2001-02 (Passey, MacGill and Watt 2004). The target was for a 15 per cent reduction over this period.

In relation to its energy management strategy, the Queensland Government reported:

> This Queensland Government initiative is aiming to achieve annual savings of $20 million by June 2008. The first target of $2 million is to be achieved by 30 June 2005. Early indications are that initiatives are already well in hand to achieve reportable savings in excess of the first target in June 2005. (sub. 38, p. 12)

The Western Australian Government target is for a 12 per cent reduction from the 2001-02 level by 2006-07, with a milestone of a 6 per cent reduction by 2003-04. This milestone was not met at the aggregate level as the average reduction to 2003-04 was 3.3 per cent.

As indicated, government agencies may have energy-use or energy-intensity targets. While neither of these relate directly to cost-effective energy efficiency, intensity targets have the following advantages:

- they make allowance for changes in agency work load; and
- they can be set in a way that does not penalise agencies that are relatively energy efficient at the commencement of the assessment period (that is, set as a target level, rather than a percentage reduction, in energy intensity).

Targets can increase the incentives to implement energy efficiency improvements, particularly where there are penalties for failing to meet them. They are, however, not directly focused on the objective of increasing cost-effective energy efficiency. Achieving a partial performance target, such as one for energy use, may result in the deterioration of the overall efficiency and effectiveness of government services. This may result from managers placing an undue emphasis on an input that accounts for as little as 1 to 2 per cent of expenditure. For example, deciding against installing electronic-mail-sorting equipment may assist in meeting an energy target, but a large increase in output, an improvement in outcomes (better sorted mail) or a large saving on labour costs, may be forgone. It can also be difficult to set targets which adequately reflect each agency’s circumstances.

In response to a finding on government targets in the Commission’s draft report, Alan Pears argued:

> The Commission’s concern that undue emphasis on energy efficiency may adversely affect overall productivity presumes that there is a potential conflict between the two objectives. In reality, such conflict is unlikely until very high standards of energy efficiency are achieved. (sub. DR113, p. 23)

In the Commission's view there are a range of circumstances that can result in a conflict between energy efficiency and overall efficiency, including where:

- an improvement in overall efficiency is available through increasing energy use and reducing other inputs (such as in the example given above);
- management resources are limited and can be used to greater effect on issues other than energy management; and
- the most energy-efficient office accommodation, appliance or equipment is otherwise less suitable than less energy-efficient options.

These considerations are as important to the public sector as they are to the private sector.

Performance indicators are preferable to targets because they provide less incentive to adopt measures that are not cost effective, but still assist in providing incentives for improved energy efficiency. Reporting on energy intensity as a performance indicator allows for comparisons within and between agencies that can be used to identify opportunities for improvement. An example of this was provided by the Western Australian Government:

> … early results from an energy efficiency program targeting government agencies have been positive. These suggest that there is considerable scope for improvement in some agencies indicated by a wide difference in energy intensity from the highest to the lowest case. (sub. 58, p. 5)

In making such comparisons, care needs to be taken to distinguish between differences due to energy efficiency performance and those due to differences in functions and operating environment.

FINDING 8.2

Energy-intensity performance indicators, or targets, can help identify opportunities for cost-effective improvements in energy efficiency. Performance indicators are preferable because they provide less incentive to adopt measures that are not cost effective.

Access to capital

Access to capital has been cited as a barrier to government agencies improving their energy efficiency (EEWG 2004). There are various reasons why this might be the case. As described in chapter 4, different managers being responsible for capital and operating budgets can limit the uptake of energy efficiency improvements, if there is a lack of cooperation. Other organisational issues, such as a poor understanding of energy efficiency investments by those responsible for allocating capital, can also hinder uptake. It is also possible that what is perceived as a barrier may, in some cases, be rational decision making.

One way for governments to address this potential barrier is to allocate part of their capital budget specifically for energy efficiency projects, as has been done by the following State Governments.

- The Western Australian Government makes capital advances available to agencies to invest in energy-saving capital projects. The funding is in the form of an interest-free advance, with repayments based on the estimated annual cost savings from the project (SEDO nd).
- The New South Wales Treasury has, since 1998, provided a $20 million rolling fund from which government agencies can draw down to finance energy efficiency capital upgrades (ABCSE, sub. 50). To be eligible, projects must be expected to deliver an internal rate of return of 12 per cent or more.

Governments determine their overall capital works programs according to various considerations including: the absolute merits of proposed projects; the relative merits of projects across sectors and policy areas, including energy efficiency; potential crowding out of the private sector in the capital market; and overall fiscal policy. Within this framework, it is desirable that agencies be able to access capital for any investments, including for energy efficiency, that can be demonstrated to be cost effective and are consistent with overall fiscal policy. This can be facilitated either through normal capital-approval processes or specific arrangements for energy efficiency investments.

It might be argued that quarantining funds for energy efficiency investments is warranted because of the organisational issues discussed above. These issues, however, have the potential to occur in many areas of government investment and so normal capital-approval processes should be adapted to deal with them. Another possible argument is that the environmental benefits of energy efficiency investments mean that they deserve special consideration. Again, there are other types of government investment that can generate environmental benefits (for example, investment in waste treatment facilities). Consistent consideration of environmental benefits is likely to require mechanisms that recognise them within normal processes. Accordingly, the Commission is not persuaded of the justification or merits of having special hypothecated funds within governments for special ‘worthy’ purposes outside of normal capital budget allocation processes.

Other policies with energy efficiency impacts

Many governments require the purchase of Australian-made vehicles for a significant part of their fleets. As the Australian industry predominantly produces medium to large vehicles these restrictions will tend to increase fuel consumption of the government fleet. Governments face tradeoffs in terms of the desired attributes of the vehicles they purchase — energy efficiency is one consideration, but others include safety, size, reliability, comfort and local manufacture. Purchasing practices must attempt to balance all of these attributes to achieve the most appropriate vehicle for each task and context. Box 8.2 illustrates some of the issues involved in achieving this balance.

9 Appliance labels and standards

Key points

- To reduce the energy used by appliances and thereby reduce greenhouse gas emissions, governments have introduced mandatory energy-performance labels and minimum energy performance standards (MEPS). These requirements are often promoted as also being cost effective for individuals.
- Labels aim to provide useful information to consumers and producers. However, for some appliances, the information on the label may not reflect how individuals use the appliance and so could be misleading.
  - Consumer research indicates that labels are not a primary determinant of which models are purchased, but they do influence individuals once they have short-listed a few models. Labels appear to be becoming more important over time.
  - While the benefits of labelling may have been overstated in regulation impact assessments, it is likely to have produced net benefits for consumers and producers.
- MEPS ban the sale of certain appliances that have energy efficiency below a specified minimum. This has the potential to:
  - remove products from the market that would be cost effective for some consumers and producers;
  - force consumers and producers to forgo product features that they may value more highly than greater energy efficiency; and
  - reduce competition.
- Past regulation impact assessments of MEPS have not given sufficient consideration to the above disadvantages. The Commission therefore recommends that future regulation impact assessments of MEPS include a more comprehensive analysis of their disadvantages and whether other policies would be more cost effective.

Various domestic and commercial appliances are subject to mandatory energy-performance labels and/or minimum energy performance standards (MEPS). These requirements are intended to reduce Australia's greenhouse gas emissions. However, they are often promoted as also being cost effective for individuals (NAEEEC 2004c). This chapter examines that proposition.

9.1 Administrative arrangements

Mandatory labelling and minimum energy performance standards (MEPS) for electrical appliances are managed by the National Appliance and Equipment Energy Efficiency Committee (NAEEEC) (appendix E). This comprises officials from the Australian, State and Territory Governments, and is ultimately directed by the Ministerial Council on Energy (NAEEEC 2004c).

Historically, the Australian Gas Association (AGA) has had responsibility for managing the certification labelling and minimum standards of gas appliances (SEAV 2003). Governments have made the labels and standards mandatory by requiring all mass-produced gas appliances offered for sale to be certified by the AGA (appendix E). This is an example of co-regulation.

The administrative arrangements for the regulation of gas appliances are currently undergoing transition (AGO 2005f). This is in line with the National Framework for Energy Efficiency (NFEE) Stage One measures, which included a commitment to broaden the scope of the National Appliance and Equipment Energy Efficiency Program (NAEEEP) for electrical products to include mandatory labelling and MEPS for gas products (MCE 2004e). Such an arrangement would allow for national uniformity for all appliances. To date, a Gas Appliance and Equipment Energy Efficiency Program (GAEEEP) has been established by NAEEEC and this will be the vehicle for implementing the future gas appliances regime (appendix E).

State and Territory regulators monitor compliance with labelling requirements at retail outlets and have taken action where breaches were suspected (NAEEEC 2004c). In addition, NAEEEC has a check-testing program to verify that the performance of appliances sold at retail outlets matches what is recorded on the label. These tests have identified cases where claimed performance does not match test results, and have led to product deregistration.

Electrical appliances that are required to satisfy a MEPS or have an energy-performance label are listed in table 9.1. The requirements for gas appliances are listed in table 9.2.

Table 9.1 **Electrical appliances subject to labelling and/or standards**

Appliance/equipment type	*Energy performance label*	*Minimum energy performance standard*
Household		
Air conditioners (single phase)	Mandatory	Mandatory
Air conditioners (three phase)	Voluntary	Mandatory
Clothes washers	Mandatory	
Clothes dryers	Mandatory	
Dishwashers	Mandatory	
Electric water heaters	Voluntary[a]	Mandatory
Refrigerators and freezers	Mandatory	Mandatory
Commercial and industrial		
Commercial refrigerators		Mandatory
Distribution transformers		Mandatory
Electric motors		Mandatory
Lamp ballasts	Mandatory[b]	Mandatory
Linear fluorescent lamps		Mandatory

[a] Electric water heaters can have an energy rating label, provided it follows the Standardised Information Disclosure requirements developed by the National Appliance and Equipment Energy Efficiency Committee. [b] Ballasts subject to MEPS must be marked with an energy efficiency index.

Sources: Harrington and Holt (2002); AGO (2004a); AGO (2005d).

Table 9.2 **Gas appliances subject to labelling and/or standards**

Appliance/equipment type[a]	*Certification label*	*Minimum standards*[b]
Gas cookers		Mandatory
Gas water heaters	Mandatory	Mandatory
Gas room heaters	Mandatory	Mandatory
Gas ducted heaters	Mandatory	Mandatory

[a] The above products as well as gas cooktops and industrial equipment are expected to be covered by GAEEEP in 2010. [b] Gas appliances have to be certified as meeting minimum safety standards. This certification process has also been used to enforce minimum energy performance requirements.

Sources: NAEEEC (2005a); AGA (2004b).

9.2 Appliance energy performance labels

In addition to the product testing and other activities of consumer associations, energy-performance labelling schemes aim to help overcome the information barriers that individual consumers and producers sometimes face. By providing information on the energy performance of specific appliances in a readily accessible and easily understandable format, individuals are more likely to make well-informed decisions regarding energy efficiency. Labels could also provide a greater incentive for suppliers to sell products that use energy cost effectively.

Although many countries require household appliances to have an energy-performance label (Harrington and Damnics 2004; IEA 2000), it is most widespread in Australia, Canada and the United States (World Energy Council 2004).

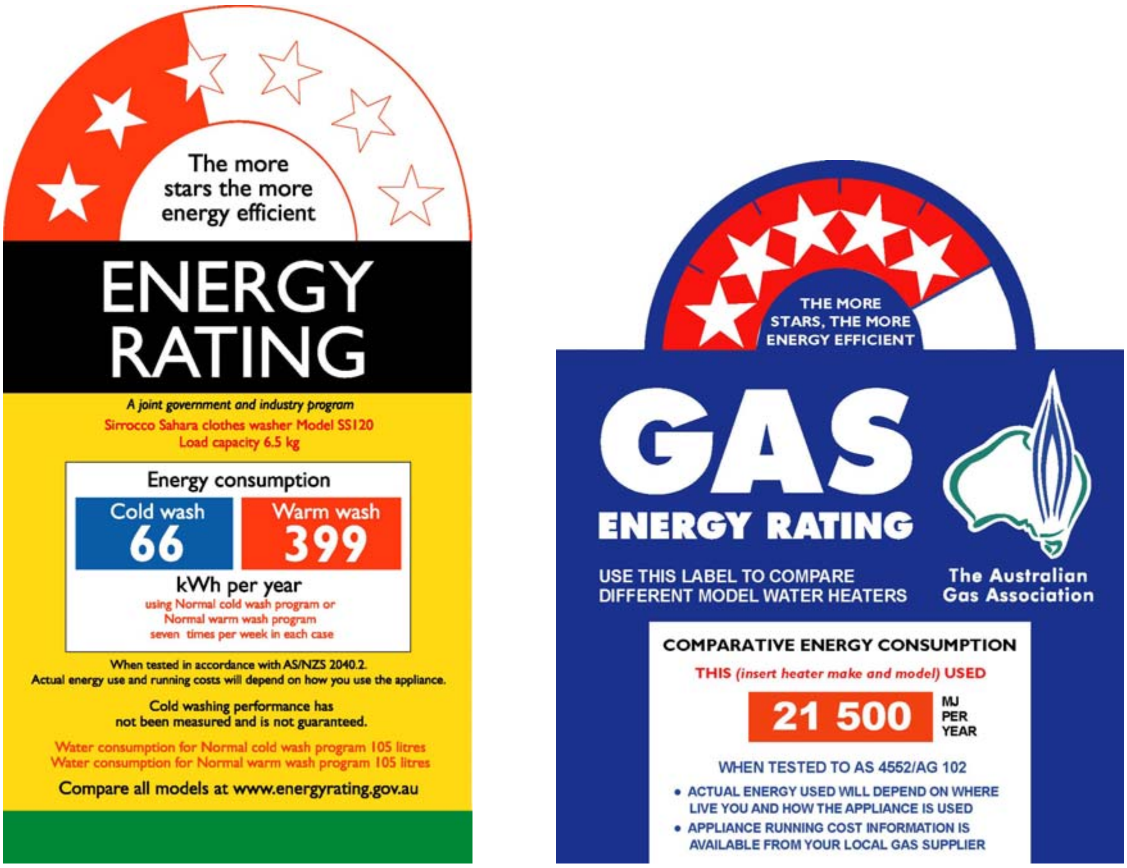
Label design

The label displayed on appliances subject to Australia's mandatory requirements must use a specified design that includes information on:

- annual energy consumption (based on a standard laboratory test); and
- a star rating to indicate energy efficiency relative to competing appliances (on a scale of one to six stars, with more stars indicating higher energy efficiency).

Sample labels for clothes washers and gas water heaters are shown in figure 9.1.

Figure 9.1 **Sample labels for clothes washers and gas water heaters**



Source: NAEEEC (2004b).

To have a discernable impact on consumers' choices and behaviour, a label needs to present information that is useful, and otherwise costly to obtain, to consumers in a format that can be readily understood. The first labelling scheme in the United States (Energy Guide) was ignored by many consumers because it had too much information and was difficult to interpret (World Energy Council 2004). Researchers also found that about a quarter of consumers thought the number most prominently displayed on the label meant savings rather than usage, suggesting that some consumers mistakenly used the label to search for the least efficient appliances (Meier 2003).

The development of Australia's energy-performance labels has included consumer research on the effectiveness of different label designs, update bulletins and a toll free phone inquiry service for manufacturers and retailers, educational material for sales floor staff, and shadow shop surveys to verify compliance at retail outlets (Energy Efficient Strategies 2004; NAEEEC 2002; Winton 2003).

However, some participants were concerned about the effectiveness of the energy consumption figure on Australian labels. Philip Clark commented that labels 'should avoid wording which is functionally irrelevant for end-users, such as kilowatts' and instead provide information on dollar impacts (sub. DR147, p. 4). Laurie Virr and Paul Hanley (trans., p. 677) noted that a label with an operating cost in dollars is a more effective way of communicating to individuals than kilowatt hours.

In the United States, energy-performance labels provide an estimate of the annual operating cost of the appliance, based on a national average cost of electricity per kilowatt hour (Federal Trade Commission 2005). The labels warn purchasers that the actual operating cost may vary due to differences in local electricity prices and individual usage.

While purchasers may find it easier to interpret a label that measures energy use in terms of dollars, such a label could be misleading for purchasers who do not face the assumed electricity or gas price. For example, in 2003-04, the average residential electricity price in South Australia was 65 per cent higher than in New South Wales (ESAA 2004). In Victoria, it was 42 per cent higher. Notwithstanding the large variation in prices, the inclusion of a dollar operating cost on labels may help purchasers compare different appliances.

Problems with measuring energy consumption

The energy consumption reported on mandatory labels comes from a laboratory test required by NAEEEC or the AGA (appendix E). A review of Australia's labelling programs for the Australian Greenhouse Office noted:

> … [the estimated annual energy consumption], derived from the laboratory tests, has been found to correspond reasonably well (within 10 per cent) to in-use energy consumption for refrigerators and freezers. The energy consumption for other appliances is highly dependent on whether actual frequency and duration of use by users corresponds to the values assumed for labelling. (Energy Efficient Strategies 2004, p. 7)

There has been some attempt to account for actual usage patterns in the tests:

> … some star rating algorithms include assumptions about user behaviour. For example, a 'field use factor' applied to clothes dryers gives a 10 per cent penalty to timer dryers when compared with auto-sensing dryers, on the assumption that manual operation more often leads to overdrying and hence higher energy consumption in use. (Energy Efficient Strategies 2004, p. 7)

However, the Australian Electrical and Electronic Manufacturers' Association (AEEMA) expressed concerns about the energy-performance tests for air conditioners not being representative of actual use:

> The task of an air conditioner is not easily defined for the purpose of a test method … Test methods are based on a high heat load condition in which the compressor and fans run continuously. In the real world, generally when air conditioners run they are subject to relatively low heat loads. Over the last 20 years, variable speed compressors with control systems to suit have been developed. Efficiencies of air conditioners with variable speed compressors are similar to those with fixed speed compressors at test conditions. Hence they have similar efficiency ratings. However, they are much more efficient at the lower load conditions at which they usually operate. This is not evident from the efficiency ratings on the labels, so *the labels are misleading in this case*. (sub. 85, p. 4) (emphasis added)

Evasave (sub. DR100) had similar reservations about the energy-performance tests for refrigerators and air conditioners.

AEEMA also raised five concerns about the energy-performance tests for washing machines, dishwashers and clothes dryers:

> 1. Amount of use: Usage rates of these appliances … are based on a Pacific Power study conducted twelve years ago … This was a reliable measure at the time but may no longer be valid …
>
> 2. What these appliances do: … Test standards … must be met on a program nominated by the supplier … Efficiency ratings are only pertinent when the appliance is used on the program specified by the supplier. If used on a different program, the

appliance will use a different amount of energy and the rating will be irrelevant to energy efficiency in actual use.

… Around half of all users of clothes washers usually wash with cold water. However, the standard test uses 35°C water …

Many users of dishwashers want their dishes dried more effectively than on the rating program and choose a program that dries better. This uses higher temperature water for the final rinse and uses more energy than the rating program.

The degree to which specified conditions match real conditions of use is important when estimating energy savings and economic benefits attributable to energy efficiency ratings …

3. Reliability of results: Test methods in dryer and dishwasher standards are considered to be of adequate reliability for effective check testing, but AEEMA doubts the accuracy of the clothes washer test method.

4. International considerations: Currently these tests are specific to Australia. However, Australian and IEC [international] test methods are progressively converging. Test reliability would be lost if Australia accepted IEC test methods as they stand at present.

5. Effects on product design: Appliances are being designed to maximise ratings while meeting minimum product performance requirements … However *the principal deficiency of energy ratings in current standards is that they do not provide any incentive for the manufacturer to improve any program other than the rating program*. (sub. 85, pp. 5–6) (emphasis added)

Two of these problems were highlighted recently by several Australian Consumers' Association (ACA) studies of dishwashers (ACA 2004a, 2004b, 2004c, 2005). The ACA studies tested various dishwasher models against set criteria including the level of energy efficiency. The ACA selected what they thought was the 'most commonly' used program in conducting the tests. A comparison of the ACA results with the same models on NAEEEC's energy rating website shows that the ranking of the products is quite different. Consumer Electronic Suppliers Association (CESA) and AEEMA stated that this difference may be due to the fact that the NAEEEC tests for energy performance were based on usage patterns that are derived from limited usage data collected prior to 1995 and therefore do not represent current usage patterns (trans., p. 624). It may also be due to the fact that energy performance tests relate to a selected cycle on the dishwasher (often the 'normal' cycle with a set temperature) whereas the ACA study tested the program 'most commonly' used by consumers, which is likely to differ. AEEMA noted that testing a selected cycle is becoming increasingly irrelevant as dishwasher programs are becoming more complex:

A recent development that threatens to make energy efficiency ratings based upon *current test methods irrelevant to real conditions of use* is sensor based automatic programs for clothes washers and dishwashers. (sub. 85, p. 6) (emphasis added)

The extent to which actual usage of an appliance differs from the tested program varies from one appliance to another. The energy consumption of some labelled appliances — refrigerators and freezers — is unlikely to vary markedly between individuals. For these ‘set and forget’ type of appliances, laboratory tests are expected to correspond closely to the actual usage patterns, given that there is little user discretion.

The use of other labelled appliances — air conditioners, clothes washers and dryers, and dishwashers — is likely to vary significantly among individuals, given that there is a large degree of user discretion.

For appliances where energy efficiency depends significantly on user behaviour, laboratory test results can be misleading, notwithstanding the ‘field use factors’ built into the tests. The dishwasher example illustrated that this outcome could have implications for the effectiveness of labelling. If labels are not an accurate guide to the *relative* energy efficiency of different models of the same type of appliance, given the usage pattern of a particular individual, then they are less likely to help that individual to rank those models.

Do appliance labels change consumer behaviour?

Given that energy accounts for a small proportion of household expenditure (chapter 6), consumers are likely to place emphasis on other factors, such as price, performance, capacity and style. In this respect, the Department of the Environment and Heritage advised:

> There is evidence from overseas and Australian studies to suggest that many consumers use energy efficiency as a tool to differentiate between the final two or three products that meet their other selection criteria (eg. appearance, colour, size etc). (sub. 30, p. 13)

Consumer research undertaken for the AGO noted that consumers tend to go through distinct steps in deciding to purchase a product, and that labelling has the greatest influence at the final step after particular models have been short-listed (Winton 2003). The research also found that the impact of labels differs between consumers, reflecting their different preferences and training (Winton 2003).

George Wilkenfeld and Associates commented that labels have raised the importance of energy efficiency to consumers, based on an analysis of data published by the ABS (1999):

> … labelling has raised ‘energy running cost’ and ‘energy-efficiency’ factors from about tenth priority in appliance purchase before the program was introduced in 1986 to second by 1999, behind purchase price but ahead of factors such as brand name, appearance and reliability. (sub. DR96, p. 7)

The most recent data from the ABS (2002) indicated that purchase cost and energy efficiency are the two main factors considered by households in purchasing white good appliances. The main consideration for choosing heaters was cost, as only 4 per cent of the households surveyed considered environmental issues (ABS 2002).

In summary, energy-performance labels are not a primary determinant of which models are purchased, but they do appear to influence individuals once they have short-listed a small number of models. In addition, recent survey data suggest that labels are becoming more important over time as consumer behaviour changes.

Periodic upgrading of rating scales

There is a tendency for the energy efficiency of appliances to progressively increase due to technological innovation and product development, regardless of regulation. This can eventually lead to most appliances clustering near the highest possible energy rating on a label. As a result, labels lose their effectiveness as a device for ranking different models.

The SEAV (2003) noted this phenomenon for gas appliances. A similar situation applied to electrical appliances in the late 1990s (Energy Efficiency Strategies 2004).

Regulators have responded to this issue by periodically making the rating criteria more stringent to give a greater spread in star ratings between appliances. However, this involves additional costs and can lead to consumer confusion until the new scale has become established. There is also a risk that recalibrating the rating scale will exaggerate minor differences between appliances, such that consumers perceive models with the highest energy efficiency as being vastly superior to those with only a slightly lower energy efficiency.

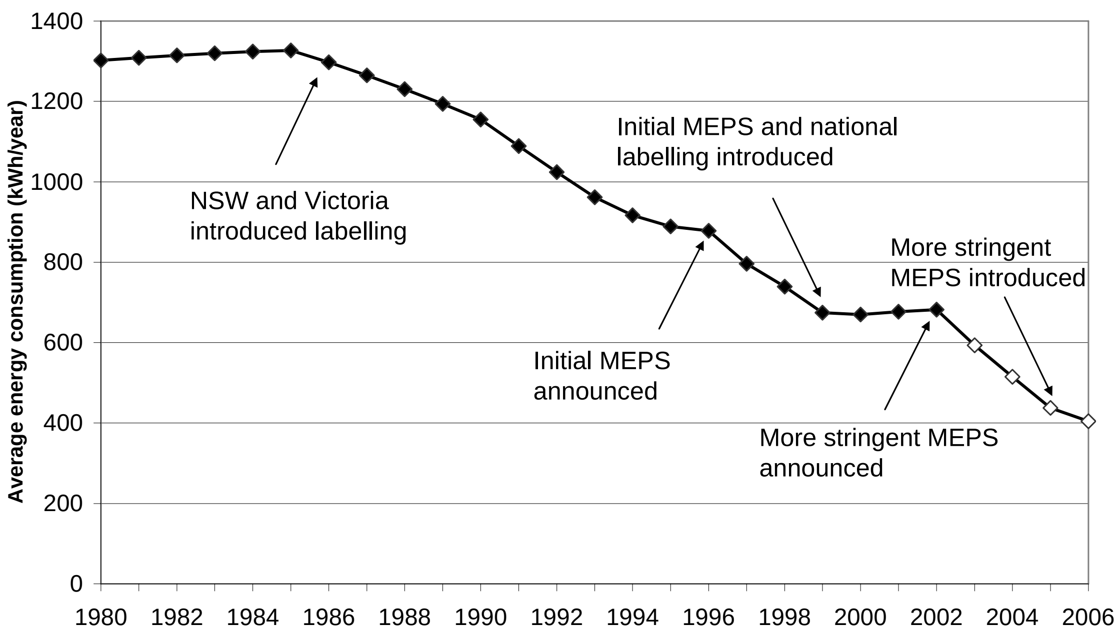
Assessments of labelling

A study for NAEEEC found that, from 1993 to 2001, there was a gradual trend of improving energy efficiency for a range of appliances sold in Australia:

> As energy consumption is not generally apparent to the general consumer without information programs like energy labelling, the credit for much of this improvement must be attributed to the National Appliance and Equipment Energy Efficiency Program (NAEEEP). (Energy Efficient Strategies 2003, p. 7)

For example, the introduction of labelling in New South Wales and Victoria in 1986 was followed by a decline in the average energy consumption of new frost-free refrigerator-freezers (figure 9.2). While it is difficult to attribute this decrease (and the increase in energy efficiency) to one explanatory variable, it appears that labelling of new frost free refrigerator-freezers has been influential.

Figure 9.2 **Average energy consumption of new frost-free refrigerator-freezers[a]**



a Average energy consumption is calculated as a weighted average with weights based on sales volume. The data for the period 1980–1985 are based on energy labelling tests conducted by Choice Magazine. The data for the period 1986–1992 are based on energy labelling registrations. The data for the period 2003–2006 are based on projected estimates and are not accurate sales-weighted estimates. The data relate to both top-mounted and bottom-mounted refrigerator-freezers.

Data source: S. Holt (Department of the Environment and Heritage, pers. comm., 1 August 2005).

Other possible reasons why appliance energy efficiency has increased include changes in energy prices, technological change that is not attributable to government policy, and increasingly stringent energy efficiency standards in other countries. It is plausible that some increase in appliance energy efficiency would have occurred in the absence of Australian energy-performance labels.

After studying US appliance energy efficiency trends, Newell, Jaffe and Stavins (1999) found that a sizeable proportion of energy efficiency improvements for air conditioners and water heaters sold in the US were independent of changes in federal regulations. However, Nadel (2004) criticised this study because it did not account for state-based standards in California and elsewhere, and so did not conclusively prove that energy efficiency standards had little impact.

In terms of the costs of labelling schemes, George Wilkenfeld and Associates identified:

- The costs to government of program development and administration.
- The costs to product suppliers of any additional product testing, registration, production and fixing of labels, and administration.
- The costs to consumers of any increases in average product price due to greater consumer preference for the more efficient models on the market. (George Wilkenfeld and Associates 2003a, pp. 5–6)

Another potential cost is that labelling distorts the market for appliances. As noted previously, the energy performance tests for labelling may be misleading when actual usage patterns differ from the tested program. This could lead to unobservable costs being imposed on consumers who purchase user-sensitive appliances based on a misleading energy-performance label. There is also the potential for labelling to distort the market for appliances in such a way that suppliers withdraw models that are cost effective for some consumers. The Department of the Environment and Heritage observed:

> In the lead up to the implementation of energy labelling for refrigerators in 1986, suppliers removed the least efficient models from the market to avoid having to label them. (sub. 30, p. 13)

Some of those refrigerators withdrawn from the market may have been cost effective for certain consumers, or could have characteristics that consumers value more highly than greater energy efficiency.

In 1999, the impact of adopting the national labelling scheme for household appliances was estimated by George Wilkenfeld and Associates and Energy Efficient Strategies (1999) in a regulation impact assessment. In net present value terms, it was estimated that the labelling requirements would increase indirect appliance costs by $688 million and reduce energy costs by $1500 million (using a 4 per cent discount rate). This indicated that, from a broad social perspective, labelling would produce considerable net benefits. However, as discussed in chapter 5, such engineering–accounting estimates are based on many assumptions, which means the results should be treated with some caution. For example, a more optimistic business-as-usual (BAU) scenario for improvements in appliance energy efficiency would decrease the benefits attributed to labelling. In addition, it could be argued that the 4 per cent discount rate applied to future benefits and costs was too low from either the private perspective of the ‘average’ individual or from a social perspective (appendix F).

FINDING 9.1

Appliance energy-performance labels have some influence on consumers after they have short-listed products on the basis of characteristics such as price, performance, capacity and style. While the benefits of labelling may have been overstated in regulation impact assessments, it is likely to have produced net benefits for consumers.

9.3 Appliance minimum energy performance standards

In addition to the mandatory labelling scheme, mandatory minimum energy performance standards (MEPS) apply to various residential and commercial appliances. MEPS prohibit the sale of products that do not achieve a specified minimum level of energy efficiency.

In Australia, MEPS apply to most, but not all, of the electrical appliances that are also subject to mandatory labelling (table 9.1) and are managed in conjunction with labelling requirements (appendix E). NAEEEC has responsibility for electrical appliance MEPS, and the AGA will continue to manage gas appliance standards until this role is transferred to NAEEEC (table 9.2).

As part of the NFEE Stage One measures announced by the Ministerial Council on Energy (MCE 2004e), the Australian, State and Territory Governments have agreed to expand NAEEEP by introducing new or more stringent MEPS for residential and commercial appliances.

The goal of MEPS is to reduce greenhouse gas emissions from appliances when it would benefit society as a whole. However, NAEEEC has claimed that MEPS are also cost effective for individual producers and consumers (NAEEEC 2004c; Harrington and Holt 2003).

NAEEEC currently sets MEPS at a level that will ‘lead the world if that option … [is] cost-effective … and … [has] widespread stakeholder support.’ (Department of the Environment and Heritage, sub. DR146, p. 2). If the option is not cost effective, then MEPS will be set to ‘match, for each appliance regulated, best practice levels imposed by Australia’s major trading partners’ (Department of the Environment and Heritage, sub. 30, p. 15).

Benefits of MEPS

The key potential benefit of MEPS for individuals is lower appliance operating costs. Other benefits that participants of this inquiry have identified include: economies of scale and the ability to sell to any market in the world; reduced search costs; and the environmental benefits associated with decreasing energy use.

Energy cost savings

All regulation impact assessments of MEPS have found that the proposed MEPS substantially lower operating costs for individuals (for example, George Wilkenfeld and Associates 2000a, 2000b, 2001a, 2001b; Syneca Consulting 2003a, 2003b, 2004, 2005b). These cost savings depend on the efficiency improvements that would have otherwise occurred under the BAU scenario. In practice, it is very difficult to separate the effect of MEPS from other influences. To illustrate, consider the decrease in average energy consumption for new frost free refrigerator-freezers over the period 1985–2005 (figure 9.2). It appears that the announcement of MEPS in 1996 decreased average energy consumption in the 'lead in' time before the MEPS were mandated in 1999[1]. However, it is not known how energy efficiency would have improved in the absence of MEPS. It is highly unlikely that the industry would have reached the same level of energy efficiency as quickly as that brought about by the MEPS. But it is plausible that the effect of MEPS was to bring forward energy efficiency improvements that would have otherwise occurred.

Some improvements could have been brought about by, among other things, the impact of labelling, technological development in Australia and overseas, changes in energy prices and an increased level of consumer demand for energy-efficient appliances. In this regard, CESA and AEEMA noted that regulation impact assessments have tended to give insufficient recognition to improvements that would have been forthcoming under a BAU scenario. They commented that there is a tendency for the energy efficiency of appliances to increase over time regardless of regulation (trans., p. 632). As a result, they considered that the benefits attributed to MEPS have been overstated.

[1] The Department of the Environment and Heritage has projected a similar response over the period 2002–2006 from the announcement in 2002 of more stringent MEPS to apply from 2005 (figure 9.2).

Benefits to Australian producers

Some participants claimed that MEPS also lead to 'economies of scale' in the production of appliances, which is of direct benefit to individual producers (ABCSE, sub. DR121, p. 12). However, CESA and AEEMA noted that an increase in the level of MEPS does not initially lead to a lower cost of production for producers because 'at that point you are not mass produced, and it is expensive' (trans., p. 627).

The Department of the Environment and Heritage claimed that another advantage of MEPS being based on 'world's best practice' or 'leading the world' is that:

> … products made in Australia can be sold in any market in the world – they at least meet the minimum regulatory requirements. (sub. DR146, p. 3)

However, while this might be true in a technical sense, manufacturers are likely to be primarily interested in supplying appliances that meet the needs of the market they are exporting to (in accord with minimising cost and maximising profit). The most cost-effective level of energy efficiency for that market may be less than what is required under Australian MEPS. Appliances that are configured for Australian MEPS would run the risk of being overengineered and therefore, less competitive in markets that have lower energy efficiency requirements. Further, Australia is a small consumer and producer of appliances by global standards and so is probably not in a position to influence supply and consumption decisions in other countries.

Reduced search costs

A further benefit of MEPS is that they, in effect, reduce the search (or transaction) costs associated with purchasing energy efficient appliances. As Jaffe, Newell and Stavins noted:

> … standards can in principle be beneficial by conserving on the need for every individual to undertake the information and assessment process inherent in trading off capital and energy operating costs. (2005, p. 172)

Thus consumers are supposedly better off by having a regulator make decisions on their behalf at a lower total cost, including search costs. But this presumes that, in the absence of MEPS, consumers would come to the same conclusion as the regulator once they had collected and assessed the relevant information. In practice they are likely to purchase a range of products for different reasons. Any advantages in reducing search costs would therefore need to be weighed against the impact on product choice (see below).

Environmental benefits

To the extent that MEPS reduce fossil fuel consumption and thereby greenhouse gas emissions, they would be achieving environmental benefits. But again, assumptions about BAU projections make it difficult to assess the incremental impact.

Combined with the small proportion of emissions that are appliance-related, the Institute of Public Affairs questioned whether the environmental benefits of MEPS have been overstated:

> MEPS targets products that account for only 2 per cent of Australia's total greenhouse gas emissions. The measures, once having reached maturity are estimated to reduce emissions by less than 0.2 per cent of the business-as-usual levels.
>
> Modest though they are, these estimated reductions exaggerate the effect of the regulations because they exclude energy efficiency improvements that are taking place without any regulation. (sub. 6, pp. 13–14)

George Wilkenfeld and Associates (sub. DR96) noted that the benefits to energy users of increasingly higher MEPS are declining. Demonstrating that MEPS are beneficial for the wider community will therefore increasingly depend on the value assigned to emission abatement. The Department of the Environment and Heritage (sub. DR131) also noted that including the value of environmental benefits in regulation impact assessments is desirable. While this approach is appropriate when assessing the net benefit of MEPS for society as a whole, it is not appropriate for assessing private cost effectiveness. If, as has been suggested, privately cost-effective MEPS are becoming increasingly difficult to find and implement, then future MEPS are likely to make more individuals worse off.

Costs of MEPS

The benefits of MEPS could be outweighed by the associated costs of:

- administering and complying with standards;
- mismeasurement of energy performance;
- removing products from the market that are more cost effective for some consumers;
- forcing individuals to forgo product features that they value more highly than greater energy efficiency;
- reduced competition;
- regressive distributional impacts; and
- an increase in embodied energy consumption.

Administration and compliance costs

The administration costs that governments can incur from MEPS include public consultation prior to mandating a standard, the design of tests to measure energy performance, certification procedures, and a check testing program. The compliance costs for suppliers can include changing appliance designs to meet performance standards, testing products, and complying with registration procedures prior to offering appliances for sale.

The Department of the Environment and Heritage stated that the administration costs of MEPS are substantially lower than for labelling, but the compliance costs can be higher:

> The administrative costs of MEPS are substantially lower, since there is no need for a physical label, for checking that the label is correctly fixed, or for publicising the label …
>
> MEPS can have a greater cost for suppliers than labelling, since suppliers must adjust their model ranges to meet the MEPS levels by the given date (which is why the lead times for MEPS implementation is often 2 to 3 years) …
>
> The costs to government of ensuring the quality of initial product tests and undertaking random check tests are the same for MEPS and energy labelling. (sub. 30, p. 16)

The first regulation impact assessment of national labelling and MEPS requirements estimated that the administration costs for MEPS would be $3 million over the period 2000–15, compared to $39 million for labelling (in present value terms using a discount rate of 4 per cent) (George Wilkenfeld and Associates and Energy Efficient Strategies 1999). It was assumed that 84 per cent of administration costs were borne by appliance purchasers, with the remainder borne by governments. The assessment also estimated that MEPS would increase the cost of appliances by $266 million over 2000–15, compared to $688 million for labelling (the latter cost being due to consumers voluntarily purchasing more efficient appliances).

AEEMA noted:

> The cost of developing standards and reliable test procedures is high. Whether the standards are national or international, product development costs and compliance testing costs are substantial both in terms of direct costs and opportunity costs when scarce skilled engineers and laboratory resources are diverted from other product improvement or cost reduction projects to meet energy efficiency targets. (sub. 85, p. 3)

Compliance costs will be influenced by the ‘lead in’ time between the introduction of the regulatory proposal and the implementation of the MEPS. In the most recent regulation impact statement on air conditioners, several manufacturers noted that the ‘lead in’ time needs to be at least three years and another noted it needs to be at least five years (Syneca Consulting 2005b, pp. 41–43).

When introducing or setting an increased level of MEPS, suppliers will need time to adjust. Where the new MEPS can be met with off-the-shelf technology, adjustment could be quite rapid. But where the new MEPS requires product development, more time will be required. Trying to accelerate the adjustment process could add to compliance costs.

Compliance costs can be high if the MEPS require different materials or components to be used. In relation to lighting components, CESA and AEEMA noted:

> … there are substantial extra costs. For example, in lighting ballast you're looking at high grade electrical steel as opposed to a lesser grade of electrical steel. You're also looking at electronic components as opposed to ferromagnetic components. (trans., p. 625)

In relation to electric motors, initially there were substantial costs involved in making a product more energy efficient:

> High efficiency motors cost 10–25 per cent more than the common variety, although the price differential is shrinking in most cases. (Lamb 2005, p. 31)

In contrast to the above industry advice, the Department of the Environment and Heritage (sub. DR131) argued that products with a higher level of energy efficiency are not necessarily more expensive to buy, and nor are they more costly to produce than those with a lower level of energy efficiency.

Ultimately, the level and relative importance of administration and compliance costs will vary between different MEPS, depending on the prescriptiveness of the standard, how stringent it is, the lead in time to implementation, and the extent to which firms can spread fixed compliance costs across appliance sales.

Mismeasurement of energy performance

MEPS compliance is tested under laboratory conditions to ensure each model of an appliance satisfies a minimum level of energy performance.

The previously mentioned problems that arise with tests for labelling also arise in relation to tests for MEPS. Primarily, these problems occur because MEPS are based on the same limited data on user behaviour (data collected prior to 1995) and it is difficult to take account of how appliances are used in practice.

Functional and/or technical attributes need to be specifically accounted for in the tests for MEPS. In relation to electric motors, for example:

> Efficiency depends on the load placed on a motor. They are most efficient when they're at full load … sizing the right motor for the job is very important because over-sizing reduces efficiency … (Lamb 2005, p. 31)

As with labelling, a distinction can be drawn between 'set and forget' appliances and user-sensitive appliances. For 'set and forget' appliances, test results probably correspond well to actual outcomes. That is, MEPS are better suited to products that have little user intervention, such as electric motors, electric water heaters, freezers and most lighting products. MEPS are 'less suited' to appliances where the energy performance is significantly affected by what the customer chooses to do with the product (CESA and AEEMA, trans., p. 633). For this reason, NAEEEC does not mandate MEPS on clothes washers, clothes dryers and dishwashers.

Removing more cost-effective products from the market

By definition, MEPS ban certain appliances from sale that have energy efficiency below a specified minimum. Therefore, appliances that might have been cost effective for some consumers are no longer available on the market. When MEPS are set to 'lead the world' or to 'match world's best practice', these effects are even more pronounced.

In an international review of energy policies, the World Energy Council found that the standards set for MEPS in other countries have led to a large proportion of models being forced out of the market:

> In Europe … 40 per cent of appliances on sale in 1996 did not comply with the standards to be introduced in 1999. In the United States, the standards were more ambitious in their goal: none of the refrigerators on the US market at the end of the 1980s met the efficiency standards planned for 1993. (World Energy Council 2004, p. 45)

Similar outcomes appear to have occurred, or are set to occur, in Australia. The regulation impact assessment for electric motors estimated that 70 per cent of models in December 2003 would be excluded from the market under the proposed MEPS scheduled for 2006 (Syneca Consulting 2003b). The regulation impact assessment for Australia's future air conditioner MEPS estimated that among the models registered in August 2004:

- 92 per cent would not comply with an alternative MEPS based on the next best European benchmarks; and
- 96 per cent would fail the MEPS scheduled for 2007 (Syneca Consulting 2005b).

In addition, the regulation impact assessment of MEPS for low pressure and heat exchanger water heaters estimated that models accounting for at least 90 per cent of existing sales would be removed from the market when the standard was introduced (Syneca Consulting 2004).

In conclusion, the Commission notes that some MEPS have led to a significant proportion of models being removed from the Australian market. It is likely that the displaced models are cost effective for some individuals, such as those who do not use appliances intensively and so cannot justify the added cost of a more efficient product.

Forcing individuals to forgo more highly valued product characteristics

Given that energy costs account for only a small proportion of household expenditure (chapter 6) and a small proportion of total costs faced by the majority of firms (chapter 7), it is unlikely that energy efficiency is as highly valued by consumers and businesses as are some other appliance characteristics. Where those other appliance characteristics come at the cost of lower energy efficiency, well-informed individuals could be willing to accept the cost (lower energy efficiency) in return for the more highly valued benefit (the relevant appliance characteristics).

For example, a consumer may want to buy a refrigerator with narrower side walls so they can fit a bigger capacity model (in terms of internal refrigerated area) into a confined space in her/his kitchen. Although a refrigerator with narrower side walls could involve less insulation and so require greater energy consumption to maintain a desired temperature, a consumer may place a higher value on the benefits (a larger refrigerated space) than the associated costs (greater energy use).

MEPS have the potential to prevent well-informed consumers and producers from making such decisions. That is, MEPS could ban products that some consumers and producers want to buy, even when they are aware of the lower energy efficiency and higher running costs (Jaffe, Newell and Stavins 2005).

The Victorian Government commented that MEPS ‘constrain consumer and producer sovereignty’ on the basis of broader environmental, social and economic criteria, including reduced greenhouse gas emissions (sub. DR125, p. 5). This may be appropriate, given the role of governments to consider the wellbeing of society as a whole. However, MEPS are often promoted by NAEEEC as also being cost effective for individuals (NAEEEC 2004c; Harrington and Holt 2003).

CESA and AEEMA (trans., p. 626) noted that when industry is required to meet a new MEPS level, there could be a cost ‘in terms of features forgone’. Despite that, CESA and AEEMA noted that not much has been given way in terms of loss of features so far.

Different MEPS levels are used for three different types of refrigerators (those with a top-mounted freezer, a bottom-mounted freezer or a side-by-side configuration). This is because the inherent energy consumption of a refrigerator for a given capacity depends on its configuration (CESA and AEEMA, trans., pp. 639–640). Therefore, MEPS for refrigerators have been set so as to give individuals an opportunity to select the style of refrigerator that they want. If the MEPS level were applied uniformly across the three styles, there would be far less choice between styles of refrigerators. This illustrates that setting the level of MEPS is a complex task and, therefore, should be set so as to avoid adverse effects such as the loss of product features. In this way, MEPS can allow for consumer choice. However, it is important to account for the fact that such an approach will involve an increased amount of administration costs.

Reduced competition

Another possible cost of MEPS for consumers is that they have the potential to reduce competition in the marketplace. This could lead to higher prices than otherwise and cause consumers to delay the replacement of very energy inefficient appliances (Australian Industry Greenhouse Network, sub. 57; Institute of Public Affairs, sub. 6).

The Department of the Environment and Heritage (sub. 30) acknowledged this possibility, but was unaware of any instance where a supplier had withdrawn from the Australian market because of MEPS.

However, one manufacturer told the Commission that it had stopped supplying the Australian market with refrigerators in response to a more stringent MEPS introduced in January 2005. The manufacturer decided that it was not economic to design refrigerators specifically for Australia’s new MEPS. This was confirmed by CESA and AEEMA:

> Two were originally pulling out. One of them did pull out, and they were a very small player. The other one went back to Japan, modified their products, and, yes, it's still on the market. (trans., p. 636)

Despite this withdrawal, AEEMA stated that there is still an ‘adequate’ level of competition:

> Generally, fewer models will be available in all size ranges of single door refrigerators, freezers and chest freezers. It is too soon to be sure, but there appears to be enough models in the market in each type and size range to maintain an adequate level of

competition, even though the number of brands and models available will decrease. (sub. 85, p. 7)

The Department of the Environment and Heritage noted that refrigerator MEPS are set at a level where an adequate level of competition is maintained:

> NAEEEC made a determined effort to consult with industry on the levels … Without that exemplary work, the limits might have been set too low or there might have been insufficient competition in several sectors of the market. (sub. DR131, p. 11)

Notwithstanding this, the Commission considers that, to date, regulation impact assessments have not included a sufficiently thorough examination of how a proposed new or upgraded standard would affect competition.

Distributional impacts

The Institute of Public Affairs (sub. 6) noted that MEPS reduce the availability of cheaper products and/or some specialised products that fill particular niches or requirements. The Australian Business Council for Sustainable Energy acknowledged that MEPS leads to the removal of some products, but claimed that it 'will only remove products that leave low-income earners worse off' (sub. DR121, p. 12).

In relation to air conditioners, MEPS tend to be beneficial for intensive users — such as retirees and families with young children — because the fall in operating costs more than compensates for the higher capital cost. However, the assessments of Australian air conditioner MEPS noted US research showing that cheaper, less efficient models are cost effective for less intensive users of air conditioners (Syneca Consulting 2003a, 2005b).

The Department of the Environment and Heritage noted that the distributional effects of MEPS differ from those for labelling:

> In labelling, a high proportion of the costs and benefits are borne voluntarily by those consumers who use the label to select more efficient products. In MEPS, the costs of increased appliance prices are borne by all consumers, even those — usually very few — who do not stand to benefit (because their energy prices or energy usage is so low). Conversely, the benefits also flow to additional classes of consumers who would not benefit from labelling — those who do not purchase their own appliances (eg tenants) or who are not label-aware. (sub. 30, p. 16)

Sutherland (2003) found that low-income households bear a disproportionately large share of the welfare loss from US minimum energy efficiency standards because the standards force cheaper appliances off the market. However, Nadel criticised Sutherland's analysis on two grounds:

> First, the majority of low-income households rent, and hence it is often the landlords who purchase the appliances and not the tenants. Second, if low-income people buy appliances, they often buy on the used appliance market, where costs are reduced since equipment is partly depreciated. (2004, p. 1)

Nadel's first point refers to the widely held notion that landlords do not have an incentive to install energy efficient appliances that have a high upfront cost because the direct benefits accrue to the tenant and not themselves — the split incentive problem. The Commission accepts that this might indeed have some effect in such situations.

With respect to Nadel's second point, what seems to be in dispute is not so much that low-income earners do not incur some cost from MEPS, but that this cost will be diminished because they purchase second hand rather than new appliances (Moreland Energy Foundation Ltd, sub. DR115).

Nadel (2004, p. 3) also criticised Sutherland for basing his distributional argument on the assumption that 'low-income households have higher discount rates than higher-income households'. However, the Commission considers that it is reasonable to expect this to be the case, given that such households are more likely to be constrained in their access to capital, and their basic needs may not have been fully satisfied (appendix F).

Australian regulation impact assessments typically assume that households do not face capital constraints. An energy efficiency investment is usually deemed to be cost effective if the additional capital cost is less than the present value of the fall in future operating costs. This implicitly assumes that householders do not face a constraint on their ability to finance a higher capital cost now in return for a stream of returns well into the future. In practice, such constraints do exist, especially for low-income households.

If a household is capital-constrained, then it is rational for it to allocate its available capital to what it considers to be the most highly-valued uses of that capital. This could involve the purchase of cheaper and less efficient appliances because they have a lower capital cost. The Institute of Public Affairs noted that this was the case for first home buyers:

> … there are strong reasons why homes built for owner-occupation would incorporate fewer energy saving features – the home buyer, at least the first home buyer, is likely to be borrowing constrained and will seek to defer unnecessary outlays. (sub. 6, p. 4)

George Wilkenfeld noted that regulation impact assessments would benefit from distributional analyses but this has been constrained by limited data:

> In the United States, there are excellent data accumulated over time on matching energy use to household structure and household income. That data set doesn't yet exist in Australia, but we have recognised the value of developing this so we can actually better analyse distributional issues. (trans., pp. 545–546)

In relation to regulation impact assessments, distributional analyses are a requirement under the COAG guidelines for regulation (COAG 2004). In addition, the Department of the Environment and Heritage (sub. DR131) stated that the analysis of distributional impacts will be recommended in a manual for preparing regulation impact statements for NAEEEC.

Potential increase in embodied energy consumption

In designing MEPS, the objective of reducing greenhouse gas emissions is confined to the energy consumption of the appliance. However, energy embodied in the manufacturing materials may also be relevant when the energy used in the manufacturing process forms a significant part of the appliance's whole-of-life energy consumption (assuming that higher energy efficiency will lead to a higher level of embodied energy). This may have an adverse impact on the private cost effectiveness of an energy efficiency measure if more embodied energy leads to a higher purchase cost.

Net benefits of MEPS

It is not possible to say that the benefits of MEPS always outweigh the costs, or vice-versa. Whether there is a net benefit has to be judged on a case-by-case basis, and requires quantification of the various benefits and costs. This quantification is important because 'MEPS is a relatively interventionist form of regulation and as such it is important that any standards are supported by clear and unambiguous benefits' (Origin Energy, sub. DR129, p. 10).

Regulation impact assessments of Australia's household appliance, and commercial and industrial appliance MEPS have predicted that the benefits substantially outweigh the costs (table 5.6). Examples are summarised in boxes 9.1 and 9.2. In a recent assessment of all labels and MEPS administered by NAEEEC, George Wilkenfeld and Associates (2005b) projected a net benefit of $4.8 billion in present value terms during 2005–20 (using a 10 per cent discount rate).

Box 9.1 Predicted impacts of MEPS for residential appliances

George Wilkenfeld and Associates and Energy Efficient Strategies (1999) estimated the combined impact of:

- imposing MEPS for refrigerators, freezers and electric hot water heaters; and
- introducing model regulations in each State and Territory that extended the use of mandatory energy labelling requirements to Tasmania and the ACT, and slightly increased the scope of NSW labelling requirements.

It was estimated that, over the period 1999 to 2015, consumers would incur an additional cost in buying appliances of $954 million in present value terms (using a discount rate of 4 per cent). The present value of the associated fall in energy costs was valued at $2287 million. Thus, the proposed package of regulations was found to generate a significant net benefit for householders. It was estimated that the proposed MEPS would generate significant net benefits for householders even if labelling regulations were not changed.

More recently, George Wilkenfeld and Associates (2005b) projected the impact of MEPS and labelling over the period 2005–20. The study estimated an overall net benefit from labelling and MEPS of $4.8 billion and a benefit–cost ratio of 1.7 (using a 10 per cent discount rate). The study also estimated the additional (unvalued) benefits from the anticipated reduction in greenhouse gas emissions to be 204 megatonnes of carbon dioxide equivalent.

Syneca Consulting (2003a) evaluated the impact of lowering the maximum permitted heat loss for low pressure and heat exchanger water heaters by 30 per cent. It argued that individuals generally fail to recognise that standing losses from electric water heaters — energy lost directly to the atmosphere from the storage tank — typically cost more over the life of the heater than its installation cost. Accordingly, it estimated that the proposed standard for low pressure and heat exchanger water heaters would generate a $19.4 million benefit for users that was more than double its cost of $9.3 million (in present value terms using a 5 per cent discount rate). Syneca Consulting (2003a) also estimated that the introduction of MEPS for single phase air-conditioners would generate benefits for users of $102 million and costs of $34 million (in present value terms using a 5 per cent discount rate).

The most recent regulation impact assessment of MEPS for air conditioners estimated the impacts of increasing MEPS to an intermediate level (based on European benchmarks) and to the South Korean world's best practice level (Syneca Consulting 2005b). The net benefit for users was estimated to be $12.5 million for the intermediate level and $82 million for the world's best practice level (in present value terms using a 10 per cent discount rate).

Box 9.2 Predicted impacts of MEPS for commercial and industrial appliances

Electric motors are responsible for the majority of electricity consumption in the industrial sector. Electric motors are estimated to account for about 30 per cent of total electricity consumption in Australia. The MEPS for electric motors with a power rating of 0.73 kilowatts – 185 kilowatts was introduced in 2001 and will remain in force until 2006. A regulation impact assessment prepared for the current MEPS estimated that the policy would result in benefits which are 80 per cent greater than the costs (Syneca Consulting 2003b). A new standard which will operate in 2006–12 has already been developed. A regulation impact assessment assessed the benefits of the proposed MEPS to be between two and five times greater than the costs (Syneca Consulting 2003b).

Fluorescent lamp ballasts are components used in linear fluorescent lighting which is the most common form of lighting in commercial buildings in Australia. Ballasts provide suitable conditions for lamp start up and limit the electrical current during normal lamp operation. The MEPS for fluorescent lamp ballasts were introduced in 2003. The regulation impact assessment estimated that the MEPS provided a net benefit of $471 million such that benefits outweighed the costs by 20 per cent (George Wilkenfeld and Associates 2001a).

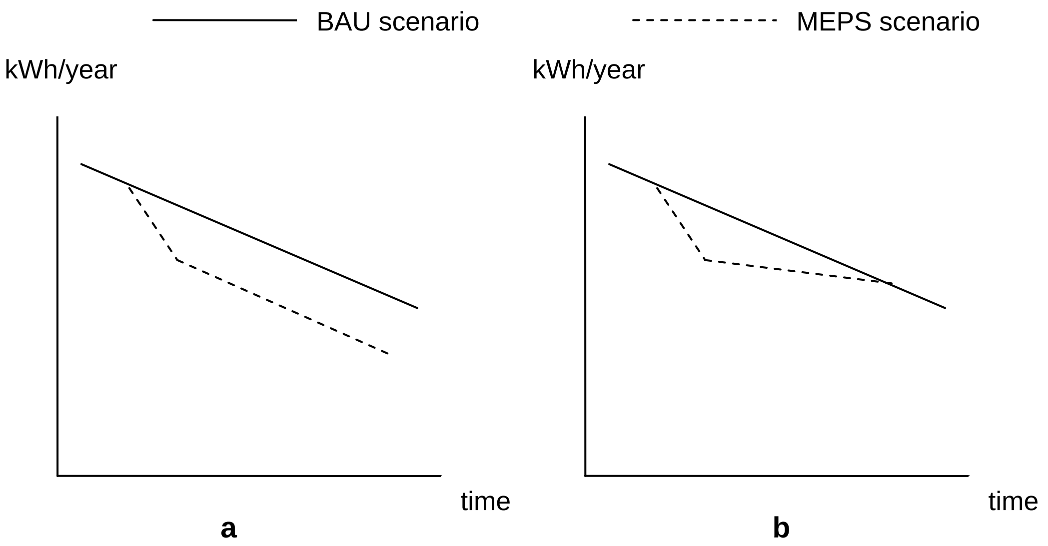
However, these assessments give little if any attention to a range of issues that could substantially influence the net benefits of MEPS. These issues include the potential for MEPS to remove appliances from the market that are more cost effective for some individuals, force consumers to forgo product characteristics that they value more highly than energy efficiency, and reduce competition. An assessment of the net benefits of MEPS also requires that adequate attention be given to the discount rate that individuals use in assessing private cost effectiveness.

One of the most crucial issues when assessing the net benefits of MEPS is the estimation of the BAU scenario. As noted previously, some improvement in energy efficiency could be expected in the absence of MEPS, so it is very difficult to isolate the MEPS effect. This is because once a MEPS is implemented, ‘the BAU scenario disappears’ (George Wilkenfeld 2001b, p. 4).

The BAU scenario for any MEPS should make provision for the impact of labelling (figure 9.2), technological developments in Australia and overseas, changes in energy prices and an increase in consumer demand for energy-efficient appliances. An increase in demand for energy efficiency might be expected as the community becomes more conscious of energy efficiency in response to labelling and rising environmental awareness (for example, through media coverage on climate change).

Most assessments of MEPS to date have tended to assume that a new level of MEPS will lead to a step change in energy efficiency that will be maintained over the life of the MEPS — that is, the two competing scenarios (BAU versus the new MEPS) never converge (figure 9.3a). However, if MEPS bring forward some of the efficiency improvements that would have otherwise occurred, a more plausible situation would be that the BAU scenario 'catches up' to the MEPS scenario at some stage in the future (figure 9.3b). Such a scenario would allow for overseas market developments and the influence of MEPS adopted by Australia's trading partners.

Figure 9.3 **Potential trends of energy consumption for an appliance**



The net benefit of a new (or tightened) MEPS will also depend on the discount rate(s) used in calculating the present value of the benefits and costs (appendix F). Assessing a policy from a social perspective requires the use of a social discount rate, whilst assessing the policy from a private perspective requires the use of a potentially different private discount rate(s) (appendix F). Yet it appears that most regulation impact assessments assumed that the average private discount rate is equal to the estimated social discount rate (chapter 5). In practice, private discount rates probably vary across individuals and, on average, do not equal the estimated social discount rate.

While overall community wellbeing should be the test by which any regulatory proposal is assessed, private cost effectiveness has also been used as a justification for MEPS (NAEEEC 2004c). If this is to continue to be the case, greater attention needs to be given to using discount rates that will allow a more accurate assessment from the private perspective of the consumers affected.

Given the above considerations, the net benefits of MEPS to individual consumers and producers estimated in regulation impact assessments are probably overstated. The problems associated with BAU scenarios and discount rates means that a more rigorous assessment of MEPS is required.

9.4 Are other market interventions better?

Policy makers need to consider whether policies other than MEPS would be more cost effective. There are four possible options:

- voluntary MEPS
- voluntary energy-performance labels
- mandatory energy-performance labels
- mandatory disendorsement labels.

These options are not necessarily mutually exclusive and, in some instances, it may be appropriate to use more than one measure.

Voluntary MEPS

A view expressed by some policy makers and their advisers is that MEPS cannot be effective unless they are mandatory. For instance, the Department of the Environment and Heritage claimed that there is little incentive for firms to unilaterally volunteer to adopt MEPS:

> The reasons why no individual firm would unilaterally introduce MEPS are the same as for labelling but more so. The costs to the producer are higher than for labelling, since not only do product designs have to change physically, but the only conceivable competitive advantage to the supplier is from publicising its actions and convincing buyers that it is a reason to prefer its products — i.e. the same costs as for a ‘private’ labelling regime. On the other hand the risks of ‘private’ MEPS are also higher, since the first mover places itself at a product price disadvantage. (sub. 30, p. 18)

The regulation impact assessment of MEPS for refrigerators, freezers and electric water heaters assumed that voluntary standards would not be effective because it ‘is unlikely to be commercially advantageous for suppliers’ and ‘there would always be a risk that competitors would not comply’ (George Wilkenfeld and Associates and Energy Efficient Strategies 1999, p. 3). However, an international review of energy policies by the World Energy Council (2004) concluded that voluntary agreements between manufacturers and governments can be an effective alternative to MEPS, provided they are accompanied by a credible threat of regulation.

The key issue seems to be that voluntary and mandatory standards do different things. Mandatory standards remove the least efficient models from the market. Voluntary standards tend to be used by suppliers to market more efficient models. This can be done in conjunction with a voluntary (endorsement) label. An example is the voluntary Energy Star label, which suppliers of office equipment and home electronics can use if they adopt the Energy Star standards (appendix E).

The case for mandatory standards appears to be strongest when split incentives typically cause individuals to use products that are very cost ineffective. In such cases, appliance suppliers have little incentive to adopt a voluntary standard to raise energy efficiency, and energy-performance labels may have little impact on purchase decisions. A possible example is water heaters in new houses, which builders may select on the basis of capital cost, rather than the running costs borne by consumers (Syneca Consulting 2004). However, this example needs to be kept in perspective. If higher energy efficiency is important to a home buyer, they would be willing to pay an extra upfront cost to their builder for ongoing energy savings.

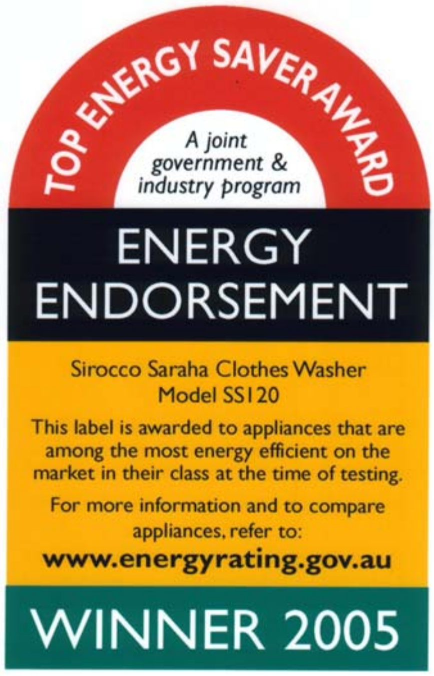
Voluntary energy-performance labels

A voluntary scheme would allow different varieties of appliances to circulate in the market — those conforming with a standard could be labelled and those not conforming with it do not require a label, but could still be sold (WTO 2005).

NAEEEC already administers variations on this approach:

- Electric water heaters can have a voluntary energy rating label, provided the label follows the Standardised Information Disclosure requirements developed by NAEEEC. These requirements apply to products that do not have to be labelled, but must still undergo an energy-performance test to satisfy a minimum energy performance standard. Thus, this combines a mandatory minimum energy performance standard with voluntary labelling.
- Appliances that receive the Top Energy Saver Award can use a special award label specified by NAEEEC (appendix E). This is an endorsement label designed to enable consumers to identify the most energy-efficient electrical and gas appliances on the market (figure 9.4). Alternatively, suppliers of electrical appliances can note the award in a green bar at the bottom of the standard energy rating label.

Figure 9.4 **Sample endorsement label for the Top Energy Saver Award**



Source: NAEEEC (2004b).

George Wilkenfeld and Associates (2003a) noted that Australia's voluntary water efficiency labelling scheme has been used by few suppliers, and those that have used it tend to only label their better performing products. This voluntary labelling scheme will be fully replaced by a *mandatory* labelling scheme next year.[2]

The Department of the Environment and Heritage stated that voluntary labelling should be seen as a supplement, rather than a substitute to a mandatory scheme (sub. 30, p. 18).

Voluntary labels tend to be more useful for endorsing the most efficient models, rather than helping consumers to rank the cost effectiveness of different models. Without compulsion, suppliers are unlikely to label less efficient models.

Mandatory energy-performance labels as a substitute for MEPS

In Australia, MEPS are often applied to appliances that are also required to have an energy-performance label (table 9.1). This raises the question of why it is necessary

2 From 1 July 2006, the Water Efficiency Labelling and Standards (WELS) scheme will require mandatory labelling for various products including clothes washers and dishwashers. Currently, products can be registered and labelled under the WELS scheme on a voluntary basis.

to restrict consumer choice if the less interventionist (and hence probably less costly) approach of labelling is as effective as a stand-alone policy.

The Department of the Environment and Heritage observed that MEPS can be more effective than labelling because:

> … MEPS … do not rely on the mechanisms of consumer awareness and choice and supplier response to consumer preference, which are all highly variable. (sub. 30, p. 16)

Similarly, the Energy Retailers’ Association of Australia noted:

> Placing liability on product manufacturers to ensure that products comply with minimum efficiency standards … is an efficient way of realising energy efficiency gains without the need to rely on consumer behavioural change. (sub. 26, p. 40)

George Wilkenfeld and Associates and Energy Efficient Strategies (1999) claimed that labelling is unlikely to be effective if:

- purchasers rarely inspect appliances in a showroom where they can compare energy performance across different models; or
- the purchaser is not the ultimate user, and so has little interest in operating costs (split incentives).

These conditions often apply for water heaters. As a result, NAEEEC has made MEPS mandatory for electric water heaters and labelling voluntary. However, it is less likely that other appliances subject to mandatory MEPS (air conditioners, refrigerators and freezers) would satisfy these conditions for mandatory labelling to be ineffective. Hence, for those appliances, there is a stronger case for using mandatory labelling. Nevertheless, NAEEEC and the AGA have imposed *both* mandatory MEPS/minimum safety standards and labelling requirements for those appliances.

Disendorsement labels

Another option is the use of disendorsement (warning/negative) labels for appliances that would otherwise be prohibited by MEPS. Such a label would have to be mandatory because no supplier would volunteer to use a label that discouraged customers from buying its products.

Consumer research commissioned by the AGO suggests that a disendorsement label warning consumers that an appliance is very inefficient could be effective:

> Many different ways of informing consumers about ... inefficient appliances were tested during the current study, including a series of mock-up labels. The general message ... is that consumers will react positively to a label which informs them that a particular ... appliance is inefficient. (Winton 2003, p. 71)

Many participants in that consumer research considered the tested warning labels to be extreme, and questioned why such appliances would be allowed to be sold (Winton 2003). This suggests that disendorsement labels would discourage most consumers from buying the least energy-efficient appliances, and so have a similar effect to a mandatory standard that removed those appliances from the market. However, a key difference is that disendorsement labels would not prevent a consumer from buying a less efficient appliance when that is the most cost-effective option for them, or they have a strong preference to buy such an appliance. Therefore, disendorsement labels are less likely to force individuals to forgo product features they value more highly than energy efficiency, remove products from the market that are more cost effective for some individuals, and to have regressive distributional impacts.

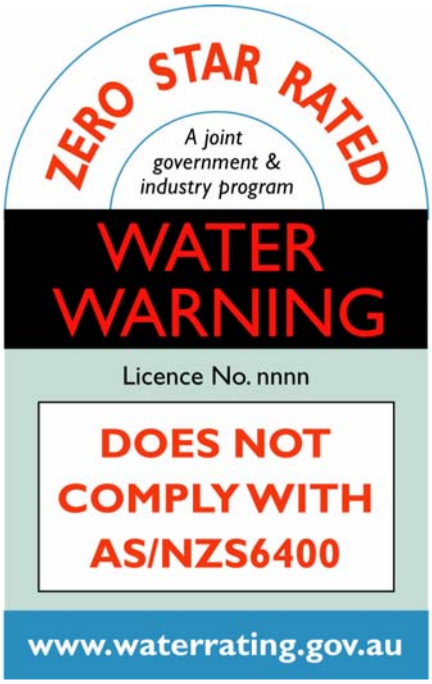
AEEMA (sub. DR118) preferred MEPS to disendorsement labels because disendorsement labels do not deal with the problem of split incentives. However, it noted that disendorsement labels may be appropriate for products that have a niche market.

Australian, State and Territory Governments have already agreed to introduce mandatory disendorsement labels for water-consuming products, such as shower heads that have a flow rate above a certain level (George Wilkenfeld and Associates 2003a). High-flow shower heads have not been banned, given that water efficient models are unsuitable for homes with low hot water pressure. The water disendorsement label shows that the product is ‘zero star rated’, which indicates that the product does not comply with the minimum standard (figure 9.5).

The Ministerial Council on Energy has previously agreed to use disendorsement labels for electrical appliances, if such labels are found to be an effective way to reduce standby power consumption. However, this option has not been pursued by NAEEEC.

Disendorsement labels were also considered as part of the MEPS arrangements for electric water heaters. The suppliers had proposed a tradeoff in which small electric water heaters not satisfying the MEPS could remain on the market if they had a disendorsement label — and in return, other heaters manufactured by those suppliers would be more efficient than required by the MEPS. The rationale for the proposal was that small inefficient water heaters were required in situations where a more efficient (and necessarily larger) unit would not fit. Ultimately, suppliers decided not to pursue the proposal.

Figure 9.5 **Sample disendorsement label for the Water Efficiency Labelling and Standards Scheme**



Source: Department of the Environment and Heritage.

RECOMMENDATION 9.1

Future regulation impact assessments of appliance minimum energy performance standards (MEPS) should include a more comprehensive analysis of:

- ***whether MEPS reduce competition and how this affects prices and service quality;***
- ***why individuals — with guidance from an energy-performance label — are not best placed to judge what is in their best interests;***
- ***whether a disendorsement label and/or voluntary standard would be a more cost-effective policy; and***
- ***the distributional impacts, including the extent to which MEPS are regressive and prevent consumers from buying products that are more cost effective for them.***

The extent to which individuals are forced to forgo product features they value more highly than energy efficiency should also be reported in regulation impact assessments if MEPS are to continue to be promoted as privately cost effective.

10 Building ratings and standards

Key points

- Mandatory ratings and standards for building energy efficiency have been adopted, or are planned to be introduced, across Australia.
- While the objective of these policies is to raise the wellbeing of society as a whole, governments often promote them as also being privately cost effective.
- It is unclear whether mandatory ratings for existing buildings deliver a net benefit to individuals. To date, building ratings have only been mandated for dwellings in the ACT, and that scheme has not been subject to an *ex post* evaluation. However, preliminary evidence suggests that the ACT scheme has been ineffective and costly. The Commission supports the Australian Government's plans to evaluate the ACT scheme before building ratings are mandated elsewhere.
- Mandatory energy efficiency standards for new buildings currently apply across Australia, with the precise requirements often varying between jurisdictions. There is considerable uncertainty about how effective these standards have been in reducing energy consumption, and whether they have been cost effective for individuals:
  - current standards have not been subject to *ex post* evaluation;
  - many questionable assumptions were used in regulation impact assessments to predict energy savings and financial impacts;
  - numerous problems have become evident in implementing the standards;
  - various recent surveys show that compliance costs are much higher than predicted in regulation impact assessments; and
  - important issues, such as the consequences of heterogeneity among individuals and buildings, the loss of building features that individuals value more than energy efficiency, and the potential discouragement of innovation and productivity growth, have been largely overlooked by policy makers.
- To aid better-informed policy making, the Commission recommends that the Australian Building Codes Board should, as a matter of urgency, commission an independent *ex post* evaluation of energy efficiency standards for new buildings to determine:
  - how effective the standards have been in reducing energy consumption; and
  - whether the financial benefits to individuals outweigh the associated costs.
- This evaluation should include the standards for residential buildings in New South Wales (BASIX), Victoria (5 star) and the ACT (ACTHERS), as well as the national standards in the Building Code of Australia.

Mandatory building energy efficiency ratings and standards have been adopted, or are planned to be introduced, across Australia. While the objective of these policies is to raise the wellbeing of society as a whole, governments often promote them as also being beneficial for individuals (for example, Victorian Government nd).

This chapter considers whether building ratings and standards are indeed cost effective for individual producers and consumers.

10.1 Do individuals overlook cost-effective building improvements?

As noted in earlier chapters, imperfect information and split incentives may cause individuals to overlook energy efficiency improvements that are cost effective for them. Both of these barriers could exist in the building market.

Imperfect information could be a barrier if a buyer does not have sufficient technical expertise to determine a building's energy efficiency. Split incentives are most often associated with residential buildings — particularly rental accommodation — and a recent ABS (2005a) survey of energy use appears to support this view (chapter 6).

An additional constraint on the adoption of energy efficiency improvements is the relatively small size of potential cost savings. As noted in earlier chapters, energy use accounts for a small proportion of expenditure by most producers and consumers. Thus, in many cases, what appears to be rewarding in monetary terms may not be cost effective after individuals take account of the time and effort required.

Many inquiry participants observed that it is technically feasible to increase the energy efficiency of buildings above their current levels. However, only a limited number of participants provided evidence to support the assertion that individual producers and consumers typically fail to adopt building energy efficiency improvements when it would be cost effective for them to do so.

The Australian Glass and Glazing Association (AGGA) submitted estimates of the impacts of more energy-efficient glazing for two different project homes offered by Simonds in Victoria:

> … two homes were drawn from the Simonds range of designs, the first being a medium sized home, rating 3.5 stars with ordinary glazing or 5 stars with energy-efficient glazing. The second example was a larger sized residence rating 3 stars with ordinary glazing and 5 stars with energy-efficient glazing …

> The two homes were … simulated on the basis that heating as well as cooling was electric … Under this scenario, reduction in energy usage for the medium sized home amounted to 2180 kWh when energy-efficient glazing was used and generated greenhouse gas emissions savings of 2921 kg. For the larger house, annual energy savings were 8178 kWh and reduction in greenhouse gas emissions was 10 960 kg. (sub. 16, pp. 1–2)

The Association estimated that the additional cost of the more energy-efficient windows could be recouped by energy cost savings within five years (table 10.1).

Table 10.1 **Cost effectiveness of energy-efficient windows for particular project homes**

	Units	*Glenwood 2201*[a]	*Toscana 4001*[b]
Additional cost of windows[c]	$	1620	5400
Annual energy cost saving[d]	$/year	327	1226
Payback period[e]	years	5.0	4.4

[a] The Glenwood 2001 is a single storey dwelling with a floor area of 21 squares. [b] The Toscana 4001 is a double storey dwelling with a floor area of 30 squares. [c] For the Glenwood 2201, windows are upgraded from a 3.5 to 5 star rating. For the Toscana 4001, windows are upgraded from 3 to 5 stars. [d] Energy cost savings for homes with electric heating and cooling. [e] Number of years it takes for cumulative savings in running costs to compensate for the increase in capital costs, assuming that the benefit from having a dollar today is the same as having a dollar in the future.

Source: Australian Glass and Glazing Association.

Moreland Energy Foundation Ltd (sub. 18, pp. 6–8) noted its involvement in two household energy efficiency programs that had been successful in achieving higher energy efficiency and lower greenhouse gas emissions. In terms of cost effectiveness for householders, a survey of participants in one of the programs revealed that almost all participants saw cost as the key barrier to implementing energy efficiency improvements. The Foundation did, however, provide examples of cost-effective energy efficiency improvements, which are summarised in table 10.2.

In conclusion, there is evidence to suggest that individual producers and consumers have not implemented the full range of building energy efficiency improvements that appear to be cost effective for them. This could be due to information barriers, split incentives, or the small size of the cost savings in monetary terms.

Table 10.2 **Cost effectiveness of selected energy efficiency improvements**

	Additional capital cost	*Fall in annual running cost*	*Payback period*[a]
	$	$	years
Lighting			
Compact fluorescent lamp[b]	5	18	0.3
Ceramic metal halide lamp[c]	11	9	1.2
Showerheads[d]			
A	5	90	0.1
AAA	35	135	0.3
R3.5 ceiling insulation			
Currently has no insulation	1026	198 – 384	5.1 – 2.6
Currently has R2 insulation[e]	571	124 – 240	4.6 – 2.3
Solar hot water system			
Electric-boosted solar[f]	2874	339	8.4
Gas-boosted solar[g]	3880	238	16.3

[a] Number of years it takes for cumulative savings in running costs to compensate for the increase in capital costs, assuming that the benefit from having a dollar today is the same as having a dollar in the future. [b] Compared to an incandescent lamp. [c] Compared to a halogen lamp. [d] Compared to a standard showerhead. Fall in running cost does not include reduction in water bills. [e] Assuming existing insulation can be 'topped up' to achieve a higher standard. [f] Compared to an off-peak electric storage heater. [g] Compared to a 2 star gas heater.

Source: Moreland Energy Foundation Ltd (sub. DR115, attachment 1).

10.2 Energy efficiency ratings for existing buildings

The Australian, State and Territory Governments have announced their intention to make it mandatory in all jurisdictions to disclose a building's energy efficiency at the time of sale or lease (MCE 2004c). This was a Stage One measure of the National Framework for Energy Efficiency (NFEE) and it applies to both residential and nonresidential buildings.

Mandating energy ratings for existing buildings is seen as a way to overcome the difficulty that purchasers and tenants face in determining the energy efficiency of a building. By making purchasers and tenants better informed, it is thought that they will be willing to pay for energy efficiency features. This will in turn encourage building owners to invest in such measures.

The Australian Conservation Foundation (sub. 24) and the Insulation Council of Australia and New Zealand (ICANZ, sub. 14) supported mandatory energy ratings at the time of sale and lease of residential buildings. The ACT already has such a requirement. Since 1999, anyone wishing to sell an existing dwelling in the ACT has had to obtain an energy efficiency rating assessment (appendix D). The energy efficiency rating has to be disclosed in all advertisements and the contract of sale.

The Housing Industry Association (sub. 27) considered that not enough evidence was available to assess whether the ACT energy-rating scheme had been worthwhile. In contrast, ICANZ (sub. 14) viewed the ACT scheme favourably because houses with a higher star rating were observed to be more expensive to purchase. But this correlation between energy ratings and prices does not prove that higher energy efficiency causes home buyers to pay higher prices. There are many other possible explanations. To determine whether energy ratings have an impact, it is necessary to undertake an econometric analysis that isolates the effects of energy ratings from the many other factors that can determine house prices. To the Commission's knowledge, no such analysis has been undertaken yet.

A government-sponsored study of the ACT home energy-rating scheme was conducted in 2001 (George Wilkenfeld and Associates, Artcraft Research and Energy Partners 2001). The study concluded that it was not possible at that time to establish whether the scheme had been effective in increasing residential energy efficiency. The study did, however, find some major problems:

- about a quarter of homes were advertised without an energy rating;
- only 39 per cent of surveyed home buyers received an energy-rating report prior to exchanging contracts (20 per cent received the report on the same day as contracts were exchanged, 13 per cent received the report after the exchange of contracts, and 28 per cent said they did not receive a rating report);
- 52 per cent of surveyed home buyers and 39 per cent of surveyed sellers did not find the energy-rating report useful;
- about half of the ratings were made by an assessor who had not visited the property;
- there were instances where sellers had deliberately inflated their rating by giving false or exaggerated data to the assessor; and
- some people were confused about home energy ratings, incorrectly thinking that they covered the energy efficiency of heating and cooling appliances.

The Australian Business Council for Sustainable Energy (ABCSE, sub. DR121) commented that the ACT scheme was a good idea, but there had been problems in practice because the scheme had not been adequately promoted, did not include the efficiency of fixed equipment, and ratings were difficult to interpret in real estate advertisements.

The Department of the Environment and Heritage (sub. DR131) advised that an *ex post* evaluation of the ACT home energy-rating scheme will be undertaken before implementing the Ministerial Council on Energy decision to mandate building energy ratings across Australia. The Commission supports this approach.

It is not clear that energy-rating schemes for existing dwellings would deliver a net benefit (see, for example, the modest gains found by Gilmer (1989) for US house energy labelling). They impose administrative and compliance costs that inevitably get passed on, at least to some extent, to tenants and home buyers. Furthermore, it is questionable whether energy ratings are effective in increasing the adoption of energy efficiency measures. As noted in chapter 6, energy costs account for a very small part of expenditure by most households. Therefore, the decision to rent or purchase a dwelling is likely to be driven more by other considerations, such as the general amenity of the property and its proximity to schools, shops and workplaces.

The effectiveness of home energy ratings is also questionable because it is debatable whether energy performance can be measured accurately. George Wilkenfeld and Associates (2003a) noted some of the constraints on developing useful energy-performance ratings for homes:

- … The use of ratings as a guide to the purchase of existing dwellings … is limited by the fact that almost every dwelling is unique in its location, quality, affordability and suitability for the buyer.
- Unlike appliance ratings, house ratings cannot directly indicate probable resource consumption, running cost or environmental impacts. Those will depend on whether there is any heating or cooling equipment installed at all, its energy type and efficiency, and the patterns of use …
- Unlike appliance rating claims, which can be tested in the laboratory, house rating claims cannot be directly tested, even after a house is built. (It is even difficult to establish that a house has been built fully in accordance with the approved design). (George Wilkenfeld and Associates 2003a, pp. 34–5)

An alternative to mandating energy-performance ratings for existing dwellings, which may be more cost effective, is a voluntary rating scheme. The Australian Window Association (sub. 59) advised that it had developed a voluntary Window Energy Rating Scheme with assistance from the Australian Greenhouse Office (AGO) (appendix D). The scheme uses star ratings to indicate a window's energy efficiency. Voluntary rating schemes also exist for commercial and industrial buildings (chapter 7).

A voluntary rating scheme has the disadvantage that there is little incentive for building owners to use it unless their building is likely to get a favourable rating. In contrast, mandatory ratings could enable building purchasers and tenants to compare the energy efficiency of any prospective building against that of any other building offered for sale or lease. Whether this advantage outweighs the increased costs of a mandatory approach relative to a voluntary rating scheme is difficult to judge.

To further inform policy makers about the merits of mandatory ratings, the Commission therefore supports an evaluation of the existing ACT scheme, particularly to determine:

- the accuracy of home energy ratings in predicting the relative energy efficiency of different dwellings for a given home buyer or tenant; and
- the costs, benefits and effectiveness of the scheme, taking account of the diverse preferences and financial circumstances of individual home buyers.

FINDING 10.1

The Australian Greenhouse Office plans to commission an ex post *evaluation of the ACT home energy-rating scheme on behalf of all Australian governments. The results should inform the Ministerial Council on Energy decision to mandate building energy ratings across Australia.*

10.3 Minimum energy efficiency standards for new buildings

Mandatory energy efficiency standards are applied to new residential and commercial buildings, with the precise requirements often varying between jurisdictions. As part of the NFEE Stage One measures announced by the Ministerial Council on Energy (MCE 2004c), Australian, State and Territory Governments have indicated their intention to make such standards nationally consistent. This section describes current and proposed energy efficiency standards for buildings.

Building Code of Australia

At the national level, building energy efficiency standards are specified in the Building Code of Australia (detailed in appendix D). The Building Code currently includes mandatory energy efficiency standards for single dwellings (class 1); other residential buildings, such as apartment buildings, hotels and motels (class 2–4); and related structures, such as garages (class 10). Energy efficiency standards for other (class 5–9) buildings — including offices, shops, warehouses, factories and public health buildings — will be included in the Building Code in 2006.

The Australian Building Codes Board (ABCB), which is responsible for maintaining the Building Code, stated that energy efficiency standards help to overcome the information and split incentive problems that people face when buying a dwelling (sub. 7). However, the objective of the Building Code's energy efficiency standards is to 'reduce greenhouse gas emissions by efficiently using energy' (Building Code of Australia 2004 (volume 2), s.O2.6). This could be used to justify increases in energy efficiency that are not cost effective for individual producers or consumers.

Prescriptive and performance-based compliance methods

Compliance with the Building Code's energy efficiency standards can be demonstrated by using prescriptive 'deemed-to-satisfy' construction methods and materials detailed in the Building Code. The ABCB (sub. 7) noted that most building designers use the deemed-to-satisfy approach.

Alternatively, compliance can be demonstrated by using a performance-based verification method to show that a building's annual heating and/or cooling load will not exceed a specified level. An annual heating/cooling load is the quantity of energy that has to be delivered/removed from a space over a year in order to maintain a desired temperature.

For houses, there are three performance-based verification approaches that can be used instead of the deemed-to-satisfy provisions:

1. Demonstrate that the predicted annual heating and/or cooling load (requirements vary between climate zones) does not exceed that of a 'reference building' in the same location. The Building Code details the characteristics of the relevant reference building.
2. In northern climate zones, demonstrate that the predicted annual energy load (combined heating and cooling load) does not exceed the maximum permitted load for the relevant location (specified in table V2.6.1 (volume 2) of the Building Code of Australia 2004).
3. Show that the building achieves an energy (star) rating that is no lower than a specified minimum, based on its predicted annual energy load. The rating has to be determined in accordance with the ABCB (2005d) Protocol for House Energy Rating Software. This requires an algorithm that takes account of climate and how specific design features affect energy performance.

In essence, new houses built in northern climate zones are required to achieve a 3.5 star rating, while houses in southern climate zones are required to achieve a 4 star rating. A lower rating is permitted in northern climate zones because the rating algorithms available when the standards were formulated did not adequately account for the benefits of natural ventilation in hot climates. The ABCB (2004d) noted that work is being undertaken to address this issue.

The current minimum 3.5 star standard for houses in the Building Code was chosen because some jurisdictions already had a requirement that residential developments achieve a 3.5 star rating. It was considered:

> … unreasonable to consider options that are weaker than those already implemented in some jurisdictions, given the policy direction from Government, which is to 'improve energy efficiency'. (ABCB 2002, p. vi)

This suggests that the level of the building energy efficiency standards has not been based on a consideration of what is most cost effective among all possible standards. The regulation impact statement for the current standards acknowledged that no attempt had been made to select the minimum required star rating that would lead to the greatest net benefit (ABCB 2002). This was seen as being impractical because of:

> … the lack of available information about the intensity of heating and cooling demand in specific climate zones. It is not enough to know how many households use space conditioners; it is also necessary to know how intensively that equipment is used. (ABCB 2002, p. vi).

This raises questions about whether the energy efficiency standards in the Building Code are based on sound evidence.

Upgrading of Building Code standards

Since the energy efficiency standards for houses were adopted in January 2003, some jurisdictions have announced that they will require a higher minimum star rating than required under the Building Code. The ABCB (2004d) responded by initiating a review of the stringency of the Building Code's energy efficiency standards. It has now proposed that the minimum required energy rating for houses in all climate zones be raised to 5 stars in the May 2006 edition of the Building Code. This proposal is currently subject to a regulation impact assessment (ABCB 2005b).

In light of this, it appears that the stringency of the Building Code's housing requirements has again been driven largely by a desire to catch up to the most stringent State or Territory standard.

The ABCB (2005a) has indicated that standards for class 5–9 buildings will also be increased in stages, and this will be done in light of experience with the initial measures and after industry has adapted to those changes.

State and Territory standards for residential buildings

In essence, Queensland, South Australia, Western Australia, Tasmania and the Northern Territory have adopted the national energy efficiency standards in the Building Code.[1] The exceptions are New South Wales, Victoria and the ACT, which have implemented their own energy efficiency requirements for residential buildings.

In New South Wales, all new single and dual occupancy dwellings must be certified under the Building Sustainability Index (BASIX) scheme. From 1 October 2005, the BASIX scheme will also cover new multi-unit residential developments, and from 1 July 2006, all residential alterations and additions.

In order for a building to be certified under BASIX, thermal comfort and energy indices have to be calculated, and the value of these indices must be within prescribed bounds.

The BASIX thermal comfort index measures the thermal performance of a building's fabric. It is derived by either using simulation software to estimate a building's heating and cooling loads, or by demonstrating compliance with prescriptive 'deemed-to-comply' building materials and methods. Designers also have access to an 'expert opinion' compliance route if a building's heating and cooling loads cannot be simulated by software. At the time of writing this report, the deemed-to-comply method was only available for basic single storey dwellings. The NSW Government intends to eventually make the deemed-to-comply approach available to a wider range of building types.

The BASIX energy index is used as an indicator of actual energy use and emissions. It is derived by taking account of factors such as installed appliances and floor area, as well as the thermal performance of a building's fabric. This is a key difference from the building energy efficiency standards applied in other jurisdictions, which focus on the thermal performance of a building's fabric.

In Victoria, most new houses are required to achieve a 5 star rating for building fabric, and have either a solar hot water heater system or a rain water tank connected to all sanitary flushing systems (Victorian Building Commission 2005). The exceptions are houses of timber floor or earthwall construction, which until 30 April 2006 can be constructed to achieve either a 5 star rating for building fabric, or a 4 star rating and have either a solar water heater system or a rain water tank connected to all sanitary flushing systems. For class 2 buildings (those containing

[1] The Queensland Government (2004a) has proposed additional energy efficiency requirements for residential buildings.

two or more separate dwellings), an average 5 star rating is required for the whole building, and each sole occupancy dwelling within the building must not achieve a rating of less than 3 stars.

In most cases, a software package is used to demonstrate compliance with Victorian housing standards. The exception is the interim 4 star option for houses of timber floor or earthwall construction, which can be satisfied by following the deemed-to-satisfy provisions of the Building Code. Two software packages have been approved for use in Victoria (FirstRate and NatHERS). The rating scores generated by FirstRate are based on the energy loads predicted by NatHERS (Nationwide House Energy Rating Scheme), and so the two packages are closely related.

In the ACT, new residential buildings are required to achieve at least a 4 star rating under the ACT House Energy Rating Scheme (ACTHERS). Star ratings are calculated by using the FirstRate computer simulation package (ACT Land and Planning Authority 2004).

Environmental impact of the standards

Current standards for building energy efficiency target a relatively small proportion of Australia's energy use and greenhouse gas emissions. For example, residential building standards are designed to moderate home heating and cooling demand, which accounts for about 5 per cent of Australia's final (end use) energy consumption (Department of the Environment and Heritage, sub. DR86; Dr Terry Williamson, sub. 78) and, in 1999, was responsible for 2 per cent of Australia's greenhouse gas emissions (George Wilkenfeld and Associates and Energy Strategies 2002; ICANZ, AGGA and ABCSE, sub. DR144).

Building standards are therefore expected to make a minor contribution to emission abatement. The AGO has projected that, in 2020, 0.8 per cent of Australia's abatement of greenhouse gas emissions (relative to business-as-usual) will come from the Building Code's mandatory energy efficiency standards for residential buildings. A further 1.7 per cent is projected to come from the Building Code's standards for commercial buildings.[2]

[2] In 2020, the Building Code's residential building standards are expected to reduce Australia's greenhouse gas emissions by 1 megatonne carbon dioxide-equivalent, and the commercial building standards are expected to reduce emissions by 2 megatonnes (relative to business-as-usual) (AGO 2004l, pp. 31–2). All emission-reducing measures across the economy are projected to reduce Australia's greenhouse gas emissions by 121 megatonnes carbon dioxide-equivalent in 2020 (AGO 2004o, p. 14).

Despite the modest contribution to Australia's annual emission reductions, ICANZ, AGGA and ABCSE (sub. DR144) argued that the current policy emphasis on buildings is warranted because they have a much longer life span than other energy-consuming products. However, the current policy emphasis would only be justified if the marginal cost of abating greenhouse gas emissions is much lower for buildings than for other emission sources. There is no evidence that this is the case.

An additional concern is that current standards do not target many building-related emissions, such as those from manufacturing building components, and from constructing and demolishing buildings. As a result, the standards may not be as effective in reducing emissions as anticipated, particularly if they encourage the use of components that require more energy to manufacture.

Ideally, a life cycle approach should be adopted that takes account of all energy and emissions associated with a building from its inception until its eventual demolition and disposal, including the energy embodied in building materials. Such an approach was supported by various participants (including the Building Products Innovation Council, sub. 44; and Green Building Council of Australia, sub. 41).

The Timber Promotion Council (sub. DR141) noted that current standards fail to recognise the lower embodied energy and emissions of a suspended timber floor compared to a concrete slab. The Australian Wood Panels Association (sub. DR91) observed that the standards favour the use of high mass materials with high embodied energy. AMCER (sub. DR105) was concerned that the standards fail to fully recognise the lower embodied energy of earth wall construction.

The precise magnitude of energy and emissions overlooked by current building standards is difficult to determine from currently available data, but it appears that the embodied energy in buildings is significant (box 10.1). A report commissioned by the AGO noted the policy implications:

> Embodied energy and its resultant greenhouse gas emissions form a significant proportion of the life cycle energy of a residential building. Any measures designed to abate greenhouse gas emissions could not be considered to be comprehensive if they did not address this issue. (Energy Efficient Strategies 1999, p. 104)

Similarly, a home design manual on the AGO website advises that it is unacceptable to ignore embodied energy:

> True low energy building design will consider this important aspect [embodied energy] and take a broader life cycle approach to energy assessment. Merely looking at the energy used to operate the building is not really acceptable. (Milne and Reardon 2001, p. 1)

In addition, the relative importance of embodied energy increases over time if building standards are successful in constraining the amount of energy used for heating and cooling.

Box 10.1 **Relative importance of a building's embodied energy**

There are limited data on the embodied energy in buildings. However, the available estimates indicate that it is significant. For example, the CSIRO (nd, p. 1) has concluded:

> The embodied energy of a building is a significant multiple of the annual operating energy consumed, ranging from around 10 for typical dwellings to over 30 for office buildings. Making buildings such as dwellings more energy efficient usually requires more embodied energy thus increasing the ratio even further.

The importance of embodied energy is also evident in two case studies undertaken for the AGO. The first case study compared concrete versus timber floors for a given house design. The study found that a concrete floor would reduce emissions from occupants' operational energy use, but it would take 62 years for this benefit to outweigh the higher embodied emissions of a concrete floor:

> … the use of a concrete floor as a means of reducing operational energy consumption as compared to a timber floor is effective in the very long term and would result in a total operational primary energy saving of approximately 208 GJ over a 100 year building life span in the Western Sydney climate type. At this rate, the added embodied energy in the concrete floor as compared to the timber floor would be paid back in approximately 47 years … In terms of greenhouse gas emissions, this return period is higher at 62 years … making this strategy marginal in terms of improving the building's life cycle greenhouse gas emissions. (Energy Efficient Strategies 1999, p. 103)

The second case study compared the use of single versus double glazed windows, and reached a more favourable conclusion:

> … the use of a double glazing is an effective means of reducing operational energy consumption compared to single glazing and would result in a total operational primary energy saving of approximately 430 GJ over a 100 year building life in the Western Sydney climate type. At this rate the added embodied energy in the double glazed as compared to the single glazed house would be paid back in approximately 9 years … In terms of greenhouse gas emissions this payback period is approximately 12 years … making this strategy effective in terms of improving the building's life cycle greenhouse gas emissions. (Energy Efficient Strategies 1999, p. 104)

Dr Terry Williamson (sub. 78) estimated that 145 petajoules of primary energy and 8.2 megatonnes of carbon dioxide equivalent emissions are embodied in the new houses built in Australia each year. In comparison, he noted that the energy consumed in heating and cooling all dwellings (not just new ones) was around 180 petajoules of primary energy in 2001-02, and the associated emissions were 8.7 megatonnes of carbon dioxide equivalent.

Energy Efficient Strategies (1999) suggested that an adjustment factor could be applied to residential building ratings to account for embodied energy. For example, it noted that a four star house (based on heating and cooling loads) using low embodied energy materials could be rated as equivalent to a five star house using higher embodied energy materials. A similar approach has already been adopted by the Green Building Council of Australia in its 'Green Star' rating scheme for office buildings. The Council noted that its rating methodology takes account of embodied energy by awarding credits for the use of recycled steel and for replacing cement with less energy-intensive materials (sub. 41, p. 3).

However, attempts to incorporate embodied energy into a building rating scheme would be very imprecise. There are limited data available on embodied energy and the accuracy of the data is questionable (Energy Efficient Strategies 1999; Milne and Reardon 2001; Drogemuller et al. 1999). Such data would have to be generalised across a wide range of circumstances in order to make a rating scheme operational. In addition, it would be difficult to maintain the timeliness of embodied energy data, given that the processes used to manufacture building materials change over time.

In conclusion, the Commission considers that the current approach of ignoring many building-related emissions has undermined the effectiveness of building standards in reducing Australia's energy use and emissions. A more comprehensive life cycle approach could address this problem, but it would be difficult to implement.

10.4 Are building standards cost effective for individuals?

While the goal of building energy efficiency standards is to raise the wellbeing of society as a whole, governments often promote the standards as also being beneficial for individuals. For example, in a promotional brochure for Victoria's 5 star housing standards, the Minister for Planning claimed:

> … it is clear that the environment is not the only beneficiary of the new 5 star standard. Consumers will reap many benefits from the standard as well.
>
> 5 star will deliver higher quality and more comfortable homes with lower running costs, at the same time as reducing greenhouse pollution and stimulating economic and employment growth for Victoria. (Victorian Government nd, p. 3)

More specifically, the Victorian Government's promotional material advises individuals that the 5 star standard will generally be cost effective for them:

> Industry experts experienced in 5 star energy efficiency rating have reported that the average house may cost less than $1000 extra to build to the 5 star standard. However, for some designs there may be no cost difference. Generally the ongoing savings in

energy bills for heating and cooling, and lower water bills will more than compensate for any increase in building costs. (Victorian Government nd, p. 5)

Whether building energy efficiency standards are indeed cost effective for an individual producer or consumer will depend on:

- how effective the standards are in reducing the individual's energy use
- whether the resulting benefits to the individual outweigh the associated costs.

Analysis in the following sections indicates that there is considerable uncertainty about these two issues, and as a result there is an urgent need for an *ex post* evaluation of building energy efficiency standards.

How effective are the standards in reducing energy consumption?

The effectiveness of current building energy efficiency standards in reducing energy consumption has not been tested comprehensively.[3] Instead, policy makers have assumed that the energy savings predicted in regulation impact assessments and supporting research have been realised in practice. This is unlikely because the predictions are based on many questionable assumptions, and they ignore numerous practical problems in implementing the standards.

Assumptions used to predict energy savings

Predicting the energy savings that result from a building standard is difficult because it depends on numerous factors, many of which are not well understood.

An important example is the behaviour of a building's occupants. This is likely to be a major determinant of how much energy is saved with a building standard, but there is remarkably little data available about the behaviour of building occupants. Nevertheless, it is obvious that occupant behaviour varies markedly across the population and this will lead to considerable diversity in the energy saved by individuals.

Another important determinant of energy savings will be the type of heating and cooling appliances an occupant uses, and how efficient those appliances are. Again, this is likely to vary considerably across the population, but limited data are available on this issue.

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3 Energy Efficient Strategies (2000) examined the impact of Victoria's mandatory insulation requirements (introduced in 1991), but it simulated (rather than measured) energy savings for individual dwellings (using FirstRate software) and relied on many questionable assumptions due to the limited availability of data on issues such as appliance efficiency and user behaviour.

A further consideration is the engineering relationship between a building's physical properties and its energy use for given occupant behaviour and appliances. Attempts to model this relationship for housing have been underway in Australia for some years, with the models being continually updated as researchers endeavour to fix known deficiencies. A recent focus has been on improved modelling of the benefits of ventilation in tropical climates. Such amendments are likely to be ongoing for the foreseeable future because the complex relationship between energy use and a building's physical characteristics is far from fully understood (discussed further below).

Given the above, any prediction of energy savings can only be based on a limited understanding of important determinants of building energy use. Examples of the many questionable assumptions used to predict energy savings from current standards are given in box 10.2. The ABCB (sub. 7, p. 9) acknowledged that 'in developing the BCA [Building Code of Australia] energy efficiency measures, some technical and policy decisions have had to be made on limited or anecdotal evidence due to the lack of energy data'.

ICANZ, AGGA and ABCSE (sub. DR144) and Tony Isaacs (trans., p. 751) noted that the uncertainty created by a lack of data on occupant behaviour has been compensated for in regulation impact assessments by using conservative assumptions. However, whether the assumptions have been conservative cannot be demonstrated objectively, given the limited available data and incomplete scientific knowledge about building energy use.

Another important assumption that is open to question is the business-as-usual projection of energy consumption. This is important because predicted energy savings are derived by calculating the difference between expected energy use under a standard and that expected under business-as-usual. As noted in chapter 5, the development of a business-as-usual projection (even one that assumes no change) involves judgements about many aspects of the future that are highly uncertain, such as future changes in the cost of energy saving technologies, relative prices, and the rate of capital turnover.

ICANZ, AGGA and ABCSE (sub. DR144, p. 30) claimed that the business-as-usual projections used to assess energy efficiency standards for buildings are sound because they 'are based on immediate past trends [and so] any natural increase in efficiency [that is, not caused by the standards] should be captured'. However, past trends are not necessarily reliable indicators of future events, and so business-as-usual projections of energy use will always have an element of uncertainty.

Box 10.2 **Assumptions used to predict building energy savings**

Many questionable assumptions are used in regulation impact assessments to predict energy savings from building standards. Some of these are mentioned below.

Residential buildings

Assumptions about how householders use heating and cooling appliances are largely based on a survey conducted about 20 years ago by the ABS (1986). To reflect changes in usage patterns since the 1980s, ad hoc adjustments are made to these historical data.

Assessments are typically based on a small number of building designs. For example, the current Building Code standards were assessed by examining only two house designs — a small 1 storey house and a large 2 storey house. The proposed upgrade of the Building Code standards was assessed on the basis of four house designs.

It is usually assumed that improved building energy efficiency will cause smaller (and hence less costly) heating and cooling appliances to be used, with the extent of this downsizing based on judgments by the analyst. Assumptions are also made about the energy efficiency of appliances on the basis of limited evidence. For the Victorian 5 star standard, it was assumed that the average efficiency of appliances would remain unchanged over the 40 year assessment period.

Simulation models, such as NatHERS and FirstRate, are used to predict energy savings. For the proposed upgrade of the Building Code standard, arbitrary adjustments were made to the simulated energy savings in order to compensate for inadequacies in the modelling. For example, the simulated energy saving for cooling was adjusted upwards by 150 per cent in climate zone 5 (Sydney). It was also assumed that only 25 per cent of total approvals will use the deemed-to-satisfy compliance method.

Nonresidential buildings

Simulated energy savings from deemed-to-satisfy compliance are assumed to eventuate, despite evidence that building construction, commissioning and maintenance could significantly weaken any relationship between simulated and actual energy use. The ABCB (2005a, p. 46) acknowledged it was possible that ‘the required design improvements will not deliver on their full potential in the absence of other complementary measures’.

For class 5–9 buildings, the business-as-usual scenario assumed a basic building with minimal attention to energy use. The Property Council of Australia criticised this as being contrary to current industry practice. There was also limited consideration of the variability of energy use within each building class. While buildings were allocated to one of three occupancy profiles (office, retail or school), this would not reflect the diversity of energy requirements between, for example, a restaurant and a jeweller.

Sources: ABCB (2002, 2005a, 2005b); Energy Efficient Strategies (2002); Property Council of Australia (2005).

Practical problems overlooked when predicting energy savings

The predicted energy savings overlook real-world problems that are encountered in implementing building standards. These implementation problems lead to uncertainty about what energy savings are achieved in practice. This section focuses on four sources of uncertainty:

- standards can be difficult to enforce;
- there is more than one compliance method, they lead to different energy savings, and the proportion that will use each compliance method is uncertain;
- deemed-to-satisfy requirements allow few tradeoffs between design features, making it unlikely that energy savings will be consistent from one building to the next; and
- energy savings using a performance-based compliance method are uncertain because the required performance is not specified in terms of energy consumption, and there are doubts about the accuracy of the performance measurement techniques.

Standards can be difficult to enforce

It can be difficult (and costly) to ensure compliance with building energy efficiency standards, especially when detecting non-compliance requires thorough on-site inspections of all new buildings. Laurie Virr (trans., pp. 676–7) noted that there is a degree of non-compliance with roof insulation requirements, despite building certifiers supposedly having a responsibility to check this. The ABCSE (2005) commented that there has been little effort by the Victorian Government to ensure that the quality of installations and the products used meet standards. ICANZ, AGGA and ABCSE (sub. DR144) urged more regulation in order to ensure that expected energy savings for commercial buildings are not undermined by poor commissioning and maintenance of systems. The extent of compliance problems is uncertain and, as a result, the extent of energy savings will also be uncertain.

Different compliance methods deliver different energy savings

The actual energy saving achieved by a particular individual will vary according to which compliance method is used (ABCB 2005b; Energy Efficient Strategies 2002; Master Builders Queensland, sub. DR90). This is because performance-based methods allow tradeoffs to be made between different design features in order to achieve a target level of energy efficiency, whereas deemed-to-satisfy methods allow few such tradeoffs. Divergent outcomes could also occur because several different performance-based methods are allowed.

This issue is most relevant when the national Building Code applies. It is less relevant for residential buildings in New South Wales and Victoria, because they are subject to state-based requirements that provide limited scope to use anything other than a single performance-based compliance method (appendix D).

It is uncertain how actual energy savings vary between different compliance methods, and what proportion of builders use each of those methods. Thus, the extent to which building standards have reduced individuals' energy consumption is also uncertain.

Uncertainty about deemed-to-satisfy outcomes

The limited scope to make tradeoffs under the deemed-to-satisfy method means that outcomes will be distributed around a particular level of energy efficiency, rather than meeting that level in most cases. Very little is known about the distribution of outcomes under the deemed-to-satisfy method, including how widely dispersed actual outcomes are, and what proportion of buildings end up below the intended level of energy efficiency. This, in turn, leads to uncertainty about the actual energy savings that particular individuals will achieve under a deemed-to-satisfy method.

Uncertainty about performance-based outcomes

The distribution of outcomes with performance-based compliance methods may also be uncertain because:

- the performance requirement is not specified in terms of energy consumption
- there are doubts about the accuracy of performance measurement techniques.

Performance requirement not specified in terms of energy consumption

The performance-based requirements in the Building Code are specified in terms of heating and cooling loads (collectively termed an energy load), which have the following meanings:

> Cooling load means the calculated amount of energy removed from the cooled spaces of the building annually by artificial means to maintain the desired temperatures in those spaces.
>
> Heating load means the calculated amount of energy delivered to the heated spaces of the building annually by artificial means to maintain the desired temperatures in those spaces. (Building Code of Australia 2004 (volume 2), s.V2.6, p. 88)

Heating and cooling loads that maintain desired temperatures do not measure actual energy consumption because:

- they ignore the energy lost by appliances in converting one form of energy into another (or gained in the case of a heat pump);
- not all buildings have the assumed heating and/or cooling appliances;
- many occupants allow indoor temperatures to fluctuate to some extent with changes in external conditions, rather than maintain the assumed temperatures;
- dwellings are often unoccupied for a large part of the day and for some weeks of the year, and this can differ markedly from the assumed occupancy pattern;
- heating and cooling is often restricted to certain parts of a dwelling, which can be very different from the assumed behaviour; and
- climate variation over a year can differ from the assumed weather pattern.

In essence, policy makers have sought to isolate the impact of a building's design from the many other factors that affect its energy consumption, such as occupant behaviour, appliance efficiency, whether heating and cooling equipment are installed, and inter-year variability in climate. As a result, the performance-based requirements target few of the determinants of a building's actual energy consumption.

If, for a given building and occupants, energy load and actual energy consumption are highly correlated, then the performance-based standards are more likely to be effective. But it cannot be assumed that such a strong correlation exists.[4] Both the Department of the Environment and Heritage (sub. 69) and Dr Terry Williamson (sub. 78) noted that the behaviour of a given householder may not be independent of a building's characteristics. In some cases, the interaction between householder behaviour and building characteristics could be counter intuitive. For example, the Department of the Environment and Heritage commented:

> Early field studies into the effect of insulation showed that savings attributed to insulation were found to be less in the field than would be predicted by thermal performance simulation.
>
> One possible theory developed to explain the difference between observed and simulated energy savings is the hypothesis known as 'comfort creep'. In an uninsulated house, it is suggested that the thermal performance of the house is so poor that it is difficult to maintain reasonable levels of comfort at an affordable cost, if at all. In houses which have installed insulation it is suggested that some of the improved

[4] The ABCSE (sub. DR121) submitted a review of Australian studies that have linked building fabric efficiency with energy consumption. However, most of the studies were quite dated (going back as far as the early 1980s) and none evaluated the effectiveness of the current simulation algorithms used for performance-based building standards.

> performance is used to improve comfort i.e. heat larger areas and/or heat to higher temperatures. Consequently the actual energy savings are significantly less than the theoretical energy savings.
>
> It should be noted that this is not the only possible explanation, and other theories may explain this phenomenon. (sub. 69, p. 18)

Master Builders Australia (sub. DR122) argued that a better approach would be to include the energy efficiency of appliances in a building's energy rating, so tradeoffs could be made between appliance efficiency and building fabric. Moreland Energy Foundation Ltd (sub. DR115) also favoured the inclusion of installed appliances in building standards. As noted previously, the BASIX requirements in New South Wales already take account of a building's appliances and other factors that can influence actual energy use and emissions (appendix D).

In contrast, Dr Angelo Delsante (sub. DR 126) commented that it is inappropriate to take account of the energy efficiency of appliances because they have a shorter life span than the buildings they are installed in.

Doubts about the accuracy of performance measurement techniques

In many cases, builders have the option of using a computer simulation program to demonstrate compliance with a performance-based standard. Such programs predict a building's energy load based on key variables, such as floor area, window sizes and building fabric. In New South Wales and Victoria, the use of simulation software is essentially compulsory for most residential buildings.

An underlying assumption of the performance-based standards, and the use of simulation software in particular, is that the relationship between particular building features and energy efficiency is well understood. Dr Terry Williamson questioned this:

> Improving dwelling energy efficiency, rather than being a straightforward matter as implied in the existing regulations and rating schemes, is far from understood. The evidence submitted here based on data from surveys and case studies reveals that:

- results are often counter intuitive (effects seem opposite to computer model predictions);
- results are often confounding … ; and
- results are often inconclusive (small sample sizes, incomplete data of existing studies). (sub. 28, pp. 2–3)

Dr Williamson submitted case study results for six houses that had won awards from the Royal Australian Institute of Architects. The houses had below-average energy consumption, but achieved only a 0 or 1 star rating using approved simulation software:

> Each house was rated using NatHERS and/or FirstRate software and results compared with actual consumption and AGO projected average house consumption for the areas ... The houses in each case were built prior to the introduction of mandatory energy efficiency regulations. Despite each of these houses having energy consumption results well below the 'average' house in the location, based on the star rating results, none could now be built because they do not achieve the required rating criteria. (sub. 28, p. 25)

In the draft report for this inquiry, the Commission noted that Dr Williamson's case studies raised doubts about the effectiveness of building standards in reducing individuals' energy consumption. Many advocates of the standards responded with a critique of the case studies and asserted that an appropriate reinterpretation of the results actually supported the argument in favour of standards (Tony Isaacs, trans., pp. 736–41; ICANZ, AGGA and ABCSE sub. DR144; Clive Blanchard, sub. DR108 and DR135; Dr Angelo Delsante, sub. DR126). ICANZ, AGGA and ABCSE (sub. DR144) noted that occupants of the case study houses had conserved energy by allowing temperatures to move outside accepted comfort standards.

Dr Williamson (sub. DR133) disagreed with the criticisms and repeated his concerns about the current performance-based approach to regulating building energy efficiency. Many other parties also questioned the current approach (for example, Timber Promotion Council, sub. DR141; Master Builders Australia, sub. DR122; Master Builders Queensland, sub. DR90; Housing Industry Association, sub. DR130; Laurie Virr and Paul Hanley, sub. DR99; Australian Wood Panels Association, sub. DR91; AMCER, sub. DR105; Royal Australian Institute of Architects, sub. DR124; Green Building Council, sub. DR137; Property Council of Australia 2005).

The Commission therefore notes that there is considerable disagreement among technical experts and other interested parties about the effectiveness of the performance-based standards. It is also evident that the debate has largely been taking place in an 'information vacuum'. The Commission is particularly concerned that the advocates of building energy efficiency standards have focused on criticising a handful of case studies submitted by Dr Williamson, rather than producing more detailed and comprehensive evidence on the effectiveness of current performance-based standards. Dr Williamson (sub. DR133, p. 1) stressed that his 'intention was not to present conclusive data, rather to demonstrate the paucity and inconsistency of existing evidence'. The onus of proof should rest with those advocating standards, given that the standards are mandatory and have the potential to impose sizeable costs on many Australians.

It should also be noted that there has been an ongoing history of deficiencies being identified in the simulation packages that have subsequently led to amendments. For example, the FirstRate package was modified after it became apparent that there were errors in how interactive effects between solar gains and uncarpeted floors and internal masonry walls were modelled. Similarly, NatHERS was recently revised, and relabelled as AccuRate, to recognise the benefits of ventilation in tropical climates (Department of the Environment and Heritage, sub. DR69; Tony Isaacs, p. 14, attachment to ICANZ, sub. DR94). The Timber Promotion Council (sub. DR141) noted that the revisions are also expected to address a bias NatHERS had against the use of suspended timber floors. The AccuRate software is currently undergoing trials (Department of the Environment and Heritage, sub. DR131). Amendments have also been made to simulation algorithms to remove a previous bias in favour of larger homes (ICANZ, AGGA and ABCSE, sub. DR144).

This process of ongoing changes in how performance is measured is likely to continue, given the complex scientific relationship between a building's physical features and its energy efficiency. For example, Dr Angelo Delsante noted a deficiency in the current approach that he considered required further changes:

> … the current way in which heating and cooling energy loads are used to derive a rating or target is not satisfactory, because they are simply added together. Doing so is physically incorrect: if heating and cooling loads are to be added, then appliance efficiency must be taken into account before doing so. But this then leads to complications … Thus this submission suggests that … separate ratings … be given for heating and cooling ... (sub. DR126, pp. 4–5)

For nonresidential buildings, Exergy Australia (sub. 40) mentioned a survey of 66 commercial buildings in Sydney that showed there was virtually no connection between design features and actual energy performance. A number of potential factors (most of them not related to tenant behaviour) could explain the weak relationship between design and actual energy use. These include poor commissioning of the building, poor workmanship, issues with the control of the hardware that determines energy use within a building, and design details not being captured in computer simulations.

Do the financial benefits of standards outweigh the associated costs?

Most of the publicly available information on the cost effectiveness of current building energy efficiency standards is in regulation impact assessments and supporting research. While regulation impact assessments are only required to assess whether society as a whole would be better off with a proposed regulation, assessments of building energy efficiency standards also examine the impact on individuals.

Box 10.3 **Predicted private cost effectiveness of building standards**

Regulation impact assessments typically predict that individuals will benefit financially from complying with a building energy efficiency standard.

Current housing standards (Building Code)

For an ‘average house’ (floor area of 200 square metres), the current requirements in the Building Code were predicted to deliver a net benefit of **$712** in present value terms. This was based on an expected increase in construction costs of $1147, a reduction in appliance capital costs of $170, and a fall in energy costs of $1689 over 30 years (using a discount rate of 5 per cent).

Proposed upgrade of housing standards (Building Code)

For a ‘representative’ house, the proposed upgrade of Building Code standards was predicted to deliver a net benefit ranging from **$205 to $1207**, depending on climate zone (excluding a ‘synthetic alpine zone’ meant to represent the small minority of populated areas that have snow during winter). The predicted increase in construction costs ranged from $432 to $1332, the expected fall in appliance costs was $0–$131, and the reduction in lifetime energy costs was $510–$2490 (using a discount rate of 6 per cent) (excluding the alpine zone).

Victorian 5 star housing standards

For the average household, Victoria’s 5 star standard was predicted to deliver a net benefit of **$861** in present value terms. This was based on an expected increase in construction costs of $3280 and a fall in energy costs of $4141 over 40 years (using a discount rate of 4 per cent).

Class 5–9 buildings (Building Code)

Across all capital cities, the net benefit was predicted to be **$41–$115 per square metre** for a typical three storey office building, **$37–$145 per square metre** for a large single storey shopping centre, and $**40–$100 per square metre** for a medium-sized school building. For most building types and locations, the increased construction cost was assumed to be offset by cost savings from smaller plant and equipment. For example, the increase in construction costs for a three storey office building in Melbourne was predicted to be $15 per square metre, which was outweighed by a reduction in plant and equipment costs of $28 per square metre.

Sources: ABCB (2002, 2005a, 2005b); Energy Efficient Strategies (2002).

The regulation impact assessments for current building energy efficiency standards predict that the standards are cost effective for individuals (box 10.3). However, the net financial benefits for housing are small compared to the cost of a dwelling. The predicted net benefits for nonresidential buildings are generally larger. For example, the ABCB (2005a) predicted that the net benefit would be 2–7 per cent of construction costs for a typical three-storey office building.

There has not been an *ex post* evaluation of whether individuals have in practice received the predicted net financial benefits of current standards. The Commission considers that there is an urgent need for such evaluation because the predictions are unlikely to be robust. Concerns about the benefit and cost predictions are outlined below.

Predicted financial benefits

A key benefit to individuals is that they spend less on energy than otherwise. However, as noted previously, there is considerable doubt about the accuracy of the predicted energy savings. In addition, converting these questionable energy savings into financial terms requires assumptions about what fuels are used and what tariffs the building occupant faces for those fuels.

An additional problem in valuing benefits is that they typically occur in small increments for many years into the future, whereas the cost of meeting standards is borne upfront. Regulation impact assessments typically use a net present value decision rule to address this issue. This involves applying a discount rate to future financial benefits to convert them into their present values (appendix F).

These regulation impact assessments typically assessed private cost effectiveness on the assumption that individuals use the estimated social opportunity cost of capital as their discount rate. As noted in chapter 5 and appendix F, the Commission considers this to be questionable. The average private discount rate is likely to be higher than the estimated social discount rate used in regulation impact assessments, and so the benefits to individuals could be less than those predicted. In any case, if private cost effectiveness is being assessed, then the private opportunity cost of capital for the relevant individual should be used.

Building energy efficiency standards may not be privately cost effective if a higher discount rate is used. The Queensland Government (2004a) found that every one percentage point increase in the discount rate reduced the net benefit of its proposed regulations by 20 per cent. In its assessment of the proposed upgrade to housing standards in the Building Code, the ABCB (2005b) found that the net benefit fell from $194 million to $44 million when the discount rate was increased from 6 per cent (the base case) to 9 per cent. It could be argued that, on the basis of observed behaviour, even a 9 per cent discount rate is too low to assess private cost effectiveness, particularly for less affluent individuals (Train 1985; Sutherland 2003).

Predicted financial costs

It is also evident that *ex post* verification of predicted financial costs is required. Like the predictions for energy savings and financial benefits, many questionable assumptions have been used to predict costs.

For example, Master Builders Australia (sub. DR122) questioned the cost of the proposed upgrade of housing requirements in the Building Code. It noted that the ABCB (2005b) had based its predicted cost on a 2002 study for Victoria's 5 star housing standard. Master Builders Australia (sub. DR122, p. 4) claimed that the study 'grossly underestimated' building costs in 2002, and would now be even more inaccurate because building costs have increased by about 20 per cent since 2002. Master Builders Queensland (sub DR90) questioned the relevance of a Victorian study to other areas of Australia.

The limited available evidence on outcomes under current standards suggests that actual costs have been very different from those predicted.

ICANZ, AGGA and ABCSE (sub. DR144) noted that a large building company had been able to satisfy the Victorian 5 star housing standard for less than half the average cost predicted by the Victorian Government.

However, more comprehensive evidence gathered by the Victorian Building Commission indicates that, in many cases, cost increases have been much higher than predicted. The Building Commission had predicted that the cost of a new house would rise by 0.7–1.9 per cent due to the 5 star standard (Victorian Building Commission 2002). In contrast, a survey of 600 builders undertaken in February 2005 for the Building Commission (with assistance from the Housing Industry Association) found that actual cost increases have often been far higher:

> The data suggest that residential building costs have increased as a result of builders achieving standards in this area, with the median estimate of such a cost increase in the range of 3 to 5 per cent … Excluding those that answered 'don't know', the mean additional cost incurred was 6.04 per cent. (Chant Link and Associates 2005, pp. 9 and 50)

Other surveys have also found that the costs of Victoria's 5 star housing standard have been much higher than predicted:

- A survey by Master Builders Australia (sub. DR122) of its members revealed that the cost of a three-bedroom brick-veneer dwelling had increased by between

$13 000 and $18 000, depending on design and location. In comparison, the Victorian Government had predicted that the average increase in the cost of a house would be $3300 (Victorian Building Commission 2002).

- The Timber Promotion Council (sub. DR141) found that the average cost increase in climate zone 6 (Melbourne) has been $28 per square metre, whereas the ABCB (2005b) had predicted a weighted average increase of less than $4 per square metre.
- The Victorian Competition and Efficiency Commission (2005) found that Victoria's 5 star housing standard had increased the cost of an 'average house' by 2.5–6.0 per cent, with the exception of one builder who thought the cost increase was negligible.

Master Builders Association Queensland (sub. DR90) submitted a detailed costing for the proposed upgrade of deemed-to-satisfy housing provisions in the Building Code. It showed that the cost increase for a sample four-bedroom house in Cairns would be at least $9359 (7.3 per cent). In comparison, the draft regulation impact statement (ABCB 2005b) predicted an average cost increase of only $478 for Australia's northern climate zone.

Net financial benefit to individuals

Given the above-mentioned uncertainty about the financial benefit and cost estimates, the Commission considers that the predicted net benefits of building energy efficiency standards are not robust.

Whether the standards are beneficial for individuals (or indeed society as a whole) can only be adequately resolved by governments undertaking comprehensive *ex post* evaluations. While this may be costly, it should nevertheless be a priority because the standards are mandatory and have the potential to impose considerable costs on many Australians.

The experience of other countries confirms the urgent need for *ex post* evaluations. In the few cases where countries have undertaken such evaluations, they have found that building standards are far less effective in reducing energy consumption than policy makers had predicted (World Energy Council 2004).

The ABCB acknowledged that the net benefit could be marginal for its proposed upgrade of housing standards (class 1 and 10 buildings):

> The benefit–cost ratio is relatively low and, under alternative assumptions in regard to the amount of energy saved or the value of energy, the proposal would be seen as more marginal. Certainly there are some areas of Australia, such as Brisbane and areas with

similarly mild climates, where the use of heating and cooling systems is minimal and it seems likely that the benefits will be about equal to the costs. (ABCB 2005b, p. iii)

For residential buildings other than houses (class 2–4), the ABCB (2004a) predicted a net benefit of only $13 million (excluding an $8 million valuation for reduced greenhouse gas emissions). The use of different plausible assumptions could lead to a net cost. For example, the ABCB found that its net benefit prediction was very sensitive to what discount rate was used. An increase in the discount rate from 5 per cent (the default assumption) to 7 per cent nearly halved the net benefit. As noted in chapter 5, firms frequently require much higher returns for an investment to be seen as being cost effective (one survey found that firms used a discount rate of 12–15 per cent).

In contrast, the ABCB (2005a) predicted a large net benefit ($2647 million) for the proposed class 5–9 building standards. However, this probably significantly overstates what will be achieved in practice, because the business-as-usual scenario was ‘a basic building with minimal attention to energy efficiency’ (ABCB 2005a, p. 46). The Property Council was critical of this approach:

> No attempt has been made to investigate the current state of the market, nor has there been any recognition that the market has come a long way in the last six years. This means that the overall savings … are … overstated. (Property Council 2005, p.39)

The Property Council of Australia (2005) and Master Builders Australia (sub. DR122) also claimed that the predictions for nonresidential buildings failed to fully account for implementation costs.

FINDING 10.2

There is considerable uncertainty about the extent to which building standards have reduced energy consumption and emissions. In addition, it is doubtful that the net financial benefits predicted in regulation impact assessments have been achieved in practice. The limited available evidence suggests that the costs of current standards have been much higher than were predicted.

10.5 Areas for improvement in the assessment of standards

In its review of building regulation, the Commission found that the ABCB had a good record of compliance with the requirements for regulation impact statements, but there was nevertheless scope for improvement (PC 2004a). On the basis of this inquiry, the Commission now considers that improved assessment procedures could also be adopted for state-based standards.

If claims of private cost effectiveness are to be robust, then future regulation impact assessments and *ex post* evaluations of building energy efficiency standards need to include a more thorough consideration of the following:

- comparison with options other than mandatory standards
- consequences of heterogeneity among individuals and buildings
- tradeoff between compliance cost and effectiveness
- loss of building features that individuals value more than energy efficiency
- potential discouragement of innovation and productivity growth
- potential adverse health effects on building occupants
- relevance of the decision rule to the affected individuals.

Comparison with options other than mandatory standards

Regulation impact assessments rarely compare mandatory building energy efficiency standards with other options, such as changing occupant behaviour through the widespread installation of 'smart' electricity meters, or publicity campaigns to raise awareness about cost-effective building designs. This is of concern because mandatory building energy efficiency standards are not necessarily superior to other approaches.

The ABCB (2005b) justifies its non-examination of other options on the grounds that the Australian, State and Territory Governments have agreed to include mandatory energy efficiency requirements in the Building Code, and this has the support of industry. In addition, the ABCB's ability to consider other options is probably constrained because it has been established primarily to develop nationally consistent building regulation through the Building Code. This constraint may require changes in policy making arrangements.

Consequences of heterogeneity among individuals and buildings

There is considerable heterogeneity among buildings and their occupants. This is likely to lead to a very wide distribution of outcomes from building standards, including possibly a large group of individuals who are made worse off. For example, many Queensland homes north of Brisbane do not have heating or cooling equipment (ABCB 2005b; Master Builders Queensland, trans., pp. 526–7). Thus, there will be few financial benefits in that region to outweigh the costs of building energy efficiency standards.

Regulation impact assessments have tended to overlook the consequences of heterogeneity by assessing impacts for a very limited number of building designs and usage patterns (box 10.2).[5] It is therefore doubtful that predicted outcomes are close to the average or median of the distribution. In any case, there needs to be more detailed analysis and reporting of how benefits and costs are distributed across the population of buildings and their occupants.

Of particular concern to governments will be the distribution of benefits and costs across socioeconomic groups. Building standards could be regressive if the proportionate increase in capital costs tends to be greatest for cheaper homes, and such homes are typically bought by less affluent people. ICANZ, AGGA and ABCSE (sub. DR144) commented that there is no evidence to suggest this is the case. However, Master Builders Queensland (sub. DR90) submitted a detailed costing for a sample house in Cairns that it considered illustrated the potential for regressive impacts.

The Victorian Building Commission (2002) observed that householders who spend a lot of time at home are the ones who benefit most from building standards because they have the greatest demand for heating and cooling in their homes. Conversely, many people who occupy a dwelling for shorter periods, such as those in full-time employment and those who own a holiday home, could be made worse off by building energy efficiency standards.

ICANZ, AGGA and ABCSE (sub. DR144) noted that it is rare for low heating and cooling demand to continue over the life of a house or household, because of factors such as the birth of children and retirement from employment. The implication is that standards will eventually generate net financial benefits for most households. Greater examination of this issue in regulation impact assessments would be useful. In some cases, the benefits may be so distant in the future that, after application of an appropriate discount rate, the financial benefits are still lower than the upfront capital cost. In addition, demographic changes, such as a falling number of children per family and the growing significance of single person households, could reduce the number of households for whom the building standards are privately cost effective.

5 An exception was the study by Energy Efficient Strategies (2002) for the Victorian 5 star housing standard, which simulated impacts for 240 houses and 112 flats, using 8 orientations and 2 floor types across 5 climate zones.

Tradeoff between compliance cost and effectiveness

The ABCB (2004a) has described the Building Code as being performance-based and concluded that this leads to lower compliance costs. But in a submission to this inquiry, the ABCB (sub. 7) noted that most building designers use the prescriptive deemed-to-satisfy provisions rather than the performance-based provisions of the Building Code. Thus, it appears that many practitioners view the performance-based options in the Building Code as more costly than following the deemed-to-satisfy provisions. This could be the right decision in many cases, particularly for smaller operators who do not have the resources to investigate innovative new building approaches (Master Builders Australia, trans., p. 608). Thus, the Commission is not urging the removal of deemed-to-satisfy provisions.

However, from a policy-maker's perspective, the effectiveness of a deemed-to-satisfy provision in raising energy efficiency could be less certain than for a performance-based standard. This is because the deemed-to-satisfy approach generalises the energy performance of particular construction materials and methods to all buildings, and allows few tradeoffs.

The 5 star standard for houses in Victoria avoids this problem by not providing a deemed-to-satisfy option. The Victorian Building Commission (2002) argued in favour of this approach because the thermal performance of buildings is too complex to define effectively using prescriptive standards. It also noted that prescriptive standards must be conservative to ensure that even worst-case designs achieve a minimum standard, and this inflexibility contributes to uneconomic outcomes for average designs. Master Builders Australia (trans., p. 607) claimed that such a problem is evident with the deemed-to-satisfy provisions in the proposed upgrade of Building Code housing standards.

In its regulatory proposal to upgrade housing energy efficiency standards in the Building Code, the ABCB (2004d) indicated a preference for a purely performance-based approach. But the ABCB noted that most jurisdictions are unwilling to move to purely performance-based standards because the deemed-to-satisfy method provides a straightforward compliance path for building practitioners.

The Commission considers that future assessments of the net financial benefits to individuals should give greater attention to differences in the effectiveness and compliance costs of deemed-to-satisfy versus performance-based standards. There should also be a more detailed examination of what proportion of builders use particular compliance options and why.

Loss of building features that individuals value more than energy efficiency

Some home buyers may prefer to have a less energy-efficient home if that is what is required to obtain certain highly-valued characteristics. Building energy efficiency standards have the potential to prevent well-informed consumers from making such decisions. Similarly, well-informed purchasers of nonresidential buildings may want to forgo the energy savings from a building standard because the standard causes more highly valued characteristics to be lost. That is, building energy efficiency standards could ban products that some producers and consumers want to buy, even when they are aware of the lower energy efficiency and potentially higher running costs. In such cases, the standard is not cost effective for the individual.

Potential to discourage innovation and productivity growth

Standards distort the building market in favour of designs that use prescribed building materials and methods (in the case of deemed-to-satisfy compliance options) or satisfy particular performance measurement algorithms (in the case of performance-based compliance). This has the potential to cause more cost-effective improvements in energy efficiency to be overlooked, particularly in the longer term (Laurie Virr and Paul Hanley, sub. DR99). Innovation could be stifled in energy-efficient designs that do not fit within the paradigms used for deemed-to-satisfy provisions or simulation software. While there is some scope to demonstrate compliance on a case-by-case basis by ‘expert judgement’, this approach is probably more costly and so is unlikely to be used for many buildings. It could also add to uncertainty because it depends on the chosen expert.

Adverse effects on building occupants

The Royal Australian Institute of Architects and Archicentre Limited (2005) noted that sealing a home to satisfy building energy efficiency standards can lead to microclimates that cause illness. A similar concern was expressed by the Green Building Council of Australia (sub. 41). The Council also noted that standards can lead to a reduction in the size of windows, which in turn causes increased reliance on artificial lighting that is likely to have a detrimental effect on the health of building occupants (sub. DR137).

Criteria used by individuals to assess cost effectiveness

The current approach to assessing cost effectiveness assumes that individuals are able to finance the upfront capital cost of meeting a standard, and the estimated social opportunity cost of capital is the discount rate used by individuals.

In practice, individuals do not have unlimited access to capital and so they will tend to invest in what they expect to be the most rewarding opportunities. Thus, the return on energy efficiency investments must be considered in the context of other investment opportunities. For firms, it may be more rewarding to invest their limited capital in core activities (such as investing in new products) rather than in increased energy efficiency. For less affluent households, the returns on meeting today's basic needs (such as for food and clothing) may far outweigh those from investing in energy efficiency improvements that only deliver benefits in small increments into the distant future. If building standards are to continue to be promoted as being privately cost effective, then future assessments will need to provide greater justification for the criterion and parameters used.

RECOMMENDATION 10.1

The Australian Building Codes Board should, as a matter of urgency, commission an independent* ex post *evaluation of building energy efficiency standards to determine:

- ***how effective the standards have been in reducing actual (not simulated) energy consumption; and***
- ***whether the financial benefits to individual producers and consumers have outweighed the associated costs.***

This evaluation should include the standards for residential buildings in New South Wales (BASIX), Victoria (5 star) and the ACT (ACTHERS), as well as the national standards in the Building Code of Australia.

11 Energy efficiency in transport

Key points

- There appears to be only limited scope for further privately cost-effective improvements in energy efficiency in the transport sector. However, if oil prices remain at their current (or higher) levels, more actions that would improve transport sector energy efficiency would become privately cost effective.
- Many potential improvements in energy efficiency in transport that would be privately cost effective result from policies designed mainly to obtain other efficiency benefits (for example, congestion pricing and improved efficiency of rail freight).
- The compulsory fuel consumption label and voluntary national average fuel consumption target for motor vehicles are likely to generate small improvements in the fuel efficiency of the new motor vehicle fleet.
- The TravelSmart information program to encourage less motor vehicle use has reduced energy use and increased energy efficiency in transport.
- Energy efficiency improvements arising from schemes that do not compel consumers and producers to move to more energy-efficient vehicles or travel modes, should, in general, be privately cost effective.
- The introduction of efficient congestion-pricing schemes in the larger capital cities could generate energy efficiency improvements that are cost effective (even excluding environmental benefits) for the community as a whole, although not for all travellers.
- Further regulatory reform in road and rail freight would be likely to engender some privately cost-effective energy efficiency improvements in each sector.

This chapter considers the potential for achieving energy efficiency improvements that are cost effective for individual producers and consumers in passenger transport (section 11.2) and freight transport (section 11.3). The terms of reference direct the Commission to examine the potential for energy efficiency improvements in vehicles and fuels resulting from improved energy efficiency information, minimum energy efficiency standards, and new and improved technologies and equipment. They also require the Commission to consider policy options for improvements in transport-related areas — including from urban planning, congestion pricing, intelligent transport systems, travel-demand management and increased efficiencies in the business and freight sectors — which may have implications for energy efficiency.

Unlike some other sectors of the economy, potential energy efficiency gains in transport are often associated with policies that offer significant other efficiency benefits — energy efficiency tends to be a useful byproduct of achieving other worthwhile gains such as reducing inefficient levels of road congestion, improving the efficiency of the provision of rail services or reducing air pollution. Particularly in such cases, the sole pursuit of energy efficiency should not determine policy settings. Conversely, in some instances, policies adopted to meet other objectives — for example, obtaining cleaner exhaust emissions from trucks and restricting or slowing traffic in suburban streets — can lower fuel efficiency. Hence, in the transport sector, perhaps even more so than in other sectors, it is essential to consider energy efficiency in a broader economic, social and environmental context.

11.1 Introduction

As noted in chapter 3, transport is a significant user of energy. In 2001-02, 37 per cent of final energy consumption in Australia was consumed in the transport sector. The Bureau of Transport and Regional Economics (BTRE) projected 2010 greenhouse gas emissions from the transport sector to be more than 40 per cent higher than their 1990 levels, increasing to nearly 70 per cent higher by 2020 (BTRE 2002c). As in many other countries, energy use (and resultant greenhouse gas emissions) in Australian transport is growing faster than in other sectors, despite the fact that motor vehicles, and transport systems generally, have continually become more energy efficient. Increases in energy use from growth in motor vehicle numbers and usage, reflecting economic and population growth, have outweighed decreases from energy efficiency gains.

Because Australia is a large, sparsely populated continent, the transport task of moving people and freight is commensurately greater than in many other countries. The availability of relatively cheap land and Australians' preferences for larger residential blocks, has also meant that major cities have generally expanded in a sprawling low-density fashion. While largely reflecting individuals' preferences, this style of development has added to the urban transport task for firms and private purposes.

In addition to providing significant benefits of mobility and lifestyle options, transport also creates important negative environmental externalities. Motor vehicles cause localised air pollution and noise in larger urban areas, particularly at peak hours, while public transport also creates some degree of noise and air pollution. In addition, motor vehicles and, to a much lesser extent (particularly on a per traveller basis), public transport, contribute significantly to greenhouse gas emissions either directly or indirectly. In 2000, direct transport energy use accounted for around 14 per cent of Australia's greenhouse gas emissions, of which road transport made up close to 90 per cent.[1] By 2020, the level of greenhouse gas emissions from transport is forecast to grow by around 60 per cent from its 1990 level (AGO 2004o).

A given transport service usually provides users with multiple outputs. As well as moving between two points, factors such as comfort, flexibility, reliability and time taken are all important attributes — in some cases travellers enjoy the trip itself. For producers, convenience, reliability, time taken and absence of damage to goods are all important. Hence, in some cases, there can be a degree of difficulty in defining and measuring the total output of a transport service, and therefore, some uncertainty in determining if an observed fuel-efficiency improvement resulting from government policy intervention is privately cost effective.

11.2 Passenger transport

This section considers a range of current and potential programs that might result in privately cost-effective improvements in the energy efficiency of road and rail passenger transport. Road-based passenger transport is the major user of energy in the transport sector, and hence, has been a particular focus of energy efficiency programs for transport under the National Greenhouse Strategy and the Environmental Strategy for the Motor Vehicle Industry. There may be potential for cost-effective improvements to energy efficiency of road transport by more efficiently managing traffic flows by using road pricing and intelligent transport systems. Planning policies have also been suggested as a longer-run tool that could increase energy efficiency by facilitating greater use of public transport.

Passenger motor vehicle fuel efficiency

There are several existing programs aimed at improving the fuel efficiency of passenger-transport activities (particularly of the motor vehicle fleet), usually with a focus on achieving communitywide benefits (reduced air pollution and greenhouse gas emissions) rather than providing direct benefits for the individuals directly affected. In these programs, achieving privately cost effective energy efficiency improvements has been incidental to achieving environmental objectives. Hence, an

[1] This excludes indirect emissions resulting from the use of energy in the transport sector which is generated in other sectors (for example, electricity).

examination of any private benefits of these policies should not be viewed as a complete assessment of their performance. Indeed, many are best considered as greenhouse and pollution abatement schemes with low net cost (after allowing for any private benefits and both private and government costs). Whether they fulfil these criteria is beyond the scope of this inquiry.

Whether reducing fuel consumption through greater fuel efficiency is privately cost effective will depend on the savings from lower fuel consumption compared to any capital cost of improving fuel consumption and the value to consumers of any other loss in amenity required to achieve those savings. The absence of any clear market failures impeding vehicle buyers from making privately cost-effective energy efficiency improvements suggests that opportunities for such improvements are limited.

Fuel consumption labelling scheme

Since 2001, all new passenger cars and all off-road vehicles and light commercial vehicles powered by petrol, up to 2.7 tonnes in gross mass, have been required to display (at the point of sale) fuel consumption labels (showing litres used per 100 kilometres).[2] A standard laboratory test procedure is applied to all vehicles (for both city and highway cycles) and hence, the resultant fuel consumption figures are comparable between models. Actual fuel consumption will vary from the test results due to different driving conditions, driver behaviour and vehicle condition.

From July 2003, the label has also indicated the grams of carbon dioxide the model would emit (under standard test conditions) per kilometre travelled. In addition, all new vehicles weighing up to 3.5 tonnes (regardless of fuel source) are now required to display the label, bringing some larger off-road vehicles under the scheme. Many other countries (for example, the United States, Canada and Japan) have similar compulsory labelling requirements providing fuel efficiency and/or greenhouse gas emissions information while others (for example, the United Kingdom) have voluntary arrangements adhered to by all producers.

The fuel consumption labelling requirement is supported by the Fuel Consumption Guide (published by the Australian Government since 1980) and the Green Vehicle Guide. The Fuel Consumption Guide contains data on the fuel consumption of vehicles (passenger motor vehicles, four wheel drives and light commercial vehicles) manufactured between 1986 and 2003, for both city and highway conditions. The Green Vehicle Guide provides information on the environmental

[2] The labels are mandated under the *Motor Vehicles Standards Act 1989* (*Australian Design Rule 81/01*).

performance and fuel consumption of new vehicles sold in Australia since 2004, using the fuel consumption label data. The Australian Government will spend $1.5 million over four years promoting the guide. These sources allow consumers to readily compare information on the fuel consumption of different vehicles.

As discussed in chapter 9 with regard to home appliances, it could be argued that the market does not necessarily provide consumers with sufficient information regarding the energy efficiency of alternative products. With regard to motor vehicles, the Bureau of Transport and Communications Economics (BTCE) commented:

> In making informed purchasing decisions, buyers generally have to rely on the claims of competing manufacturers. Because of uncertainty on the part of buyers, genuinely more fuel-efficient products may attract prices below their optimal value. A vehicle labelling scheme supervised by the government has the potential to reduce the information asymmetry between buyers and sellers. (BTCE 1996b, p. 154)

Nonetheless, energy is a much more significant and visible cost for motor vehicle use than for most home appliances. Hence, consumers would be expected to be reasonably aware of fuel efficiency differences, even if other factors are more influential in their final purchase decision. For example, the RACV (2004) indicates that for most new passenger motor vehicles, fuel costs make up around 15 to 20 per cent of the total cost of running a motor vehicle and over one-third of the non-capital costs. A wide variety of market sources — car magazines, newspapers, motoring organisations and motor vehicle retailers and producers — provide consumers with information on fuel consumption. Any small deficiencies in this market-provided information may not justify the expense to government, the industry and consumers of government intervention. There may be many areas of motor vehicle performance about which consumers have less than perfect knowledge.

However, the fuel consumption labelling scheme is part of the broader environmental strategy for the motor vehicle industry. In this regard, the new requirement that fuel efficiency labels include information on greenhouse gas emissions — something markets would underprovide from a social perspective — better focuses on the program’s primary objectives, namely to lower emissions and reduce urban air pollution. In particular, the environmental performance of vehicles powered by fuels or fuel combinations producing lower greenhouse gas emissions will now be better brought to consumers’ attention.

The Ford Motor Company of Australia (sub. 76) noted the potential for greater in-use fuel efficiency, such as that achieved in some European eco-driving programs, by changing motorists’ driving behaviour. Such programs have the advantage of influencing the fuel consumption of all vehicles, not just the new vehicles covered by the fuel labelling scheme.

As the fuel labelling scheme provides comparative information to consumers to assist in making informed decisions, rather than restricts or directs their purchasing decision, any resultant improvement in the energy efficiency of the motor vehicle fleet should be privately cost effective. However, analysis by the Bureau of Transport and Regional Economics (BTRE 2002a) indicates that actual fuel consumption is consistently above the test results by an average of 20 per cent, with underestimation greatest for the highway cycle. This may distort the vehicle choices of some consumers, possibly towards less fuel-efficient vehicles, as the absolute size of the underestimation of fuel consumption will be greater for vehicles with higher fuel consumption.

Overseas studies of the impact of fuel-labelling schemes on consumer behaviour indicated that many consumers were aware of fuel consumption labels. European studies suggested that only modest reductions in average fuel consumption of the new vehicle fleet, in the order of one to four per cent, were likely to have been attributable to the schemes (BTRE 2002b and BTCE 1996b). However, greater gains might be expected as awareness of environmental impacts of motor vehicle use increases. A 1993 survey of two Australian car showrooms indicated a 15 per cent reduction in fuel consumption due to consumers changing their preferred vehicle on the basis of fuel consumption labels (Wallis 1993). In assessing the likely impact of an Australian fuel consumption label, the BTCE (1996b) assumed an average (over time) 1 litre per 100 kilometre (around 12 per cent) reduction in fuel consumption of the new vehicle purchases of private buyers in response to a label. On this basis, the fuel-saving benefits of the scheme were found to make it a privately cost-effective measure.

The labelling scheme appears relatively low cost to administer and comply with, particularly given that manufacturers have to meet similar requirements in many overseas markets. The BTCE (1996b) suggested a cost of between $2 and $15 per new car sold. These costs have been further reduced, particularly for imported vehicles and export models, by bringing the test procedure into line with internationally-recognised standards.

FINDING 11.1

Markets provide extensive information to consumers regarding fuel consumption of motor vehicles. Nonetheless, the Australian Government's Fuel Consumption Labelling Scheme and Green Vehicle Guide provide relatively low cost, accessible and comparable information to consumers, and may be justified as part of the more *fundamental objective of encouraging consumers to reduce the adverse environmental impacts of motor vehicle use.*

National average fuel consumption target

A voluntary industrywide average fuel consumption target for new (petrol-powered) passenger motor vehicles was first negotiated between the Australian Government and the automobile industry association (Federal Chamber of Automotive Industries – FCAI) in 1978. It aimed for a 15 per cent improvement in fleetwide fuel efficiency (to 9.5 litres per 100 km) by 1983 and a 20 per cent improvement by 1987 (9 litres per 100 km). A further voluntary target of 8.2 litres per 100 km by 2000 (12 per cent below the actual 1990 levels) was agreed to in 1996. Outcomes have been slightly above the targets but no penalties applied as the schemes were voluntary.

The current average fuel consumption target, established under an industry voluntary code of practice in 2003, is 6.8 litres per 100 km by 2010 — a reduction in average new vehicle fuel consumption of 18 per cent below the actual 2001 level of 8.3 litres per 100 km. This compares with the United States corporate-specific target for new passenger vehicles of around 8.6 litres per 100 km (box 11.1). In assessing possible fuel efficiency targets, ACIL (1999) argued that a figure of 6.7 litres per 100 km by 2010 would be a challenging but realistic lower limit. Sharp increases in fuel prices in recent years should increase consumers' interest in fuel efficiency, making it more likely that the target will be achieved. The FCAI (2005a) suggested 6.3 litres per 100 km as a feasible objective for 2015.

In addition, a separate national average carbon dioxide emissions target covering cars, vans, four wheel drives and light commercial vehicles up to 3.5 tonnes is being negotiated with the industry. The existing fuel-efficiency target will also be converted to a carbon dioxide (grams per kilometre) target. Achievement of the fleet fuel efficiency target is estimated to represent a reduction of greenhouse gas emissions from motor vehicles of up to a total of two million tonnes per annum (around 4 per cent) by 2010 compared to that which would have occurred under base level fuel consumption (Kemp and Macfarlane 2003).

Box 11.1 **Overseas fuel efficiency targets**

Many countries have implemented mandatory or voluntary motor vehicle fuel-efficiency targets, sometimes supported by other fiscal or regulatory policies aimed at reducing petrol consumption (for example, the US tax on vehicles with high fuel consumption).

United States

Since 1978, the United States has had compulsory Corporate Average Fuel Economy (CAFE) standards for each automotive manufacturer's sales (segregated between their imported and domestically produced vehicles) in the US market. These standards were introduced because of concerns about energy security after the 1970s oil price shocks. The initial CAFE for passenger motor vehicles was 18 mpg (13.1 litres/100 km) rising to 27.5 mpg (8.6 litres/100 km) by 1985, where, after a brief reduction to 26.5 mpg, it has remained. Light trucks, SUVs and minivans are required to average at least 20.7 mpg. Penalties exist for companies that fail to meet the target. Overseas producers (mostly European importers of larger cars such as BMW and Mercedes-Benz) have paid over $US 500 million in penalties since the scheme's inception.

Average actual fuel economy for new passenger cars had fallen from 16.1 mpg in 1955 to 13 mpg in 1973. The first oil price shock saw fuel economy increase to 15.9 mpg in 1975 and 19.9 mpg in 1978, gradually rising to 28.8 mpg in 1988. Since then it has varied between 28 mpg and 29 mpg, but has risen above 29 mpg in the last two years.

European Union

In 1998, the European Commission negotiated a voluntary agreement with European manufacturers for a fleetwide target for carbon dioxide emissions from new passenger vehicles of 140 grams per kilometre (equivalent to fuel consumption of around 5.7 litres/100 km) by 2008. This represents around a 33 per cent reduction from 1995 average fuel consumption (and a 25 per cent reduction in average emissions). Japanese and Korean manufacturers have also agreed to meet this target for their exports to the European Union by 2009. The focus on emission levels means that the target can also be met by increasing the share of vehicles using less-polluting fuels as well as by improving fuel efficiency.

Japan

In 1999, Japan established fuel-efficiency targets for new passenger cars and light trucks (up to 2.5 tonnes) based on vehicle weight classes and fuel type. For most vehicles, the targets are to be met by each vehicle maker for each vehicle weight class by 2010. The targets represent fleetwide new vehicle fuel consumption of around 6.7 litres/100 km for petrol passenger cars (23 per cent lower than the average for 1995). Small penalties apply if the targets are not met. The targets are based on the most fuel-efficient vehicle in each weight class in 1997, adjusted for likely feasible future fuel-saving technologies and factors adversely affecting fuel efficiency (for example, tighter regulation for pollution, noise and safety). Because the Japanese testing procedure is weighted more to lower fuel-efficiency driving cycles, vehicles would achieve lower fuel-efficiency ratings under the Japanese regime than the European and US testing procedures.

The impact of these various targets on observed fuel consumption is likely to be limited by the high import share in the new motor vehicle market. Around 70 per cent of new vehicles are imported and the fuel efficiency or emission levels of these vehicles will be significantly affected by the preferences of overseas consumers and by government fuel-efficiency regulations in those countries. A good deal of the technology used in Australian-made vehicles is also developed overseas or developed in Australia to meet overseas fuel-efficiency standards for models exported. In this regard, such voluntary and mandatory fuel-efficiency targets implemented overseas (box 11.1) may have served to further encourage innovation for greater fuel efficiency by putting the motor vehicle industry in those countries on notice that fuel efficiency is an important government priority.

The rate at which Australian producers and importers incorporate overseas developments in fuel saving technologies which consumers are willing to pay for, might be influenced somewhat by the voluntary fuel-efficiency target. The possibility of mandatory targets could also affect industry behaviour. FCAI commented:

> … the industry has sought to cooperate with successive Australian governments to adopt voluntary targets to achieve improvements in the energy efficiency and environmental performance of vehicles, thereby avoiding unnecessary resort to more draconian mandatory regulation which would otherwise increase compliance costs and undermine the competitiveness of the Australian industry. (sub. 77, p. 1)

Achieving the targets will also depend on the preferences of Australian consumers for fuel-saving technology and other features which might affect fuel efficiency, as well as by the mix of vehicles sold (weight and engine size). The Department of the Environment and Heritage (DEH) (sub. 30, p. 22) noted that, with regard to motor vehicle fuel consumption, 'over time, weight specific efficiency has improved, but increasing vehicle weight has worked against overall efficiency improvement'.

In this regard, the BTRE (2002a) indicated that estimated national average fuel consumption of new passenger motor vehicles had fallen by around 15 per cent between 1979 and 2001. Engine technologies had improved substantially, reducing fuel consumption per unit of maximum engine power output of around 45 per cent. However, the impact of this improvement on fuel consumption had been largely offset, particularly during the 1990s, by consumers' preferences (on average) for larger more powerful vehicles with more accessories that have increased fuel consumption. Recent sharp rises in petrol prices should increase the importance consumers place on vehicle fuel efficiency.

The voluntary code of practice (FCAI 2003) acknowledges that external influences (such as consumer preferences) may affect the achievement of the target. In such instances, the industry will discuss changes to the target with the Australian Government.

Unlike many industrial and commercial firms where energy is a relatively small cost, the importance of fuel in vehicle operating costs should make motor vehicle producers particularly cognisant of consumers' interest in fuel efficiency. The highly competitive nature of the Australian motor vehicle market should mean that producers provide the vehicle features sought by consumers, of which energy efficiency is one. The Ford Motor Company of Australia observed that significant reductions in industry protection in Australia had contributed to the development of a highly competitive automotive market and argued:

> In such a congested marketplace, a manufacturer's success will inevitably be dependent on sought-after and high value product (sub. 76, p. 2)

Fleetwide fuel-efficiency targets that go much beyond what the market would deliver are likely to suffer from a number of drawbacks. To the extent that such targets distorted producer and consumer behaviour, the resultant energy efficiency gains would not be privately cost effective — consumers would value improved fuel efficiency less than the associated costs and additional constraints on vehicle choice. In addition, with over 50 producers supplying around 350 models of motor vehicles to the Australian market, the temptation to free ride on any efforts of others in meeting a marketwide target would be strong.

As with other sectors of the economy, increased motor vehicle energy efficiency will also have some 'rebound effect' — in this case by encouraging greater use of motor vehicles or the purchase of vehicles with more energy consuming features. This would partly offset the environmental benefits from the initial fuel saving. Greene et al. (1999) estimate that for US households, a 10 per cent increase in vehicle fuel efficiency leads directly to a 2 per cent increase in distance travelled.

FINDING 11.2

Fleetwide fuel consumption targets for new motor vehicles sold in Australia are likely to have had only a limited impact on the fuel efficiency of the new vehicle fleet. Significantly tightening such targets and making them compulsory would be likely to impose additional costs on consumers.

Composition of the motor vehicle fleet

A number of participants (for example, Sara Gipton, sub. 34; Sustainable Transport Coalition, sub. 70 and Alan Pears, sub. DR113) observed that the fuel efficiency of the motor vehicle fleet would increase if the proportion of vehicles with relatively poor fuel economy (in particular, four wheel drives used in large cities) were reduced. Fuel consumption of large four wheel drive vehicles and larger sedans is significantly higher than smaller engine capacity sedans.[3]

The share of larger vehicles and Sports Utility Vehicles (SUVs) in new car sales has increased in recent years, mirroring trends in a number of large developed countries such as the United States and Canada. This trend may partly reflect the relatively low petrol prices experienced during much of the 1990s, along with growing real incomes. However, the recent significant increases in world oil prices, if expected to continue, should discourage some consumers from purchasing vehicles with lower fuel efficiency. [4] The FCAI, in noting the increase in the share of light and small vehicles in total passenger and SUV sales from 34.7 per cent in 2004 to 38.4 per cent in the first half of 2005, commented:

> The small car segment is booming this year, … suggesting that fuel economy has risen on the list of priorities for many buyers. (FCAI 2005b)

Given the extent of competition in the motor vehicle industry, it would be expected that the attributes of different vehicles would be well communicated to consumers.[5] Hence, consumers' current purchasing patterns should adequately represent their view of the most cost-effective vehicles for their needs, given the level of factors such as income, motor vehicle prices and current and anticipated fuel prices. Any policy measures to mandate or subsidise a switch to a less energy-intensive car fleet are unlikely to provide privately cost-effective energy efficiency improvements. Whether they would be cost effective in achieving broader policy objectives is not clear.

In the past, four wheel drives have faced much lower tariffs than passenger motor vehicles, thereby distorting demand towards them and, as a consequence, lowering the energy efficiency of the motor vehicle fleet. With the progressive lowering of passenger motor vehicle tariffs, only a small tariff preference remains (5 per cent compared to the 10 per cent for passenger motor vehicles). Because Australian tariffs are only applied to the price of a vehicle when it leaves its country of origin

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[3] The Green Vehicle Guide (AGO 2005c) shows that many small 4 cylinder manual vehicles average petrol consumption of around 6 to 9 litres of petrol per 100 kilometres (under the assumed driving cycles and testing conditions used) while larger sedans and four wheel drives predominantly range from 12 to 17 litres per 100 kilometres.

[4] A number of participants (for example, Matt Mushalik, sub. 4 and 75, Alan Parker sub. 35 and DR112 and Phillip Laird sub. DR127) have argued that world oil production will soon reach its peak and hence petroleum product prices could be expected to remain high in the long term. BTRE (2005a) provided a review of the debate concerning future oil supplies and noted that international energy agencies expect oil supply to broadly keep pace with demand over the next 30 years at prices around $US30 per barrel (in year 2000 dollars).

[5] This is particularly so since the reduction of the very high levels of assistance to the domestic motor vehicle industry, commencing in 1989, has significantly increased competition.

(hence they are not levied on shipping costs and wholesaler and retailer margins in Australia) the lower tariff for four wheel drives will only reduce their final retail prices by a little over 3 per cent. The tariff differential will be removed in 2010 when passenger motor vehicle tariffs are scheduled to fall to 5 per cent.

The composition and fuel efficiency of the government motor vehicle fleet were discussed in chapter 8.

New vehicle and fuel technology

Technological developments (related to vehicle engines, chassis, tyres and transmissions) have been critical in delivering improvements in the energy efficiency performance of the Australian motor vehicle fleet. At the same time, consumer demands for more comfortable motoring and improved vehicle performance have seen a greater provision of accessories (for example, air conditioning) and larger cars with higher fuel consumption although providing other services of value to consumers. The wide variety of automotive market niches suggests that consumers' varied preferences for fuel efficiency and other vehicle attributes should be well provided for.

Currently available and potential new technologies that would significantly improve the fuel efficiency of new vehicles include improvements in aerodynamics, automated manual transmissions (SwRI 2004), direct injection engines, cylinder deactivation and on-board diagnostic systems. As well as market availability and consumer preferences, the rate at which more fuel-efficient technology of this type is introduced to the motor vehicle fleet depends on the level of new car sales and the rate at which old vehicles are scrapped. In this regard, the price reductions and quality improvements which have accompanied the very large reductions in protection to the local motor vehicle industry in the last 15 years should have significantly stimulated demand for new vehicles.

Average fuel efficiency of new vehicles in Australia was over 11 litres per 100 km in the 1970s, improving to around 9 litres per 100 km by 1990. This compares to current levels of close to 8 litres per 100 km. Hence, in the immediate future, the rate of replacement of the existing fleet is likely to make a more significant impact on total fleet fuel economy (depending as it does on previous improvements in new vehicle fuel efficiency) than foreseeable future improvements. The fall in passenger motor vehicle tariffs to 10 per cent in 2005 and the scheduled reduction to 5 per cent in 2010 should further stimulate the modernisation of the fleet. Prohibitive tariffs on second-hand vehicles ($12 000 plus the normal vehicle tariff) preclude relatively new overseas used cars as a privately cost-effective source of improving the fuel efficiency of the Australian car fleet.

Sara Gipton noted that, in some cases, fuel-efficient motor vehicle technology may require increased energy use in other parts of the production process:

> … energy saving in one step of production or operation may in fact cause an increase in energy use in a different part of the process. For example, to reduce fuel consumed per distance travelled by the substitution of more energy-intensive materials such as aluminium to reduce the weight of a vehicle. The net impact of energy consumption over the life of a vehicle should therefore be taken into account. (sub. 34, p. 5)

To the extent that motor vehicle energy efficiency programs are targeting greenhouse gas abatement, they should consider the full impact of alternative technologies on energy use.

Improved fuel quality is a prerequisite to the efficient introduction of certain more fuel-efficient engine technologies. The FCAI noted the importance of adopting new fuel standards if the current voluntary fuel consumption targets are to be achieved:

> The achievement of these targets is dependent on a range of factors including more widespread uptake of higher octane (95 RON) petrol and introduction of very low sulphur petrol to facilitate the introduction of a range of advanced engine and emission control technologies. (FCAI 2005a)

Some technological improvements in fuel would also offer the potential to improve the energy efficiency of the whole motor vehicle fleet rather than just new vehicles. The BTRE (2002a) noted that about half of new passenger vehicles sold in any year are still on the road 20 years later.

Several participants (for example, the Queensland Government, sub. 38 and Electricity Markets Research Institute, sub. DR110) have noted that the use of non-petroleum based automotive fuels, such as ethanol and fuel cells, can offer better conversion of energy inputs to energy output or provide considerable environmental benefits. However, comparisons of relative energy outputs and greenhouse gas emissions from alternative fuel sources are beyond the scope of this inquiry. Such comparisons do not directly relate to the privately cost-effective energy efficiency of different fuels. In any event, there do not appear to be market failures which prevent individuals from making privately cost-effective choices between alternative fuels.

Congestion pricing

Beyond a certain level of traffic, every vehicle entering a road space imposes congestion costs on *all* other vehicles using that road. As road usage approaches the capacity of a road, additional vehicles slow traffic significantly and fuel consumption is around twice that under free-flow conditions (BTE 2000).[6] However, for individual drivers (and their passengers) the congestion costs they impose on others are externalities and do not enter the decision to make the trip by road at that time on that route. Because these congestion costs are largely ‘external’ to the individual driver’s decision making, the level of traffic on a congested road will be inefficiently high.

One approach to dealing with this externality is to require road users to directly meet a significant cost of their travel choice through user charges, thereby improving overall economic efficiency. The Bureau of Transport Economics (BTE 1999) estimated that the social costs of congestion on capital city roads was around $12.8 billion in 1995, nearly half of which was in Sydney, and a further 20 per cent in each of Melbourne and Brisbane. It predicted that due to urban traffic growth exceeding increases in road capacity, annual congestion costs in the six capitals could increase to around $30 billion by 2015.

However, even under optimal pricing, only some of this congestion would be alleviated and there would also be initial and ongoing costs involved in implementing such charges and losses for those ‘tolled-off’ the road at congested times. The BTCE (1996a) estimated that accurately-calibrated peak-period congestion pricing in the five largest Australian state capitals would provide net benefits of around $1.1 billion per year (only including time savings benefits).[7] The BTRE (2002b) reported that the fuel savings resulting from optimal congestion pricing would be around 30 per cent, with consequent reductions in greenhouse gas emissions of 5 million tonnes per annum (about one per cent of Australian emissions from all sources). At current fuel prices, the value of these fuel savings to motorists will have increased significantly.

As far back as the 1960s, the UK Ministry of Transport (1964) concluded that direct road pricing in the United Kingdom would yield net benefits of between £100 and £150 million (1964 prices). Hau (1990) reported annual net benefits (in 1985 prices) of introducing road pricing in Hong Kong of over $US150 million. MVA (1995) estimated the net benefits from road pricing in London at £225 million per annum. Prud’homme estimated annual net benefits for Paris at 2.5 billion francs (reported in Nash and Sansom 1999). Schrank and Lomax (2004) estimated that in 2002, the

[6] The BTE (2000) noted that ‘free-flow’ conditions are an unrealisable hypothetical situation which provide a benchmark to indicate the size of the congestion problem, but which could not be attained in practice.

[7] The BTCE (1996a) stressed that, particularly given that data for different cities was for different years and did not take account of recent changes in the road system, their estimates were to be treated as ‘indicative and exploratory’.

cost of congestion to US travellers in 85 major metropolitan areas at peak times was $US63 billion.

Despite the significant potential benefits, congestion pricing has been applied internationally in only a few quite localised cases of particularly severe traffic problems, such as in Singapore and London (box 11.2). Although toll roads have become more prevalent in a number of countries, they are not examples of congestion pricing as such — prices do not vary between times of higher and lower congestion. Express transit lanes (for vehicles with two or more occupants) have been one non-price strategy aimed at reducing congestion by encouraging car pooling. However, these lanes tend to be underutilised and result in increased congestion in the remaining lanes (BTRE 2002b). Congestion (or peak) pricing is widespread in other services where it is designed to spread demand for fixed infrastructure more evenly over time. Higher long-distance telecommunications prices during weekdays, lower train fares during certain off-peak periods, lower overnight electricity charges, cheaper cinema tickets for particular days and times, and higher accommodation charges during peak seasons are all examples of congestion pricing. Often these differentials are expressed as off-peak discounts — in the case of congestion-priced roads, such discounts might be no charge at non-congested times.

Whether switches of some journeys from congested roads to (often subsidised) public transport provide net community benefits will also depend on the costs and benefits in the public transport sector as a result of making this transition. For example, if greater peaks in public transport were to result, this might require more capital and labour resources which are idle for much of the day and at weekends. Alternatively, the public transport system may become more congested at peak times, imposing costs of additional discomfort and delays on commuters. If these costs are not adequately reflected in fares, the choice between private and public transport (or between any other options facing the traveller) will be distorted.

Congestion pricing does not result in energy efficiency improvements that are cost effective for those drivers priced off the road — they are shifted to other options which they value less than travelling on (congested) roads at a particular time. If congestion tolls are set appropriately, these costs will be more than made up for by the efficiency gains (time saving and lower vehicle operating costs) accruing to those still using (and now directly paying for) the less congested road system. The size of the net efficiency benefits will then depend on the costs of administration and compliance. However, remaining road users will also be paying tolls — a transfer payment to government that does not have negative efficiency implications because it involves taxing a negative externality. These charges will, on average, exceed the efficiency benefits received by this group (BTCE 1996a) and hence, in a financial sense, they are also worse off. Those travellers who place a high value on time will be better off but those with lower valuations of time savings will be worse off after paying the congestion charge. The latter group still make the journey because the value of the trip to them is greater than all of the costs involved, including vehicle operating costs, travel time and the congestion toll.

The Industry Commission (IC 1994b) recommended the incremental introduction of areawide electronic road pricing, starting with new or upgraded urban arterial roads in Sydney and Melbourne. The AATSE (1997) inquiry into urban air pollution also recommended that congestion pricing be introduced as part of a range of demand-management measures to enable consumers to make informed travel choices. Governments have not acted on these recommendations.

However, since then, further advances in charging technology and the extension of the use of (non-congestion) toll roads to finance expansion of the road capacity, together with increasing congestion on certain urban roads, have increased the technical (and political) feasibility of introducing congestion pricing.

The Ministerial Inquiry into Sustainable Transport in New South Wales (Parry 2003) recommended that the New South Wales Government consider implementing electronic road pricing within the next five to ten years in order to effectively signal the costs (including congestion) of road use.

FINDING 11.3

Efficient road congestion pricing would lead to communitywide, cost effective increases in energy efficiency. However, these gains will not be privately cost effective for all road users. Reductions in fuel consumption and cleaner burning of fuel would also provide significant local environmental benefits and reductions in greenhouse gas emissions.

While congestion pricing can offer significant efficiency benefits, it needs to be implemented in an effective manner if maximum benefits are to be obtained. In particular, congestion levies would need to be variable over time depending on the level of congestion and implemented in an areawide context to minimise inefficient diversion of traffic to minor roads. Given the extent of interstate road travel, particularly by freight vehicles, coordination of charging technology between jurisdictions would lower costs of implementing congestion pricing.

Box 11.2 **Congestion pricing schemes**

While there are numerous instances where tolls have been used to finance road construction, there are only a few cases where road-user charging has been totally or partially focused on reducing inefficient levels of road congestion. These include:

Singapore

Singapore, in 1975, introduced a requirement for a prepaid area license for a vehicle to *enter* a restricted zone encompassing the most congested parts of the city. Initially the charge was only for the morning peak but was later extended to between 7:30 am and 7:00 pm on weekdays and 7:30 am and 2:00 pm on Saturday. The entry charge varied between vehicle types and was greater for entry during the morning and evening peaks. While achieving only a portion of the potential benefits from congestion pricing, the scheme's administration costs were relatively low. Car parks were set up around the restricted zone to facilitate the use of public transport into the city. During the 1990s a similar scheme was progressively introduced along congested sections of a number of expressways between 7:30 am and 9:30 pm on weekdays. While manually enforced and fairly rudimentary as a congestion control technique, the scheme did serve to reduce traffic congestion towards more efficient levels. In 1998, Singapore switched to electronic tolling and enforcement methods, facilitating the better targeting of the level of charges to address congestion.

London

In 2003, a daily charge of £5 was introduced for all vehicles (with certain exemptions and also discounts for residents) driving or parking in a 21 square kilometre zone of central London between 7:00 am to 6:30 pm on Mondays to Fridays. In periods when congestion is not considered a serious problem there is no charge. The scheme is a paper-based charge enforced by a series of over 200 camera sites. It is now proposed to extend the charging zone to include adjacent congested areas of central London. The charge has been accompanied by a 30 per cent reduction in the level of congestion in the charging zone, an 18 per cent decline in motor vehicles entering the zone and a 12 per cent fall in vehicle emissions. Public transport usage increased by around 40 per cent of which about half was attributed to the congestion charge.

California

Since 1995, a ten mile section of a four-lane tollway (located on the median strip of the existing congested eight-lane public freeway) in Orange County, has had tolls which vary according to the time of day, week and year. Motorists have a direct choice between priced and unpriced (on the parallel freeway) travel. Tolls currently vary from $US 1.05 to $US 6.25. Tolls are reviewed every six months to recognise changing congestion levels to more efficiently ration tollway use. In 1998, the first 'dynamic congestion pricing' scheme was introduced in San Diego by converting two existing underutilised 13 kilometre high-occupancy vehicle lanes on the ten lane I-15 into reversible high-occupancy toll lanes. Tolls are continuously varied according to the level of congestion, normally ranging from $US 0.75 to $US 4.00 but potentially increasing to up to $US 8.00 if congestion is very high.

In both the short and long term, congestion pricing is only one of a number of complementary policies for improving the efficiency of investment, in and use of, transport infrastructure. In the short term, traffic control measures and improvements in access to public transport may be efficient means of reducing road congestion. In the longer term, efficient investment in both roads and public transport infrastructure together with effective urban planning will also play a part in efficiently addressing road congestion.

There are a number of other issues regarding charging for road use, some of which may indirectly have implications for energy efficiency. A number of participants (for example, the Sustainable Transport Coalition, sub. 70, the South Australian Government, sub. 79 and Urban Ecology Australia, sub. DR132) have argued that there are efficiency and equity reasons for changing some currently fixed road user charges into variable charges (for example, by incorporating them into petrol excise). By increasing the cost of road journeys, higher variable charges for road use would result in both energy conservation (by reducing the amount of travel) and some increase in transport energy efficiency (by, for example, transferring some journeys to public transport or encouraging more energy-efficient private transport).

In addition, certain external costs of road use such as local air and noise pollution as well as greenhouse gas emissions are not directly accounted for in current taxation of road users. Several participants (for example, Philip Laird, sub. 1, the Railway Technical Society of Australasia, sub. 45 and Environment Victoria, sub. 67) noted the significant health costs attributed to motor vehicle emissions. The BTRE has estimated that the economic cost of health impacts from motor vehicle emissions in 2000 was \$2.7 billion (central estimate) (BTRE 2005b).[8] Governments have used vehicle emission controls and fuel standards, rather than taxation, as the main means to reduce motor vehicle pollution. However, the impact of these technologies on vehicle and fuel prices will also have reduced motor vehicle use to some extent (even in locations and times at which emissions are not a problem) but may also have reduced vehicle fuel efficiency. Hence, their net impact on the fuel efficiency of the transport task is uncertain.

The possibility of varying the basis of road taxation (including congestion pricing) is part of the National Action Plan of the Australian Transport Council, which gives the Standing Committee on Transport the responsibility to:

> Develop an approach to move travel costs from predominantly fixed to predominantly variable costs in the areas of registration pricing; the cost of fuel; insurance charges; parking policies and congestion pricing.

[8] This cost estimate relates solely to the impact of outdoor ambient air pollution and BTRE note that it will vary substantially with changes to key assumptions such as the extent of observed pollution levels that are due to motor vehicle use.

The Commission's Review of National Competition (NCP) Policy Reforms (PC 2005) has recommended a national review of the passenger transport sector. Such a review could encompass issues of congestion pricing and other road pricing issues including the treatment of environmental externalities.

RECOMMENDATION 11.1

Australian governments should investigate the feasibility of introducing congestion pricing where it is likely to improve the economic efficiency of road use (including greater energy efficiency). It may be appropriate for such a study to be incorporated in a wider examination of efficient road pricing or in a review of passenger transport reform as a whole.

Intelligent transport systems (ITS)

ITS Australia (2003, p. 4) defines intelligent transport systems as '… the application of computing, information and communications technologies to the vehicles and networks that move people and goods'. Generally ITS are a range of relatively small projects which cumulatively could provide useful economic benefits, including privately profitable gains in energy efficiency and possibly environmental benefits. The BTRE noted:

> There is a wide range of ITS developments with equally varied impacts. ITS should result in more efficient use of the transport network through better informed decision making and low cost communication for the transport community. (BTRE 2002b, p. xvi)

Examples of ITS include managing and coordinating traffic signals, provision of transport information and optimising train, bus and truck fleet operations. The feasibility and potential benefits of congestion pricing have also been significantly enhanced by advances in ITS.

Austroads argued that the National Strategy for Intelligent Transport Systems offered significant benefits from further implementation of ITS:

> This Strategy will harness ITS to meet Australia's transport challenges. Estimates suggest an overall reduction in the total costs of road accidents, congestion and vehicle emissions by at least 12 per cent by 2012 from using ITS, is achievable, and indeed should be a minimum expectation of the total gains from using ITS. (Austroads 1999, p. 8)

The private benefits of improved traffic flow and efficiency in the use of transport vehicles may justify the public (and sometimes private) expenditure in certain ITS involved in achieving such improvements. However, the resultant energy efficiency and environmental benefits may not be as great as expected. Reduced congestion caused by more efficient traffic control (rather than by congestion tolls), while worth pursuing, may encourage more road use which may eventually partly or wholly offset the initial reduction in fuel consumption and emissions — effectively a 'rebound effect'.

Much of the investment in ITS likely to deliver energy efficiency improvements is undertaken by government. The key to such investment being cost effective for the community is the rigorous benefit–cost analysis of projects implemented within an efficiently operated, regulated and priced transport system. With regard to the latter, implementation of remaining regulatory reform in transport, reform of the rail sector and introduction of efficient congestion pricing are all necessary to enable accurate assessment of the benefits of further developments in ITS. Indeed, use of ITS would play an important part in achieving greater benefits from any introduction of congestion pricing.

In some cases, government budgetary restrictions can prevent or delay efficient capital investments. However, the Commission has not received any indications of any budgetary, regulatory or other impediments to the implementation of efficient ITS investments that would have improved energy efficiency.

Urban planning and energy efficiency in transport

The terms of reference direct the Commission to consider the role that urban planning policies might play in achieving privately cost-effective energy efficiency improvements in transport. The availability and cost of the various transport options for individuals and firms can be significantly influenced by urban and transport planning decisions of state and local authorities. In turn, this can affect actual transport choices with associated energy efficiency implications. Planning also impacts on the amount of energy used in transport activities by influencing both the need to make journeys and their length.[9] This energy-use effect is not the focus of this inquiry, but particular government programs often focus on both improved energy efficiency and reduced energy use simultaneously.

Urban planning involves a complex interaction of multiple objectives and multiple policy instruments to influence the way cities develop. Once made, the impacts of planning decisions are often effectively irreversible for long periods. Also, the extent of externalities — the actions of one person or firm impacting on others —

[9] For example, planning which facilitates residential, shopping, leisure and industrial and commercial zones in a local area can reduce the number and extent of energy-using transport journeys.

means that urban planning has to deal with the sometimes conflicting interests of individuals and firms in their roles as producers, employees and consumers.

The Planning Institute of Australia's (PIA) view of planning was that:

> Planners guide and manage the way suburbs, cities and regions develop, making sure that they are good places in which to live, work and play. Planners are involved in making decisions about land use proposals and other types of developments whilst balancing the needs of communities and the environment. (PIA 2005)

With regard to transport issues, the National Charter of Integrated Land Use and Transport Planning[10] (developed by the National Transport Secretariat for the Australian Transport Council) states:

> Land use and transport planning has a key role to play in delivering social, economic, and environmental sustainability. Roads will continue to dominate as the means of movement for the majority of people and freight in Australia in the foreseeable future. However, by shaping the pattern of development and influencing the location, scale, density, design and mix of land uses, planning can help to facilitate an efficient transport and land use system … (DoTARS 2003, p. 1)

The Australian Transport Council (ATC) has developed national guidelines for transport infrastructure planning:

> They adopt a total system approach to transport planning and investment. A multi-modal approach, providing for integrated infrastructure, travel demand management strategies (including land use planning), travel behaviour and Intelligent Transport Systems (ITS)/traffic operations is taken. (ATC 2004)

A number of parties have argued that urban planning needs to place greater emphasis on both reducing the need for travel and facilitating passenger journeys other than by private vehicle, thereby reducing energy use and increasing energy efficiency in transport. The Public Transport Users Association commented:

> It makes no sense to continue to build suburbs that have street layouts that are unsuitable for anything but the private car. Instead new subdivisions should provide sensible street layouts for efficient direct bus routes, and have permeable easily crossed local grid streets so residents can walk or cycle to neighbourhood facilities. (sub. 63, p. 7)

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[10] DoTARS (2003) notes that the Charter originated as an action in the Integrated National Strategy and Action Plan for Lowering Emissions from Urban Traffic which had been developed by the National Transport Secretariat following a request from the Australian Transport Council to improve the environmental performance of the transport sector. The Charter also incorporates the intent of the strategic responses prepared for the National Greenhouse Strategy measure 5.3 on land use and transport planning.

The National Charter of Integrated Land Use and Transport Planning place a focus on:

> … developing an urban and regional form that concentrates the provision of goods and services at hubs, and provides effective transport linkage between those hubs. (DoTARS 2003, p. 3)

Similarly, the PIA considered that transport considerations should play an integral role in urban planning:

> Australian cities should pursue urban development policies that strengthen the multi-modal city by increasing density and diversifying uses in activity centres linked to public transport, and by promoting integrated residential and employment precincts at the urban fringe and in larger infill development. (PIA 2003, p. 58)

In some cases, the underlying objective is to reduce greenhouse gas emissions. Environment Victoria argued:

> Energy efficiency and reductions in greenhouse emissions should be planned for in land-use and transport planning and where new Commonwealth funded development is proposed; as such development design affects energy use for generations. (sub. 67, p. 1)

In the National Charter of Integrated Land Use and Transport Planning it is noted that improved environmental performance of the transport sector (involving both less travel and improved energy efficiency of those journeys undertaken) is one of many outcomes resulting from best practice in integrated land-use and transport planning.

However, the BTRE cautioned that an excessive focus on transport outcomes could lead to inefficient planning decisions:

> While there are many lessons to be learnt from past development practices, these alone do not justify a radical change in direction. The uncritical pursuit of policies to increase the density of cities to achieve better utilisation of public transport may not be in the public interest. A prerequisite for sound land use would be to ensure that development costs are not distorted by subsidies (such as partial recovery of infrastructure costs): In other words, that the price signals that determine settlement patterns accurately reflect the benefits and costs facing society. (BTRE 2002b, p. 56)

The Industry Commission report on the impacts of financial policy on urban settlement noted the potentially high cost of mandating shifts in travel mode:

> It is not practical or cost effective to attempt to control urban land use such that no pollution or other adverse environmental impacts occur. Simple solutions are scarce: for example, mandated reduction in use of private motor vehicles is often advocated to remedy air pollution and congestion but this would imply an extreme judgement about alternative means of achieving those objectives, and neglect the considerable range of benefits to households and firms of the mobility enabled by private vehicles. (IC 1993, p. 8)

The energy efficiency of transport is only one relatively small and rather indirect consequence out of numerous outcomes influenced by the planning process. For the impacts of planning on transport energy efficiency to be privately cost effective, the other costs and benefits to individuals flowing from planning decisions will need to have been appropriately incorporated into the planning process. In particular, if outcomes are to be privately cost effective, the shares of motor vehicle and public transport use will be determined by individuals' and firms' responses to an efficient planning framework. The setting of target shares by governments is unlikely to result in privately cost effective transport outcomes nor in minimum-cost greenhouse gas abatement.

Given the complexity and longevity of the impacts of the planning process and the limited role of pricing signals, the costs and benefits of planning decisions can be difficult to determine. However, any focus of planning on improving transport energy efficiency and reducing energy use must be balanced against other objectives of individuals, firms and the economy and society more generally. Urban planning involves many competing social, economic and environmental priorities. No single consideration, such as energy usage or energy efficiency, should be given undue weight.

Other passenger transport issues

Corporate and leased vehicles

There can be tax advantages for individuals in using a vehicle leased for them by their employer rather than purchasing a vehicle out of their after-tax income. This will tend to increase employees' expenditure on motor vehicles. Some employers also pay for the cost of fuel which may (depending on the details of the salary package) lower the incentive for employees to select more fuel-efficient vehicles and to drive them economically. Further, some employers, particularly governments, require that leased vehicles be produced in Australia. As only medium and large vehicles are now produced in Australia, such requirements will tend to lead to lower energy efficiency of the overall vehicle fleet.

A motor vehicle provided by an employer which is available for an employee's private use is subject to fringe benefits tax (FBT) payable by the employer. Under the predominant method for calculating the tax liability (the statutory formula method) the tax liability reduces as kilometres travelled increase through various thresholds. If a company-provided vehicle is driven less than 15 000 kilometres in a year, its taxable value for that year is 26 per cent of its purchase price, whereas travelling over 40 000 kilometres reduces this to 7 per cent. The presumption is that, as a ‘rule of thumb’, the greater the kilometres travelled, the lower the proportion of private travel.

The FBT methodology provides an incentive to use a company-provided vehicle more, either by substituting for other modes of travel or for other family vehicles, or by increasing the amount of travel undertaken. To the extent that any substitution is away from more fuel-efficient means of travel, the energy efficiency of passenger transport will be reduced.[11] Several participants argued that the FBT statutory formula method should be amended to remove this encouragement to increased car travel (Public Transport Users Association, sub. 63; Sustainable Transport Coalition, sub. 70).

Many factors determine the choice of particular taxation rules — for example, efficiency, equity and, particularly, it would appear in this case, administrative simplicity. While the rules for calculating FBT liability will encourage somewhat greater vehicle ownership and greater use of the vehicles concerned, the impact on the *energy efficiency* of the transport sector appears likely to be relatively small and may not justify amendments to rules which have been developed to meet other objectives.

Changing transport modes

Public transport is, in most cases, a more energy-efficient means of transporting passengers than private motor vehicles. However, as many factors other than energy efficiency are considered when making travel-mode decisions, the vast majority of passenger trips are undertaken using private transport.

TravelSmart is a travel behaviour change program that aims to reduce the reliance on cars for private travel by providing information to transport users on the benefits of alternative means of travel, and the environmental costs imposed by car travel. State, Territory and local governments implement a wide range of projects under the TravelSmart banner and TravelSmart Australia brings together many government and community programs aimed at reducing the use of cars and increasing the energy efficiency of the transport task.

The objectives of TravelSmart are local and global environmental improvements together with improving individual’s health. TravelSmart Australia commented:

> TravelSmart is essentially a voluntary program that aims to inform and motivate people for changing their travelling behaviour through personal choice. It does not involve any

[11] A greater quantum of travel, while increasing negative externalities associated with motor vehicle use, is outside the energy efficiency focus of this inquiry.

> form of regulations, fees or taxes directed at compelling changes in travel behaviour. (TravelSmart Australia 2004).

The Conservation Council of Western Australia argued that the public needs to be educated about travel choices because:

> Lack of awareness of travel alternatives or misconceptions about the relative performance of different modes or preference for driving is a major factor behind car use in our cities — behavioural programs should be run to capitalise on system improvements. (sub. 54, p. 12)

The Queensland Government commented favourably on the program, observing:

> TravelSmart enables each participant to review and adjust their own travel behaviour to achieve reductions in vehicle travel within the context of their lifestyle and transport needs. The initiative does not compromise an individual's mobility needs. (sub. 38, p. 15)

TravelSmart initiatives aim to reduce the energy requirements of the passenger transport task by providing information aimed at encouraging a voluntary switch from motor vehicle travel (particularly involving a single occupant) to other less energy-intensive methods of transport. Hence, aggregate reductions in transport energy intensity resulting from the campaign should be beneficial for the private individuals affected, but will involve government expenditure. Whether TravelSmart is an effective means of achieving these private benefits will depend on the costs of the campaign and the value of any environmental and health benefits flowing from it. It is also important to consider if the program is the most cost-effective means of achieving these benefits.

The Victorian Government has evaluated a TravelSmart trial in suburban Alamein and found that there had been reduced car trips (10 per cent) and increased public transport, cycling and walking trips, compared to a control group not covered by the project. The South Australian Government (sub. 80) indicated benefit–cost ratios ranging from 4:1 to 44:1 from TravelSmart programs, with significant shifts observed from motor vehicles to public transport.

Even if the whole journey is not changed from motor vehicle to public transport, there are opportunities for part of the journey to be substituted. There are many possibilities for passenger transport (particularly in urban areas) to involve several modes. For example, in 2003 the Victorian Government developed a park and ride facility with 400 car spaces, bike lockers and a fast 'drop-off' zone to link with a freeway bus service to the city. If such facilities meet appropriate benefit–cost criteria they can generate both private and economywide, cost-effective energy efficiency improvements.

As noted above, cost-effective opportunities for greater use of multiple transport modes would be efficiently enhanced if congestion pricing were introduced on urban roads in conjunction with planning to efficiently satisfy the resultant increased demand for public transport.

FINDING 11.4

The TravelSmart program improves the energy efficiency of transport by providing consumers with information regarding less fuel-intensive travel options and means to reduce the need to travel. TravelSmart simultaneously addresses several policy issues — greenhouse gases, air pollution, and personal health and fitness — in a way that allows consumers to choose which options are most cost effective for them.

11.3 Freight transport

A large proportion of freight transport within Australia is undertaken using either road or rail. In many (although not all) cases, rail freight will be a more energy-efficient means of transport than road, particularly for heavy loads over long distances. For example, Apelbaum Consulting (2004) estimated that, on average, in 2001-02 rail freight used 0.31 megajoules of energy per tonne kilometre of freight carried compared to 0.96 megajoules for articulated trucks (the main competitor with rail freight). However, technical energy efficiency will be only one consideration among the range of costs and services that determine the choice of freight mode. Because of its overall advantages in other cost and service areas, road freight is used for the majority of non-bulk freight transport tasks where both modes are practicable. However, if current petroleum prices are maintained or increase further, the energy efficiency advantage of rail will assume greater importance in freight transport decisions.

Voluntary shifts by producers towards using rail (on the basis that it was more cost effective than road transport) would usually result in cost-effective increases in the average energy efficiency of the transport sector. A number of possible impediments or barriers to using rail freight may direct customers' choices away from rail — some are rational and efficient reasons while some reflect market or regulatory failures. In line with the inquiry's terms of reference, the focus here is on the private costs and benefits of alternative freight transport options. In particular, environmental costs and benefits are only noted insofar as they are the outcome of privately cost-effective freight transport choices. A full evaluation of policies for freight transport would also need to include environmental and social costs and benefits.

Significant amounts of freight traffic are effectively non-contestable between road and rail in that one or the other mode has a clear cost/service advantage. Domestic carriage of bulky low value freight such as coal and iron ore is largely the province of rail (and, to a lesser extent, sea) transport, while short distance freight traffic is largely the province of road. Phillip Laird (sub. 56) estimated that at least 8 per cent of the 2002-03 road freight task might be potentially transferred to rail if road freight input costs (for example, diesel and road user charges) increase and more rail investment is undertaken. The BTRE considered that '… generally, only a small proportion of total freight carried by road is contestable' (BTRE 2002b, pp 58–59).

Efficiency of rail freight

If the costs of rail transport services are inefficiently high, or service quality is too low, firms (and passengers) will, in the absence of subsidies, tend to use less rail transport (and more of other forms of transport) than is potentially desirable for economic efficiency. For example, Pacific National considered that:

> The NSW interstate track operates at significantly above efficient levels in terms of its continuing operating and maintenance costs. (Pacific National 2004b, p. 2)

Generally, this will also have adverse energy efficiency implications for the freight transport task by lowering rails share of freight carried.

The reform process in road transport proceeded ahead of that in rail and did so on an integrated national basis via the National Road Transport Commission (NRTC) which was established by COAG in 1992. As a result, inter- and intra-state road reform is well advanced and the already strong competitiveness of road freight has improved further.

While producing highly beneficial economic efficiency gains in road freight transport and the economy, the success of these reforms, in conjunction with a slower rate of rail reform, is likely to have encouraged some substitution of long-distance freight from rail to road. The National Transport Commission (NTC) (replacing the NRTC in 2004) was established principally to progress nationally-consistent regulatory and operational reform in road, rail and intermodal transport. While recognising the recent increased pace of rail reform, the NTC argued:

> Further reform, however, is required to enable rail to meet its full potential — especially if it is to carry a much larger proportion of the nation's rapidly growing non-bulk freight task. (NTC 2003, p. 1)

Improving the competitiveness of the rail sector offers the potential for cost-effective gains in energy efficiency through freight being shifted from road to rail transport. In addition, there are also likely to be opportunities for improved fuel efficiency of rail freight (and passenger) services through greater competitive pressure, improved regulation and better incentives for rail operators.

The Commission's examination of NCP reforms (PC 2005) has recommended a national review into the requirements for an efficient and sustainable national freight transport system. It recommended that such a review should include consideration of impediments to competition and efficiency in individual modes, including rail freight. The Australian Government (Costello 2005) has announced that the recommendations from the Commission's NCP report will be considered as part of the COAG review of NCP arrangements now due to be completed by the end of 2005.

Heavy vehicle charges

There has been considerable debate over many years regarding the appropriate level of road-user charges that heavy vehicles should pay. Interest has focused on equity and efficiency between different classes of road users and on competitive neutrality between road and rail.

The NTC is responsible for recommending the level of road charges to be levied on heavy vehicles. It has established a nationally-uniform set of charges (registration fee and fuel excise) that aims to recover the share of current road construction and maintenance costs attributable to heavy vehicles as a group and, at least to some degree, for sub-classes of heavy vehicles. The charges do not contain any allowance for environmental costs (such as noise and pollution), road safety costs or the costs of enforcing heavy vehicle regulation.

The former NRTC produced two heavy-vehicle charging determinations in 1992 (implemented in 1995 and 1996) and 2000. The NTC is currently undertaking a third pricing determination and has produced a discussion paper for public comment (NTC 2005a). New heavy vehicle charges (to be approved by the Australian Transport Council) will apply from July 2006.

There has been considerable argument that heavy vehicles are undercharged for their use of road infrastructure. For example, Pacific National considered:

> Road access pricing policy provides a significant subsidy for heavy vehicle owners, which not only inflates charges for passenger car owners, but also severely impacts on the competitive position of rail. (Pacific National 2004a, p. 4)

In particular, Pacific National (2004a) argued that both the averaging processes involved in determining fixed charges for particular vehicle classes and the use of fuel excise as a proxy for recovering variable road-use costs, resulted in undercharging of the large heavy vehicles which typically competed with rail for long-distance freight. It argued that a charging regime which was more closely correlated with mass carried and distance travelled would more accurately reflect the costs imposed by heavy vehicles. This, in turn, would enhance the competitive position of rail freight. It also noted that external costs of road freight, such as congestion, accidents and environmental costs, were not incorporated into road charges.

Conversely, the Australian Trucking Association (ATA) was concerned about subsidies to rail freight, arguing that the road freight industry:

> … more than pays for its attributed share of road costs. The same does not apply to rail freight, which pays for part of its infrastructure costs but benefits from government grants towards some of its infrastructure upgrading. (ATA 2004, p. 14)

The BTRE (2000b) noted that while road charging mechanisms had tended to under-recover costs for long distance freight vehicles, non-bulk rail freight often did not fully recover the costs of the infrastructure it used.

The Commission (PC 1999) has noted that the averaging process used to determine charges by vehicle class masks significant within-class differences in the road costs attributable to individual vehicles. It concluded that, at the time, heavy vehicles travelling longer distances — those most likely to be competing with rail — were being undercharged but noted that it was unclear whether changes in heavy vehicle charges proposed by the (then) NRTC would be sufficient to correct this undercharging.

The NRTC implemented a second charging determination in 2000, which significantly increased charges (which had not changed from the cost base used to establish the 1992 charges determination) for heavy vehicles and introduced an adjustment process to annually update the registration component of the charges between formal determinations. The second determination increased charges differentially between categories of trucks in order to better recognise average differences in factors such as distances travelled, utilisation of load capacity and fuel efficiency.

In preparation for the third heavy vehicle determination, the NTC (2004b) noted that some important issues in determining efficient charges still needed to be resolved. It has now released a discussion paper presenting indicative cost calculations for various types of heavy vehicles, to form the basis of its draft charges determination later in 2005 (NTC 2005a). While preliminary, these costings suggest a close to doubling of the registration charges component for B-double and Road Train vehicles.

The NTC estimated that such an increase would take registration charges to around 5 per cent of the total annual cost of providing and operating a B-double (NTC 2005b). It considered that the impact on rail's freight market share would be 'relatively small' (NTC 2005b, p. 69). The ATA indicated that an increase in road transport costs of between 5 and 8 per cent is likely from the proposed excise and registration fee increases (ATA 2005). These estimates suggest that relatively modest increases in freight charges would result if the NTC draft proposals were implemented and the NTC considers that only a small modal shift in freight would occur (NTC 2005b). In addition, the large trucks competing with rail are often the most fuel efficient.[12] Hence, the impact on energy efficiency of freight transport of the NTC charges proposals is likely to be very small.

Further refinements to the level and method of charging heavy vehicles offer important economic efficiency benefits. However, the extent of further appropriate increases in charges for heavy vehicles and the extent to which these would lead to energy efficiency improvements from switches in freight from road to rail is unclear. With regard to competitive neutrality between road and rail, the NTC argued:

> … the impacts of road pricing, within the scope of NTC's current sphere of influence, are likely to produce only marginal changes in the overall pricing of transport services. (NTC 2004b, p. 8)

The process for determining heavy vehicle charges is detailed and transparent, involving substantial industry consultation and an opportunity for public involvement. The charging methodology has evolved over time in order to more closely approximate the costs attributable to different classes of road users. Nonetheless, the charges necessarily involve many approximations and are averages of attributed costs across each of the various heavy-vehicle charging categories rather than the marginal costs imposed by individual vehicles.

Competitive neutrality between competing transport modes is an important objective of the NTC in undertaking this process. However, administrative simplicity and cost are also significant factors that are likely to continue to restrict the precision with which charges can be set to reflect the road costs attributable to individual vehicles or narrow vehicle groups. Equity and efficiency benefits from introducing a more sophisticated charging system would need to clearly outweigh the additional costs of implementing it. While increases in heavy-vehicle charges would encourage substitution of rail for road freight, any resultant energy efficiency improvements would only be cost effective if the charges were set appropriately. The achievement of competitive neutrality across all transport modes is a proposed

12 BTRE (2002b) estimated that the intercapital routes that competed directly with rail made up 12 per cent of the trucking task but accounted for 3.5 per cent of truck fuel use.

objective of the national review of the freight transport system recommended by the Commission (PC 2005).

The NTC process does not currently include an allowance for external costs of road freight. Some of these such as safety, urban air pollution and noise are being partly handled by regulatory approaches rather than pricing mechanisms. However, the ATC approved pricing principles underlying the NTC's considerations do allow for externality charges relating to noise and air emissions in certain circumstances (NTC 2005a). Addressing the broader greenhouse gas issue may justify higher prices for carbon-based fuels used by both road and rail. However, such increases in fuel prices may be best dealt with in an economywide (or indeed worldwide) context, rather than introduced on a sector-by-sector basis via, for example, increased heavy-vehicle charges.

Energy efficiency of road freight

Because fuel represents a significant proportion of the costs of road freight, providers would be expected to place considerable emphasis on energy efficiency.

The ATA noted:

> Because fuel consumption comprises some 25 to 30 per cent of the operating costs in line-haul trucking, in hire and reward trucking, then the trucking industry is well apprised of the need to control its consumption for business as well as environmental reasons … (trans. p. 253)

Energy efficiency of road freight movements has been further enhanced by regulatory reforms overseen by the NTC, such as greater opportunities for the use of B-doubles where appropriate. The BTRE (2003) indicated that, over the 1990s, fuel efficiency in terms of litres per net tonne kilometre travelled had improved by around 3 per cent for rigid trucks and 17 per cent for articulated trucks. Given that, on average, the fuel efficiency per tonne kilometre of articulated trucks is nearly three times greater than that of rigid trucks (BTRE 2003), the 10 per cent increase over the 1990s in the share of tonne kilometres carried by articulated vehicles has further increased the average fuel efficiency of the road freight transport task.

However, further reform opportunities remain, some of which would deliver additional privately cost-effective fuel-efficiency gains — for example, the ATA observed (trans. pp. 258–59) the potential for a number of jurisdictions to further increase regulatory mass limits for trucks with 'road friendly' suspensions without causing more road damage than under previous limits. Reviews of mass limits which identify justified increases (with higher heavy-vehicle charges if appropriate) would tend to generate privately cost-effective energy efficiency improvements within the road freight industry.

FINDING 11.5

There remains some scope for additional regulatory reform within both the road and rail sectors, that would improve overall efficiency and is likely to lead to some increase in energy efficiency within each sector. Some individual reforms may alter the competitive position of road freight compared to rail. This may change the energy efficiency of the overall freight task, in some cases reducing energy efficiency overall. However, this would not be an appropriate reason for delaying such reforms.

Intermodal transport

Many longer-distance transport tasks offer potential for the use of a combination of several types of transport to complete the task — intermodal transport. For most freight (other than some bulk commodities), at least some road element is usually needed. The opportunities for more energy-efficient transport modes to also be involved will be influenced by the cost or efficiency of intermodal transfers. In particular, concerns have sometimes been raised that barriers or impediments to intermodal operations have limited the share of rail and, to a lesser extent, sea in domestic freight transport. One of the objectives of the Inter-Governmental Agreement for Regulatory and Operational Reform in Road Rail and Intermodal Transport, which established the NTC, involves:

> Facilitating effective intermodal transport arrangements by addressing regulatory and operational issues. (ATC 2003, p. 1)

Reforms to remove inefficient impediments to intermodal transport could generally improve both economic and energy efficiency. However, an NTC discussion paper into impediments to improving efficiency in intermodal transport concluded:

> … there are no obvious gaps and/or shortcomings of regulation that has influence on interaction of operations between modes. (NTC 2004a, p. 63)

Similarly, this inquiry has received no submissions arguing that regulatory impediments to intermodal transport are inhibiting energy efficiency in freight transport. Nonetheless, concerns have been raised (for example, ACEA 2004) about the need for a more integrated approach to investment (some of it by government) in transport infrastructure. The Minerals Council of Australia (2004) argued that significant future growth in container throughput at ports would place pressure on the linked-land transport infrastructure.

In this regard, the Australian Government appointed a taskforce to identify physical or regulatory bottlenecks in the operation of Australia's infrastructure that may impede the realisation of export opportunities (Howard 2005a). The Exports and Infrastructure Taskforce made a number of recommendations with direct relevance to intermodal transport (EIT 2005). It argued that the Auslink transport infrastructure investment program should be extended to include ports of national significance and that Auslink should be used to expedite joint planning processes, especially with respect to the port/rail/road interface. The Taskforce also noted the success of road-rail-port logistics chains in the coal and meat industries. It recommended that, to the extent that it was consistent with competition law, the Australian Government should assist in the formation and operation of groups for the coordination of logistics chains of national importance.

In response, COAG has agreed in principle to:

- extend Auslink planning and coordination to ports and associated shipping channels;
- reinvigorate the agenda for harmonising road and rail regulation;
- the Commonwealth facilitating the establishment of groups to coordinate logistics chains of national importance (COAG 2005).

The NTC also noted that there appeared to be strong support for its existing road and rail reform program. It observed:

> Improved efficiency of modes (rail in particular) and flexibility of mode regulation (road in particular) is needed to improve attractiveness of potential intermodal transport chains. (NTC 2004a, p. 64)

Reliability and timeliness are critical elements of freight transport in today's 'just-in-time' world. Switching from one transport mode to another may increase both the duration of a transport task and the risks of missing deadlines. As well as coordination between modes, minimising these costs also requires efficient operation within all of the transport modes involved. Regulatory issues impacting on within-mode efficiency were discussed above.

Sea transport has played only a very small role in intermodal freight within Australia. It has been limited by the relatively high cost and limited availability of Australian coastal shipping, together with the restrictions on the use of international vessels — cabotage.[13] Although the number of single voyage permits granted has increased substantially since the late 1980s, the considerable uncertainty created by the need to obtain permits has inhibited any long-term relationship between overseas shipping lines and current or potential users of the coastal trade. The use of international vessels already travelling between Australian ports offers the potential for lower-cost freight transport which might also increase transport energy efficiency to the extent that it displaced road freight. The scheduled review of cabotage under the NCP is yet to occur. The ASA (2004) argued that there was a number of regulatory restrictions which impeded the Australian shipping industry's ability to compete for coastal trade.

The Commission (PC 2005) has argued that identifying barriers to efficient intermodal transport and developing appropriate policy responses, as well as examining impediments to better outcomes in coastal shipping, should be part of a proposed review into the requirements for an efficient and sustainable national freight transport system.

Overall, there appear to be limited opportunities for privately cost-effective increases in energy efficiency in freight transport. Improvements to the regulatory environment and efficiency of the rail sector could increase rail's share of the long-distance freight market and lead to cost-effective increases in energy efficiency in that sector. Road freight operators have significant incentives to be efficient in their use of fuel, although some further efficient regulatory reforms allowing greater use of large trucks would enable road freight transport to be somewhat more energy efficient. Possible large increases in registration charges for the largest trucks in 2006 (NTC 2005) would make rail freight more price competitive and could, thereby, lead to improved energy efficiency in long distance freight. As with passenger transport, an appropriate congestion pricing regime in large capital cities would provide a cost-effective increase in energy efficiency of urban freight transport.

[13] Cabotage refers to the practice of restricting access of international (essentially foreign-flagged) vessels to the Australian coastal trade. Vessels participating in the coastal trade must be licensed. A licence is only granted if the crew is paid at least Australian wage rates. Alternatively, a single voyage or a continuing voyage permit may be granted if licensed ships able to adequately provide the shipping task are not available.

12 Coordinating government programs

Key points

- Improving the coordination of energy efficiency policies would reduce compliance costs for firms that operate nationally.
- Levels of coordination across jurisdictions range from strict uniformity at one end, to consistency between similar programs at the other. The benefits and costs of different levels of coordination need to be compared on a case-by-case basis.
- National uniformity has been achieved in the regulation of energy labelling and minimum energy performance standards for electrical appliances. A lack of uniformity would be likely to increase business costs and inconvenience consumers.
- Despite efforts to achieve minimum energy efficiency standards for new houses that are nationally uniform (within climate zones), there are some State and Territory-based variations. These increase business costs and the case for continuing with them appears weak. Also, some local governments effectively override these standards. Ways to prevent this from occurring should be examined.
- For a range of other energy efficiency measures (such as information provision) national uniformity would not necessarily be beneficial. However, the inclusion of common elements (such as measurement systems) is desirable. Consistency with other policies is always appropriate.
- There is scope to improve the coordination of energy efficiency policies with other greenhouse gas abatement policies and economic efficiency objectives.
- The Ministerial Council on Energy has made some progress in improving the coordination of energy efficiency programs. Elements of the National Framework for Energy Efficiency (NFEE) Stage One could result in further improvement. However, there is need for:
  - greater clarity on the objectives of government intervention
  - more emphasis on priority setting
  - rigorous evaluation of past policies and programs
  - greater commitment of governments to the more rigorous framework.
- Stage One proposals of the NFEE that expand the scope of existing programs (to new jurisdictions or products) should only proceed after the net social benefits of those programs has been established.

There are around ninety Australian, State and Territory Government programs directed, at least in part, at improving energy efficiency (appendix C). Energy efficiency is also affected by many government activities that do not have an explicit energy efficiency focus (such as public housing policies). Programs aimed at improving energy efficiency can in turn affect other government policies, such as those aimed at stimulating economic growth. The interaction of all of these government initiatives raises a range of coordination issues.

The terms of reference direct the Commission to consider the level of coordination between Australian, State and Territory Government energy efficiency programs. This chapter examines:

- the coordination of energy efficiency policies and programs;
- coordination between energy efficiency policies and other policies; and
- institutional frameworks for achieving coordination and the role of the National Framework for Energy Efficiency (NFEE).

Appendix B provides detailed background on the existing institutional arrangements for coordinating government policies in regard to increasing energy efficiency.

12.1 Coordination of energy efficiency policies

This section examines participants' views on the coordination of energy efficiency policies and general principles of coordination. The insights gained are then used in assessing the desirable approach to coordination for individual energy efficiency policy measures.

Participants' views

A common theme expressed by many inquiry participants is that the coordination of government energy efficiency policies — both within and between jurisdictions — needs to be improved (box 12.1).

Box 12.1 **Selected inquiry participants' views on policy coordination**

Origin Energy:

> Poor coordination between current jurisdictional energy efficiency policies and related programs reduces the potential for cost-effective energy efficiency improvement across the economy. (sub. 25, p. 9)

Building Products Innovation Council:

> … there are a number of different approaches to energy efficiency in Australia and the eastern states are certainly leading the way. Unfortunately they are each leading their own way and we have a need to understand and implement different energy solutions for the same building requirement, varying based on the state in which it is constructed. (sub. 44, p. 3)

Housing Industry Association (HIA)

> HIA is concerned that conflicting State, Territory and local government regulations are damaging the capacity of the industry to deliver compliant homes. The competitiveness of local manufacturing is being damaged by regulations which fragment the Australian market into small niche markets. Australian manufacturing cannot achieve economies of scale if it has to tailor production to comply with different regulatory regimes nor does this represent an environment in which it can pursue innovative solutions. (sub. DR130, p. 9)

Government of Western Australia:

> A lack of government coordination has meant that organisations operating across jurisdictions often face different regulations, reporting requirements and formats in relation to energy programs. (sub. 58, p. 8)

Sustainable Projects:

> There are over four energy rating programs around Australia, each of which costs over $3000 to buy and train one person, not counting the additional costs of buying updates and training. So if your business operates in Queensland, NSW and other states (as mine does) I may have to buy over four programs to do the same job to comply with different state rules and prejudices (NatHERS, BERS, FirstRate). (sub. 3, p. 8)

GridX:

> GridX has found it difficult to access and comply with the regulatory landscape which is different in each state. It is an extremely costly process to obtain approval and licences for our projects within the various states of Australia and it would be better to have one framework. (sub. 5, p. 1)

Plastics and Chemicals Industries Association:

> Policies and programmes remain unfocused and uncoordinated, even to the extent that there is no consistent method to measure greenhouse gas emissions, or the implications for this of energy efficiency or energy consumption. (sub. 49, pp. 5–6)

Moreland Energy Foundation Ltd (MEFL):

> One feedback MEFL receives from schools is their confusion at the number of different approaches and initiatives underway which relate to sustainability. While innovation is good and different approaches are needed for different situations, it would be much easier for schools if all the sustainability initiatives came under one Government umbrella, linked to a State level strategy and policy. (sub. 18, p. 22)

Several inquiry participants supported national coordination as a means of overcoming current deficiencies. The precise form of coordination favoured, however, is sometimes unclear, given the use of different, undefined terms (such as coordination, harmonisation, consistency and uniformity). Some examples of support for a national approach, however expressed, are included below.

> AGA [Australian Gas Association] believes that national consistency is required in any energy efficiency framework for it to be workable for industry and at least cost to the community. (sub. 2, p. 2)

> Friends of the Earth … recommend … tough MEPS [minimum energy performance standards] and building standards in a timely manner, coordinated nationally as imperative measures in energy efficiency … (sub. 20, p. 15)

> The AAC [Australian Aluminium Council] supports the coordination of energy efficiency programs at the national level. While recognising the need for variations to accommodate differing climatic conditions across Australia and hence the need to be flexible around any notion of national uniformity in some areas, such as building standards, national coordination can have benefits, such as economies of scale in the development of programs and reduced costs of compliance for national businesses. (sub. 29, p. 11)

> From the BPIC [Building Products Innovation Council] perspective a nationally coordinated approach is essential to ensure the most efficient operation of the materials suppliers. (sub. 44, p. 5)

> AIGN [Australian Industry Greenhouse Network] is utterly convinced that national coordination and national uniformity of these [energy efficiency] programs … is an imperative for the efficient governance of the economy. (sub. 57, p. 8)

The Australasian Energy Performance Contracting Association (and the Australian Business Council for Sustainable Energy) had a different view, arguing that attempts to achieve national coordination can result in delays or failure:

> While coordination of energy efficiency policy and programs potentially reduces the costs and time spent in delivery and enhances compliance, the reality is often far from this. However history shows very long delays or complete failures in the delivery of such energy efficiency programs when attempts have been made to coordinate programs nationally. (sub. 47, p. 17)

In summary, coordination is often perceived as being inadequate where there are different regulations in each jurisdiction, resulting in increased compliance costs. This mainly affects firms which operate nationally. Another problem that can result from poor coordination is confusion for those targeted by different information programs or subject to conflicting reporting requirements. National coordination is supported by many inquiry participants as a means of overcoming these problems. The main arguments presented against national coordination are that it can take too long and there may be failure to agree on a common approach.

Many of the concerns raised have the potential to be addressed through the Ministerial Council on Energy's (MCE's) NFEE. The role of the NFEE is considered in section 12.3.

General principles of coordination

Greater coordination at the national level can reduce duplication of effort, improve program effectiveness and reduce costs to firms and the wider community. It is not always the case, however, that more coordination is better.

Decentralised government action can generate the following benefits:

- Development of more effective policies — different approaches in different jurisdictions can allow for greater innovation and opportunities for learning from the experiences of others.
- Reduced information asymmetries — it may be easier for local agencies to obtain accurate information about the firms and communities who are to be regulated or provided with programs.
- Closer matching with community needs — regional variations in community needs may justify differences in government objectives and policies.
- Greater responsiveness — local agencies may be able to respond more quickly to community needs.

Of relevance to these benefits is the principle of subsidiarity, which recognises that decisions whose impact is restricted to a local area should be made at the local level. The European Community makes use of this principle to require that actions be left to member states unless 'by reason of the scale or effects of the proposed action, [it] be better achieved by the Community' (van den Bergh 1996, p. 363). A Productivity Commission report into National Competition Policy (NCP) applied the principle of subsidiarity to the coordination of ongoing reform, arguing:

> For some areas … reform will best be pursued on a jurisdictional basis. This would be the case, for example, where an activity is not of national significance and where the impacts of policy decisions taken by individual jurisdictions are largely confined within those jurisdictions. (PC 2005, p. 323)

On the other hand, some policy problems transcend regional boundaries and may require a more coordinated approach that involves a higher level of government or a combination of jurisdictions (local, state, national, international). The three broad approaches to coordination are:

- uniformity — the same across all jurisdictions;

- harmonisation — agreement on common elements, such as definitions, measurement systems and rating systems; and
- consistency — not contradicting broader policy settings.

Each approach has its own strengths and limitations and these determine the circumstances in which they are likely to be appropriate (box 12.2). The remainder of this section considers these strengths and limitations in assessing the desirable approach to coordination for individual energy efficiency policy measures.

Box 12.2 **Approaches to coordination**

Uniformity

Uniformity can have the following benefits:

- Scale economies for government — costs of policy development and implementation may be lower when undertaken centrally or collectively.
- Scale economies for firms — costs may be lower because one product or service can be supplied across Australia, rather than having variations to meet local regulatory requirements.
- Reduced transaction costs — firms' costs may be lower where there is no requirement to provide different information, or follow different administrative procedures, when operating in different jurisdictions.
- Enhanced competition — uniform regulation may encourage Australian firms to expand their operations across jurisdictions and encourage international manufacturers to supply the Australian market.
- More effective treatment of externalities — where government action is required to address externalities (such as greenhouse gas emissions), it may be more effective when taken at a level that can 'internalise' the effects of the externality.

Uniformity has benefits where governments impose mandatory standards, where different standards in different areas (for example, in different industry sectors or across jurisdictions) could increase costs and have anticompetitive effects. Different mandatory standards for substitutable goods (for example, cars and four-wheel-drive vehicles) could distort consumer choices. Different standards in different jurisdictions will affect national companies and cross-border trading.

Uniformity is also important where governments establish regulatory schemes where trading is possible, such as emissions trading schemes. The larger the potential trading pool, the greater the potential gains from trading. Schemes that allow interjurisdictional trading (between States and, potentially, internationally) create scope for achieving given outcomes at least cost.

(Continued on next page)

Box 12.2 (Continued)

Where the Australian Government does not have responsibility, national uniformity requires the agreement of all States and Territories. Such agreement can be brought into effect by enacting model or template legislation across all jurisdictions.

Harmonisation

Harmonisation can be used to achieve the minimum effective resolution of coordination issues in circumstances in which uniformity is not appropriate. For some policies, uniformity may not be necessary, or even desirable. For example, it might be beneficial to tailor educational and awareness programs to specific circumstances. Similarly, different approaches to incentive programs (such as subsidies on energy-efficient products) are not likely to cause significant compliance problems, and might enable best-practice approaches to evolve more quickly than under a uniform national approach. Even in these circumstances, however, having uniformity in the definition and measurement of energy efficiency improvements can allow the effectiveness and efficiency of different programs to be compared, and can facilitate the assessment of each program's contribution to national or international objectives.

Consistency

Consistency of government policies within a jurisdiction reduces the risk that the pursuit of the specific objective will come at the expense of other, perhaps more important, objectives.

Government energy efficiency policies may interact with broader government objectives of economic efficiency, equity and community wellbeing. Energy efficiency policies that are consistent with related policies (or at least not inconsistent), including those addressing climate change, will be more effective at achieving the government's overall objectives.

Governments employ several mechanisms to promote consistency in their programs, including Cabinet, central agencies (including Premier's Departments and Treasuries) and rules and procedures for policy decision making. Governments have established policy development and evaluation mechanisms, such as regulation impact statement guidelines and environmental impact assessment guidelines, to assess the effect of specified activities on priority areas of government interest.

Consistency of policies and programs across jurisdictions is, however, often the only level of coordination that is able to be achieved, even where greater uniformity would be desirable.

Appliance labelling and standards

Schemes for energy labelling and minimum energy performance standards (MEPS) for electrical appliances were developed by the MCE and the Energy Efficiency Working Group (EEWG). The schemes are coordinated by the National Appliance and Equipment Energy Efficiency Committee (NAEEEC). Further information on the these bodies and the schemes themselves was provided in appendix B and chapter 9 respectively.

Regulations for these schemes are included in State and Territory Government legislation and are administered by State and Territory regulatory agencies. The legislation, however, is based on a nationally endorsed 'model regulation' and is intended to be administered in a uniform manner. The aim is to achieve 'consistent outcomes for all affected products irrespective of the product or jurisdictional location' (NAEEEC 2004a, p. 5).

Historically, the Australian Gas Association (AGA) has had responsibility for managing energy labelling and MEPS for gas appliances (SEAV 2003). Consistent with NFEE Stage One, NAEEEC has established a Gas Appliance and Equipment Energy Efficiency Program (GAEEEP) to take over these functions. It is intended that:

> A nationally consistent legislative framework, including penalties for noncompliance, will [be] put in place before the formal commencement of the GAEEEP. This will be based on legislation and model regulations developed by Victoria, which will be replicated in all jurisdictions from an agreed date to ensure national consistency. (AGO 2005f, p. 7)

The coordination of energy labelling and MEPS for electrical appliances is designed to achieve uniform outcomes across jurisdictions. If these schemes are to continue, it is appropriate that they be coordinated in this way, given that a lack of uniformity would be likely to increase business costs, for what are internationally traded goods. In the case of labelling, such uniformity also assists consumers who purchase appliances in different jurisdictions. It is planned that the GAEEEP will achieve a similar level of coordination for gas appliances.

FINDING 12.1

National uniformity has been achieved in the regulation of energy labelling and minimum energy performance standards for electrical appliances and the same is planned for gas appliances. To the extent that appliance regulation is justifiable, national uniformity is appropriate.

Minimum energy efficiency standards for new buildings

The Building Code of Australia (the Building Code) is intended to form the basis of building regulation across Australia. The Building Code was amended in 2003 to include standards to ensure a minimum level of energy efficiency in new houses and additions to existing houses.[1] Most jurisdictions have adopted these standards in full but some have not. The exceptions are Victoria — where state-based standards take precedence over some of the energy efficiency requirements in the Building Code — and New South Wales and the ACT — which have adopted their own energy efficiency standards for residential buildings (appendix D). In addition, some local governments, through the planning approval process, have imposed building requirements related to energy efficiency that are beyond the scope of the Building Code (PC 2004a).

Energy efficiency standards for other residential buildings (class 2–4) were adopted in May 2005 and standards for offices, shops, warehouses, factories and public health buildings (class 5–9) are scheduled to be introduced in 2006. While coordination of these standards is not considered here, many of the same issues apply.

Research report into the reform of building regulation

In 2004, the Australian Government requested the Productivity Commission to examine the reform of building regulation. In its report, published in November 2004, the Commission found that:

- some progress had been made in reducing differences in mandatory technical requirements across jurisdictions;
- further reductions in variations across jurisdictions should be pursued;
- ways to reduce the erosion of a national approach to building regulation caused by actions of local governments should be examined; and
- a new intergovernmental agreement should be negotiated to, amongst other things, strengthen the commitment to national consistency (PC 2004a).

[1] The desirability of including minimum energy efficiency standards in building regulations is discussed in chapter 10 and further information on the Building Code and its administration is included in appendix D.

The Commission noted that business and industry were frustrated by the multiple regulatory environments of the States and Territories, which limit interstate and international trade, and result in lower growth (PC 2004a). The research report concluded:

> Any variations to the BCA [the Building Code] need to be justified. Sometimes, differences are intrinsic to a locality and require particular, tailor-made regulations. Sometimes, they reflect the aspirations of the inhabitants of a community. In almost all cases, where a particular jurisdiction wants to set a different standard from the national one, the case for the variation should be put under scrutiny. Important questions to ask include what is the difference worth and how much would it cost to maintain it (for example, in terms of greater costs of compliance and decreased competition)? (PC 2004a, p. 38)

Following the release of the report, the Australian Minister for Industry announced that in-principle agreement had been reached on a new intergovernmental agreement that will result in greater consistency in building regulation across Australia. He stated:

> … [the new intergovernmental agreement is] a key step towards a truly nationally consistent building code based on minimum industry upset through regulation.
>
> I am also pleased that my State and Territory counterparts will begin implementing measures to ensure local governments do not undermine these principles through their planning approval processes … (Macfarlane 2005)

Are state and territory-based variations of minimum energy efficiency standards warranted?

State and Territory Governments may see a benefit in departing from uniform standards because their constituents have views on energy efficiency that differ from those that underpin the national standards. Where governments propose standards that are higher than those in the national code, however, the importance of this reason is weakened. This is because home owners who are strongly in favour of energy efficiency are free to go beyond the minimum standards required for their own homes. Variation in climate has been suggested as another possible reason for variations in standards. However, as the Building Code currently has energy efficiency standards that vary by climatic zone, there is no necessity for jurisdiction-based variations on these grounds.

A benefit of uniform standards is the reduction of costs to the building and building products industries. While there is only limited interstate trade in houses (for example, mobile and prefabricated houses), house designs and building products are actively traded, and some builders operate in multiple jurisdictions. Variations in standards tend to increase costs for this cross-border activity. Several inquiry participants provided information on the effects of variations in standards on their businesses (box 12.1). As stated by the Australian Glass and Glazing Association:

> It is very inefficient, difficult and costly, for a manufacturing industry to deal with fundamentally different state based approaches to energy efficiency, or any other regulation. (sub. 16, p. 3)

An alternative way that firms could deal with variations in standards was suggested by Alan Pears:

> Complaints about the cost of compliance with different requirements can also be addressed by developing higher standards that are sufficient to achieve all performance standards. For example, major building company Australand has developed internal environmental standards that allow it to comply with all existing measures. This minimises their compliance cost. (sub. DR113, p. 24)

While adopting uniformly high standards reduces compliance costs associated with variations in standards (such as administrative costs and loss of economies of scale), it tends to increase other costs (such as the materials and labour costs required to meet higher standards). Firms would need to weigh up these costs, and the possible marketing advantage of supplying products of a higher standard, in deciding whether this strategy is viable for them.

The benefits of national uniformity (for each climate zone) can not be considered in isolation from what those standards are. Common adoption of the most stringent standards could result in the benefits of uniformity being outweighed by a reduction in the cost effectiveness of the regulations in those states whose stringency must increase to comply with uniformity.[2] An analysis of the cost effectiveness of minimum energy efficiency standards for new houses, including the influence of stringencies, is included in chapter 10.

The fact that some firms may be able to effectively work around variations in standards, does not mean that there are not benefits in moving to national uniformity at an appropriate standard.

FINDING 12.2

The current State and Territory-based variations in energy efficiency standards for new houses increase costs for the building and building products industries. The case for such variations appears to be weak.

[2] A discussed in chapter 10, recent efforts to achieve national uniformity, while being only partially successful, involved this sort of ‘ratcheting up’ to the most stringent existing standard.

Are local government-based variations of minimum energy efficiency standards warranted?

In a national survey of Master Builders Australia members, 42 per cent of respondents indicated that, in their last residential contract, the local council had imposed extra energy rating requirements (sub. DR122). Local government energy efficiency requirements can be set out explicitly in regulations or be raised in negotiations. The Queensland Master Builders Association reported that some local governments have influenced land developers to impose covenants on the sale of land that deal with energy matters. They cited an example where the covenant on the sale of land in a housing estate requires that only solar, instantaneous gas or heat-pump water heaters can be used (sub. DR92).

Several inquiry participants opposed local government energy efficiency requirements that contradict, override or disregard the performance requirements of the Building Code. For example, Master Builders Australia stated:

> The level of additional documentation, plans and specialist reports required to be lodged with local government for planning approval is adding significant costs and delays to the assessment and approval processes by Councils. Many of these local government regulations are often designed in isolation and do not consider how they should fit with other statutory legislation, ie BCA [Building Code of Australia] and Australian Standards. They are developed without a regulatory impact statement and the costs are not calculated or balanced against the benefits. The increasing incidence of local government energy measures makes it extremely difficult for designers and builders to keep up-to-date with the rate of change as variations range from Council to Council. (sub. DR122, p. 2)

Some local government requirements relate to the appliances installed in new buildings. The Australian Electrical and Electronic Manufacturers' Association (AEEMA) opposed such requirements:

> … it's crucial local government does not erode the uniformity of minimum energy efficiency standards for new homes. That is a real worry for us. We're finding already some local councils [saying]: 'Sorry, if you want my signature on the development application, you can have four-star clothes dryers' [for] example. (AEEMA, trans., p. 638)

There was some support for local government variations in building standards, with Moreland Energy Foundation Ltd arguing that they could foster policy innovation:

> … some leading local governments in Victoria are implementing approaches which provide builders with an impetus to integrate a range of sustainability measures in building projects. Once local governments have made this work, the State Government will no doubt respond by adopting some of the practices which have been trialled at a local level. This is an important process in working towards best practice in our built environment. (sub. DR115, pp. 16–17)

The Commission's view is that the case for local decision making is generally strongest where the greatest knowledge and the greatest impact of the changes is at a local level. Determining effective energy efficiency requirements for houses requires specialist knowledge that is more likely to be available to national bodies than to local governments. The effects of such requirements are predominately experienced outside of the local government area. The impacts on suppliers of building products and appliances, and the building industry are often statewide or national. The possible environmental impacts associated with residential energy regulation are predominately global in nature. In addition, the costs associated with local government area based variations in energy efficiency standards are potentially higher than for State and Territory-based ones. This is because they can cause a higher degree of regulatory fragmentation and uncertainty.

The Commission recommended in its final report on building regulation:

> The future work agenda for the ABCB [Australian Building Codes Board] should include an examination of ways to reduce the scope for the inappropriate erosion of national consistency of building regulation by local governments through their planning approval processes. (PC 2004a, p. 184)

A number of avenues for doing this were also given in the report. This recommendation allows for the possibility of there being building regulation issues that could be appropriately dealt with by local governments. It is the Commission's view that energy efficiency standards are not in this category and the aim should be to remove local government involvement altogether. It is acknowledged that some progress has been made already. For example, in New South Wales the Building Sustainability Index scheme is enacted through legislation that prevails over any other environmental planning instrument (appendix D). The proposed new intergovernmental agreement, discussed earlier, may also help to improve the consistency of building regulation.

RECOMMENDATION 12.1

Australian, State and Territory Governments and the Australian Building Codes Board should examine ways to prevent local governments creating variations in minimum energy efficiency standards for buildings.

Other (less significant) coordination issues concerning the administration of the Building Code are covered in appendix D.

Reporting requirements

Firms are required to provide information on their energy use and greenhouse gas emissions to a range of Australian and State and Territory Government agencies.

This can result in significant compliance costs for firms, particularly where the information is required in different formats or where different data definitions apply. An example of this was provided by the Plastics and Chemicals Industries Association:

> This program [Victorian Protocol for Environmental Management] involves different reporting requirements to that of the Greenhouse Challenge, and a different and separate demand on those companies that would also be involved in the proposed MEEOA [Mandatory Energy Efficiency Opportunity Assessments], and the different reporting requirements are in themselves a significant cost and diversion for industry. (sub. 49, p. 6)

The *Energy Administration Amendment (Water and Energy Savings) Bill* that was passed by the NSW Parliament in May 2005 has the potential to add to the complexity of reporting requirements for firms in New South Wales. Under this Bill, some firms are required to report on their current energy usage and develop an action plan for making energy savings (chapter 7).

The Australian Government is looking to streamline the provision of information on energy use and emissions, using the Greenhouse Challenge program (now called Challenge Plus) as a single point of entry (Australian Government 2004). The Moreland Energy Foundation Ltd objected to this initiative, on the grounds that it would not cover all firms:

> While signatories to the Challenge should be reporting to the AGO [Australian Greenhouse Office] on what they have achieved in meeting their targets, this program is a voluntary one and so should not be relied upon as the means by which industry and business reports on emissions and energy use. (sub. DR115, p. 17)

The Commission sees value in better administrative coordination of reporting requirements, irrespective of what role the Challenge Plus program plays, provided that the information collected serves a valuable purpose.

FINDING 12.3

A review of the requirements on firms to report on their energy use and greenhouse gas emissions has the potential to reduce compliance costs. The review should consider whether the information currently collected serves a useful purpose as well as examining opportunities to harmonise reporting formats and data definitions.

Other energy efficiency policies

Coordination issues relating to information provision, incentives and government energy management are considered below. The focus is on whether national uniformity is necessary or desirable. Harmonisation of programs, which includes uniformity of some elements (such as defining and measuring energy efficiency improvements), may be desirable where this allows the effectiveness and efficiency of programs to be compared. Policy consistency is desirable in all cases.

Information provision

There are many government programs that provide households and firms with information about energy efficiency. With the exception of appliance labelling (see previous discussion), information programs do not need to be nationally uniform. Local programs may more closely match local needs, foster innovation and allow governments to learn from successful programs in other jurisdictions. Different information programs in different jurisdictions would not result in any particular disadvantages for firms or affect competition. There may be some scale economies for governments in developing information programs that are implemented nationally. Provided governments are able to learn from one another, however, duplication of effort is unlikely to be a significant disadvantage of local programs.

Incentives

The benefits of uniformity do not apply in any significant way to programs that provide financial and other incentives for the uptake of specific energy efficiency opportunities. By contrast, a benefit of allowing regional variation is that programs can respond to particular local circumstances. For example, the Remote Area Energy Efficiency Rebates Scheme (now discontinued) provided rebates on compact fluorescent lamps and insulation to households and businesses in off-grid communities in regional and remote South Australia. One objective of this scheme was to reduce government expenditure on electricity subsidies that are provided to these communities. While the Commission has not evaluated the program itself, clearly this objective is not relevant to other areas, where subsidies are not paid.

Government energy management

Managing the energy use of government agencies is an operational issue for each government. It would not be appropriate, therefore, to have a uniform approach to government energy management programs. It would be beneficial, however, to be able to compare the effectiveness of these programs and so a uniform approach to matters such as measurement of energy use would be a significant advantage. The NFEE Stage One measure to develop nationally consistent standards for measuring and reporting on programs that deal with government energy efficiency has the potential to improve policy coordination in this regard.

12.2 Coordination with other policies

Energy efficiency policies do not operate in isolation. They affect, and are affected by, a variety of other policies. This section distinguishes three situations which lead to different coordination issues, as follows:

- The consistency of energy efficiency policies with other policies for greenhouse gas abatement.
- The integration of energy efficiency into the broader energy and economic efficiency policy frameworks.
- The pursuit of policies that do not have an explicit energy focus (such as public housing policies) which nevertheless affect energy efficiency.

Greenhouse gas abatement policies

This is not an inquiry into Australia's response to climate change (see terms of reference and chapter 1). However, the Commission recognises that many energy efficiency policies are embedded within broader policies designed to reduce greenhouse gas emissions.

An important policy principle is the alignment of policy objectives and policy instruments. This inquiry is focused primarily on the policy objective of addressing barriers and impediments to the adoption of energy efficiency improvements that are cost effective for individual producers and consumers. The main objective of climate change policies is to reduce emissions of greenhouse gases, including those that result from the production and consumption of energy from fossil fuels.

Energy efficiency policies are consistent with climate change policies when they result in energy efficiency improvements with net private benefits that exceed the cost of the government programs. More marginal energy efficiency improvements may still be consistent with greenhouse policies if they result in a reduction in emissions with no net financial gain, or even a small loss. Inconsistency arises where energy efficiency measures are pursued in favour of other abatement options that have a lower cost (per unit of carbon dioxide equivalent gases abated).

The Commission is concerned that some current government programs to improve energy efficiency may produce a net private loss. Such programs could have a higher cost than abatement options that are not being pursued. Rigorous evaluation of programs is necessary to determine whether this is the case.

The Commission's review of National Competition Policy recommended:

> The Australian Government, in consultation with State and Territory Governments, should as a matter of urgency develop a more effective process for achieving a national approach to greenhouse gas abatement. (PC 2005, p. 349)

Following a meeting on 3 June 2005, the Council of Australian Governments announced that it had:

> … agreed to set up a Senior Officials' group to examine the scope for national cooperation on climate change policy, focusing on areas of common ground between jurisdictions where practical progress can be made. This would include consideration of the scope to improve investment certainty for business, encourage renewable energy (including ethanol) and enhance cooperation in areas such as technology development, energy efficiency and adaptation. (COAG 2005, p. 7)

There are some lower-order coordination issues between energy efficiency policy and greenhouse gas abatement policy that concern the relative emphasis given to the financial and environmental benefits of increasing energy efficiency. Appliance labelling is an example, where there is a choice between providing information on end-point energy use, energy costs, greenhouse gas emissions, or some combination of these. For appliances that have both gas and electric models available, this choice potentially makes a significant difference to rankings. Resolution of these issues relies on coordination between policy makers involved in both policy areas.

The broader energy and economic efficiency policy frameworks

The Australian Government's 2004 White Paper, *Securing Australia's Energy Future* announced its commitment to 'energy prosperity, security and sustainability':

> Improving Australia's energy efficiency performance is a key part of the government's plans to deliver prosperity and sustainability from energy. Increasing the uptake of commercially attractive energy efficiency opportunities would deliver substantial economic and environmental benefits. (Australian Government 2004, p. 17)

Energy efficiency is only one aspect of an integrated energy policy. As noted by the International Energy Agency:

> Energy policy must achieve a balance between energy security, economic growth and environmental protection. (IEA 2004c, p. 1)

Whether policies to improve energy efficiency are consistent with government policies and objectives to improve economic efficiency depends on the extent to which they result in increased use of other inputs (such as labour and capital), and the cost of government programs. Policies that result in net private benefits that exceed their costs to governments are consistent with economic efficiency objectives.

The price of energy is a key factor that influences the balance between environmental protection and economic growth. High prices encourage greater energy conservation and energy efficiency, which may have environmental and energy security benefits. High energy prices, however, tend to reduce economic growth. It would appear that developers of energy efficiency policy in Australia have generally been cognisant of this balance, and have sought to avoid measures that increase domestic energy prices.[3] However, a more comprehensive view of government objectives relating to economic efficiency and economic growth would appreciate how energy efficiency policies may decrease economic efficiency through means such as restricting the choices available to households and firms.[4]

Examples of where the Commission considers that energy efficiency programs are likely to be inconsistent with economic efficiency objectives are discussed elsewhere in this report.

Other policies

Many government policies outside the energy field nevertheless affect energy efficiency. Urban planning policies can affect the energy efficiency of residential and commercial developments. Policies affecting traffic congestion or public transport can affect the observed average energy efficiency of transport. In most cases, energy efficiency is not the driving force or main objective behind the policy, although the benefits of improved energy efficiency would be an input into any benefit–cost analysis of the policy (chapter 11).

To improve policy consistency, governments already employ mechanisms of good regulatory practice. All Australian jurisdictions, with the exception of Western Australia, use regulation impact statements (RISs) to formalise and document the steps taken in developing good regulation (PC 2004b). RIS requirements applied in Australia are integrated with, and reinforce, other regulatory quality control systems, including regulatory performance indicators and regulatory plans, and the requirements of National Competition Policy (PC 2004b). These mechanisms can contribute to the coordination of the overall policy platform, including consideration of energy efficiency.

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[3] One of the major consequences of microeconomic reform in the 1990s was a fall in real prices of energy, especially electricity and gas.

[4] A wider ranging and more detailed discussion of energy pricing issues is included in chapter 14.

Public housing

Provision of public housing is another example of where government policy affects energy efficiency without being its main objective. Governments provide various forms of housing assistance, including public housing, for people that face problems in accessing suitable private accommodation due to cost or other reasons. State and Territory Governments are responsible for providing public housing, and in 2004 there were around 336 000 occupied public housing dwellings in Australia (SCRGSP 2005).

Public housing policy and energy efficiency policy should both be consistent with reliable evidence on what constitutes privately cost-effective energy efficiency in housing. On the one hand, public housing policy should seek to avoid imposing high energy costs (or high levels of discomfort) on tenants through the provision of housing that is energy inefficient. This is necessary to ensure that government housing assistance is provided in a cost-effective manner. On the other hand, energy efficiency policy should be informed by the practical experience gained by public housing authorities on the tradeoffs between the energy efficiency and capital cost of housing. Failure to do this could result in governments imposing, or encouraging the adoption of, measures that they find not to be appropriate for their own housing stock.

Energy efficiency policies for the residential sector are premised on there being a significant gap between actual and the most privately cost-effective level of energy efficiency. As discussed in chapter 4, information deficiencies, split incentives and other barriers and impediments may be responsible for this gap. In providing public housing, governments are able to overcome many of these barriers and impediments. For example, while some private-sector landlords may seek to reduce outlays and increase profits by providing accommodation that is energy inefficient, it would be contrary to the objectives of providing public housing for governments to do this. Also, governments have access to information that would enable them to provide housing that — in the building fabric, fittings and installed appliances — provides a cost-effective level of energy efficiency. Another reason for State and Territory Governments to ensure that public housing is energy efficient is their objective of improving the affordability of energy services to people on low incomes (chapter 6).

Some inquiry participants provided anecdotal information that some public housing was energy inefficient. The Moreland Energy Foundation Ltd reported:

> A significant proportion of low income and disadvantaged householders reside in public housing supplied by the Department of Housing or Aboriginal Housing Board in each State. According to participants [in householder workshops], this housing is often poorly designed from the perspective of energy efficiency (especially heating and

> cooling requirements), stocked with inefficient appliances and lacking in insulation, including window and door seals and drapes. (sub. 18. p. XIX)

The Energy and Water Ombudsman NSW (EWON) stated:

> … EWON was contacted by a worker from a community agency who advised that the majority of their clients live in public housing and seem to have very high energy bills on a regular basis. They believe that much of the housing stock is not energy efficient, and generally properties are not insulated. This often means that their clients incur large energy accounts that are a significant financial burden. (sub. 48, p. 2)

More systematic information is provided by an Australian Bureau of Statistics survey that found that 39 per cent of renters with a government housing authority in South Australia used electric heaters (most commonly portable ones) as their main type of heater in 2004. This compares to 27 per cent for other renters and 13 per cent for owner-occupied households in South Australia (ABS 2005a). Electric heaters, while often being the cheapest to buy, are generally more expensive to operate than either gas heaters or reverse cycle air conditioners — which were the most common heater types overall (SEAV 2004c).

The South Australian Government reported that the energy efficiency of their public housing has improved:

> For example, over the past five years, the South Australian Government has installed approximately 2200 efficient heaters in Housing Trust homes within the colder, wetter parts of the State …
>
> … the Housing Trust builds houses that exceed the mandatory 4 star house energy rating, with the majority achieving a 5 star house energy rating. (sub. DR153, pp. 1–2)

On the basis of the evidence available, the Commission has not been able to come to any firm conclusions regarding the energy efficiency of public housing across Australia. While there appear to be deficiencies, it is acknowledged that some governments have programs aimed at improving the energy efficiency of their public housing stock (appendix C).

12.3 Institutional framework and the National Framework for Energy Efficiency

The institutional framework for coordinating energy efficiency programs needs to be able to address coordination across jurisdictions, between programs and with other policies. As argued in this chapter, coordination needs to take the form of uniformity, harmonisation or consistency, depending on the circumstance.

The current institutional framework includes the MCE and its committees — the EEWG and NAEEEC. These national bodies make recommendations and decisions that generally require agreement by the government in each jurisdiction, before they come into effect. The ABCB also has a role in relation to coordinating building regulations. Further information on the institutional framework is included in appendix B.

The institutional framework for coordinating energy efficiency policy appears to be appropriate for achieving coordination across jurisdictions and between programs. Appliance labelling and MEPS is an example of where the MCE has achieved an appropriate level of coordination. The MCE is also well placed to coordinate energy efficiency policy with other energy policies.

There are, however, aspects of coordinating energy efficiency policy with other government objectives, such as those for climate change and economic growth, that are likely to require a broader perspective. The current arrangements allow this to occur as individual Australian, State and Territory Governments make the final decisions, and it is at this level that energy efficiency policy can be considered in the context of broader government objectives. Nonetheless, throughout this report there are examples of where the Commission's assessment is that energy efficiency programs (including regulatory programs) are likely to be inconsistent with other government objectives — in particular those relating to economic efficiency.

A factor that may have contributed to this apparent inconsistency is inadequate consideration of nonregulatory alternatives during the policy-development process. RISs require alternative approaches to be considered. However, where RISs are conducted late in the process this may not be done effectively.

> In many cases, the RIS is prepared too late in the policy development process to be of any real assistance to decision makers. In those circumstances, it effectively becomes little more than an *ex post* justification for a policy decision already taken, subverting its role.
>
> When this happens, the telltale signs in the RIS tend to be inadequate consideration of alternative options, and lack of consultation, both of which are critical to good decision-making. (Banks 2005, p. 10)

For some energy efficiency measures, the problem of RISs being done late in the process is exacerbated by them being done by entities that do not have the ability to implement nonregulatory measures. An example of this relates to the introduction of mandatory energy efficiency measures in the Building Code. The ABCB reported:

> … the Australian Government announced in July 2000 that agreement had been reached with State and Territory Governments to introduce mandatory energy efficiency measures in the BCA [Building Code of Australia] … (sub. 7, p. 5)

A subsequent RIS for such measures, undertaken by the ABCB in 2002, included a section on the identification of alternatives, that stated:

> The ABCB has no responsibility for providing advice, education and information, except in relation to the BCA [Building Code of Australia]. This consideration of alternatives is therefore limited to regulatory measures that can be implemented through the BCA. (ABCB 2002, p. 6)

While the ABCB did consult with stakeholders during the development of the RIS, it is not apparent that nonregulatory options were adequately considered at any stage during the policy-development process.

In general, conducting RISs earlier in the policy-development process could help to achieve more comprehensive consideration of all policy options. If the ABCB continues to be involved in preparing RISs for building energy efficiency regulations, a measure suggested in a Commission report on building regulation might also assist (PC 2004a). This report noted that there is no Ministerial Council overseeing the operation of the ABCB. The Commission found that establishing such a Council may not be justified, but:

> An annual meeting of Ministers (with appropriate whole-of-government backing) may be a useful mechanism to demonstrate ongoing commitment to a nationally consistent approach to reform of building regulation. Ministers could also set broad strategic direction and priorities. (PC 2004a, p. 339)

Such an arrangement could provide a forum for the consideration of nonregulatory options for achieving greenhouse objectives in the building sector.

National Framework for Energy Efficiency

The MCE has overseen the development of the NFEE. In August 2004, Energy Ministers committed to implementing a package of measures as Stage One of the NFEE. The MCE has stated that '[t]he package will assist improved coordination amongst jurisdictions in delivering energy efficiency programs' (MCE 2004c, p. 2).

Many inquiry participants were supportive of the NFEE. For example:

> The AIGN [Australian Industry Greenhouse Network] applauds the agreement within the Ministerial Council on Energy (MCE) to proceed with energy efficiency improvement initiatives on a national basis through the NFEE framework. If the NFEE delivers in coordinating and delivering uniform national programs in this area, it will be a success. (sub. 57, p. 9)

> MEFL [Moreland Energy Foundation Ltd] is aware that the MCE has signed off on a package of measures as part of the NFEE. We support the policy package as a significant positive step towards overcoming the barriers to energy efficiency and unlocking the potential benefits. (sub. 18, p. 4)

Some participants were qualified in their support for the NFEE, arguing that there were deficiencies. Origin Energy noted:

> Development of the National Framework on Energy Efficiency (NFEE), although clearly valuable in many respects, has not focused sufficiently on the underlying rationale for government policy intervention in the area of energy efficiency. A poor understanding and specification of the policy problem being addressed potentially leads to misguided and ineffective policy prescriptions which risk imposing unnecessary costs on the economy and the community more generally. (sub. 25, p. 1)

There is a range of conclusions reached in this report that are relevant to particular NFEE Stage One proposals. These are summarised in table 12.1. Considering the NFEE more generally, the Commission's view is that it will improve national coordination and help guide the development of energy efficiency programs. There are, however, four main areas that could be improved:

- clarity on the rationale for, and objectives of, government intervention;
- emphasis on priority setting;
- use of *ex post* policy and program evaluations; and
- commitment of governments to the revised framework.

Clarity of objectives

The NFEE would benefit from a clear statement of the rationale for, and objectives of, energy efficiency policy. Some possible objectives of energy efficiency policy suggested by inquiry participants are to:

- enable producers and consumers to obtain energy services more cost effectively;
- compensate for people's failure to take environmental externalities (such as greenhouse gas emissions) into account when making energy consumption decisions;
- compensate for distortion in energy prices;
- reduce the need for investment in energy supply infrastructure; and
- improve energy security.

Energy efficiency policy is the most direct means of meeting only the first of these objectives. Energy efficiency policy can legitimately be used to pursue other objectives, but only where (or to the extent that) it is preferred to more direct policy responses. For example, using energy efficiency regulation (such as MEPS for air conditioners) as a means to reduce peaks in demand for electricity should only be considered if it has been decided that this is preferable to allowing electricity prices to become more cost reflective or implementing other demand management strategies such as interruptible supply contracts or direct load control (chapter 14). Deliberate choices need to be made and the objectives of energy efficiency policy clearly articulated. A risk in not doing this is that improving energy efficiency may be taken to be the sole objective, and government intervention seen to be warranted wherever there are perceived barriers to this occurring. As argued in this report, such an approach is likely to reduce economic efficiency.

Priority setting

It would be useful for the NFEE to identify the areas with greatest potential for generating net benefits, so that policy priorities can be set. The assessment of potential should consider both the amount of energy used, and the degree and type of market failure in the various sectors. Reference to specific policy measures could then be confined to those instances where national uniformity or harmonisation are warranted. Such a framework could improve national coordination, without being overly prescriptive. It would also assist individual governments to develop energy efficiency programs that deliver the greatest net benefits.

Ex post *program evaluation*

The Commission's view that there is a need for more rigorous evaluation of energy efficiency policies and programs is evident from the conclusions presented in table 12.1. In general, there appears to have been little *ex post* evaluation of progress by any jurisdiction. In conducting this inquiry the Commission asked all jurisdictions to supply it with copies of any public evaluations of existing and recent programs that they had undertaken. The jurisdictions provided the Commission with several RIS assessments undertaken before programs commenced, but very few *ex post* evaluations. In some cases, presumably, internal assessments of programs were undertaken.

Lack of rigorous evaluation is of particular concern where the NFEE foreshadows the expansion of the scope of programs. For example, one NFEE Stage One measure is for elements of the ACT House Energy Rating Scheme to be extended to all other jurisdictions. This was announced without having established that this scheme was efficient and effective. In response to the Commission's draft report for this inquiry, the Department of the Environment and Heritage reported that a number of evaluations are being undertaken, including:

> The ACT Government mandatory disclosure of building energy performance scheme is being evaluated as a necessary first step to implement the national mandatory building energy performance disclosure measure as announced in the Prime Minister's Energy Statement and NFEE Stage One policy packages … (sub. DR131, p. 2)

This move to undertake more program evaluations is a positive one. Formal, independent evaluation of key programs would help establish the knowledge base needed for future policy and program development. These should all be made publicly available. To achieve the widest possible benefits, future evaluations could be overseen by the MCE, or by relevant Auditor-Generals' offices.

Government commitment to the framework

One potential benefit in having a national framework is that the types of government energy efficiency interventions that can be expected in the future is made clear to stakeholders. This benefit is lost if governments introduce new energy efficiency policies that do not conform to the framework.

NFEE Stage One makes clear that the Australian Government will act to require large energy users to undertake mandatory energy assessments and report on energy efficiency opportunities. The *Energy Administration Amendment (Water and Energy Savings) Bill* introduced in New South Wales potentially cuts across this by requiring that large energy users in that State prepare energy savings action plans.

FINDING 12.4

The National Framework for Energy Efficiency will improve national coordination and guide the development of energy efficiency programs. It would be further enhanced by greater clarity on the rationale for, and the objectives of, government intervention and by more rigorous evaluation of existing policies and programs.

RECOMMENDATION 12.2

Stage One proposals of the National Framework for Energy Efficiency that expand the scope of existing programs (to new jurisdictions or products) should only proceed after the net social benefits of those programs has been established and a convincing case can be made for their expansion. Evaluations should also consider the impact on private cost effectiveness.

Commission conclusions relevant to NFEE Stage One measures

The Commission's conclusions that are relevant to particular NFEE Stage One proposals are summarised in table 12.1. The table indicates where in the report the full conclusion (and supporting argument) can be found.

Table 12.1 **Summary of conclusions that are relevant to the NFEE Stage One measures**

NFEE Stage One measure[a]	*Most relevant report conclusions (summarised)*
Residential buildings	
Nationally consistent minimum energy efficiency design standards for new homes, units and apartments	• The ABCB should, as a matter of urgency, commission an independent *ex post* evaluation of building energy efficiency standards (see recommendation 10.1). • The case for State and Territory-based variations in standards for new houses appears to be weak (see finding 12.2). • Ways to prevent local governments creating variations in standards for new houses should be examined (see recommendation 12.1).
Minimum energy efficiency design standards for major renovations	• As above.
Mandatory disclosure of the energy performance of homes, units and apartments at the time of sale or lease	• The results of a planned *ex post* evaluation of the ACT home energy-rating scheme should inform the implementation of this measure (see finding 10.1).
Commercial buildings	
Introduce nationally consistent minimum energy efficiency design standards for new and refurbished buildings	• Measures that expand the scope of existing programs (to new jurisdictions or products) should only proceed after the net social benefits of those programs has been established and a convincing case can be made for their expansion. Evaluations should consider the impact on private and social cost effectiveness (see recommendation 12.2).
Introduce mandatory disclosure of building energy performance at time of sale or lease	• As above.
Commercial/industrial energy efficiency	
The requirement for large energy consumers to undertake mandatory energy assessments and report on the energy efficiency opportunities that these identify, as announced in the Australian Government's Energy White Paper	• The policy of mandating assessments of energy efficiency opportunities is not warranted on private cost-effectiveness grounds. The demonstration effects that might be achieved by this policy could be pursued more effectively and at less cost by voluntary programs (see finding 7.5).

(Continued next page)

Table 12.1 (continued)

NFEE Stage One measure[a]	*Most relevant report conclusions (summarised)*
Nationally coordinated training and accreditation for energy auditors and energy performance contractors in conjunction with programs and protocols already in place	• Government should not become involved in accreditation of energy consultants and energy service companies because this function can be adequately performed by others (see finding 7.1).
Government energy efficiency	
Develop nationally consistent standards for measuring and reporting on government energy efficiency programs	• This measure has the potential to improve policy coordination (see section 12.1).
Introduce public annual reporting by all jurisdictions on energy use and progress towards achieving the targets set for government agencies	• Energy-intensity performance indicators, or targets, can help identify opportunities for cost-effective improvements in energy efficiency. Performance indicators are preferable because they provide less incentive to adopt measures that are not cost effective (see finding 8.2). • The costs of providing and analysing data should be considered when deciding what, if any, energy-use information government agencies are required to report (see section 8.3).
Establish minimum energy performance standards for government buildings	• Addressing cost-effective energy efficiency in procurement policies (including those relating to government buildings), provided there is sufficient flexibility, could lead to net benefits. Possible demonstration effects and market development benefits are unlikely to justify procurement decisions that are not cost effective for government operations (see finding 8.1) (see also section 8.3).
Develop best practice models for government departments to implement energy efficiency programs	• To the extent that it is cost effective, governments should be supplying energy efficiency information to their constituent parts as part of normal operations (see section 8.3).
Appliance and equipment energy efficiency	
The National Appliance and Equipment Energy Efficiency Program (NAEEEP) for electrical products will be broadened in scope to include MEPS and labelling for gas products	• Future regulation impact assessments of appliance MEPS should include more comprehensive analysis of a range of issues (see recommendation 9.1). • National uniformity has been achieved in the regulation of energy labelling and MEPS for electrical appliances and the same is planned for gas appliances. To the extent that appliance regulation is justifiable, national uniformity is appropriate (see finding 12.1).

(Continued next page)

Table 12.1 (continued)

NFEE Stage One measure[a]	*Most relevant report conclusions (summarised)*
The NAEEEP for electrical products will be expanded through the introduction of new or more stringent MEPS for residential, commercial and industrial products, with a key focus on increasing the number of commercial and industrial products regulated	• As above. • See also recommendation 12.2.
Trade and professional training and accreditation	
Undertake a nationally coordinated effort to integrate energy efficiency concepts into the courses for the key trades and professions that influence energy efficiency outcomes	• Not covered.
Develop training and accreditation courses for practising tradespersons	• Not covered.
Commercial/industrial sector capacity building	
Develop a nationally coordinated program to generate highly visible examples of energy-efficient equipment or processes in key industrial sectors and new or refurbished commercial buildings	• In some cases, government provision of information (which could include publicising industry best practice) may be warranted (see section 7.5). • Information failures are generally less significant in the commercial and industrial sectors than in the householder sector, suggesting a commensurately smaller role for governments (see section 7.5).
Establish nationally coordinated energy efficiency best practice networks	• As above.
Link industry and government to key centres for leading edge energy efficiency research and development	• Not covered.
General consumer awareness	
Require energy retailers to provide benchmark data on energy bills	• Not covered.
Development of a nationally coordinated network to facilitate easy and timely access to high quality and relevant information	• Government advisory services can be justified on public good, credibility and accessibility grounds. Private providers can also supply useful information. The case for government provision is strongest for general advice (see section 6.3).
Targeted promotional campaigns for specific energy efficiency issues	• As above.
Integration of energy efficiency concepts into the school curriculum	• Not covered.
Finance sector awareness	• Not covered.

[a] Adapted from MCE (2004c).

13 National energy efficiency target

Key points

- A possible national energy efficiency target (NEET) has been canvassed during the development of the National Framework for Energy Efficiency (NFEE).
- In Europe, there is considerable interest in energy efficiency target schemes as part of climate change policy.
- There are various options for how a NEET could operate. The Commission's assessment focuses on schemes in which:
  – major energy users or energy retailers would be required to achieve target levels of efficiency-related energy savings; and
  – trading in eligible energy savings would be permitted via the use of certificates (known as white certificates).
- Modelling for the NFEE suggests that a NEET would have substantial economywide benefits. The Commission's view is that it would not be possible to design a NEET scheme that would have the effects assumed by the modelling.
- A NEET is not supported because it:
  – would not directly address the market failures that cause the energy efficiency gap;
  – would require measurement and verification of efficiency-related energy savings from business-as-usual baselines, which would be very difficult and costly;
  – would alter investment patterns and encourage energy efficiency investments that are not necessarily cost effective; and
  – would not be a well-targeted measure to reduce greenhouse gas emissions.

Although there is no formal proposal for how a national energy efficiency target (NEET) would operate in Australia, the idea of adopting a NEET has been canvassed by the Energy Efficiency Working Group (EEWG 2004) during the development of the National Framework for Energy Efficiency (NFEE). A NEET has parallels with the Mandatory Renewable Energy Target (MRET) and the New South Wales Greenhouse Gas Abatement Scheme (NGAS), both currently operating in Australia. There are also emerging experiences in European countries with implementing energy efficiency targets as part of climate change policy.

Proponents of a NEET generally argue that it would encourage investment in energy efficiency improvements — and that if efficiency-related energy savings could be traded between participants, the overall target could be met in a lowest-cost manner. However, as discussed in this chapter, there are a number of reasons why the efficiency-related energy savings would not necessarily be achieved in an economically-efficient way.

The terms of reference require the Commission to consider a NEET including, but not limited to, the establishment of an annual requirement for major users of stationary energy to generate, or otherwise acquire, a target level of efficiency-related energy savings. This chapter examines this approach to a NEET, and also canvasses other options that involve placing obligations on energy retailers and that allow for trading in efficiency-related energy savings. The analysis is structured as follows:

- broad options for introducing a NEET (section 13.1);
- emerging experiences with energy efficiency targets, or related schemes, in Australia and internationally (section 13.2);
- assessment of a NEET on the grounds of private cost-effectiveness (section 13.3); and
- discussion on whether energy efficiency targets could help to achieve other policy objectives, particularly greenhouse gas abatement (section 13.4).

13.1 Broad options for introducing a NEET

There is a range of options for introducing a NEET. At its simplest, a NEET could be no more or less than what it implies — an aspirational target. It could be expressed as a broad objective of energy policy, for example that energy intensity in the economy be lowered by a given amount. The intention could be to meet this aspirational target through a range of energy efficiency policy measures. However, as the Australian Conservation Foundation noted, broad aspirational targets ‘provide little information about the effectiveness of actual policy measures’ (sub. 30, p. 9).

A NEET is usually viewed as a policy mechanism to drive improvements in energy efficiency. For example, the Energy Efficiency Working Group (through consulting with stakeholders on the development of a NFEE) identified the introduction of ‘a national energy efficiency target scheme to provide sufficient market drivers to increase energy efficiency’ as a potential policy option (EEWG 2004, p. 33).

The targets could be set and applied in two ways. The national target could be set first, with targets for individual firms set so as to aggregate to the national level.

Alternatively, the national target could be the aggregate of the energy savings targets for each firm.

Voluntary or mandatory participation

A NEET that involved setting targets for individual participants could operate with or without penalties for noncompliance.

In the case of a NEET without sanctions for noncompliance, individual firms would volunteer to participate in the scheme, and could be involved in setting and measuring progress towards their own targets. Essentially, this form of a NEET could be implemented through voluntary partnerships with industry, such as Greenhouse Challenge Plus. As voluntary programs are discussed in chapter 7, voluntary participation in a NEET is not analysed further in this chapter.

Energy efficiency targets and related schemes implemented in Australia and internationally generally impose mandatory requirements on individual firms. For a market in tradeable energy savings to operate, it would also be necessary to impose penalties for noncompliance on participants.

Participants

The group of participants required to meet energy efficiency targets could be all major energy users or — as is the case for the MRET — energy retailers.

If major energy users were regulated, each would presumably be required to achieve target levels of efficiency-related energy savings on an annual basis. A regulator would set targets relative to a business-as-usual (BAU) case for each user and annually verify the energy savings claimed. Firms would face a penalty if they failed to meet their target.

If energy retailers were regulated, targets could be set for reductions in energy sales relative to a BAU scenario, to be achieved through efficiency-related energy savings. To avoid penalties, the retailers could devise ways of rewarding their customers for achieving eligible energy savings. This would require negotiations with customers and annual verification of energy savings.

Trading in efficiency-related energy savings

Trading could be included in a NEET scheme if obligations to meet targets were regulated. A market could be established by allowing regulated firms to purchase the right to claim efficiency-related energy savings made by other firms. A regulated firm could then meet its target by making energy savings itself, or purchasing the rights to savings made by others, or a combination of the two.

Energy efficiency certificates (usually referred to as ‘white certificates’) could be issued for the purpose of trading. A trading scheme could allow efficiency-related energy savings made by both regulated and unregulated firms to count towards the national target, provided they could be verified. In such a scheme, regulated firms would be required to meet their targets and could act as either buyers or sellers of white certificates, whereas unregulated firms could act as sellers only. The penalties for noncompliance would establish the maximum value of white certificates, although their market value could be less depending on the supply of eligible energy savings. Trade in certificates would theoretically result in the lowest-cost compliance with the national target.

13.2 Emerging experiences with energy efficiency targets and related schemes

There is considerable interest in energy efficiency targets and related schemes in Europe and Australia. The key policy driver for these schemes is usually climate change.

European experiences

In Europe, several countries have introduced schemes that set mandatory energy efficiency targets. Some of these schemes involve tradeable white certificates, and the general intention in most schemes is that opportunities for trade will be introduced or further developed (box 13.1). Research is also being undertaken by the International Energy Agency on market-based policies for accelerating energy efficiency programs in five of its member countries (France, Italy, Norway, Sweden and the United Kingdom).

In the European Union, the European Parliament and the Council of the European Union have proposed that member states adopt a six-year indicative target for energy savings that is at least 1 per cent of energy consumed during an earlier reference period. Once reporting on this target has commenced, consideration will be given to whether a white certificates scheme should be introduced (CEU 2005).

Box 13.1 **Energy efficiency targets: examples from European countries**

United Kingdom

The Energy Efficiency Commitment (EEC) scheme requires gas and electricity suppliers to save a total of 62 terawatt hours (TWh) over the three years to 2005 (compared to 2002) (Langniss and Praetorius 2004). There are current proposals to extend the scheme to 2011 (DEFRA 2004b). The objectives of the scheme are to:

- contribute to the reduction of greenhouse gas emissions in line with the United Kingdom's Kyoto Protocol obligation;
- help electricity and gas consumers to use less energy and reduce their fuel costs, or to enjoy greater comfort; and
- give particular help to lower income consumers (DEFRA 2001).

The EEC only covers the energy supply to households. There is a requirement that half of the savings come from lower income households (which includes approximately one-third of all households). The regulator has defined standard energy efficiency measures that are acceptable for filling obligations. Other measures can be accepted, but require independent verification.

Energy suppliers have the option of trading energy savings and obligations. However, each trade needs to be approved by the regulator. In the first year of the scheme, there was no trading activity (OFGEM 2003), although an increase in the scope for trading within the scheme has been proposed (DEFRA 2004a).

France

The French Government has proposed the introduction of a white certificates scheme to help reduce energy intensity (final energy consumption per unit of GDP) (MEFI 2003). Under the scheme, major suppliers of electricity, gas, fuel oil and motor fuels would be required to achieve a level of energy savings based on the amount of energy they supply. These targets could be achieved through their own operations and/or the purchase of white certificates. The scheme is expected to begin in 2005, with a total energy savings target of 54.5 TWh over the first three years (IEA 2004d). These savings are equivalent to 2.7 per cent of French total final consumption of energy in 2001.

Italy

In 2001, targets were set for reducing the consumption of electricity by 18.6 TWh per year and of gas by 15.1 TWh per year against a business-as-usual scenario for the period 2002 to 2006 (Langniss and Praetorius 2004). The national targets are apportioned to electricity and gas suppliers with more than 100 000 customers.

A white certificates scheme to support energy savings targets is still being designed. It is envisaged that this scheme will credit energy efficiency measures that reduce consumption of electricity, gas and other fuels, such as heating oil (IEA 2004d).

Related schemes in Australia

A NEET has parallels with the NSW Greenhouse Gas Abatement Scheme (box 13.2) and the MRET (box 13.3) that currently operate in Australia. Under the New South Wales scheme, credit toward meeting greenhouse gas abatement targets can be gained by implementing energy efficiency measures. Both schemes involve tradeable certificates.

Box 13.2 **NSW Greenhouse Gas Abatement Scheme**

The NSW Greenhouse Gas Abatement Scheme commenced on 1 January 2003 and will remain in force until 2012. The purpose of the scheme is to reduce the emissions of greenhouse gases associated with electricity consumption. To accomplish this, the scheme sets benchmarks for per capita emissions of carbon dioxide equivalent gases. The statewide benchmark is to reduce per capita emissions to 5 per cent below the 1989-90 levels by 2007 and to maintain this level through to 2012.

The scheme covers all electricity retailers operating in New South Wales, as well as some large electricity consumers who have voluntarily elected to manage their own greenhouse gas emissions benchmarks, thereby avoiding having the compliance costs of the scheme being passed on to them by energy retailers. Energy retailers do not manage a benchmark for the load supplied to these consumers. Nine large consumers were voluntary members of the scheme in 2003, joining the 22 compulsory participants. Each of these benchmark participants is responsible for meeting a share of the statewide emission reduction target that is based on the proportion of electricity that they sell or use. Penalties are imposed on firms who fail to meet their targets (currently $10.50 per tonne of carbon dioxide equivalent gases).

Under the scheme, benchmark participants must meet their targets by surrendering the required quantity of NSW Greenhouse Gas Abatement Certificates (NGACs). These certificates can be traded.

NGACs can be earned by:

- using low or zero emission technology to generate electricity;
- demand-side abatement through energy efficiency and/or fuel switching; and
- carbon sequestration.

In 2003, electricity-generation measures accounted for 95 per cent, and demand-side abatement accounted for 5 per cent, of NGACs surrendered.

Source: Adapted from IPART (2004c).

Box 13.3 **Mandatory Renewable Energy Target (MRET)**

The *Renewable Energy (Electricity) Act 2000* (Cwlth) (the Act) originated as part of the Prime Minister's 'Safeguarding the Future: Australia's Response to Climate Change' announced in November 1997. The Act is supported by the *Renewable Energy (Electricity) (Charge) Act 2000* (Cwlth) and the *Renewable Energy (Electricity) Regulations 2001* (Cwlth).

The effect of the legislation, known as the Mandatory Renewable Energy Target (MRET), is to place a legal liability on wholesale purchasers of electricity to proportionately contribute towards the generation of an additional 9500 gigawatt hours of renewable energy annually by 2010. This level of generation is equivalent to more than twice the annual output of the Snowy Mountains Scheme.

The legislation is administered by an Australian Government statutory authority, the Office of the Renewable Energy Regulator (ORER). Tradeable Renewable Energy Certificates (RECs) are created on the basis of eligible renewable energy generation. Each REC is equivalent to one megawatt hour of renewable energy generation. A range of energy sources and technologies is eligible including hydro, wind, solar and various biomass sources, with provision for emerging technologies not yet commercialised in Australia, such as wave, tidal and geothermal energy.

Accredited generators that commenced operating on or after 1 January 1997 can earn RECs for all eligible electricity generated following accreditation. Pre-existing generators can only earn RECs for an increase in output above baselines determined by the ORER. Achievement of the 9500 gigawatt hours target and interim targets prior to 2010 is underpinned by a $40 per megawatt hour shortfall charge.

Source: AGO (2003e).

13.3 Could a NEET be justified on the grounds of privately cost-effective energy efficiency?

It might be presumed that the objective of a NEET is the adoption of cost-effective energy efficiency opportunities. For example, the Government of Western Australia suggested that '… a NEET would have the effect of ultimately saving individuals and businesses money as well as improving the performance of the economy …' (sub. 58, p. 15).

As discussed in section 13.1, there are a variety of options for a NEET. However, the assessment presented here focuses on NEET schemes that include:

- a regulator that sets efficiency-related energy-savings targets for designated participants (who could be energy retailers or all major energy users);
- financial penalties for those who fail to meet their targets;

- trading in eligible energy savings that is open to all via the use of white certificates; and
- the eligibility of energy-savings measures and verification of claimed energy savings being determined by the regulator.

While the idea of a NEET seemingly draws on well-established principles for creating tradeable permits, the Commission considers that the proposal has significant flaws — including its failure to address the policy-relevant market failures preventing the uptake of privately cost-effective energy efficiency. Furthermore, as discussed later in this section, difficulties with measuring and verifying efficiency-related energy savings would result in property rights being poorly defined. Consequently, markets in white certificates would not operate efficiently and so would not result in the most cost-effective energy efficiency investments being made.

Participants' views on the benefits of a NEET

Several inquiry participants suggested that a NEET could drive improvements in energy efficiency. For example:

> A market mechanism like a NEET could deliver measurable energy savings through the uptake of eligible energy efficiency activities and would be independent of the level of economic activity. (Department of the Environment and Heritage, sub. 30, p. 10)
>
> The Green Building Council of Australia supports the conclusions of the National Framework for Energy Efficiency… Introduce national energy efficiency target scheme and provide market drivers to assist the transition to increased energy efficiency. (sub. 41, p. 7)
>
> AEPCA … recommends that broad-based market signals be introduced to drive new investment in energy efficiency. Two major types of signal can be used, preferably in combination … A greenhouse market signal … An energy efficiency certificate trading scheme. (The Australian Energy Performance Contracting Association, sub. 47, p. 19)
>
> There is … an opportunity we think for altering incentive structures through some mechanism; NEET, the National Energy Target, is one that's been put forward. (Australian Business Council for Sustainable Energy, trans., p. 770)

Some participants who supported further investigation into the idea of a NEET referred to modelling undertaken as part of the NFEE process (for example, Department of the Environment and Heritage, sub. 30, p. 10; South Australian Government, sub. 80, p. 4). The modelling suggested that the benefits of achieving a NEET are substantial (box 13.4). However, the Commission would be concerned if this modelling was to be used to justify the desirability of introducing a NEET scheme (and indeed no claim of this type is made in Allen Consulting

Group (2004b) or MMA (2004), by the consulting firms that undertook the modelling). The Commission's concerns focus particularly on the assumptions needed to incorporate energy efficiency and a NEET into general equilibrium and other models.

In estimating the benefits of achieving certain targets, the modelling did not examine whether a NEET would be effective in encouraging firms to invest in privately cost-effective energy efficiency improvements. In effect, the modelling assumed that many privately cost-effective energy efficiency investment opportunities exist but have not yet been taken up, and that targets would be successfully met solely through the widespread uptake of these investments. As discussed in the remainder of this chapter, the Commission's assessment is that this would not occur.

Box 13.4 **NFEE modelling of a NEET**

The Allen Consulting Group was engaged by the Sustainable Energy Authority of Victoria (SEAV) to undertake analysis of the impacts of reaching targeted annual reductions in end-use energy consumption, as part of the National Framework for Energy Efficiency (NFEE) process (Allen Consulting Group 2004b). This work involved general equilibrium modelling to assess economywide impacts. The results suggest that the benefits of achieving a NEET are substantial.

The Department of the Environment and Heritage referred to the results for one version of the model:

> Analysis done for the NFEE showed that a 1 per cent NEET (annual energy savings of 1 per cent beyond business-as-usual) would deliver an increase in [real private] consumption of approximately 0.18 per cent by 2014, while reducing greenhouse gas emissions by 16.5 megatonnes carbon dioxide equivalent and reducing electricity prices to end users. The total net present value of increased consumption over the life of the investments initiated by a 1 per cent NEET is $8.4 billion. (sub. 30, p. 9)

A version of the model that seeks to simulate the effects of trade in energy efficiency certificates shows a lower, although still strongly positive, net present value of $6.4 billion (Allen Consulting Group 2004b).

McLennan Magasanik Associates was engaged by the SEAV to estimate any additional benefits that might flow from achieving targeted reductions in energy consumption. They estimated benefits with a net present value of $2.4–$6.6 billion (depending on the NEET scenario) from:

- deferral of new electricity and gas plants
- higher levels and longer periods of mothballing of plants
- plants operating at reduced capacity (MMA 2004).

What kind of incentives would a NEET create?

Retailers or energy users participating in a NEET would incur costs directly associated with meeting targets. For example, if a NEET involved setting targets for retailers:

- Some retailers would aim to meet these targets by purchasing white certificates and/or by encouraging customers to undertake energy efficiency improvements (for example, through subsidising purchases of energy-efficient appliances).
- Other retailers might find it profitable to overcomply with their targets, and sell white certificates on the market. Such retailers would gain revenue from trading on the market, but costs would be incurred through encouraging their customers to undertake energy efficiency improvements.

The retailers would seek to pass the costs of meeting energy efficiency targets to their customers (through increased retail energy prices) and to energy suppliers (through decreased wholesale energy prices). In this situation, a NEET would be equivalent to a tax on energy that is imposed on retailers, the proceeds of which are used to subsidise energy efficiency improvements. Like the tax and subsidy policy combination, a NEET could encourage energy efficiency improvements — but these investments will not necessarily be privately cost effective.

A NEET would not address market failures

Regardless of what target levels are set, a NEET would not directly address the underlying market failures, such as imperfect information, that may limit the uptake of privately cost-effective energy efficiency opportunities (chapter 4). If cost effectiveness is the objective, policy instruments that target these failures directly would be more appropriate. The Energy Supply Association of Australia referred to this issue:

> … since the target would not address the underlying barriers to the uptake of energy efficiency improvement opportunities … it would be unlikely to drive significant energy efficiency gains. (sub. 68, p. 12)

The Energy Retailers Association of Australia (ERAA) also questioned the rationale for a NEET:

> A national energy efficiency target, considered by some participants an appropriate policy response, is not in the interests of the community because it fails to address an underlying market failure. (sub. 26, p. 3)

Defining property rights for the market

In order for a market to work efficiently, property rights must be clearly defined, allow exclusive use of the property in question, be readily transferable, and be enforceable by law (Murtough, Aretino and Matysek 2002; PC 2002). A NEET would appear to have major shortcomings in this regard, largely because the attendant property rights can not be readily defined.

For a NEET to work effectively, property rights need to be assigned to parties that undertake energy efficiency measures that result in energy savings that are additional to that which would have occurred without a NEET. This requires:

- determining what would have happened without a NEET (by establishing BAU baselines);
- measuring energy savings resulting from energy efficiency measures; and
- verifying that eligible energy savings have occurred.

A NEET is described as a 'baseline-and-credit' scheme because it involves establishing baselines and issuing credits for efficiency-related energy savings measured from that baseline. (See box 13.5 for examples from New South Wales and the United Kingdom that illustrate some of the potential difficulties with determining additionality in baseline-and-credit schemes.)

Establishing business-as-usual baselines

While it is relatively easy to measure how much energy is being produced or consumed, it is very difficult to measure how much energy is being saved due to efficiency measures as a result of a policy, because it relies on estimating hypothetical BAU baselines.

As discussed in chapter 5, it is highly debatable what BAU energy use might be. To estimate BAU baselines in a way that considered the individual circumstances of each entity would be impractical, necessitating the use of indiscriminate rules. A balance would need to be struck between issuing certificates for activities that would have occurred anyway and disallowing activities genuinely motivated by a NEET.

Box 13.5 **Additionality of measures in baseline-and-credit schemes**

A key test of the effectiveness of an energy efficiency target is whether the energy savings credited under the scheme are additional to those that would have occurred in the absence of the target. Experiences from schemes in New South Wales and the United Kingdom demonstrate the potential difficulties with ensuring additionality in baseline-and-credit schemes.

New South Wales Greenhouse Gas Abatement Scheme (NGAS)

One way that participants in this scheme can earn certificates is through a range of energy efficiency activities. Certificate entitlements from these demand-side abatement activities can be calculated using one of three methods:

1. Project impact assessment method — engineering assessments of activities are conducted against baselines that are based on current energy consumption (for existing installations) or the most energy-efficient equivalent installation that exists in New South Wales, or otherwise in Australia (for new installations).
2. The metered baseline method — baselines are calculated by measuring consumption over a period before demand-side abatement occurs.
3. Default abatement factors method — each item on a list of commonly installed equipment (such as domestic appliances and electric motors) is allocated a default abatement value, based on National Appliance and Equipment Energy Efficiency Program energy star ratings (chapter 9).

Activities credited under this scheme are not necessarily additional to what would have occurred anyway, because the assessment methods fail to take into account several factors (such as other policy measures) that could influence energy efficiency investment decisions. Energy reductions credited under the NGAS may have occurred for reasons unrelated to the scheme.

United Kingdom Energy Efficiency Commitment (EEC)

Domestic energy suppliers under the EEC scheme are obliged to meet their energy efficiency targets by encouraging householders to install energy-saving measures.

It is acknowledged that some eligible energy efficiency measures would have occurred in the absence of the EEC. However, the scheme does not adjust the overall target or suppliers' individual targets to account for such installations. Although suppliers are obliged to demonstrate additionality to the regulator, it is assumed that they will meet the cost of subsidising households that would have otherwise implemented the measure — referred to as 'deadweight'.

The stated rationale behind setting targets that represent total, rather than additional, energy efficiency installations, is that 'this avoids the otherwise intractable problem of allocating deadweight to individual schemes when determining the energy savings' (DEFRA 2004b, p. 22).

Sources: MacGill and Outhred (2003); DEFRA (2004b).

In schemes that require the establishment of baselines, certification of activities that would have occurred anyway is likely to be prevalent, because participants would have a strong incentive to seek credit for these zero-cost opportunities (Langniss and Praetorius 2004, OECD 2000). For example, MacGill et al (2005) observed that 95 per cent of the certificates registered under the NSW Greenhouse Gas Abatement Scheme in 2003 appeared to have been earned from installations that were built or planned prior to the commencement of the scheme. In the majority of these cases, firms were not required to undertake operational changes.

There is also the potential that firms which are already energy efficient could be the most disadvantaged by the introduction of a NEET. The Australian Industry Greenhouse Network argued that:

> … any target that might have reference to a contemporary or recent benchmark or baseline risks penalizing those businesses which have already achieved a high level of energy efficiency, and face much higher marginal costs to improve further. (sub. 57, p. 13)

Consequently, there is a risk that once the scheme was announced firms would try to game the system by artificially inflating BAU projections and delaying energy efficiency improvements that they already had in the pipeline (OECD 2000). In this respect, the Energy Supply Association of Australia noted that:

> Major energy users would have an incentive to understate their energy efficiency prior to the commencement of the scheme in order to gain credit for business-as-usual (BAU) activities. (sub. 68, p. 13)

Measuring and verifying eligible energy savings

Changes in energy use over time can be measured relatively easily. However, isolating energy savings resulting from energy efficiency measures from other influences on energy use is much more difficult. This is because energy efficiency is difficult to define and distinguish from variations in energy use due to other factors, such as changes in the output of firms, lifestyles, and the weather.

If energy savings resulting from energy efficiency measures could not be isolated accurately, as is likely, a NEET might discourage energy consumption *per se*. This would be distortionary by discouraging energy-intensive but economically-efficient activities.

A NEET would require a verification system that balanced the competing objectives of minimising transaction costs and maintaining the integrity of the scheme. For large industrial energy users, this would involve detailed scrutiny of individual energy efficiency projects. For savings made by households, it would be necessary to determine that energy savings had occurred from consumer actions, such as the purchase of an energy-efficient appliance or the installation of insulation.

Due to the ill-defined nature of the property rights, and the potentially large number of suppliers of energy-savings credits, the task of verifying white certificates would be extremely difficult and time consuming. The likely result is that verification would fail to maintain a high level of integrity.

Effect on investment

Rather than addressing market failures, a NEET would increase the incentives to invest in energy efficiency improvements. Consequently, it would alter investment patterns and encourage investment in energy efficiency projects that are not privately cost-effective under current expectations about energy prices. As discussed above, difficulties in defining property rights could also lead to a bias against energy-intensive but economically-efficient activities. The effect of these distortions would be to cause a reduction in economic efficiency and economic growth.

Several inquiry participants were of the view that a NEET would distort investment. For example:

> The Australian Aluminium Council is strongly opposed to any form of a national energy efficiency target (NEET). A NEET would cause economic inefficiency due to the enforcement of a particular outcome irrespective of the cost imposed on the economy and individual enterprises to achieve the specific target. (sub. 29, p. 14)

> Is the objective to drive EEI [energy efficiency improvements] across the economy or to reduce energy consumption? … a NEET would be more likely to force firms to allocate capital away from other more productive uses towards energy conservation projects in an attempt to achieve their target. (Energy Supply Association of Australia, sub. 68, p. 12)

> Liable entities would be collecting an energy efficiency tax from energy consumers and forced to spend the proceeds on energy efficiency investments to meet some arbitrary target at the expense of other capital projects. Energy efficiency performance in the economy may improve as a result but the allocation of capital would deteriorate. (Energy Retailers Association of Australia, sub. 26, pp. 39–40)

Choice of designated participants

Regardless of the initial distribution of obligations, trading under a NEET would fail to allocate the obligations to improve energy efficiency in the most cost-effective way. The choice of designated participants (between energy retailers or major energy users) could further influence efficiency outcomes — as well as having equity implications.

As discussed previously, energy retailers participating in a NEET would incur costs associated with purchasing white certificates or encouraging customers to improve energy efficiency — and would seek to pass on these costs through increasing the price of energy. The costs could therefore be spread over a large group of domestic, commercial and industrial customers. The effect of higher energy prices might be regressive if the retailers' lower-income households spent a higher proportion of their income on energy than did other customers. However, the overall distributional consequences of a NEET would also depend on the effects of energy price increases on retailers' commercial and industrial customers.

In comparison, large energy users — particularly those which are price takers and export-oriented — might have limited scope to pass on the costs imposed by a NEET to their customers. Firms which use energy intensively are likely to be the most affected, and thus investment and production would be distorted in an economically-inefficient way. The distributional consequences of targeting large energy users will also be different than targeting energy retailers.

Administration costs

The administration costs faced by regulators of, and participants in, a NEET could be significant. The Australian Aluminium Council noted:

> The administration and compliance costs of a NEET scheme would be very significant given the individual circumstances of firms even within the same industry. Establishing benchmarks for each business, accounting for 'business-as-usual' improvements, setting uniform industry or individual targets for each business, avoiding the danger of penalising those who have achieved a high level of energy efficiency make such a policy almost unworkable, very costly and counter-productive to achieving economic efficiency. (sub. 29, p. 15)

The task of regulating a NEET would involve setting targets, determining the eligibility of energy-savings measures, verifying energy savings and administering the issue and surrender of certificates. Verification would likely be the most costly component. The verification task has been described earlier — to maintain even a moderate level of system integrity would require considerable resources and expense. The costs associated with performing the other tasks would also be significant.

In addition to the costs of purchasing white certificates, paying penalties, undertaking energy efficiency improvements and the opportunity cost of forgoing more profitable uses of capital, a NEET would impose a range of administrative costs on designated participants. These costs would be associated with demonstrating compliance with targets, such as the administrative costs involved with obtaining and trading certificates.

Consistency of a NEET with other energy efficiency policies

A NEET might be viewed as being complementary to existing energy efficiency programs and the NFEE Stage One measures. This is because it would encourage the uptake of energy efficiency investments by regulated firms or those producing white certificates. To some extent, it might be thought that it would even obviate the need for some of these programs. However, the distorting impacts of a NEET would also encourage the uptake of energy efficiency investments that are not cost effective. And since the NEET does not directly address the underlying market failures preventing the uptake of cost-effective energy efficiency improvements, it will tend to cut across, rather than complement, programs that do.

FINDING 13.1

A national energy efficiency target, based on an annual requirement for major users of stationary energy (or energy retailers) to generate or otherwise acquire a target level of energy efficiency related savings, can not be justified on the grounds of privately cost-effective energy efficiency. It may help to drive investment in energy efficiency, but this would be at the expense of economic efficiency. It would also be very difficult and costly to implement effectively.

13.4 Could a NEET be justified as a means of meeting broader objectives?

As discussed in the previous section, a NEET has significant flaws as a policy to address privately cost-effective energy efficiency. This section examines whether it might be justified because of the social benefits from increased investments in energy efficiency — in particular, the benefits associated with greenhouse gas abatement.

Schemes that incorporate energy efficiency targets usually aim to meet broad objectives (section 13.2):

- In the United Kingdom, improving energy efficiency is seen as a cost-effective way of meeting multiple policy goals including reducing carbon emissions, ensuring security of energy supply and tackling ‘fuel poverty’. In particular, the Energy Efficiency Commitment addresses ‘fuel poverty’ by targeting poorer households (DEFRA 2004a).

- In France, the objective of the proposed system of tradeable energy efficiency certificates is to decrease energy consumption, in order to stabilise energy consumption to 2003 levels by 2015. This energy-consumption target appears to reflect policy goals including reducing carbon emissions and reducing dependency on imported fuels (IEA 2004).

A greenhouse gas abatement objective could potentially be met by subsidising energy efficiency investments — such as those that could, in effect, be provided by energy retailers to energy users under a NEET. However, several inquiry participants argued that a NEET is not the best way to achieve a greenhouse gas abatement objective. For example:

> If the primary objective is to drive a reduction in greenhouse gas emissions, ESAA believes that this would be better achieved through a coordinated, national approach, rather than adding an energy efficiency target to the existing mix of state and federal measures. (Energy Supply Association of Australia, sub. 68, pp. 12–13)

Why implement an energy efficiency target to address a greenhouse gas abatement objective?

In chapter 2, the Commission set out some important principles for good policy design. In particular, the objective of the policy needs to be identified clearly and policy measures chosen that target that objective as directly as possible. As the Australian Industry Greenhouse Network observed:

> Energy efficiency improvement is not an end in itself. It can benefit profits, consumer welfare and energy security and the mitigation of climate change. Policy makers would do better to address and improve markets more directly related to those benefits than to a partial objective like energy efficiency improvement. (sub. 57, p. 13)

As a policy to address greenhouse gas abatement, a NEET would target energy efficiency improvements rather than emissions themselves. It would not be the most directly-targeted instrument and is therefore unlikely to be the most efficient or cost-effective option.

For example, in a ‘cap-and-trade’ emissions trading scheme, regulators set a cap on total carbon emissions and distribute allowances to the emissions amongst the participants. Participants could then trade in emissions allowances. Some participants may find it profitable to undertake a range of activities, including but not limited to energy efficiency improvements, which reduce their emissions and enable them to sell excess allowances. This type of cap-and-trade scheme, which operates entirely on traded allowances (and does not provide offset credits for emissions reductions based on BAU projections) is likely to have several advantages over a baseline-and-credit NEET. These advantages include:

- More comprehensive inclusion of greenhouse gas abatement options — a NEET that restricted abatement options to energy efficiency improvements would result in a higher total cost of abatement compared with emissions trading.
- Better functioning markets, due to more easily defined property rights (AGO 1999b) — defining property rights for a baseline-and-credit scheme, such as a NEET, would be difficult and costly due to reasons outlined in section 13.2.
- Potentially lower administration costs — a baseline-and-credit scheme such as a NEET would require ongoing, costly monitoring and verification of energy savings, and is likely to result in higher administration costs than emissions trading (AGO 1999b).
- Greater certainty of meeting a greenhouse gas abatement objective — due to the difficulties with establishing baselines and measuring and verifying activities, there is a greater risk that a baseline-and-credit scheme, such as a NEET, would not result in the desired level of abatement (Dewees 2001).

If a NEET was introduced in addition to an emissions trading scheme, it would not necessarily create emissions reductions additional to what would be achieved with emissions trading alone. If a cap-and-trade scheme can be adequately enforced and compliance levels are high, then it is likely that total emissions from participants will be less than or equal to the aggregate cap. If both schemes are in place, activities that are implemented to earn energy efficiency certificates could also reduce total emissions. These emissions allowances, which have been ‘freed up’ by energy efficiency activities, would then be banked for subsequent use or sold to other emissions trading participants to cover equivalent increases in emissions. (Sorrell 2003).

There is also doubt as to whether a NEET can be integrated with an emissions trading scheme without threatening the credibility of the latter (box 13.6). The issues are similar to those identified by various organisations when assessing the problems associated with linking project-based mechanisms with domestic greenhouse gas emissions trading schemes (for example, Bygrave and Bosi (2004)). These problems would arise through grafting a baseline-and-credit NEET onto the ‘cap-and-trade’ architecture of an emissions trading scheme, which does not rely on BAU assumptions.

Box 13.6 **Integrating a NEET with an emissions trading scheme**

The issues involved in integrating a NEET with an emissions trading scheme depend in part on the type of emissions trading envisaged.

Integrating a NEET with baseline-and-credit emissions trading

It is possible, with some assumptions, to convert energy savings under a NEET to emissions reductions (MacGill and Outhred 2003). This allows for a NEET to be integrated with other systems that trade in emission reductions from a business-as-usual (BAU) baseline. This could involve having a NEET for emissions reduction from energy efficiency, and similar schemes for emissions reductions from low-emission fuels and carbon sequestration. An alternative would be to subsume efficiency-related energy savings within an economywide scheme for trading in emissions reduction. No target would be set for energy efficiency, as the amount of emissions reductions from each type of abatement activity would be left to the market. The New South Wales Greenhouse Gas Abatement Scheme is an example of such an approach.

Integrating a NEET with cap-and-trade emissions trading

The generally preferred option, however, is for trading in *emissions*, not *reductions in emissions*. This is consistent with the Kyoto Protocol, that sets emissions caps for developed countries, rather than targets for reductions from a BAU baseline.

There are substantial difficulties in integrating a NEET (which trades in intangible energy savings) with a ‘cap-and-trade’ emissions trading scheme (which trades in tangible emissions). While work is being done on ways to overcome the difficulties, some commentators believe that the inclusion of intangible energy savings would threaten the credibility of emissions trading schemes, because there is a high level of uncertainty about whether credited energy savings correspond to actual reductions in emissions (MacGill and Outhred 2003; Sorrell 2003). This mainly arises because of the uncertainty involved in setting baselines and difficulties in monitoring and verification. For example, in the case of the United Kingdom Energy Efficiency Commitment investments, the energy savings are estimated rather than monitored and the accuracy of these estimates will depend on the models used and assumptions taken.

Another possible consequence of coexisting NEET and emissions trading schemes is that emissions reductions might be ‘double counted’ under both schemes (Sorrell 2003, AGO 1999b). Emissions reductions will be attributed to activities earning credits under a NEET, but these activities will also ‘free up’ some emissions allowances under an emissions trading scheme. For example, if an energy retailer participating in a NEET scheme subsidises a household to install energy-efficient appliances, the retailer will earn credits under the NEET — which will be accounted for as emissions reductions. However, if the household reduces electricity consumption as a result of the installation, then additional carbon allowances will also become available in the emissions trading market.

Could a NEET be justified on the basis of wider coverage?

Some proponents of a NEET regard it as being able to operate effectively in combination with a greenhouse gas emissions trading scheme and an MRET scheme. As discussed in section 13.2, the implementation of all three measures is being considered in some European countries. One common argument is that a NEET would complement emissions trading because it would enable wider coverage of emissions reduction opportunities. For example:

- The AGO (1999b) suggested that if larger emitters participated in emissions trading, then there could also be a role for a baseline-crediting arrangement to include small emitters that would otherwise be difficult to bring within the scope of a cap-and-trade scheme.
- In the United Kingdom's White Paper on energy policy, DTI (2003) suggested that, although the European Union emissions trading (which will cover direct emissions from large emitters) will play a central role in reducing emissions, the EEC would enable greater coverage of the household sector.

However, if markets are functioning efficiently, in theory the price signal reflecting the cost of greenhouse gas emissions would be incorporated into the price of energy faced by other sectors not directly involved in emissions trading.

As Sorrell (2003, p. 696) observed, once emissions trading is in place, it is unlikely that an energy efficiency target such as the EEC could be justified on the grounds of greenhouse gas abatement:

> … the justification for retaining those instruments must rely more heavily on their contribution to, first, policy objectives other than efficiency; and second, overcoming market failures other than carbon externalities.

Because the EEC scheme requires retailers to achieve 50 per cent of energy savings from lower-income households, it could be viewed as a measure to address an equity objective of United Kingdom energy policy — which is 'to ensure that every home is adequately and affordably heated' (DTI 2003, p. 11). However, if the intention is for a NEET to address policy objectives other than efficiency, these objectives must be clearly outlined (chapter 2). A NEET should be evaluated against other policy options that could achieve the stated objective — for example, in the case of the affordability of household heating, direct subsidies or concessions to lower-income households.

Another proposition in support of a NEET seems to be that an emissions trading scheme will not overcome all of the barriers to energy efficiency (MacGill and Outhred 2003). For example, in the United Kingdom, DEFRA (2004a, p. 65) suggested that:

> Due to the low elasticity of demand for electricity, price signals from the generators alone will not reduce demand in line with our emission reduction goals … We will continue to explore other ways in which trading-based approaches could be used … for demand-side energy saving, both in households and in other sectors that do not fall under the ETS [emissions trading scheme]. Options include … developing a separate market in accredited energy savings — so-called “White Certificates” …

To some extent, emissions trading schemes may not achieve emissions targets at lowest cost if failures in the market for energy efficiency technologies that warrant government intervention — such as those caused by asymmetric information — prevent the adoption of some low-cost options. If this is the case, however, policy measures that address these barriers directly are required — and as discussed above, a NEET would not do this.

FINDING 13.2

As a measure to address greenhouse gas abatement, a national energy efficiency target has serious disadvantages compared to other more directly-targeted policy options. It is unlikely to complement those options, and could reduce the overall economic efficiency with which a greenhouse gas abatement objective is met.

RECOMMENDATION 13.1

A national energy efficiency target, based on an annual requirement for major users of stationary energy (or energy retailers) to generate or otherwise acquire a target level of energy efficiency related savings, should not be implemented.

14 What is the role of energy market reforms?

Key points

- The price of energy does not always reflect the costs of its production and consumption. This is particularly the case with electricity. Making electricity prices more cost reflective will improve economic efficiency.
- Regulatory arrangements governing the transmission, distribution and retail price of electricity insulate consumers from variations in the costs of delivering electricity to them and dampen demand-side responses.
  - Retail price caps should be removed as soon as effective competition is established.
  - Network regulation could be improved to provide better incentives to invest in demand side management.
  - The introduction of more cost-reflective pricing (including time-of-use pricing) will require the roll out of smart metering and billing systems but this should be subject to a comprehensive benefit–cost analysis.
  - More cost reflective pricing might improve energy efficiency in peak load periods.
- Environmental externalities associated with the use of energy, such as greenhouse gas emissions, add to the cost of producing and consuming energy. Recognising these costs, either explicitly or implicitly, would encourage a greater uptake of energy efficiency and renewable energy technologies.
- Improving competition among electricity generators will lower pool prices, which will tend to decrease incentives for end users to invest in greater energy efficiency.

The scope for energy market reforms to improve energy efficiency is discussed in this chapter. The terms of reference direct the Commission to consider the scope for further energy market reform (including, but not limited to, more efficient cost-reflective pricing) to improve the management of the demand and supply of energy.

Many participants in this inquiry have argued that energy prices do not precisely reflect the costs of supplying and using energy, and that this is leading to inefficient and/or overuse of energy. They have also argued that by making energy prices more cost reflective, suppliers and users will improve their management of energy in a way that increases energy efficiency.

Other chapters presented in this report are concerned with the policy implications of barriers and impediments to the adoption of cost-effective investments in energy efficiency. Those chapters examine the effect of barriers and impediments from the perspective of current energy prices — that is, current expectations about the energy prices likely to be experienced over the relevant investment time frame. In contrast, this chapter is mainly concerned with how reforms to energy markets, by influencing energy prices, can improve demand- and supply-side responses in energy markets and bring about energy efficiency improvements.

The costs of energy vary significantly over time and between locations of energy use (section 14.1). Although microeconomic reform since the early 1990s has made energy prices more cost reflective, some distortions are still present. These include:

- the regulation of retail prices and network tariffs faced by residential and small business customers (section 14.2);
- insufficient levels of competition in electricity generation (section 14.3); and
- unaccounted environmental externalities, such as those arising from greenhouse gas emissions (section 14.4).

These factors prevent the prices for energy from fully reflecting the economic costs of its production and consumption, leading to a misallocation of resources. Though improved competition might reduce energy efficiency, other measures that would make prices more cost reflective (including addressing the unaccounted externalities) have the potential to raise energy efficiency. Before addressing these issues the chapter gives a brief account of some of the influences on electricity costs and prices.

14.1 Energy pricing and costs

One means of encouraging demand- and supply-side responses in an energy market, and thereby promoting economic efficiency, is to ensure that the price of energy reflects the economic cost of its supply and use.

Economic efficiency does not imply that energy use must be minimised. In some circumstances, using high levels of energy might minimise the total costs of production (including the costs of capital and other inputs) as energy is used or consumed in preference to other inputs (chapter 2).

Electricity markets

Electricity markets are dynamic. Demand and supply are constantly changing throughout the day, week, season and year, and these changes vary between different locations in the market. In the case of electricity, there is considerable volatility in both the volume of electricity generated and price for which electricity is traded in the spot market (figure 14.1).

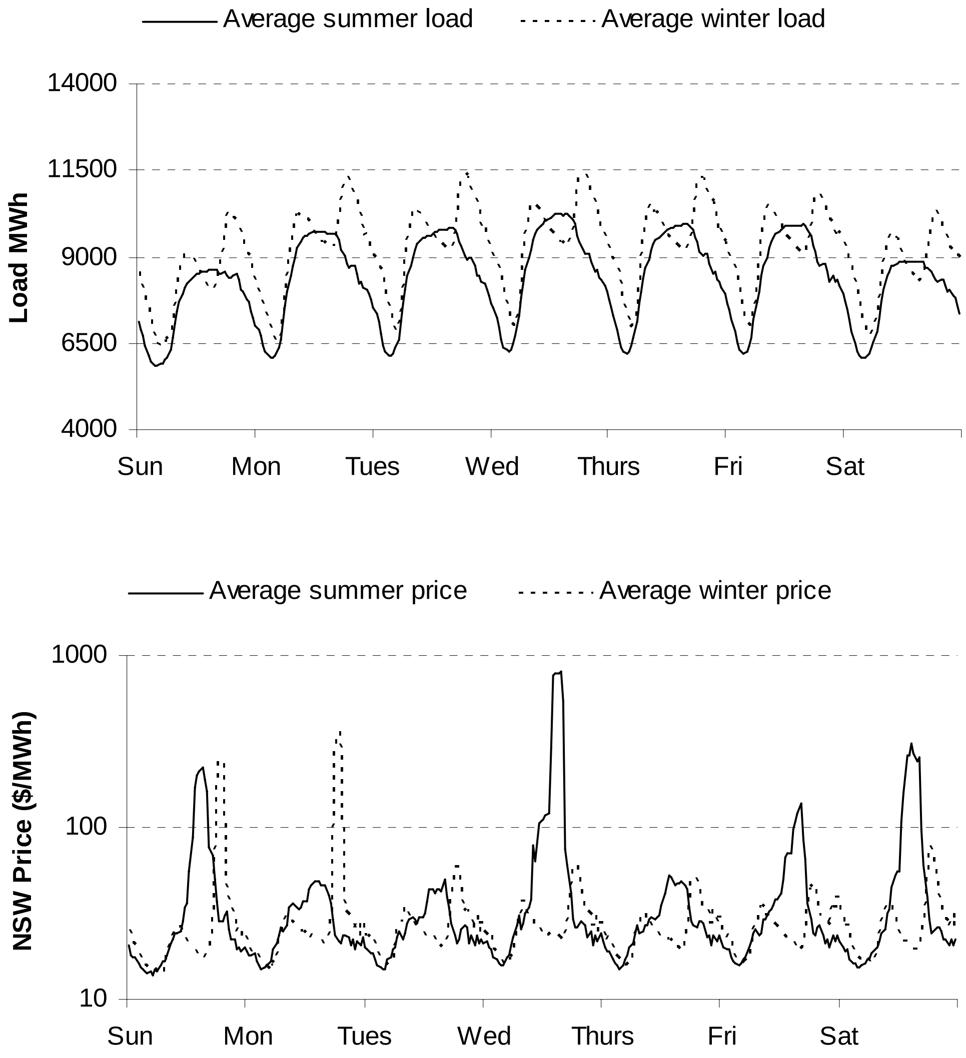
The reasons for the volatility in spot prices and volumes are well understood (Sayers and Shields 2001; Salerian 1991). Electricity cannot be easily stored in large volumes, and instead it must be generated when it is required. This means that small imbalances in supply and demand can have large effects on wholesale prices. As demand increases during the day, so does the cost of supplying additional energy, as incrementally more expensive capacity is required to be brought on-stream. Coal-fired generators have the lowest operating costs and provide base load electricity, while gas-fired generators have higher operating costs and supply the market's intermediate and peak demands.

Electricity costs can also vary over time because of congestion in transmission and distribution networks. Networks can become congested as a result of peak demand or through regional development such as the construction of a new housing or industrial estate, which creates local bottlenecks.

In recent years, peak wholesale prices in some regional markets of the National Electricity Market (NEM) have been highest in summer. Peak loads have only been occurring for a few hours and days of the year. Summer peaking appears to be primarily driven by the increasing adoption of air conditioners by residential customers. The Energy Supply Association of Australia (ESAA) attributed the increased uptake of space cooling equipment to:

- the impact of hot summer temperatures on discretionary purchases of space cooling equipment;
- improved marketing penetration and technological advances in space cooling equipment;
- the coincident increase in construction activity in both the commercial and residential sectors. The increase in townhouse and apartment construction for residential dwellings is a key factor, as these buildings are particularly suited to reverse cycle units; and
- the continued ageing of the population and the associated expansion in retirement villages for senior persons. (sub. 68, p. 3)

Figure 14.1 **New South Wales regional electricity prices and loads, daily averages for summer and winter, 2004**



Data source: NEMMCO (nd).

The costs of supplying electricity will also differ according to the location of the user. Costs will vary according to how much transmission and distribution infrastructure is needed to service each customer and because of line losses.

Line losses are, on average, a relatively small proportion of the overall amount of electricity transported. For example, the Queensland Department of Energy estimated that average line losses were about 4.2 per cent and 6.2 per cent across its transmission and distribution networks respectively (Queensland Department of Energy 2005). In Tasmania, distribution line losses were estimated to be 6.0 per cent in 1999 (OTTER 2003).

TransGrid commented on the average efficiency of its transmission network:

> The existing high voltage network is about 97 per cent efficient with some components such as large transformers achieving 99.8 per cent efficiency. Increased dependence on power transported from other States could see a slight increase in average transmission losses over time. (sub. 62, p. 4)

Although average line losses within a NEM region are relatively small, they can increase significantly during periods of congestion. Sections of a network can experience marginal losses that are much higher than the average losses.

Microeconomic reform since the 1990s has improved the economic efficiency with which electricity is priced. However, actual prices faced by electricity users and producers still do not reflect the dynamic and spatial nature of the industry as much as they could. As a result, the energy market's demand- and supply-side responses are muted.

Natural gas markets

Natural gas markets demonstrate some of the dynamic and spatial characteristics of electricity markets. However, unlike electricity, natural gas can be stored and, as a result, natural gas markets do not exhibit the same degree of wholesale price volatility or network congestion as do electricity markets.

There has also been considerable reform of natural gas markets since the 1990s aimed at ensuring that prices reflect the costs of production. Few participants in this inquiry have raised concerns regarding the lack of cost-reflective pricing of natural gas — apart from those issues surrounding distributed generation and greenhouse gas emissions, both of which are discussed in later sections. This contrasts with the extent of participants' concerns regarding the efficient pricing of the electricity market.

Another exception is the efficient pricing of access to natural gas pipelines. The Queensland Government noted:

> Gas pipeline service providers have raised concerns that, under the current regulatory environment for gas pipeline access, the level of risk and associated costs involved in major pipeline investments is not fully considered in the regulator's determination of reference tariffs included in pipeline access arrangements.
>
> The Productivity Commission's Review of [the National] Gas Access Regime indicated that whilst the current National Gas Access Regime has delivered benefits, it is also likely to be distorting investment in favour of less risky projects. Such issues have the potential to impact the introduction of energy-efficient practices if infrastructure owners see it as an additional risk. (sub. 38, p. 8)

Matters regarding efficient access pricing are discussed in the Commission's review of the Gas Access Regime. Some matters have been incorporated in the work program of the Ministerial Council on Energy. As part of this program, the Council has developed a set of fundamental principles for the future development of the Australian gas market, and explored the feasibility of promoting more competitive arrangements (MCE 2004b, 2004d).

14.2 The regulation of electricity prices

The existing regulatory arrangements governing electricity retailers and network operators are numerous, and their full examination is beyond the scope of this inquiry. While one purpose of these arrangements is to encourage economically efficient prices, they can have consequences for the incentives of market participants to invest in new infrastructure and to undertake energy conservation and energy efficiency measures.

Retail price and network tariff caps

All jurisdictions have adopted, or are adopting, policies of full retail contestability (FRC) in electricity. FRC is intended to encourage price and service competition between retailers. Increased competition has the potential to encourage retailers to introduce innovative pricing strategies and electrical services (products) that reflect the dynamic and spatial nature of electricity markets. In Queensland, FRC has not yet been scheduled for residential and small business customers.

Despite having adopted FRC, all jurisdictions continue to cap retail prices for residential and small business customers that have chosen to remain with the incumbent retailer and not accept market (negotiated) contracts. Price capping is intended to protect residential and small business customers from any residual market power in the energy supply industry — although it is not always clear whether this is intended to address concerns of market power of generators or retailers. Governments also cap transmission and distribution network tariffs (or in some cases, revenues) to protect all electricity users from the market power of network operators.

For most governments, an additional objective for capping retail prices and distribution network tariffs is to minimise or eliminate the retail price differences between metropolitan and non-metropolitan energy users. In many cases, the policy objectives are achieved by:

- directly subsidising residential and small business customers for their distribution network costs (for example, the Network Tariff Rebate in Victoria);
- directly subsidising distributors funded from general revenue (such as the community service obligation payments in Queensland);
- requiring metropolitan distributors to make payments to non-metropolitan distributors (for example, through the VENCorp administered tariff equalisation scheme in Victoria) (ORG 2000a); and
- revaluing non-metropolitan network assets (for example, by setting network tariffs through government regulation and allowing these to be reflected in the value of the assets) (ORG 2000a; ESCOSA 2004).

In addition, the New South Wales Government has implemented the Electricity Tariff Equalisation Fund to reduce the price volatility faced by government-owned retailers. Retailers are required to contribute to the fund when pool prices are lower than the costs they recover from residential and small business customers. When pool prices are higher than the recoverable costs, the fund will compensate retailers. Government-owned generators will contribute to the fund if there are any shortfalls (NSW Treasury 2000).

Impediments to more cost-reflective pricing

Retail price caps for residential and small business customers can limit the ability of retailers to use prices to encourage consumers and producers to adjust their demand and supply in response to changing market conditions (PC 2005). Retailers do not have flexibility in setting the overall price level in any given year or to restructure overall price levels between years — that is, to accept low or high prices in one year in exchange for high or low prices in another year. Retailers are required to comply with price paths that specify the overall prices that can be charged in each year.

However, retail price caps do provide retailers with some flexibility to set the prices for individual electricity users and groups of users, provided the average of the individual prices complies with the overall price cap. They can also provide retailers with sufficient flexibility to rebalance tariffs for safety net customers (Victorian Government, sub. DR125, p. 20). This is because retail price caps are applied to a hypothetical basket of individual electricity tariffs. As a result, retailers can adopt some forms of time-of-use pricing within the current regulatory framework (box 14.1).

Box 14.1 Time-of-use pricing

Time-of-use pricing includes both time-of-day pricing and real-time pricing.

Real-time pricing

Under real-time pricing, retail prices are allowed to vary half-hourly every day, based on the actual cost of electricity for that half hour.

Time-of-day pricing

Time-of-day pricing is a simplification of real-time pricing, where different prices are set in advance for set time blocks during the day (such as off-peak, shoulder, peak and critical peak) (US GAO 2004). Critical peak prices can occur at any time for a preset number of hours per year. Tariff schedules can also vary each season (such as winter and summer). Each tariff is determined from historical use patterns, forecasts of future requirements and average costs of supply for each period and/or season.

The variable component of a time-of-day price can be configured to a declining, flat or inclining block tariff. Inclining block tariffs can be used as a demand management strategy to reflect costs of network congestion, since network congestion tends to be correlated with increasing peak demand.

Network operators will not adopt cost-reflective tariffs if retailers are unable to pass increased network costs to final energy users because of retail price caps. Network tariff caps also restrict network operators from setting and varying overall network tariffs.

Nonetheless, network operators have some freedom to set the tariffs for individual customers and groups of customers — provided that the average of the individual tariffs complies with the overall cap. This is because network caps are applied as either a weighted-average tariff cap, or a revenue cap, or a hybrid of the two approaches. However, network operators are unable to vary overall network tariffs or revenues between years.

To date, retailers have not adopted time-of-use prices for residential and small business customers except in the case of off-peak hot water systems — a very simple and limited form of time-of-day pricing. One exception is South Australia, where seasonal winter/summer and peak/off-peak tariffs have been introduced (South Australian Government, sub. 80). Similarly, distributors have yet to widely implement time-of-use network tariffs for residential and small business customers.

In relation to location-based network tariffs, Origin Energy observed:

> … customers face largely uniform network tariffs regardless of capacity congestion at various locations in the network. (sub. 25, p. 10)

Government policies aimed at equalising or minimising price differences between metropolitan and non-metropolitan customers is one reason for the limited adoption of location-based network and retail prices. For example, the Victorian Network Tariff Rebate limits the extent to which final electricity prices differ between locations of customers. And in New South Wales, the Electricity Tariff Equalisation Fund provides a disincentive for government-owned retailers to adopt time-of-use and location-based pricing. Since the fund provides a hedge against volatile wholesale prices, retailers face weakened incentives to manage the demand of their regulated customers by adopting more innovative pricing strategies (IPART 2002).

FINDING 14.1

The real costs of supplying electricity to final users vary significantly in terms of both the time and location of its use. Regulatory arrangements governing the transmission, distribution and retail price of electricity insulate consumers from these variations and dampen demand-side responses.

The most significant impediment to more cost-reflective retail prices and network tariffs is the absence of 'smart' metering among residential and small business customers. 'Smart' meters provide energy users, retailers and distributors with the means of obtaining information about energy consumption and network use. 'Smart' meters also provide a means by which retailers and distributors can set time-of-use for different locations and to provide various demand-side management services such as direct load control (box 14.2)

Box 14.2 **'Smart' meters**

A 'smart' meter is any meter that provides timely information to the electricity user, retailer and distributor about the contemporaneous use of electricity and the electrical network. They can also be used by retailers and distributors to set time-of-day or real-time retail prices and network tariffs. Type 5 interval meters, such as those currently being rolled out in Victoria for residential and small business customers, record electricity use data in half hourly increments for each day of the year. Information recorded by type 5 interval meters are manually read at the end of every billing period.

Some 'smart' meters can provide other functions, such as recording the amount of electricity that was used in an immediately preceding period (such as day, week, month or year), recording the maximum demand readings (for the purpose of setting capacity-related charges), informing the user about their current tariff, allowing the user to switch between different electricity tariffs, and allowing users to prepay their electricity. Some meters may even have direct communication links via a modem to the electricity retailer or distributor (for the purpose of reading meters, setting tariffs and controlling loads remotely).

Effects of current arrangements

The Commission has argued previously (in its review of Part IIIA of the *Trade Practices Act 1974*, the review on National Competition Policy, and the review of the Gas Access Regime) that retail and network price caps may act as a disincentive for investment in the industry. If prices are unduly suppressed, the industry will face diminished incentives to invest in new capacity despite the demand of consumers (PC 2001, 2004c and 2005).

Undue suppression of retail prices also compromises the long-term sustainability of energy supply. Retail price caps limit the ability for retailers to pass on cost increases, leaving them exposed to considerable risk of default if they are unable to mitigate the effects of increasing wholesale prices. The electricity crisis in California in 2000-01 highlighted the dangers, among other things, of unduly focusing on containing consumer prices while allowing wholesale prices to rise (PC 2005).

In the case of network industries, tariff regulation can also compromise longer-term investment in infrastructure. Differences in the principles applied by individual regulators in setting allowable charges, the short-term imperatives confronting regulators, and the fact that price regulation ‘taxes’ successful projects but does not subsidise unsuccessful ones, have the effect of diminishing the incentive to undertake new network investment (PC 2005).

Current network tariff arrangements also discourage investment in distributed generation. In the absence of congestion-based pricing, industry participants face suppressed incentives to invest in distributed generation when such generation might be otherwise economical to bypass congested network infrastructure.

The Australian Competition and Consumer Commission (ACCC) argued that current approaches to regulating electricity transmission network tariffs were not leading to an underinvestment in capacity. The ACCC argued that investment in electricity (and other) infrastructure industries was healthy and that the high rates of return on infrastructure were well in excess of those in many other economic activities:

> Since 1996, the Utilities Accumulation Index has generated a compound annual return of 17.4 per cent, well in excess of the compound annual return of the ASX200 Accumulation Index of 11.1 per cent. (Willet 2005, p. 8)

The Commission notes that evidence that spending in infrastructure has been growing is not evidence in itself that there has not been a deterrent or distortionary effect on investment (PC 2005).

Price capping also has the potential to reduce the scope for competition in the retail industry. The ESAA argued:

> … the retention of price caps that do not allow for full recovery of costs … has the potential to further delay the emergence of a fully competitive market. (sub. DR120, p. 2)

The lack of retail competition also maintains cross-subsidies between different customer groups. The New South Wales Independent Pricing and Regulatory Tribunal (IPART) argued that current regulatory approaches lead to 'cross-subsidies across different kinds of residential and small business customers' (IPART 2003, p. 8). According to the ESAA:

> … where individual customers are not exposed to the costs associated with their individual consumption patterns, a cross subsidy is effectively paid by lighter users of peak electricity to heavier users of peak electricity. In other words, a heavy peak user doesn't pay the full cost of their contribution to the need for investment in generation to meet peak demand. (sub. 68, p. 7)

Effects on demand-side and supply-side management

The current regulatory arrangements and the absence of 'smart' metering combine to inhibit the ability of residential and small business energy users to respond to the economic costs of electricity supply. This can distort the demand for electricity. The Climate Action Network of Australia noted that 'the lack of time-of-use tariffs for most customers masks the real cost of electricity during peak times' (sub. 19, p. 5). As a consequence, final users have an incentive to demand more electricity than it is economically feasible for the industry to supply in the absence of peak prices.

Current arrangements also limit the ability of retailers and distributors to use other demand-management strategies to manage the electrical load of residential and small business customers. Such strategies include interruptible supply contracts and voluntary reduction programs and are currently limited to the largest energy users (box 14.3).

Origin Energy said that current regulatory approaches did not provide distributors with sufficiently strong incentives to undertake demand-side practices because:

> … networks face asymmetric incentives between augmenting network infrastructure and implementing initiatives that reduce capacity constraints to the extent that they are unable to capture the net saving from avoided or deferred network infrastructure expenditure. (sub. 25, p. 10)

Box 14.3 **Selected demand-side management and related programs**

Voluntary reduction programs

Voluntary reduction (or voluntary load control) programs are targeted to larger commercial and industrial customers. During peak load, the retailer or network operator negotiates and compensates customers to reduce their load below an agreed baseline level.

Interruptible supply contracts

Utilities pay energy users or provide them with discounts on the normal tariff rate in exchange for the right of the electricity retailer to interrupt electricity supplies as needed. Typically, the customer agrees to reduce electricity usage by a predetermined amount, and interruptions are limited to only a few hours per year.

Direct load control

Similar to interruptible supply contracts, utilities pay customers for the right to interrupt from a distance the electricity use of one or more devices, such as air conditioners. Interruptions may last for an hour or more, and may be rotated through several appliances. Generally, these programs rely on a switch installed in the appliance that the retailer can remotely activate.

Demand bidding

Demand bidding allows retailers and large customers to sell back into wholesale markets electricity that they otherwise would have consumed. Customers are not penalised if they do not bid, but they are penalised if they bid but fail to act on the agreed reduction.

Investment in energy efficiency technologies

Energy retailers can also sell a range of energy-efficient technologies to reduce demand during peak periods. For example, retailers will supply insulation and energy-efficient appliances to households (and sometimes provide the up-front finance). This may be cheaper for the retailer than supplying the additional energy the household would have used.

Distributed generation and energy storage

Distributed generation is sometimes used to reduce network congestion because the distributed generator bypasses the congested part of the network. Where distributed generators and energy storages are embedded with energy users, they can also provide a standby role.

Sources: US GAO (2004); IPART (2004a); CR Associates (2004).

Similarly, the Total Environment Centre noted:

> The pricing system in the NEM does not impose limitations on distribution network augmentations even when more cost-effective demand management alternatives are available. (sub. 81, p. 6)

The limited incentive and ability of network operators to manage the load of their customers has meant that regulators are under increased pressure to approve expansions in network capacity to meet the growth in demand. IPART noted:

> In most cases, DNSPs [distribution network service providers] have addressed these [network] constraints (or potential constraints) by augmenting the network to increase its capacity. This has resulted in substantial increases in their capital expenditure and reduced their asset utilisation. (For example, 10 per cent of EnergyAustralia's network capacity is used for less than 1 per cent of the time.) (IPART 2004b, p. 89)

Effects on energy efficiency

The limited ability of existing pricing arrangements to encourage a demand- or supply-side response might also affect energy efficiency. The absence of demand-side responses in a market can lead to more or less energy being used, for a given level of output, than if more cost-reflective prices were used. For example, with uniform tariffs, electricity prices will be lower during peak periods than the economic costs of supply, thereby encouraging overconsumption. The converse will occur during off-peak periods.

At the same time, users face no penalty from overinvestment in peak-load energy-intensive appliances such as air conditioners, nor do they receive much benefit from investment in off-peak and energy-efficient appliances.

The absence of location-based pricing can also discourage energy efficiency. There are weakened incentives for distributed generators to locate near their customers and to bypass the effects of line losses — particularly in rural and regional communities where line losses and network costs are greatest.

Options to improve electricity price regulation

Suggestions to improve cost-reflective pricing of electricity have included deregulating retail prices and taking a more light-handed approach to setting network tariffs, and encouraging greater demand-side responsiveness within existing regulatory frameworks. Both of these options have implications for the roll out of 'smart' metering.

Freeing-up prices and tariffs

The first option is to take a more light-handed approach to regulating network tariffs and removing retail price caps altogether. Retailers and network service operators would have more flexibility in implementing time-of-use and location-based prices for individual customers. This has the effect of improving the incentives faced by producers to increase investment and the incentive for final customers to use energy commensurate with its economic cost.

However, the regulation of retail prices and network tariffs provides an important check on the potential for market power in retail and network markets. For this reason, retail price caps should only be removed once effective competition has been established, but some form of ongoing regulation of network operators will be required to address their monopoly power.

But network tariffs could be freed up to some extent. This would require removing 'postage-stamp' pricing of electricity networks since, as noted, these policies discourage investment in local distributed generation (including energy storage) and do not provide any incentive for producers and consumers of electricity to minimise costs by locating closer to each other.

Related to this, is the need to reconsider the treatment of congestion in the regions of the NEM. The Ministerial Council on Energy (MCE) is currently exploring options for financial trading instruments to manage congestion of the transmission networks within and between the regions of the NEM (MCE 2005b).

Some measures may still be needed to ensure that specific customer groups, such as non-metropolitan households, continue to have adequate access to services at affordable prices. However, these would be better pursued through explicit and transparent community service obligations (or other appropriate mechanisms).

The Commission in its review of National Competition Policy, argued that retail price caps should be removed as soon as effective competition has been established, and that governments and regulatory agencies should explore opportunities to improve the efficacy of price setting arrangements for network operators (PC 2005). These would go hand-in-hand to improve the economic efficiency of electricity markets.

FINDING 14.2

Removing retail price caps (as soon as effective competition has been established), and exploring opportunities to improve the efficacy of price setting arrangements for network operators will improve the economic efficiency of electricity markets.

Improving existing incentives

A second although inferior option would be to encourage demand- and supply-side management within existing network and retail price caps. However, this may require economic regulators to provide additional incentives for network operators to offer demand-side management services and more cost-reflective prices — within the constraints of the retail price caps.

Whether additional incentives need to be introduced will depend on the regulatory regime of each jurisdiction. In jurisdictions that regulate their distribution networks through price caps and average revenue caps, incentives may be needed to encourage the networks to undertake demand-side management. This is because total revenues are linked to the amount of service (or throughput) provided by the network operator. In contrast, fixed revenue caps are not sensitive to network throughput (IPART 2004a and 1999; ERAA sub. DR114). IPART has already signalled that it is prepared to allow New South Wales distributors to be compensated for revenue foregone from undertaking demand-side management strategies. IPART also encouraged distributors to undertake trials of congestion pricing (2004b).

Distributors have also been trialling demand-side management in other jurisdictions. Some Victorian distributors are exploring options to introduce time-of-use pricing and expand their demand- and supply-side management programs for smaller energy users (ESC 2004a). In South Australia, ETSA Utilities is proposing to trial voluntary load curtailment for large customers, direct load control for residential equipment (such as air conditioners and pool pumps), and the use of standby generation. It is also exploring the use of incentives to reduce demand during peak times (ESCOSA 2004).

At the retail level a constrained form of time-of-use pricing can be offered within existing price caps. Country Energy, a New South Wales government-owned electricity distributor and retailer, is currently trialling ‘smart’ meters and time-of-use prices to improve demand management in parts of New South Wales (box 14.4).

The effect of this option is to improve the incentives and effectiveness of demand- and supply-side responsiveness in managing electrical load. It does not, however, directly address the disincentives for new investment in the electricity supply industry created by retail price caps and existing network tariff caps.

Box 14.4 Trialling 'smart' meters and time-of-use pricing

Country Energy, a New South Wales government-owned electricity distributor and retailer is trialling a 'smart' metering technology and time-of-use prices to assist households to manage their electricity demands.

The trial involves 200 households in Queanbeyan and Jerrabomberra in south eastern New South Wales. Trial households will use an in-house display unit to receive real-time information about their household energy consumption and face time-of-use prices that include a fixed charge, a peak price and a critical peak price.

It is anticipated that the technology and pricing would provide customers with information to monitor their energy consumption and modify their behaviour as they judge appropriate.

The trial is scheduled to last for approximately 18 months and include two summers and one winter.

Preliminary results suggest that smart meters in conjunction with time-of-use pricing (including critical peak prices) has led to reductions of energy use during peak periods which would represent either energy efficiency improvements or energy conservation.

Source: Country Energy (2005a, 2005b).

The Commission, nevertheless, considers the current trials of demand- and supply-side management techniques are a welcome development. It encourages further trials of ways to signal to consumers and producers the real costs of electricity they consume and supply, and monitoring changes in their behaviour and electricity use.

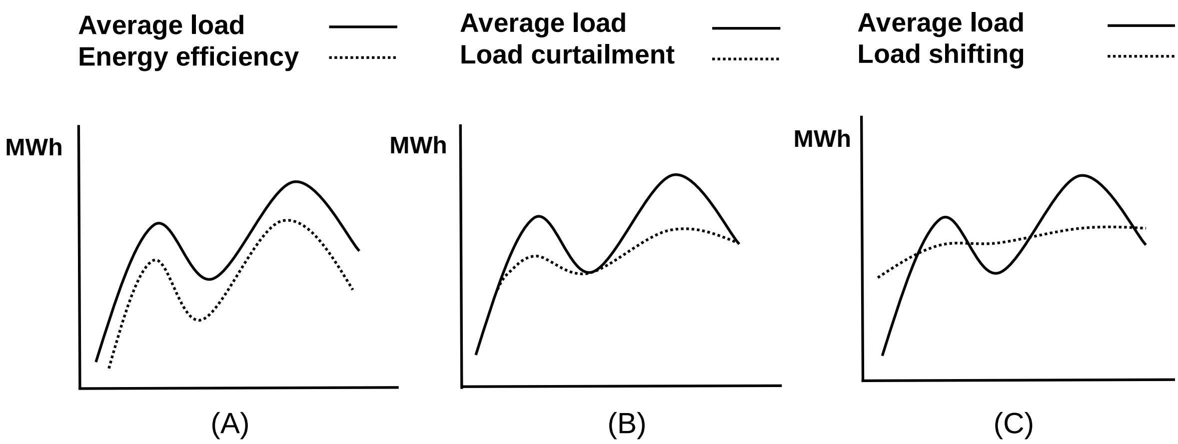
Effectiveness of cost-reflective pricing

There is an economic efficiency case for more cost-reflective pricing, but it is far from clear how much effect such pricing might have on energy efficiency. More cost-reflective pricing can potentially change energy use in three ways. Depending on whether final energy users are sensitive to electricity prices, consumers can:

- *improve their energy efficiency* — users can reduce their level of energy use for some or all periods while maintaining output by adopting more energy-efficient appliances and equipment (figure 14.2, chart A);
- *conserve (curtail) their energy use* — users can curtail their electricity demand at peak-load prices while reducing the corresponding level of output (figure 14.2, chart B); and
- *shift their energy demand* — users can redistribute their energy use from peak to off-peak times, leaving total energy use unchanged (figure 14.2, chart C).

Figure 14.2 **Potential demand-side responses to cost-reflective pricing**

Megawatt hour load during the course of a day



Load curtailment and load shifting do not necessarily result in energy efficiency improvements. Load curtailment is a conservation measure, meaning that some output or outcome is foregone leaving energy efficiency unchanged. Load shifting similarly does not constitute an energy efficiency improvement, since the end use consumption of energy does not change.

A number of inquiry participants were circumspect about the ability of more cost-reflective pricing to induce any response by consumers. The National Generators' Forum (NGF) argued:

> … it is unrealistic to assume that this [time-of-use pricing] will better drive energy efficiency as electricity use is notoriously unresponsive to price signals. (sub. 65, p. 3)

The New South Wales Government, in its Energy Directions Green Paper, said:

> Electricity demand is likely to be reasonably inelastic. Even if time-of-use pricing is implemented, consumers are unlikely to turn off many 'essential service' appliances (eg. heating and air conditioning) at times of high demand. (NSW Government 2004, p. 44)

The Australian Consumers' Association (ACA) argued that time-of-use prices would not lead to reductions in air conditioning use:

> It is far from clear exactly how high prices would have to rise to actually deter consumers from using their air conditioning units in the circumstances for which they bought them, that is when it is very hot. If the consumers continue to use their air conditioners in the face of even savage pricing … then the peak reduction sought will not be achieved. (sub. 52, p. 4)

The Australian Meat Processor Corporation said:

> Some industries, such as the meat processing industries, are limited in terms of conservation measures because [of] the strict nature of quality controls [imposed on the industry] eg room temperatures are mandatory, hot water delivery temperatures are mandatory. (sub. DR95, p. 2)

Some inquiry participants and commentators argued that consumers would respond to more cost-reflective pricing over time. The ESAA pointed out that while electricity demand is known to be inelastic in the short term:

> … behavioural patterns will change over time as consumers are made increasingly aware of the economic and environmental costs of the energy they use and are equipped with the information required to make better consumer choices. (sub. 68, p. 8)

Several inquiry participants also said that consumers would be able to respond to time-of-use prices, but this would be limited to load shifting or conserving energy use in peak periods. For example, the NGF said:

> Responding to price signals, requiring at least a ten-fold price differential between lowest and highest prices, will lead to some load shifting where this is practicable (i.e. having real loads to shift) … In general, US evidence suggests that consumers may curtail some load where possible … (sub. 65, p. 3)

Indeed, empirical evidence from overseas shows that customers do respond to prices by load shifting. In the short term, residential customers have some ability to switch the time at which certain appliances are operated (for example, Caves and Christensen 1980; Train and Mehrez 1994; Matsukawa 2001). Similar evidence was found for industrial and commercial customers (Aigner and Hirschberg 1985).

Even if load-shifting was possible, some inquiry participants and commentators argued that this would not lead to improvements in energy efficiency. The Energy Action Group argued that load-shifting responses would not lead to improvements in energy efficiency because cost-reflective prices:

> … still provide strong incentives to increase energy consumption in non-peak demand periods. (sub. DR139, p. 5)

Herriges et al. (1993) also found evidence that load-shifting response of industrial customers involved increased energy use during off-peak periods.

An evaluation of time-of-use pricing among Californian residential and small business customers found evidence for load shifting but not for energy efficiency gains. Between July 2003 and December 2004, 2500 customers took part in a trial of time-of-use pricing. The final evaluation report concluded that time-of-use pricing, coupled with critical peak pricing, induced a reduction of energy use in peak-load periods, but did not change overall energy use over the year (CRAI 2005).

The South Australian Government suggested that load shifting might even *decrease* energy efficiency:

> Not all peak demand management strategies deliver energy efficiency outcomes. Measures such as off-peak water heating — one of the most common forms of peak load shifting — result in energy inefficiency due to standing losses from storage water tanks. (sub. 80, p. 8)

In addition, load shifting could also be accompanied by an increase in greenhouse gas emissions. Load shifting would typically involve increasing the electrical output of coal-fired power stations supplying base load power at the expense of gas-fired power stations supplying peak loads. Since coal-fired power stations have highest greenhouse gas intensity per unit of energy, load shifting effectively increases greenhouse gas emissions (AGA sub. DR87; AEPCA sub. 47; ABCSE sub. 50).

Despite the main outcome being load shifting, several inquiry participants and commentators still argued that more cost-reflective pricing would encourage greater energy efficiency. The Australian Industry Greenhouse Network noted:

> Correct locational pricing signals also offer some prospect of improved system efficiency, and may result in better aggregate energy efficiency overall in power generation. But this is not a straightforward issue by any means … (sub. 57, p. 10)

The South Australian Government commented:

> Greater cost-reflective pricing would allow for energy efficiency and energy conservation to be aligned better to peak [load] management objectives … (sub. 80, p. 9)

Taylor, Schwarz and Cochell (2005) found evidence that day-ahead real-time pricing encouraged industrial customers to make energy efficiency improvements. The energy efficiency improvements from real-time pricing were stronger than those observed for time-of-use pricing.

Country Energy (2005b) in a preliminary report on its trial of time-of-use tariffs and critical peak pricing, found that there were reductions in energy use during the summer and the early winter months of 2005, which suggests either improvements in energy efficiency or energy conservation (box 14.4).

There is also some evidence that time-of-use pricing has led to greater energy efficiency in the United States:

> Time-of-use rates that charge more for electricity use during peak load, high cost periods (and less during off-peak, low-cost periods) can also stimulate energy savings.

> While time-of-use rates primarily shift electricity use from peak to off-peak periods, experience shows that there tends to be a larger reduction in peak period electricity use than the increase in electricity use during off-peak periods, meaning some level of energy savings at least for residential time-of-use programs ... (SWEEP 2002, chap. 5, p. 11)

In the Commission's view, more cost-reflective pricing will influence consumer behaviour and encourage improvements in load shifting and curtailment, thereby improving economic efficiency. Consistent with the recommendations of the Commission's inquiry into National Competition Policy, governments should continue to explore the efficacy of price setting of regulated infrastructure providers. Governments should also remove retail price constraints once effective competition has been established (PC 2005).

More cost-reflective pricing may also improve energy efficiency in peak-load periods, particularly in the longer term when consumers and suppliers have more information and the opportunity to modify their behaviour.

FINDING 14.3

More cost-reflective pricing should improve energy efficiency in peak-load periods, particularly in the longer term when consumers have both more information, and the opportunity to modify their behaviour, and suppliers can respond to changed market conditions. This would be facilitated by a roll out of 'smart' meters.

Options to improve the roll out of 'smart' meters

The successful implementation of more cost-reflective pricing requires the roll out of 'smart' meters — such as interval meters. The Climate Action Network of Australia suggested that the success of time-of-use pricing required 'a large roll out of metering technology' that would 'enable householders and businesses to obtain information in a straightforward manner' (sub. 19, p. 7).

What is not generally accepted is the type of meter that should be rolled out, and whether the roll out should be voluntary or made compulsory by governments.

Type of metering technology

Various metering technologies are available that can provide residential and small business users with information about their energy and network use, to set time-of-use or real-time prices, and that are necessary for the delivery of other electrical services such as direct load control (box 14.3). Limiting the range of metering that is available to suppliers and users will influence the economic gains that result from cost-reflective pricing and other demand-management services.

The Victorian Government has mandated that type 5 interval meters be rolled out by distributors to residential and small business customers for the purpose of providing more information to market participants and permitting time-of-use prices at some future date (ESC 2004b). However, many inquiry participants have argued that type 5 interval meters are not the most appropriate technology. For example, the ACA said of type 5 interval meters:

> Metering does not equal billing, and it is misleading to state that metering of any variety will send a price signal to consumers … Displaying the actual price being billed to the consumer in real time with predictive costs for the next consumption periods, along with a cumulative amount for the billing period might be a desirable state of affairs ... (sub. 52, p. 2)

Similarly, the Energy and Water Ombudsman New South Wales also argued that type 5 interval meters do not provide for sufficient immediacy to influence consumers' consumption. It also said that an alternative would be to introduce prepayment meters:

> Prepayment meters should be one of a range of options to assist customers with energy management and payment of accounts. If the Tasmanian experience is any indication, prepayment meters would suit customers who want to closely manage their consumption, as well as customers who need to budget carefully. (sub. 48, p. 9)

Jeff Beal argued that interval meters were not necessary to enable energy users to better manage their electricity use. He proposed that existing electronic meters could be reconfigured to provide more useful information regarding their current and past energy use (sub. DR93).

Several inquiry participants and commentators have argued that type 5 interval meters would not provide users with sufficient information for demand-side responsiveness. The absence of remote load control technology on type 5 meters limits the ability of retailers and distributors to curb the electrical load of smaller customers during peak periods (ERAA subs. 26 and DR106; ENA sub. DR114; Pareto Associates 2003).

The main benefit of limiting the roll out to one or a few metering technologies is that the economies of scale of supply and installation will reduce the costs of the roll out (ORG 2000b). In contrast, the main benefit of opening up the choice of 'smart' meters is that, through competition, a diversity of energy services would arise. For example, AGL argued that competition would allow retailers to introduce new metering technologies that include both mass market meters as well as direct load control technologies (AGL sub. DR119).

It is possible that the roll out of a single appropriate 'smart' meter could still permit future diversity of electrical services. The Energy Action Group argued that such a meter:

> … should be designed to be upgradable by providing slot and card interfaces within the meter to facilitate third party enhancements to the meter and there be a single common set of addressing protocols. (sub. DR139, p. 18)

Should the roll out be mandated or voluntary?

The other issue is whether the adoption of 'smart' meters should be voluntary or made compulsory by governments. This is important, because it can influence the net social benefits that would arise from the roll out of meters.

The Victorian Essential Services Commission (ESC) argued that there was a case for mandating the widespread roll out of type 5 interval meters. It argued that allowing customers, retailers and distributors to choose whether to voluntarily invest in meters would not maximise the net benefits of metering because individual market participants would not be able to capture the full benefits of the roll out. For example, a retailer that sought to introduce interval meters to reduce consumption when wholesale prices were high would also reduce coincident peak network use to the benefit of the distributor (ESC 2004b).

The ESC also argued that mandating the roll out of meters would increase net benefits by speeding up the adoption of meters by high energy users. Under current practices, residential and small business customers are billed according to an 'average' load profile. High-cost energy users, who are cross-subsidised in their load profile by low-cost energy users, have an incentive to delay adopting interval meters. Requiring high-cost energy users to adopt meters quickly will increase the net benefits (ESC 2004b).

Several electricity retailers argued that a mandated roll out of interval meters imposes additional costs on retailers to invest in information and billing systems and would not be cost effective for them. They argued that retailers should instead be permitted to voluntarily adopt their own metering technologies over time as these become increasingly cost effective for retailers and their customers (ERAA sub. DR106; AGL sub. DR119; Origin sub. DR129).

AGL, for example, argued that a mandated roll out of interval meters was not desirable:

> Currently there is [a] view among policy makers that energy efficiency price signals could be more finely tuned by the wide spread use of interval meters. AGL maintains that the cost–benefit of a rollout of Type 5 interval meters to customers using less than

> 160MWh annually has not been proven and should not be mandated. The market place should be left to work out the most efficient metering solutions rather than have potentially inefficient solutions mandated. Retailers are already researching new technical solutions, including two way communications, that could create better price signals and be cost effective. (sub. 66, pp. 3–4)

Assessing the benefits and costs

The case for any roll out of 'smart' metering is not straightforward. The main benefit is the increased economic efficiency that would arise from the implementation of more cost-reflective prices and demand-management strategies that the 'smart' meters would allow. However, the cost of a widespread roll out is likely to be considerable, and for many small customers the cost savings they might achieve will not warrant the additional cost. IPART recommended that any roll out of interval meters be subject to a benefit–cost analysis (IPART 2003).

A benefit–cost analysis would need to compare the benefits to economic efficiency with the costs of rolling out interval meters. Benefits include the:

- reduced network costs — through avoiding the costs of augmenting transmission and distribution networks;
- reduced electricity generation costs — through avoiding the costs of new generation capacity;
- increased supply reliability — through reducing the number of interruptions; and
- fewer environmental externality costs — such as reduced greenhouse gas emissions (ESC 2004b).

Where 'smart' meters have direct communication links with distributors, benefits also could include reduced site visits, quicker connection and disconnection of customers and the detection of outages and voltage fluctuations. Finally, where 'smart' metering allows for more precisely specified cost-reflective prices, benefits include the increase in welfare that results from the removal of cross-subsidies (ORG 2000b).

A benefit–cost analysis would also include the costs of supplying and installing 'smart' meters, and the costs to distributors and retailers of installing the appropriate information technology and management systems (ESC 2004b).

The Essential Services Commission of South Australia (ESCOSA) commissioned an assessment of the net benefits of managing network congestion using interval metering and time-of-use pricing. It found that the widespread roll out of interval meters in conjunction with time-of-use pricing was not as cost effective in reducing network load as other options, such as correcting for power factors and employing standby generation (CR Associates 2004, ESCOSA 2004).[1] However, the study did not take into account the potential benefits that might be captured by third parties from the roll out of metering technologies.

In its assessment of the net benefits of interval metering, the ESC found that there were just sufficient net benefits to warrant the widespread roll out of interval meters. The ESC found that metering would provide, among other things, effective electricity competition, improved conservation, improved market efficiency through demand management, and improved security of supply (ESC 2004b).

In the Commission's view, while there may be net benefits in a widespread roll out of 'smart' meters, prescribing the device or the provider has the potential to limit the adoption of alternative technologies and demand management strategies. The prescription should be limited to setting the minimum performance standards of the meter — such as standard operating protocols. The meters should also be upgradable to allow for potential third party enhancements, which would improve contestability in the provision of electricity services.

RECOMMENDATION 14.1

Any mandated roll out of 'smart' metering devices should be subject to a comprehensive benefit–cost analysis. Mandated roll out of technologies should not preclude choice in the device or competition between service providers.

14.3 Imperfect competition in electricity generation

The principle of cost-reflective pricing implies that wholesale energy prices must also be economically efficient. Yet imperfect competition in the wholesale electricity market has the potential to increase retail prices, thereby distorting the end users' incentives to use energy in a manner that is consistent with economic efficiency.

[1] Power factor is defined as the ratio between the actual load power (measured in terms of kilowatts) and the apparent load power (measured in terms of kilovolt Amperes) drawn by a load. Inductive loads (such as electric motors) and switching loads (such as switch mode power supplies) can distort electrical wave patterns and reduce the efficiency with which energy is used. Power factors can be corrected (thereby improving energy efficiency) through the installation of capacitors in the equipment itself or in the mains switch.

Sources of imperfect competition

Factors that may contribute to imperfect competition in electricity markets include the horizontal aggregation of electricity generators, the level of interconnection between regional markets and the vertical reintegration taking place in the electricity industry.

Aggregation of electricity generators

The COAG Energy Markets Review (the Parer Review) was concerned that there was insufficient competition among electricity generators. It reported that the concentration ratios for the three largest generators were consistent with the presence of market power. For example, the concentration ratio for generators in New South Wales was 96.4 per cent (COAG 2002).

It also argued that generators in some jurisdictions were able to exercise market power at certain times. This power had the effect of increasing average electricity prices. High average retail prices increase the incentives for users to reduce their energy use or adopt energy-efficient investments — albeit for the wrong reasons.

The National Generators' Forum observed that countries with economically inefficient energy markets had high levels of energy use efficiency:

> Globally there is little correlation between energy market reform and energy efficiency. Some of the most heavily regulated electricity markets in Europe and Japan also are the most energy use efficient … (sub. DR138, p. 3)

The Parer review also argued that generator market power increased spot price volatility. Highly volatile spot prices increase the risk and uncertainty associated with current and future NEM pool prices, thereby discouraging investment in energy-efficient technologies.

It made a number of recommendations, many of which were included in the MCE's energy market work program. However, the MCE has adopted only part of the package of reforms recommended by the review. It has emphasised a role for expanding regional interconnections but did not address the key recommendation of structurally disaggregating government-owned generation businesses.

The Commission considers that, due to the cost to the community, there is scope for further disaggregation of publicly-owned generation assets. This represents the most cost-effective means of reducing generator market power in a region (PC 2005).

Insufficient regional interconnection

A contributing factor to the imperfect competition in electricity markets is the insufficient capacity of regional interconnection. Regional electricity interconnectors are high voltage transmission lines that connect the regions of the NEM and provide capacity for the interstate trade of electricity. By increasing the size of the markets in which electricity is traded, regional interconnectors effectively increase the level of competition among generators.

The Parer Review examined the capacity of regional interconnection and found that current interconnectors did not provide sufficient capacity for generators in one region to adequately respond to peak demands in other regions. As a result, the NEM cannot effectively offset the market power that generators possess in their own region. According to the International Energy Agency:

> During periods of peak demand, the network can become congested and the NEM separates into its regions, potentially exacerbating reliability problems and market power of regional utilities. (IEA 2001, p. 7)

The Commission notes that the MCE released an energy market reform package in 2003 that includes policy principles and directions for the investment in new transmission assets including regional interconnectors (MCE 2003).

Vertical reintegration

In its review of the National Competition Policy reforms, the Commission inquired into the adequacy of institutional arrangements in screening the competition implications of merger and acquisition activity in the electricity industry. The Commission had argued that such merger activity can have the effect of stifling competition, particularly in the generation sector when generators merge with transmission network providers, and raised concerns regarding the adequacy of current institutional arrangements necessary for determining the appropriate levels of merger activity (PC 2005).

The Commission considered it important to have effective institutional arrangements in place to deal with potentially anticompetitive mergers between generators and transmission operators. Given that the existing regulatory regime was developed on the basis of structural separation between generators and transmission operators, the Commission found it questionable whether current regulatory safeguards were sufficient to deal with anti-competitive mergers and acquisitions. The Commission recommended that there be an independent national review of the competition implications of cross-ownership of transmission and generation assets in the electricity industry. This review should include examining the adequacy of the access, prices oversight and merger provisions of the *Trade Practices Act 1974* (Clth) and whether it is necessary to proscribe some forms of cross-ownership that involve the transmission network (PC 2005).

Effect on energy efficiency

In the Commission's view, imperfect competition in the electricity industry increases both average electricity prices and their volatility. These can have differing and countervailing effects on energy consumption and efficiency. Increasing competition (whether through horizontal disaggregation or increased regional interconnection) may lower electricity prices and would weaken incentives for energy efficiency investments. In contrast, increasing competition may also decrease price volatility, which could decrease the risk and uncertainty of future electricity prices. This in turn could enhance the economic viability of a range of energy infrastructure and energy efficiency investments.

14.4 Unpriced environmental externalities

The third important influence on the costs of energy is the costs of pollution and other negative externalities associated with its production and use. An externality occurs when an action by one person affects the wellbeing of others without that effect being reflected in market prices. Negative externalities in the market for energy include greenhouse gas emissions from fossil fuel-powered electricity generators and local pollution ranging from car exhaust fumes to the visual impact of wind turbines and the environmental impact of hydro-electric schemes.

Ideally, energy prices would reflect all of the costs of production and consumption including these external costs. At the moment, energy prices by-and-large exclude these costs, meaning that energy users are encouraged to consume more energy, and invest less in energy efficiency, than might be desirable from a communitywide perspective.

Participants' comments

There was widespread acknowledgement among participants that externality costs were not incorporated in energy prices. For example, Origin Energy noted:

> Energy prices do not reflect the environmental cost associated with consumption and production of energy. (sub. 25, p. 10)

TransGrid observed that current wholesale prices in the NEM did not take into account the environmental costs. It argued that this strengthened the incentive to install open-cycle gas-fired generators relative to combined-cycle gas-fired generators, even though open-cycle generators emit relatively more greenhouse gases and are relatively less energy efficient than do closed-cycle generators (sub. 62, p. 4).

Several inquiry participants said that failure to incorporate externality costs meant that energy-efficient (and renewable energy) technologies were uncompetitive. For example, TransGrid stated:

> Like renewable energy sources, energy efficiency technologies tend to have a smaller impact on the environment and human health than conventional supply of energy. Since these 'external costs' of supply are not fully incorporated in the market price of energy, the resource conserving and other environmental benefits of improving energy efficiency are not reflected as a relative cost saving advantage. (sub. 62, p. 3)

Several inquiry participants noted that if the prices of fossil fuels were raised in relation to their carbon content, there would be greater incentive to adopt energy-efficient alternatives. According to Origin Energy:

> It is clear however that any valuation of greenhouse gas emissions is likely to cause energy prices to increase, which is likely to raise the potential of cost-effective energy efficiency improvements across the economy. (sub. 25, p. 10)

The Australian Conservation Foundation said:

> Carbon levies and emissions trading are two ways to change the price of energy in a way that drives emission abatement and hence supports energy efficiency actions. It makes little sense to exclude energy intensive industry from such arrangements as they are amongst the most likely to respond to price. However, for many decision makers energy prices alone are insufficient to drive enhanced energy efficiency and other policies will be required. (sub. 24, pp. 10–11)

TransGrid commented that the wholesale electricity prices could be augmented with:

> … a universal Australian carbon fuel tax or greenhouse gas emissions tax (or permit charge) which would tend to highlight the inefficiency of a poor conversion choice (even in a gas fuelled plant) … (sub. 62, p. 5)

Alternatively, transferable carbon permits could be used to ensure that wholesale energy prices could incorporate externality costs of energy supply and use. Similarly, subsidies could also be provided to more energy efficient (and renewable energy) technologies (IC 1991).

But there were also warnings that such approaches should be comprehensive, across all sources of greenhouse gas emissions and abatement activities. Origin Energy argued:

> … it is Origin's strong contention that the long term interests of the community are best served by a comprehensive climate change policy. Such a policy would establish a national framework for creating a clear, long term carbon signal across the economy. (sub. 25, p. 11)

The Australian Aluminium Council warned of the effects of addressing greenhouse gas externalities for export-oriented producers:

> Inappropriate policy interventions at the national level to address externalities with an international reach or impact could be extremely detrimental to national economic performance where similar or equivalent action is not taken in a broadly global manner. (sub. 29, p. 13)

Commission's assessment

Incorporating the externalities associated with fossil fuel use into the prices of energy would make those prices more cost reflective and promote socially efficient outcomes. If the external costs can be measured, the price of energy would encourage producers and consumers to factor those costs into their decisions, leading to the right amount of energy consumption, the appropriate sources of energy, and the appropriate mix of energy and other inputs. Use of incentive mechanisms such as transferable permits and taxes would also help ensure that the environmental objectives are achieved at the lowest possible cost to society.

Targeting the price of energy would also have the advantage of tackling directly the explicit or implicit objective of many energy efficiency policies, viz. pollution abatement (including greenhouse gas emission abatement). This would substantially obviate the need for many of these policies. For example, efforts to regulate the energy consumption of appliances and vehicles captures only part of the life-cycle consumption of energy associated with the production, use and scrapping of those products. With some interest now being shown in regulating the other stages of the product life cycle to achieve greater reduction in greenhouse gases, it might be appropriate to ask if there is not a better policy solution. As an alternative, a tax on energy would allow market participants to make a judgement on the tradeoffs that might be made between the costs of energy used in production (such as aluminium in cars) against the lower operating costs (in this case lower fuel bills).

A policy of pricing energy externalities would not replace all energy efficiency policies. As this report argues, there would still be a case for some policy intervention to address market failures associated with imperfect information (such as information asymmetry).

While conceptually appealing, the pricing of energy externalities is fraught with problems. In particular, the challenges of setting an economically efficient tax for carbon, the economically efficient level of emissions, and the economically efficient subsidy for energy-efficient technologies, are formidable. There is little agreement on the extent of the costs (and benefits) of increases in the concentration of greenhouse gases in the atmosphere, thus making it difficult to settle on the right carbon tax or the volume of emissions permits. And the information requirements and administrative logistics could make it costly to implement. (Similar problems arise in dealing with more localised pollution issues such as urban air quality.)

Furthermore, greenhouse gas issues are, above all, global issues and require a global response. Any country (or group of countries) that takes unilateral action must weigh up the benefits of world leadership against the far reaching consequences for their economies of imposing higher energy prices on their consumers and producers. In particular, higher energy prices would diminish the competitiveness of many industries and encourage the migration of the most energy-intensive to countries that do not have such policies (IC 1991). This might, nevertheless, be manageable if, as the Parer Review suggested, energy-intensive industries were exempted from an emissions trading scheme until such time as Australia's trading partners also introduced similar schemes (COAG 2002).

As the Commission has emphasised, this has not been an inquiry into greenhouse policy: it has been about the policies that Australia should follow in promoting cost-effective energy efficiency improvements. Such policies might contribute to greenhouse gas (and other pollution) abatement — and indeed some are explicitly targeted at this objective — but they would need to be considered alongside all other greenhouse gas policy options, including emissions trading and carbon taxes. These are issues that warrant separate consideration. Nevertheless, what is clear is that if energy prices incorporated the costs of externalities, and energy prices rose, the private incentives to invest in energy efficiency would also rise.

A Conduct of the inquiry

This appendix outlines the inquiry process and lists the organisations and individuals that participated.

Following receipt of the terms of reference on 31 August 2004, the Commission placed a notice in the press inviting public participation in the inquiry and released an issues paper to assist inquiry participants in preparing their submissions. The Commission received 85 submissions before releasing the draft report. A further 70 submissions were received following the release of the draft report (a total of 155). Those who made submissions are listed in table A.1.

The Commission also held informal discussions with organisations and government departments and agencies. This visit program assisted the Commission to obtain a wide understanding of the issues and the views of inquiry participants. Organisations visited by the Commission are listed in table A.2.

In November 2004, the Commission held pre-draft report public hearings in Sydney, Brisbane, Canberra and Melbourne. Following the release of the draft report a second round of public hearings were held in Brisbane, Sydney, Canberra and Melbourne in May and June 2005. Additional hearings were held via telephone conference with participants from Adelaide. Presentations were given by 61 individuals and organisations at these public hearings (table A.3).

Table A.1 **Submissions received**

Participant	*Submission no.*
AGL	66, DR119
Alternative Technology Association	13
AMCER Pty Ltd	DR105
Australasian Energy Performance Contracting Association	47
Australian Aluminium Council	29
Australian Building Codes Board	7, DR111, DR148
Australian Business Council for Sustainable Energy	50, DR121, DR144
Australian Conservation Foundation	24, DR154
Australian Consumers’ Association	52
Australian Electrical and Electronic Manufacturers’ Association	85, DR118, DR140
Australian Gas Association	2, DR87
Australian Glass and Glazing Association	16, DR144
Australian Industry Greenhouse Network	57
Australian Liquefied Petroleum Gas Association	37
Australian Meat Processor Corporation	12, DR95
Australian Plantation Products and Paper Industry Council	82
Australian Trucking Association	74
Australian Window Association	59
Australian Wood Panels Association	DR91
Beal, Jeff	64, DR93
Bell, Graham	73
Blanchard, Clive	72, DR108, DR135
BP Australia	60
Building Products Innovation Council	44, DR128
Cement Industry Federation	39
Central West Environment Council Inc NSW	9
Centre for Energy and Environmental Markets	DR123
Ceramic Fuel Cells Limited	23
Clark, Philip	DR147
Climate Action Network Australia	19, DR116
Cole, Peter	DR89

(Continued on next page)

Table A.1 (continued)

Participant	*Submission no.*
Conservation Council of Western Australia	54
Consumer Utilities Advocacy Centre	DR107
CSIRO Manufacturing and Infrastructure Technology	DR126
CSR Bradford Insulation	15
Department of Agriculture WA	36
Department of Energy Qld	38
Department of the Environment and Heritage	30, 69, DR86, DR131, DR146
ecoSAVVY	DR145
Electricity Markets Research Institute	DR110
Energetics	DR104
Energy Action Group	DR139
Energy and Water Ombudsman NSW	48
Energy Consumers' Council	DR103
Energy Networks Association	DR114
Energy Retailers Association of Australia Inc	26, 55, 71, DR106
Energy Supply Association of Australia	68, DR120
Energy Systems and Services	33
Energy Users Association of Australia	84, DR150
Engineers Australia	DR136
Environment Business Australia	DR134
Environment Victoria	67
Evasave	DR100
Exergy Australia Pty Ltd	40, DR97
Federated Chamber of Automotive Industries	77
Ford Motor Company of Australia Ltd	76
Foster, Bob	11
Friends of the Earth Australia	20, DR117
Gas Appliance Manufacturers Association of Australia	DR98
George Wilkenfeld and Associates Pty Ltd	10, DR96
Gipton, Sara	34

(Continued on next page)

Table A.1 (continued)

Participant	*Submission no.*
Green Building Council of Australia	41, DR137
GridX Power	5
Hanley, Paul	DR99
Housing Industry Association	27, DR130
Institute of Public Affairs	6
Insulation Council of Australia and New Zealand	14, DR94, DR144, DR149
Jameson, Allan	31
Johnson, Harry, Kingfisher Centre, Aspley Special School	21, DR88
Laird, Philip	1, 56, DR127
Lincolne Scott Australia Pty Ltd	53
Master Builders Australia	DR122
McGregor and Associates	22
McNeilly, Tom	DR143
Moreland Energy Foundation Ltd	18, DR115
Mushalik, Matt	4, 75
National Generators Forum	65, DR138
Nicolosi, Fred	32
Origin Energy	25, DR129
Parker, Alan	35, DR112
Pears, Alan	DR113
Penny, John	8
Plastics and Chemicals Industries Association	49
Public Transport Users Association	63
Queensland Master Builders Association	DR90, DR92
Railway Technical Society of Australasia	45, DR142
Renewable and Sustainable Energy Roundtable	DR155
Rheem Australia Pty Ltd	46
Rowden-Rich, Murray	61
Royal Australian Institute of Architects	42, DR124
Schwieters, Ben	DR109

(Continued on next page)

Table A.1 (continued)

Participant	*Submission no.*
South Australian Government	79, 80, DR101, DR153
SPI Electricity Pty Ltd	51
Steam Link	43
Sustainable Energy Development Office	DR151
Sustainable Projects Pty Ltd	3
Sustainable Transport Coalition	70
Tasmanian Government	DR152
Timber Promotion Council	DR141
Total Environment Centre	81
TransGrid	62
Troppo Architects (Qld) Pty Ltd	DR145
TXU	DR102
Urban Ecology Australia	DR132
Victorian Government	DR125
Virr Laurie	DR99
Western Australian Government	58
Western Australian Sustainable Energy Association	17
Williamson, Terry	28, 78, DR133
Zorbas, Angelo	83

Table A.2 **Visits**

Organisation
AMCOR
Australasian Railways Association
Australian Building Codes Board
Australian Business Council for Sustainable Energy
Australian Electrical and Electronic Manufacturers' Association
Australian Greenhouse Office
Australian Industry Greenhouse Network
Australian Industry Group

(Continued on next page)

Table A.2 (continued)

Organisation
Australian Trucking Association
BP
Bureau of Transport and Regional Economics
Centre for Energy and Greenhouse Technology
Climate Action Network of Australia
Department of the Environment and Heritage
Department of Industry, Tourism and Resources
Department of Transport and Regional Services
Energetics
Energy Retailers Association of Australia
Energy Supply Association of Australia
Energy Users Association of Australia
Engineers Australia
Essential Services Commission (Victoria)
ETSA Utilities
Federal Chamber of Automotive Industries
Foster’s Group Limited
Master Builders Australia
National Electricity Code Administrator
National Generators Forum
New South Wales Government
Origin Energy
Department of the Prime Minister and Cabinet
Property Council of Australia
South Australian Government
Sustainable Energy Authority Victoria
The Treasury (Australian Government)
Victorian Government

Table A.3	**Public hearing participants**
Sydney 15 November	
Sustainable Projects Pty Ltd	
Penny, John	
GridX Power Pty Ltd	
McGregor and Associates	
Housing Industry Association	
World Wide Fund for Nature Australia and Climate Action Network Australia	
Australian Consumers’ Association	
Centre for Energy and Environmental Markets, University of NSW	
Sydney 16 November	
Australian Meat Processor Corporation	
Energy Retailers Association of Australia	
Railway Technical Society of Australasia and University of Wollongong	
George Wilkenfeld and Associates Pty Ltd	
Brisbane 17 November	
Queensland Government	
Department of Energy (Qld)	
Steam Link	
Friends of the Earth Australia	
Johnson, Harry, Kingfisher Centre, Aspley Special School	
Lincolne, Scott	
Little, Phil	
Canberra 22 November	
Australian Trucking Association	
Royal Australian Institute of Architects	
Department of the Environment and Heritage	
Plastics and Chemicals Industries Association	
Exergy Australia Pty Ltd	
Ocean Research Pty Ltd	

(Continued on next page)

Table A.3 (continued)

Melbourne 24 November
Australian Business Council for Sustainable Energy
Australasian Energy Performance Contracting Association
Institute of Public Affairs
Moreland Energy Foundation Ltd
Williamson, Terry, School of Architecture, University of Adelaide
Lavoisier Group
Timber Promotion Council
Energy Advice
Melbourne 25 November
Energy Supply Association of Australia
Parker, Alan
Rheem Australia
Building Products Innovation Council
Brisbane 30 May
Friends of the Earth
Beal, Jeff
Evasave
Queensland Master Builders Association
Cole, Peter
Sydney 31 May
George Wilkenfeld and Associates Pty Ltd
Centre for Energy and Environmental Markets
Energetics
Canberra 3 June
Master Builders Australia
Australian Electrical and Electronic Manufacturers' Association
Department of the Environment and Heritage
Virr, Laurie and Hanley, Paul

(Continued on next page)

Table A.3 (continued)

Melbourne 6 June
Building Products Innovation Council
Coolmax Pty Ltd
Energy Retailers Association of Australia
Insulation Council of Australia and New Zealand
Australian Business Council for Sustainable Energy
Housing Industry Association
Melbourne 7 June
Australian Conservation Foundation
Parker, Alan
Electricity Markets Research Institute
Urban Ecology

B Institutional background

Governments have established a number of mechanisms for developing and implementing energy policy and, in particular, energy efficiency policy. Reflecting their genesis in greenhouse abatement policies, the state and national administrative arrangements for energy efficiency policy have generally been part of the broader greenhouse agenda. Some of the key components of this institutional framework are summarised here together with an outline of the arrangements for regulating key energy markets.

B.1 Institutional arrangements for increasing energy efficiency

This section provides some background to the development of greenhouse gas abatement policies that were an important part of governments' interest in energy efficiency. The main institutional arrangements in place for the development, implementation and national coordination of energy efficiency policies in Australia are then summarised.

The Kyoto Protocol

Control of greenhouse gases is by necessity an international, rather than a state or national issue — efficient and equitable outcomes can only be achieved via international agreement. For this reason an international treaty — the United Nations Framework Convention on Climate Change — was established in 1992.[1] The Convention provides a framework for intergovernmental efforts to address climate change and to deal with its impacts.

In order to develop stronger commitments to address climate change, the Kyoto Protocol to the Convention was negotiated and was adopted in 1997. Eighty four countries signed the Protocol.[2] It established individual country targets for

1 The Convention came into force in 1994 after the required 50 countries had ratified it. There are now over 180 parties to the Convention, including Australia.

2 Signing the Protocol (which Australia has done) meant agreeing to continue with the treaty-making process but did not bind signatories to the conditions of the Protocol.

industrialised countries to limit or reduce their greenhouse gas emissions. In total these targets amounted to a minimum 5 per cent reduction for industrialised countries as a whole between 1990 and 2008–12. Australia agreed to a target under the Kyoto Protocol of limiting the growth in greenhouse gas emissions to 8 per cent above 1990 levels over the period 2008–12. A number of developing countries are also Parties to the Protocol but do not have emissions targets.

The Protocol came into force in February 2005. This followed its ratification by industrialised countries that, between them, accounted for at least 55 per cent of industrialised country emissions in 1990. The Protocol is binding on those countries that have ratified it. Australia has signed but not ratified the Protocol, but is committed to achieving its Kyoto emissions target (Campbell 2004).

The Minister for the Environment and Heritage has indicated that the Australian Government considers the Kyoto protocol response to greenhouse gas emissions is clearly inadequate and that major international reductions in emissions will be needed in order to limit the extent of climate change.

> We're going to have a 40 per cent increase in greenhouse gas emissions under the Kyoto Protocol and the world needs a 50 per cent reduction. We've got to find something that works better. Australia is working on that with partners around the world. (Campbell 2005)

In this regard, the Australian Government has announced the formation of the Asia-Pacific Partnership on Clean Development and Climate, comprising the US, China, India, Japan, South Korea and Australia. The partnership will collaborate to develop and deploy existing and emerging cost-effective, cleaner energy technology and practices. Possible areas for collaboration include:

> … energy efficiency, clean coal, integrated gasification combined cycle, liquefied natural gas, carbon capture and storage, combined heat and power, methane capture and use, civilian nuclear power, geothermal, rural/village energy systems, advanced transportation, building and home construction and operation, bioenergy, agriculture and forestry, hydropower, wind power, solar power, and other renewables. (Howard et al. 2005b)

The national greenhouse strategy

In 1998, the Australian, State and Territory Governments agreed on a National Greenhouse Strategy (NGS) to meet Australia's international commitments on greenhouse gas emissions (AGO 1998). The NGS outlined over 80 measures to be pursued by governments. The NGS built on the 1992 National Greenhouse Response Strategy (which it superseded and which had aimed to address all sources and sinks of greenhouse gases across the whole economy), the Australian

Government's Greenhouse 21C package of further measures introduced in 1995 and its 1997 Safeguarding the Future initiative. Further Australian Government greenhouse policies were announced in the Measures for a Better Environment package in 1999 and the Climate Change Strategy detailed in the 2004-05 Budget and the Energy White Paper (Australian Government 2004).

The NGS provides:

> … a broad menu of actions some of which will be implemented by governments acting individually, some by joint intergovernmental initiatives and some through partnerships between government, various stakeholders and the community. (AGO 1998, p. viii)

Several components of the NGS involve improving energy efficiency in the government, industrial, power generation, commercial, residential and transport sectors. In this regard, the NGS focuses on:

> … cost-effective ways to reduce net greenhouse gas emissions in particular through 'no regrets' actions. The actions will deliver substantial non-greenhouse benefits to Australia. (AGO 1998, p. ix)

Implementation of the NGS was initially overseen by an Implementation Planning Group of senior officials from the Australian, State and Territory Governments and a representative of local government. It is progressed through a range of other bodies including Ministerial Councils (such as the Ministerial Council on Energy, formed in 2001, and the Australian Transport Council) that coordinate joint national action and various government committees and working groups that further develop and implement the diverse range of measures contained in the NGS framework. In addition, jurisdictions continue to take independent action on greenhouse and energy efficiency issues and some have their own strategies on greenhouse abatement. The Australian Greenhouse Office (AGO) noted:

> Reflecting Australia's regional diversity, the NGS contains measures that different governments are pursuing through different policy approaches. (AGO 2000b, p. vii)

At its June 2005 meeting, the Council of Australian Governments (COAG) agreed to set up a Senior Officials' group to examine the scope for national cooperation on climate change policy (COAG 2005). Areas of focus for this group will include the scope to improve investment certainty for business, encouraging renewable energy and enhancing cooperation in areas such as technology development, energy efficiency and adaptation.

A progress report on the early stages of the implementation of the NGS was produced in 2000 (AGO 2000b). It noted that Australia's Kyoto greenhouse emissions target appeared achievable as long as there was ongoing significant effort to control emissions. However, strong economic growth had made the task more difficult. The report observed that all jurisdictions had prepared NGS implementation plans that indicated the abatement measures that they would undertake, and considerable progress had been made in establishing the majority of measures in the NGS. However, the longer-term nature of most of the abatement measures meant that many had not been fully implemented and hence had only had a limited impact at such an early stage of the NGS.

A report prepared for the Australian Government on the risk and vulnerability assessment of climate change impacts has stated:

> There is little doubt that Australia will face some degree of climate change over the next 30 to 50 years irrespective of global or local efforts to reduce greenhouse emissions. The scale of that change, and the way it will be manifested in different regions is less certain ... (Allen Consulting 2005a, p. vii)

The report argued that the development of adaptation strategies needed to be an important component of climate change policy.

Ministerial Council on Energy

In 2001, COAG established the Ministerial Council on Energy (MCE) to provide 'effective policy leadership to meet the opportunities and challenges facing the energy sector and to oversee the continued development of national energy policy' (COAG 2001). The MCE is responsible for broad-ranging energy policy including: energy security; energy market reform; and energy efficiency. In doing so, it considers both economic and environmental issues.

The Council comprises Ministers with responsibility for energy from the Australian Government and all States and Territories. The Australian Government Minister for Industry, Tourism and Resources chairs the Council and the department provides Secretariat support. The New Zealand Energy Minister has full member status when Trans-Tasman Mutual Recognition Agreement issues are considered; otherwise the New Zealand and Papua New Guinea Energy Ministers have observer status.

Energy Efficiency Working Group

Energy efficiency policies and programs, particularly those involving coordinated action between the jurisdictions, is one of the MCE's responsibilities. The Energy Efficiency Working Group (EEWG) was established under the auspices of the MCE and advises it on the performance of end-use energy efficiency policies and programs.[3] Its major responsibility is to implement the National Framework for

[3] The EEWG was originally the Energy Efficiency and Greenhouse Gas Working Group.

Energy Efficiency (NFEE). It has also developed the administrative guidelines for appliance labelling and performance (which are administered by NAEEEC).

National Appliance and Equipment Energy Efficiency Committee

The National Appliance and Equipment Energy Efficiency Committee (NAEEEC) is responsible for managing Australian end-use energy efficiency programs (NAEEEC 2004a). It consists of officials from the Australian, State and Territory Government agencies and representatives from New Zealand (box B.1).

Box B.1 **NAEEEC institutional arrangements**

The Ministerial Council on Energy (MCE) is responsible for the development of the programs for appliance and equipment energy labelling and for minimum energy performance standards (MEPS). Established under the MCE, the Energy Efficiency Working Group has the responsibility for developing administrative guidelines for use by each relevant State and Territory in the administration of its legislation covering energy-performance labelling and performance standards.

In turn, the National Appliance and Equipment Energy Efficiency Committee (NAEEEC) is charged with the ongoing management of these Guidelines. NAEEEC reports to both MCE and the Working Group.

NAEEEC comprises the State and Territory regulatory agencies that are responsible for administering State and Territory legislation concerning energy-performance labelling and performance standards.

The national labelling and MEPS scheme is made up of three elements:

1. the legislation and subordinate regulations of the States and Territories;
2. the Australian Standards published by Standards Australia, which are incorporated by reference into the State and Territory legislation and contain the detail of the minimum energy performance standards and labelling requirements; and
3. NAEEEC Guidelines.

While the State and Territory legislation is administered by the relevant State or Territory regulatory agency, the legislative scheme is of a national character and is ‘intended to be administered in a uniform and consistent manner’. Although the NAEEEC Guidelines are not a legally binding instrument intended to impose legal obligations upon relevant State and Territory regulatory agencies, they are intended to ‘act as a guide to facilitate uniform and consistent practice’.

Source:: Adapted from NAEEEC (2004b).

NAEEEC’s two major programs relate to mandatory energy labelling and mandatory minimum energy performance standards (MEPS) (appendix E). It is currently mandatory for a range of electrical products offered for sale in Australia to carry an approved energy label. Several products are also subject to MEPS (NAEEEC 2004c). These programs are discussed in more detail in chapter 9. In addition to the these two programs, NAEEEC's charter encompasses a number of broader coordination functions (box B.2).

Box B.2 **The NAEEEC charter**

The charter of NAEEEC encompasses the following functions:

- to provide assistance to all States and Territories, as required, in the development and regulatory implementation of technical, legal, and administrative aspects of national appliance and equipment energy-efficiency initiatives;
- to coordinate the national development and implementation of energy efficiency programs of a non-regulatory nature and enhance existing regulator programs. These may include voluntary labelling initiatives, market transformation projects, and similar voluntary actions;
- to coordinate national marketing and communication projects to support new, and enhance existing, energy efficiency programs;
- to review existing appliance energy consumption and improve standards and test procedures;
- to monitor program performance and achievements;
- to provide a forum to exchange information on enforcement/compliance issues and community information and marketing initiatives;
- to administer an effective, coordinated testing regime of the energy efficiency claims of suppliers; and
- to coordinate broad consultative processes with industry and other interested parties in the development and implementation of energy labelling and associated programs.

This charter recognises the maturity of the program and the need for a 'holistic' approach to government policies for greenhouse gas abatement in the appliance and equipment field. The focus of the program continues to be the delivery of nationally consistent regulation. The implementation of most voluntary programs remains an individual jurisdictional responsibility, although voluntary programs that assist the regulatory program to maximise benefits are being added to NAEEEC's work plans.

Source: NAEEEC (2004b).

Gas appliances are currently subject to voluntary self-regulation run by the Australian Gas Association (AGA). The AGA (sub. 2) argued that MEPS should be extended to gas appliances on the grounds that coordinating the programs would be ‘least-cost’ regulation, and allow direct comparison of the energy and greenhouse performance of gas and electrical appliances.

Further details on the operation and history of NAEEEC are provided in appendix E.

National Framework for Energy Efficiency

In November 2002, the MCE endorsed a proposal to develop the NFEE (box 1.1). The NFEE is intended to provide an ongoing framework for national coordination of energy efficiency policy and programs. The development of the NFEE is being directed by the EEWG, under the auspices of the MCE.

The purpose of the NFEE is to unlock ‘the significant economic potential associated with increased implementation of energy-efficient technologies and processes to deliver a least-cost approach to energy provision in Australia’ (EEWG 2003, p. 2). The Framework is being developed cooperatively with all jurisdictions and key stakeholders. However, individual jurisdictions retain control over program implementation. The Victorian Government commented:

> It should be noted that final decisions about whether and when to proceed with implementation and detailed implementation arrangements are yet to be determined and will be at the discretion of **individual jurisdictions**. [emphasis in original] (sub. DR125, p. 15)

The NFEE will largely focus on demand-side energy efficiency in the domestic, industrial and commercial sectors. However, it will also consider energy use in energy conversion and address intermediaries with the ability to influence energy efficiency choices, such as energy retailers, builders, suppliers of appliances, equipment and materials, and financiers. It does not cover the transport sector.

An EEWG discussion paper released in November 2003 argued that a number of barriers prevented adoption of cost-effective energy-efficient practices. The paper called for stakeholder comment on the existence of a perceived energy efficiency gap and on the specific barriers to improving energy efficiency. A summary of the views of those who were consulted about, or responded to, the discussion paper, has been published (EEWG 2004).

Stage One of the NFEE, announced by the MCE in August 2004, involves a set of 9 integrated packages of measures designed to improve coordination among jurisdictions in delivering energy efficiency programs. The measures involve nationally consistent minimum energy efficiency design standards (including expansion of the existing MEPS scheme), mandatory disclosure of energy performance, mandatory assessment and reporting of energy efficiency opportunities for large users, government leadership on energy efficiency, and education and training for consumers, the finance sector and a range of industry operatives (box 1.1). The NFEE will involve spending of around $33 million over three years.

The MCE noted:

> With the implementation plans now agreed, governments will also consider possible further measures, which could include broad-based incentives under a Stage Two NFEE … (MCE 2004e, p. 1)

State and Territory Governments have a range of mechanisms for implementing jurisdiction-based energy efficiency policies developed under the NFEE (see below and sectoral chapters).

The energy White Paper

In June 2004, the Australian Government released a White Paper on energy policy, *Securing Australia's Energy Future*. The paper outlined policies covering exploration and resource development, energy markets, energy security and energy efficiency, together with environmental, taxation and innovation issues. A taskforce covering a number of Australian Government departments, reporting to the Energy Committee of Cabinet, prepared the paper.

The white paper noted the importance of improved energy efficiency for a cost-effective greenhouse gas abatement strategy and also the potential economic benefits of such improvements. The White Paper brought together a range of new and ongoing policies aimed at improving energy efficiency. These included: reforms to energy markets (particularly improving pricing signals); increasing minimum efficiency standards and an expansion of the range of appliances and buildings subject to MEPS; improving and extending energy efficiency information provided to energy consumers for appliances, buildings and motor vehicles; introducing compulsory audits (and public reports) of energy efficiency opportunities of firms using more than 0.5 petajoules of energy per year; and improving energy efficiency of Australian Government agencies. Many of these initiatives were subsequently incorporated in NFEE Stage One.

In addition, the Solar Cities initiative — a series of demonstration projects in sections of at least four cities and receiving $75 million in government funding — was announced. Solar Cities will involve the subsidised large-scale uptake of solar power together with energy efficiency measures and more effective energy market price signalling (including the use of 'smart meters'). It is to be implemented by the AGO. The White Paper also foreshadowed the establishment of this inquiry.

Jurisdictional energy efficiency programs

All jurisdictions have in place policies aimed at improving energy efficiency in both the private and public sector. These policies were often developed, initially at least, as part of greenhouse gas abatement strategies (for example, under the NGS) and in some cases pre-date the national coordination mechanisms now in place.

Some jurisdictional energy efficiency initiatives are discussed in more detail in the following sectoral chapters and are outlined in appendix C. Only selected examples from some jurisdictions are provided below. While these programs are often part of the national institutional framework outlined above, individual jurisdictions also take energy efficiency policy actions within their own greenhouse gas abatement or energy policy frameworks. These programs sometimes go beyond the national strategy requirements. Most jurisdictions have developed or are developing their own greenhouse strategies which include a diverse range of energy efficiency initiatives (see below). With regard to implementation of the NGS, the AGO noted:

> A key feature of this process is recognition of Australia's regional diversity, and the capacity for different governments to pursue effective greenhouse response through different policy approaches. (AGO 2005a)

For example, in 2002 the Victorian Government released a Greenhouse Strategy which:

> … does more than just meet Victoria's commitments under the NGS — it represents a significant strengthening of action beyond these commitments. (DNRE 2002, p. 15)

The strategy incorporates a number of energy efficiency elements: For example, all new residential buildings in Victoria are required to achieve a five star energy efficiency rating, while existing and new Environment Protection Authority licensees and works approval applicants that are medium to large energy users are required to undertake energy audits and implement those options to reduce energy use that have a payback period of three years or less (chapter 7). The Victorian Government has recently released an update of its greenhouse strategy (DSE 2005). As part of this update, a Victorian Energy Efficiency Strategy is being prepared that will further develop existing measures and initiate new policies and programs as well as incorporate actions from NFEE Stage One.

The Queensland Government released a greenhouse strategy in 2004 (EPA 2004). Energy efficiency initiatives include the ecoBiz program to encourage and assist business to identify and exploit energy efficiency opportunities, and grants to assist commercialisation of new and substantially more energy-efficient products or technologies. The Western Australian Government produced a greenhouse strategy in 2004 that requires companies with large annual greenhouse emissions (above 100 000 tonnes of carbon dioxide from 2006-07) to develop strategies to minimise emissions. The strategy also contains the Building Code of Australia mandatory minimum energy efficiency standards for new homes. The South Australian Government is to publish an industry-wide greenhouse strategy by 2006 that will exceed the State’s current National Greenhouse Strategy commitments.

The New South Wales Government has introduced a compulsory greenhouse gas abatement scheme for electricity generators and suppliers, for which certain energy efficiency projects can qualify as abatement activities. It also requires government agencies and other designated energy users to submit an energy savings action plan every four years. The ACT Government requires an energy efficiency rating statement to be supplied for residential property sales. It also subsidises home energy audits and provides rebates for wall insulation.

All jurisdictions place emphasis on government entities taking a leadership role in reducing greenhouse gas emissions, particularly through reducing energy use, including by increasing the energy efficiency of their operations (chapter 8).

B.2 Recent reforms to regulation of energy markets

The terms of reference raise the possibility of achieving cost-effective energy efficiency improvements through energy market reform to facilitate improved demand and supply management. This section briefly outlines some of the important changes to the regulatory framework for the electricity, gas and petroleum markets since 1990. While many of these developments may have limited, if any, direct implications for energy efficiency, they provide the regulatory framework and incentive structure against which energy efficiency initiatives by energy producers and users are undertaken.

Microeconomic reforms of the electricity and gas industries began in some individual jurisdictions during the 1980s — largely involving corporatising government-owned, vertically integrated monopolies and introducing competitive neutrality reforms. The electricity industry reforms were brought together under the umbrella of COAG, with jurisdictions agreeing to introduce greater competition and vertical separation of the industry, and later, to establish a National Electricity Market (NEM). In 1994, COAG agreed to a timetable and framework to introduce free and fair trade in natural gas. In 1995, both the national electricity and gas reforms were incorporated as related reforms to the National Competition Policy (NCP).

National Competition Policy reforms

The NCP reforms were, among other things, focused on improving economic efficiency of the gas and electricity industries. One objective of these reforms was making energy prices more reflective of costs of production at both the aggregate level and for different classes of consumers. Following structural separation, industries were either opened to competition where markets were contestable or were subject to pro-competitive price and access regulation where there were strong natural monopoly characteristics.

Electricity

In 1993, COAG agreed to the development of a competitive NEM in the southern and eastern jurisdictions. The creation of the NEM, which commenced operation in 1998, and the related reforms to the structure and governance of the industry, involved a variety of fundamental changes to the production and distribution of electricity including:

- structural separation of generation, transmission and distribution activities;
- corporatisation of government owned electricity utilities;
- allowing customers to choose their supplier (whether generators, retailers or traders);
- establishing an interstate transmission network and non-discriminatory access to the interconnected transmission and distribution network;
- removing all discriminatory barriers to entry for new participants in generation or retail supply, and to interstate and/or intrastate trade;
- implementing cost-reflective pricing for transmission services with greater scope for averaging for distribution network services, and transparency and inter-jurisdictional consistency of network pricing and access charges; and
- facilitating inter-jurisdictional dispatch and sourcing of generation capacity, (where cost effective). (PC 2005, p. 21)

Competition has been introduced into the generation and retail sectors. In the case of retail competition, eligible users were permitted to negotiate directly with suppliers of their choice. Full retail contestability is (or will be) available to all users in Australia, except residential and small business customers in Queensland. Structural separation of previously vertically integrated electricity providers has been completed in all jurisdictions. Electricity utilities have also been either corporatised or privatised or assets have been leased to the private sector.

Natural gas

In 1994, COAG agreed to the free and fair trade in natural gas. Since then, reforms to the gas market have focused on increasing the extent of competition in the gas industry. Reforms included:

- removing all legislative and regulatory barriers to free trade in gas;
- corporatisation of government-owned utilities;
- structural separation (or ring fencing) of transmission and distribution activities in each State and Territory;
- introduction of a national framework for third party access to gas transmission and distribution pipelines (the National Gas Access Code); and
- full retail contestability allowing consumers to choose gas suppliers. (PC 2005, p. 23)

Most of these reforms have been implemented, the main exception being the absence of retail contestability in Queensland and the assessment of the Queensland gas access regime by the National Competition Council as not being 'effective' (PC 2005).

COAG Review of Energy Market Directions (Parer Review)

While the reforms of the 1990s had transformed energy markets, there were concerns regarding the efficiency of regulatory arrangements and the need for further reforms to develop efficient and integrated national energy markets. In 2001, COAG established an independent review of the strategic direction for market reform in the electricity and gas industries — the Parer Review.

The Review reported in December 2002 and, while noting the significant achievements flowing from the previous decade's reforms, found opportunities for regulatory reform to further improve the economic efficiency of the electricity and gas industries. The Review's key findings were:

- the energy sector governance arrangements are confused, there is excessive regulation and perceptions of conflict of interest;
- there is insufficient generator competition to allow Australia's gross pool system to work as intended;
- electricity transmission investment and operation is flawed, and the current regions do not reflect the needs of the market;
- the financial contracts market is extremely illiquid, in part reflecting large regulatory uncertainty;
- there are many impediments to the demand side playing its true role in the market;

- there is insufficient competition in the east coast gas market, and too much uncertainty surrounding new pipeline development;
- greenhouse responses so far are ad hoc, and poorly targeted; and
- the NEM is currently disadvantaging some regional areas. (COAG 2002, p. 9)

Of particular relevance to energy efficiency issues, the Review noted that impediments to demand-side responses to market developments meant that NEM pool prices were more volatile than necessary and generation capacity was greater than necessary because of insufficient peak demand pricing signals. For example, retail price caps limited the price incentives for residential users to vary the time pattern of energy consumption.

The MCE and the NEM Ministers' Forum (now subsumed into the MCE) have sought to address these deficiencies in the operation of the markets for electricity and gas. Major initiatives have included:

- the establishment of the Australian Energy Regulator (AER) to regulate the operations of the national energy market. Initially, the AER has taken over electricity transmission regulation from the Australian Competition and Consumer Commission (ACCC) and the electricity code enforcement functions of the National Electricity Code Administrator. Its regulatory responsibilities are to be extended to include gas transmission. Following the development of an agreed national framework, the AER will be responsible for the regulation of distribution and retailing (other than retail pricing) by the end of 2006;
- the establishment of the Australian Energy Market Commission (AEMC) as a separate statutory commission to make changes to energy market rules (codes) and to undertake reviews and other market development functions. It will be accountable to the MCE;
- the MCE to assume the national policy oversight role for the Australian energy market and to oversee the policy framework under which the AER and AEMC will operate;
- all jurisdictions where full retail competition is operating, to align retail price caps with costs and the need for these caps to be periodically reviewed;
- an examination of the scope for facilitating the commercialisation or establishment of a demand side response pool in the NEM; and
- the introduction of a range of reforms relating to pricing, planning and investment in electricity transmission facilities.

In addition, the MCE (2004b) has released a statement on principles for wholesale gas market development and a report has been prepared on options for the future development of that market (Allen Consulting Group 2005b). Further, the MCE proposes to respond to the Productivity Commission's 2004 review of the national gas access regime (PC 2004c) in November 2005 (MCE 2005a).

Petroleum

While not possessing the natural monopoly characteristics of some parts of the gas and electricity markets, the petroleum market has been subject to significant government regulation for many years. In the retail sector, the *Petroleum Retail Sites Act (1980)* (Cwlth), places quotas on the number of retail sites that may be operated on behalf of each of the four major oil refining companies in Australia. The quotas are determined on the basis of average wholesale market share and currently limit the number of oil company-operated sites to just over 400. A key objective of the Act is to limit the role of vertically integrated oil companies in setting retail prices.

The *Petroleum Retail Marketing Franchise Act (1980)* (Cwlth), provides lessee service station operators of oil company-owned sites with protection of tenure, prohibits discrimination in the price of motor fuel sold to franchisees and requires certain disclosures of information by oil companies to potential franchisees.

However, the Australian Government has announced that it intends to:

> … commence consultations with all key industry groups over the next few weeks to see if we can reach an acceptable level of consensus on the introduction of an industry Oilcode and the repeal of the existing legislation ... (Macfarlane 2004)

The Government has proposed that this reform package be implemented in the second half of 2005 (Macfarlane 2004).

The Australian Government or State Governments were involved in price regulation of petroleum products at various times from 1939 until 1998 (IC 1994a). From 1973 to 1998, various Australian Government authorities determined maximum wholesale prices for petrol and diesel. There was often substantial discounting below these maximum prices, especially in capital city markets. In 1998, the Australian Government deregulated petrol and diesel prices and gave the ACCC an informal price monitoring role. The ACCC presently monitors and analyses retail prices in the capital cities and around 110 country towns.

B.3 Improving regulatory practice

In 1995, COAG endorsed principles and guidelines for national regulation making and assessment that were consistent with the objectives of the NCP (COAG 2004).[4] The principles and guidelines incorporate the best practice processes to follow in determining whether a standard (and associated laws and regulations) is the most appropriate course of action. COAG agreed that all proposed standards requiring consideration by Ministerial Councils or national standard-setting bodies be subject to this assessment.[5]

The major element of the process is the preparation of a regulation impact statement (RIS), the purpose of which is to:

> … draw conclusions on whether regulation is necessary, and if so, on what the most efficient regulatory approach might be. Completion of a RIS should ensure that new or amended regulatory proposals are subject to proper analysis and scrutiny as to their necessity, efficiency and net impact on community welfare. Governments should then be able to make well-based decisions. (COAG 2004, p. 14)

RISs are mandatory for significant regulations that have the potential to affect business or individuals, or to restrict competition. Numerous RISs have been undertaken for standards and regulations related to energy efficiency (for example, those prepared for the National Appliance and Equipment Energy Efficiency Program listed in DEH, sub. DR131). RISs related to energy-performance labelling, mandatory energy efficiency standards for buildings, and minimum energy performance standards for appliances and equipment, are discussed in chapters 9 and 10.

The Office of Regulation Review (ORR), which is part of the Productivity Commission and shares its statutory independence, is required under the COAG guidelines to provide advice and assistance on the preparation of RISs and to monitor compliance with the requirements of those guidelines (COAG 2004, attachment A). In particular, the ORR should provide advice on whether a RIS is necessary, and it should assess the adequacy of the RIS at two stages — prior to public consultation and prior to decision making by the Ministerial Council or national standard-setting body.

A department or agency is considered to be compliant with the COAG requirements if it meets the adequacy criteria set out in box B.3.

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4 COAG principles and guidelines were amended in 1997 and 2004.

5 Regulatory decision making by the States and Territories is therefore excluded from this process, although individual jurisdictions each have their own regulation assessment processes.

Box B.3 Adequacy criteria for COAG RISs

The ORR assesses:

- whether the RIS guidelines have been followed;
- whether the type and level of analysis are adequate and commensurate with the potential economic and social impact of the proposal; and
- whether alternatives to regulation have been adequately considered.

For proposals which maintain or establish restrictions on competition (such as barriers to entry for new businesses or restrictions on the quality of goods and services available), it must be established that:

- the benefits to the community outweigh the costs; and
- the objectives of regulation can be achieved only by restricting competition;

both of which are requirements under the *Competition Principles Agreement* (NCC 1997).

There appears to be a degree of misunderstanding among some participants to this inquiry regarding the role of the ORR in the RIS preparation process. Participants commented that the Productivity Commission should not be critical of the analysis in particular RISs, or of the regulatory options implemented, because the ORR (a part of the Commission) had 'signed-off', 'approved' or 'endorsed' those RISs.

For example, the Australian Business Council for Sustainable Energy argued:

> To state that energy efficiency regulations are not justified when there are several Office of Regulatory Review approved regulatory impact statements available to say they are, necessitates some substantial substantiation. (sub. DR121, p. 11)

The Victorian Government commented (in regard to Draft Report Recommendation 8.2 that recommended that energy efficiency standards for commercial buildings should not be introduced without a more thorough evaluation of the costs and benefits and of other policy options):

> The Draft RIS published by ABCB in April 2005 supporting the proposed BCA energy efficiency measures for non-residential buildings was signed off by the Commission through its Office of Regulation Review. (sub. DR125, p. 12)

And Alan Pears stated:

> The Commission also questions the economic analysis in Regulatory Impact Statements for appliance energy efficiency measures, a curious position given RISs are approved by the Office of Regulatory Review within the Productivity Commission. (sub. DR113, p. 16)

The ORR provides independent advice on regulatory best practice *processes*. This includes providing advice on whether a RIS should be prepared and whether it meets minimum adequacy standards given the significance of the regulatory issue under consideration. The ORR bases its assessments on information provided by those preparing the RIS and on information included in each RIS. In undertaking this role, the ORR has not verified the underlying data or methodology. Nor does the ORR endorse, support or offer a view on the merits of regulatory options or outcomes. It is the Ministerial Council or national standard-setting body, not the ORR, which is responsible for the content of RISs.

C Government energy efficiency programs

This appendix provides information on government energy efficiency programs that currently operate in Australia and recent programs that ceased operation in the last few years. Programs whose main aim is to reduce greenhouse gas emissions or encourage the adoption of alternative sources of energy, but that have a component aimed at improving energy efficiency, have been included. The appendix has been compiled primarily from information provided to the Commission by the Australian, State and Territory Governments.

Table C.1 **Abbreviations used in this appendix**

Acronym	*Agency name*	*Jurisdiction*
ABCB	Australian Building Codes Board	Australian Government
DAIS	Department for Administrative and Information Services	South Australia
DEH	Department of the Environment and Heritage	Australian Government
DEUS	Department of Energy, Utilities and Sustainability	New South Wales
DHS	Department of Human Services	Victoria
DHW	Department of Housing and Works	Western Australia
DIPE	Department of Infrastructure, Planning and Environment	Northern Territory
DIPNR	Department of Infrastructure, Planning and Natural Resources	New South Wales
DITR	Department of Industry, Tourism and Resources	Australian Government
DLGPSR	Department of Local Government, Planning, Sport and Recreation	Queensland
DOH	Department of Housing	Queensland
DOI	Department of Infrastructure	Victoria
DPW	Department of Public Works	Queensland
DTEI	Department of Transport, Energy and Infrastructure	South Australia
DTF	Department of Treasury and Finance	Victoria
EPA Qld	Environmental Protection Agency, Queensland	Queensland
EPA SA	Environmental Protection Agency, South Australia	South Australia
EPA Vic	Environmental Protection Agency, Victoria	Victoria
NAEEEC	National Appliance and Equipment Energy Efficiency Committee	All jurisdictions
SAHT	South Australian Housing Trust	South Australia
SEAV	Sustainable Energy Authority Victoria	Victoria
SEDA	Sustainable Energy Development Authority	New South Wales
SEDO	Sustainable Energy Development Office	Western Australia
SENRAC	Sustainable Energy Research Advisory Committee	South Australia

Table C.2 **Energy efficiency programs that are jointly administered by all jurisdictions**

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Building Code of Australia Energy Efficiency Project	ABCB, DEH	Commenced 2001; ongoing (to 2006)	Building industry, property industry, owners of houses and commercial buildings, government building agencies	The Building Code has been adopted by each State and Territory as a technical standard for the design and construction of buildings. In January 2003, energy efficiency standards were introduced into the Building Code for new houses and additions to existing houses. Standards for multiple-occupancy buildings were introduced in May 2005. It is planned to introduce standards for all other commercial buildings in 2006. Further information on the Building Code is included in appendix D.	• To reduce the demand for energy for heating and cooling for human comfort, thereby reducing Australia's greenhouse emissions.	Mandatory standards
National Appliance and Equipment Energy Efficiency Program (NAEEEP)	NAEEEC	Commenced 1992; ongoing	State and Territory Government agencies, appliance manufac-turers	NAEEEP is a collection of coordinated end-use energy efficiency programs relating to household appliances and equipment and commercial and industrial equipment. The main policy instruments used are minimum energy performance standards, mandatory energy efficiency labelling and voluntary measures including endorsement labelling, and training. Further information on NAEEEP is included in appendix E.	• Improve the energy efficiency of appliances and equipment more rapidly than the market has in the past. • Deliver nationally consistent regulation of appliances and equipment. • Assist State and Territory Governments to work consistently and in a manner that minimises cost and inconvenience to industry.	Mandatory standards, labelling, information provision

Source: Adapted from Australian Government response to Commission request for information (unpublished).

Table C.3 **Australian Government energy efficiency programs**

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Challenge Plus – Enhanced Industry Partnerships	DEH	Commenced 2005; ongoing (to 2007-08)	Commercial and industrial sector	Encourages participants to demonstrate corporate greenhouse performance through emissions inventory reporting and the development and implementation of action plans to achieve cost-effective abatement. Certifies products and/or services with zero net greenhouse gas emissions and provides for collaboration between government and industry to identify technical best practice for reducing greenhouse gas emissions in key sectors. Successor to the Greenhouse Challenge program.	• Reduce greenhouse gas emissions. • Accelerate the uptake of energy efficiency. • Integrate greenhouse issues into business decision making. • Provide more consistent reporting of emissions levels.	Voluntary arrangements, to be made compulsory for large energy resource development projects and recipients of fuel excise credits in excess of $3 million.
Cities for Climate Protection Australia	DEH	Commenced September 1998; incorporated in Local Greenhouse Action from July 2004	Local government, businesses, community groups	Encourages local councils to reduce their greenhouse gas emissions. Provides participating councils with funding and information on emission abatement strategies including energy efficiency.	• Reduce greenhouse gas emissions through changes in council's own operations and through action with the wider community.	Funding, information provision
Energy Efficiency Best Practice	DITR	Commenced 1998; discontinued June 2003	Commercial and industrial energy users	Practical demonstrations and advice in delivering innovative energy savings projects in parallel with improvements in productivity and energy management systems.	• Demonstrate that even when energy is managed closely, significant and additional energy efficiency savings and productivity gains can still be achieved in a range of businesses.	Information provision, energy consultants

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Table C.3 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Energy Efficiency Opportunities Assessment	DITR	Commenced June 2004; ongoing	Large energy users	Large energy users will be required to complete an energy efficiency opportunities assessment and report publicly on the outcomes. While the assessment and public reporting are mandatory, all decisions on investments in energy efficiency opportunities will be at the discretion of the business.	• To improve the uptake of commercial energy efficiency opportunities by large energy users.	Mandatory audits and public reporting (legislative regime to be introduced in 2005-06)
Generator Efficiency Standards	DEH	Commenced July 2000; ongoing as part of Greenhouse Challenge Plus	Electricity generation industry	Requires electricity generators to sign agreements with the Australian Government which commit them to reducing the greenhouse gas intensity of their generation. The agreed actions must be implemented within five years. Applies only to electricity generation facilities that exceed stated size levels. Now incorporated into Greenhouse Challenge Plus program.	• Encourage electricity generators that use fossil fuels to adopt energy efficiency best practice in their generation.	Mandatory reporting, enforceable contracts
Greenhouse Challenge	DEH	Commenced 1995; replaced by Challenge Plus 2005	Commercial and industrial energy users	Provided technical advice to firms about measures they could take to reduce their greenhouse gas emissions. Often these were measures to encourage energy efficiency in building design or use. Incorporated into Challenge Plus program in 2005.	• Reduce greenhouse gas emissions through cooperative partnerships with businesses and industry.	Technical assistance, voluntary arrangements

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Table C.3 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Greenhouse Gas Abatement Program	DEH	Commenced May 1999; ongoing	Industrial energy users, electricity generation industry	Provides funding for programs that will lead to large scale, sustainable, cost-effective abatement of greenhouse gas emissions. Funding is based on a competitive process under which applicants must demonstrate that their proposed project will provide cost-effective greenhouse gas abatement. Funded projects have included subsidies for the replacement of industrial equipment with more energy-efficient technologies.	• Assist Australia to meet the 108 per cent Kyoto Protocol target.	Financial incentives
Local Greenhouse Action	DEH	Ongoing	Commercial and industrial energy users, government and the community	Previous versions of this program: provided grants for projects and research on approaches to reduce emissions of greenhouse gases from the residential sector; and, with non-government conservation organisations, provided assistance to households. In 2004, the new program was introduced, drawing on elements of the previous versions and the Cities for Climate Protection program, to engage a larger number of Australians in actions to reduce household emissions.	• Reduce greenhouse gas emissions from the household sector through effective and sustainable partnerships. • Increase the demand for, and the effective use of, greenhouse efficient goods and services.	Financial incentives, partnerships
Measures for improving energy efficiency in Common-wealth operations	DEH	Commenced 1997; ongoing	Australian Government agencies	Specified targets for reductions in energy intensity by Australian Government departments and budget-dependent agencies. Annual reporting on energy use is required.	• Reduce energy costs for the Australian Government. • Demonstrate leadership in energy efficiency performance.	Energy intensity targets, reporting requirements

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Table C.3 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Motor Solutions Online	DEH	Ongoing	Users of electric motors	Provides users of electric motors with information that allows them to compare motors with case studies demonstrating the efficiency gains to be made by choosing more efficient motors.	• Encourage users of electric motors to consider the energy efficiency of their motors and adopt best practice when choosing motors. • Reduce greenhouse gas emissions.	Information provision
Solar Cities	DEH, DITR	Commenced June 2004; ongoing (to 2012-13)	Electricity generation industry, residential and commercial energy users	Will involve the large scale implementation of energy efficiency initiatives, smart meters, cost-reflective pricing and new technology in urban sites. Four or more discrete trials in urban centres will be supported. The first trial will take place in Adelaide. The program will bring together interested parties from both the electricity supply and demand sides.	• Support the exploration of new sustainable models for energy production and use.	Financial incentives, technology trials, information provision
Voluntary Building Industries Initiative	DEH	Commenced 2000; ongoing	Building industry, households, consumers, businesses, Australian, State and Territory Government building agencies	Provides information through printed and electronic materials and public seminars. Offers professional development training programs through industry organisations.	• Encourage industry and the community to voluntarily adopt better energy and environmental sustainability practices in buildings.	Information provision

Source: Adapted from Australian Government response to Commission request for information (unpublished).

Table C.4 **New South Wales Government energy efficiency programs**

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Australian Building Greenhouse Rating Scheme	DEUS	Commenced 1999; ongoing	Commercial building owners, managers and tenants	Enables commercial office building owners, managers and tenants to voluntarily rate the greenhouse impact of their buildings on a scale of one to five. The program is coordinated nationally by DEUS with Australian and State Government funding, and implemented locally through State and Territory Government agencies and nationally accredited assessors.	• Provide a nationally consistent benchmark for commercial office building energy use and greenhouse performance, against which owners and managers can compare and improve their facilities' operation.	Energy efficiency rating scheme
Building Sustainability Index (BASIX) Certification	DIPNR	Commenced 1 July 2004; ongoing	Residential building industry, home renovators	Requires all new homes in Sydney to have a BASIX certificate. To receive a BASIX certificate, dwelling design must offer the potential for a 25 per cent reduction in greenhouse gas emissions compared to the average house of the same type in New South Wales. This requirement will be strengthened to 40 per cent in July 2006. Mains water consumption must be potentially 40 per cent lower than the average. The scheme will be extended to include new residential buildings (including multi-unit buildings) from 1 July 2005 and alterations to existing dwellings anywhere in New South Wales from 1 October 2005.	• Reduce water consumption and greenhouse gas emissions and thereby reduce the demand on existing infrastructure and increase affordability of energy and water to consumers.	Mandatory standards *(Environmental Planning and Assessment Amendment (Building Sustainability Index: BASIX) Regulation 2004* and the *State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004)*

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Table C.4 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Cogeneration Development	SEDA	Commenced 2000; discontinued 2004	Industrial and commercial energy users, energy generation sector	Cofunded feasibility studies to assess the viability of small-scale gas fired cogeneration at sites in NSW, at no cost to the site owner. In return, the site owner committed to calling for expressions of interest if the project was found to be viable. Private companies cofunded the studies, which were carried out by private consultants under contract to SEDA. Communications activities were undertaken to raise awareness of cogeneration in industry, and to provide information and advice to those investigating cogeneration.	• Encourage the uptake of cogeneration technologies.	Financial incentives, voluntary arrangements
Energy Savings Action Plans	DEUS	Commenced May 2005; ongoing	Large energy users, (including NSW Government agencies & local government)	Designated energy users are required to submit an energy savings action plan every 4 years. The plan must include a description of the energy use of the reporting entity, a list of potential measures to reduce energy use and a statement of the measures proposed to be implemented over a 4 year period. The Minister can introduce regulations to mandate the implementation of measures.	• Improve energy efficiency and encourage cost-effective investments.	Mandatory reporting (*Energy Administration Amendment (Water and Energy Savings) Act 2005*)
Energy Savings Fund	DEUS	Commenced May 2005; ongoing (to 2010-11)	Large private sector energy users, government, residential sector	A $40 million annual fund to support energy savings initiatives by large private sector energy users, government and the residential sector (primarily on a contestable basis). The fund will, in effect, be financed by taxing electricity consumers.	• Encourage energy savings. • Address peak demand for energy. • Stimulate investment in innovative energy savings measures.	Financial incentives (*Energy Administration Amendment Act 2005*)

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Table C.4 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Energy Smart Business	DEUS	Commenced 1997; ongoing	Commercial, industrial and government sectors	Assists businesses that have energy bills of over $300 000 per year to identify and implement cost-effective energy efficiency measures. Participating businesses pay a fee to join the program and receive technical advice and assistance with marketing and communication.	• Assist businesses to reduce energy consumption and greenhouse gas emissions.	Voluntary agreements, technical assistance
Energy Smart Government	DEUS	Commenced 1997; ongoing	NSW Government agencies	Assists NSW Government agencies to meet energy reduction targets by implementing cost-effective energy efficiency upgrades. Promotes the uptake of Energy Performance Contracting as a tool for financing large energy efficiency upgrades and the Government Energy Efficiency Investment Program for smaller projects.	• Reduce the energy consumed by NSW Government facilities by 25 per cent by 2005-06 (from 1995-96 levels).	Energy use reduction targets, financial incentives, information provision
Energy Smart Home Rating	DEUS	Commenced 2002; ongoing	Households	Offers two options for rating the energy performance of existing homes. The first is a web-based self-assessment tool. The second is an official rating with a home energy audit conducted by accredited assessors. This enables home owners to rate and improve their greenhouse gas performance.	• Provide a consistent and credible greenhouse performance benchmark for existing homes. Deliver energy savings through behaviour change and informed product purchases.	Energy efficiency rating scheme
Energy Smart Homes for Councils	SEDA	Commenced 1997; discontinued 2004	Local councils and households	Assisted NSW Councils to implement a model energy-efficient housing policy by providing energy rating tools, design alternatives and minimum energy performance standards for new homes.	• Assist NSW Councils to implement energy-efficient housing policy.	Voluntary arrangements

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Table C.4 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Energy Smart Information Centre	DEUS	Commenced 1998; ongoing	Households and consumers	Provides practical advice on residential energy efficiency and renewable energy applications to consumers, home builders, renovators, appliance purchasers, and primary and secondary school students. Offers a telephone information service and appointments with consultants to provide advice on household energy use.	• Provide consumers with commercially-independent advice about sustainable energy.	Information provision
Energy Smart Zone	DEUS	Commenced 2002; ongoing	Schools (year 5 and 6 students and teachers)	Operates a website that teaches school students to 'live energy smart'. Includes interactive exercises that encourage students to adopt energy efficiency practices in their homes and schools.	• Support the NSW 'Human Society and its Environment' syllabus, the 'NSW Science & Technology' syllabus and the 'Environmental Education Policy for Schools'.	Teaching materials
Live Energy Smart	SEDA	Commenced 2000; discontinued 2004	Producers and consumers of sustainable energy products	Assisted manufacturers of sustainable energy technologies, including manufacturers of energy efficiency products. Membership entitled firms to use the Energy Smart logo on packaging and in marketing material. Information was disseminated through local governments, retailers, financial institutions, installers and builders’ associations.	• Assist consumers to adopt sustainable energy technologies.	Information provision, voluntary arrangements
NSW Sustainable Energy Research and Development Fund	DEUS	Ongoing	Commercial and industrial sector, research organis-ations	Provides funding for research and development initiatives in energy efficiency, renewable energy, low greenhouse emission transport fuels and enabling technologies.	• Assist the development of new technologies in the field of sustainable energy.	Financial incentives

Sources: Adapted from NSW Government response to Commission request for information (unpublished); NSW DEUS (2005a); NSW DEUS (2005b).

Table C.5 **Victorian Government energy efficiency programs**

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Business Energy Innovation Initiative	SEAV	Commenced November 2003; ongoing	Businesses, particularly manufac-turing	Provides support for projects that invest in new and innovative energy efficiency solutions, or in solutions that combine energy efficiency with sustainable industry practices. This can involve: identifying and assessing new technology options; performing detailed technical and commercial appraisals; installing and commissioning new solutions and securing local and international expertise for energy efficiency initiatives. The focus is on productivity improvement through innovative demonstrations of sustainable energy supply, design and operation of state-of-the-art production facilities, and the development of new energy efficient or renewable energy products. SEAV may contribute up to $150 000 matched dollar for dollar with the business partner.	• Demonstrate commercially viable energy efficiency and sustainable energy projects to manufacturers and potential new investors in manufacturing in Victoria.	Financial incentives

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Table C.5 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Centre for Energy and Greenhouse Technologies (CEGT)	CEGT is a private company that manages funds allocated to it by the Victorian Government	Ongoing	Developers and providers of low greenhouse gas emission technologies	Provides investment funds and support services for the development of new sustainable energy technologies. Facilitates investment in new sustainable energy and greenhouse pollution reduction technologies to capitalise on Australia's specific energy sector requirements and existing global export opportunities. Focuses exclusively on driving energy technology towards commercialisation in areas such as: energy-efficient processes and products; demand management; greenhouse pollution reduction; renewable and fossil fuel energy generation; and energy transmission and distribution systems.	• Promote energy efficiency practices and technology uptake. • Function as a source of expertise and knowledge to the energy, greenhouse gas emitting and investment sectors. • Successfully coinvest in new sustainable energy technologies and technologies that reduce greenhouse gas emissions.	Financial incentives, information provision, technical assistance
Commercial Office Building Energy Innovation Initiative	SEAV	Commenced 2003; ongoing	Commercial building developers, builders and owners	Makes resources available to property industry leaders to support the development of projects that demonstrate high quality and energy efficiency in commercial property. It is estimated that within 15 years, the demonstration projects will influence 30 per cent of office building activity.	• Stimulate greater investment in high quality, energy-efficient commercial property. Demonstrate innovation in the design and application of sustainable energy in new and existing office buildings. • Apply a broad range of other sustainability measures, such as water conservation and waste reduction to Victoria's commercial buildings. • Improve the quality and value of Victoria’s commercial buildings and reduce greenhouse gas emissions.	Information provision, financial incentives

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Table C.5 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Energy Efficient Government Buildings Policy (15 per cent target)	SEAV	Commenced 1999; ongoing	Victorian Government agencies	Obliges agencies within the general government budget sector to reduce their energy use by 15 per cent by 2005-06 against their 1999-2000 consumption and purchase 10 per cent of their electricity from 'green power' sources. Agencies appoint an energy manager and develop action plans for meeting the targets. SEAV assists agencies to meet these targets, but agencies have the flexibility to determine and pursue the most cost-effective options for reducing energy use within their operations. No additional funding is provided for meeting the target. However, agencies retain the revenue saved from the reduced energy use.	• Reduce Victorian Government energy consumption by 15 per cent and to purchase 10 per cent of the electricity consumed by Government agencies from 'green power' sources by 2005-06. • Assist in expanding the market to support the development of a sustainable energy industry.	Mandatory reporting, targets
Energy efficiency standards for new homes (5 star standard)	SEAV, Building Commission, Plumbing Industry Commission	Commenced July 2004; ongoing	Residential builders and new home buyers	Previously required that all new homes and multi-unit housing built in Victoria achieve either: • a 5 Star energy rating on the building fabric; or • a 4 Star energy rating on the building fabric plus the installation of either a solar hot water service or a rain water tank. From 1 July 2005 all new housing is required to achieve a minimum 5 star energy rating and have installed either a solar hot water service or a rain water tank.	• Reduce emissions of greenhouse gases from residential buildings. • Improve the quality of Victoria's housing stock. • Divert resources from the capital-intensive energy sector to the more labour-intensive building sector, generating new jobs and stimulating economic growth.	Mandatory standards *(Building Code of Australia, Plumbing (Water and Energy Savings) Regulations 2004)*

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Table C.5 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Energy Smart Advisory Centres	SEAV	Commenced 1999; discontinued 2002	Households and consumers	Provided information and advice to consumers through six centres in Melbourne and regional Victoria. Areas covered include: energy-efficient appliances, energy-efficient buildings, energy-saving practices with the potential to reduce energy costs, renewable energy technologies and promotion of other SEAV services.	• Improve the efficiency of energy use in the community through increased access to information and expertise.	Information provision
Energy Smart Builders and Estates	SEAV	Commenced 2000; discontinued 2002	Builders and residential developers	Provided builders with support in designing and marketing 4 and 5 Star energy rated homes. The Energy Smart Builders program was aimed at the largest builders in Victoria. Five builders – including the largest builder in Victoria – joined the program. The SEAV provided building companies with technical support and training to assist in the redesign and marketing of energy-efficient homes. The Energy Smart Estates program required all houses built on the estate to achieve a minimum 4 Star energy rating. Participating builders were permitted to use Energy Smart Estate branding.	• Increase the number of energy-efficient homes offered to new home buyers. • Increase the capacity of builders and developers to design, build and market energy-efficient homes.	Information provision, training and accreditation, voluntary arrangements, marketing
Energy Smart Business	SEAV	Commenced 2000; discontinued 2002	High energy users in the manufact-uring, education & commercial sectors	Developed partnerships with organisations and offered financial assistance to help them undertake energy audits and prepare plans for implementing energy-saving actions. Replaced by the Business Energy Innovation Initiative.	• Reduce energy use and carbon dioxide emissions and achieve ongoing energy management in line with the Victorian Government's Greenhouse Policy.	Financial incentives, information provision and voluntary arrangements

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Table C.5 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Energy Smart Cascade	SEAV	Commenced 1998; discontinued 2000	Commercial and industrial sectors	Provided information on energy management and energy efficiency to 'hosts' such as large companies and industry associations. It was intended that the concepts would then 'cascade' to smaller companies from their industry peers. Participants were expected to establish an energy management program and an energy policy and action plan for improving energy efficiency.	• Assist large companies to establish energy management programs. • Reduce Victoria's greenhouse pollution through energy management in business.	Information provision, voluntary arrangements, training
Energy Smart Living Campaign	SEAV	Commenced September 2000; discontinued 2001	Households and consumers	Promoted changes in the home energy-use habits of Victorian households and consumers. Used television, radio, daily newspapers, magazines, seminars and displays to raise awareness of the benefits of energy saving. In addition, energy-saving tips were incorporated into commercial radio weather bulletins and newsletters mailed to retail energy consumers by energy supply companies AGL, Origin and Pulse.	• Raise awareness and facilitate the uptake of energy efficiency by Victorian households. • Promote energy saving measures to Victorians with an emphasis on reducing energy use for cooling.	Information provision

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Table C.5 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Energy Smart Schools	SEAV	Commenced 2000; discontinued 2002	Schools, architects	Provided a range of technical, advisory and information support services to schools to assist them to introduce improved energy management in school facilities. Member schools were provided with a resource kit, software for monitoring and benchmarking school energy use, and ongoing communication and technical support. Three training seminars for school energy managers were conducted. Casual relief teacher grants were provided to enable classroom teachers to implement the program's initiatives. Subsidies were delivered to 13 schools for minor energy efficiency works. Additional funding was also provided for the Schools Low Energy Challenge initiative to highlight energy savings achievable in schools.	• Facilitate improved energy efficiency in the design, construction and operation of school facilities. • Encourage schools to establish energy management programs that would lead to sustained reductions in energy consumption, energy costs and greenhouse pollution.	Financial incentives, information provision, technical advice
Energy Task Force	SEAV, DHS, Office of Housing	Commenced 2003; ongoing	Low income households	Offers energy retrofitting to low income households to improve the comfort of their homes and reduce their energy bills. Energy efficiency retrofits managed by local community organisations are conducted by a number of small mobile work teams that are engaged and trained as part of a government-funded labour market program.	• Provide opportunities for unemployed Victorians to gain skills in energy auditing and retrofitting and to increase people's participation in their local community. • Reduce energy consumption. • Foster the development of community-based enterprises to undertake energy efficiency improvements in public, low income and other housing. • Engage energy utilities in the energy efficiency retrofit projects, & encourage them to explore energy efficiency improvements.	Financial incentives, information provision, training, voluntary arrangements

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Table C.5 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
High Efficiency Gas Heater Rebate	SEAV	Commenced April 2004; ongoing (to March 2006)	Households	Provides rebates of up to $1000 to concession card holders, and $600 to others for the purchase of highly energy-efficient gas heaters. The rebates are only available to consumers living in certain rural and outer metropolitan areas and are only available to subsidise the purchase of energy-efficient gas heaters to replace electricity or wood as the household's main source of heating. Houses built after 1 January 2002 are not eligible to receive the rebate.	• Assist regional and outer metropolitan Victorians to convert to an energy source that causes lower greenhouse gas emissions and is more cost effective. • Provide access to affordable and sustainable energy supplies for all Victorians. • Address the shortages of firewood in some country areas of Victoria.	Financial incentives
Local Energy Efficiency Demonstration Initiative	SEAV, Moreland Energy Foundation Ltd	Commenced 2004; ongoing	Local government	Supports local governments in rural and regional areas to provide examples to their local community of what can be achieved by implementing energy efficiency measures in their own facilities. With the assistance of the Moreland Energy Foundation, participating councils will develop business and community awareness programs to facilitate the replication of demonstration projects across each municipality. Partnerships have been established with 15 rural and regional councils.	• Promote the benefits of specific energy efficiency investments. • Demonstrate how local residents and businesses can achieve similar energy savings. • Reduce energy consumption within council facilities.	Information provision, financial incentives
Office Accommoda-tion Guidelines	DTF	Commenced July 2005; ongoing	Budget sector government agencies	Includes minimum energy performance standards for new offices and existing offices.	• Help project teams achieve environmentally, socially and economically sustainable workplaces.	Government procurement policy

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Table C.5 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Solar Hot Water Rebate	SEAV	2000; ongoing	Households	Provides rebates for solar water heaters that replace conventional gas, wood, briquette or oil-fuelled water heaters. The amount of the rebate is up to $1500 depending on the performance and capacity of the system.	• Reduce end-use energy consumption. • Promote the development of the solar water heater industry in Victoria.	Financial incentives
State Environment Protection Act (Air Quality Management) Greenhouse Program	EPA Vic	Commenced January 2002; ongoing	Commercial and industrial sectors	Requires EPA licence holders to: consider their energy use and associated greenhouse gas emissions; conduct an energy audit if required by the Act; prepare an action plan including all audit recommendations with a payback period of three years or less; and complete implementation of the plan by 2006. They must then report annually to the EPA on their energy use, associated greenhouse gas emissions and progress with implementation of their action plan. Those applying for a works approval to construct or modify plant must demonstrate that the plant will be of world's best practice for energy efficiency.	• Reduce energy use and carbon dioxide emissions in line with the Victorian Government's Greenhouse Policy.	Mandatory audits, mandatory investment *(State Environment Protection Act (Air Quality Management))*, information provision
Sustainable Energy Centre	SEAV	Commenced September 2003; ongoing	Commercial, industrial, household, consumer, government and energy generation sectors	Provides a hub for the exchange of international, national and local information and expertise on sustainable energy. Operates a bookshop and resource centre offering a wide range of information on sustainable energy drawn from around the world. Hosts events and workshops and is equipped with video conferencing and multimedia equipment to facilitate exchange with experts from around the world.	• Provide external stakeholders with timely and accurate information on sustainable energy. • Bring together people from many different organisations to discuss and debate new ways to progress sustainable energy.	Information provision, seminars

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Table C.5 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Sustainable Energy Info Initiative Partnerships (Regional Information Partnerships)	SEAV	Commenced January 2004; ongoing	Small businesses, households, community groups	Involves developing closer working relationships with local and regional organisations that have strong connections, expertise, networks and knowledge and are well placed to provide independent information on sustainable energy in their local areas. Local organisations involved in the program provide information to residents, small businesses and community groups through a range of communication channels, such as physical information access points, workshops and regional events.	• Expand the reach of sustainable energy information to Victorian businesses and households. • Develop new and innovative information products, services and channels. • Reach consumers, small business and community organisations at a point where they are making key decisions in regard to energy use. • Encourage choice and action which has a significant impact on the uptake of sustainable energy products and practices.	Information provision
Sustainable Public Lighting Initiative	SEAV	Commenced 2004; ongoing	Local government, developers	Establishes partnerships between the SEAV, local government and other key stakeholders to identify opportunities to maximise the sustainability of public lighting. For example, by replacing mercury vapour lighting with other technologies that consume less energy and require the disposal of lower levels of heavy metals.	• Reduce the energy consumption of lighting, and to encourage the adoption of technologies that result in the disposal of lower levels of heavy metals. • Provide leadership to public lighting owners, managers and developers.	Information provision, financial incentives
TravelSmart Local	SEAV, DOI	Commenced January 2001; ongoing	Households and consumers	Works in cooperation with local governments to encourage changes in travel behaviour. A particular focus is to reduce dependence on cars and the associated greenhouse gas emissions.	• Achieve small scale, measurable changes in travel behaviour. • Develop the capacity of local government officers to deliver such programs in the future.	Voluntary arrangements, information provision, financial incentives

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Table C.5 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Victorian Solar Innovation Initiative	SEAV	Commenced 2003; ongoing	Local government and community groups	Encourages the innovative use of solar energy design and technology, and demonstrates its application in community facilities such as schools, kindergartens, childcare and community health centres. Most projects involve the incorporation of passive solar design features into the building shell, which decreases energy use and increases energy efficiency.	• Showcase the application of solar technology and design in community buildings undergoing upgrade or renovation.	Information provision, financial incentives

Source: Adapted from Victorian Government response to Commission request for information (unpublished); DTF (2005).

Table C.6 **Queensland Government energy efficiency programs**

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Cleaner Production Partnerships	EPA Qld	Commenced May 1999; discontinued December 2000	Businesses	Provided support to businesses in conducting 'eco-efficiency' assessments on their premises and assisted in implementing recommendations. Participants received a $1000 grant to support the appointment of a consultant to identify 'eco-efficiency' opportunities, with a possible follow up $9000 to support the implementation of the consultant's recommendations.	• Support businesses in the identification and implementation of 'eco-efficiency' opportunities.	Financial incentives
EcoBiz	EPA Qld	Commenced July 2003; ongoing (3 year program)	Businesses (particularly the agribusiness and food processing sectors, and urban development projects)	Offers tools and extension services to support the establishment of the 'eco-efficiency' baseline of businesses and to assist with action planning. Offers financial incentives (rebates) to support the implementation of best practice technologies in 'eco-efficiency' action plans, and branding to capitalise on market influence as a 'green company'.	• Improve the capacity of individual companies to achieve improved business competitiveness through 'eco-efficiency' and brand differentiation. • Provide local company case studies that can be diffused to the wider sector through industry networks (via the Greenhouse Industry Partnerships program).	Information provision, financial incentives, branding
Energy Advisory Service	EPA Qld	Ongoing	Households and consumers	Provides advice on energy efficiency in the home, access to information, resources and basic program information.	• Provide impartial, free advice on energy efficiency and renewable energy	Information provision

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Table C.6 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Government Energy Management Strategy	DPW on behalf of Queensland Treasury	Commenced November 2003; ongoing (to June 2008)	26 core Queensland Government departments and agencies	Encourages Queensland Government departments and agencies to adopt practices which contribute to efficiencies in energy use, reduce greenhouse gas emissions and generate financial savings. Assists agencies to tender for preferred suppliers to audit, design, install, monitor and guarantee energy savings. Assists agencies in implementing a generic smart metering program at key facilities to monitor electricity usage patterns, select the best available tariffs and position agencies to take advantage of potential savings from the bulk purchase of electricity.	• Improve the efficiency of energy consumption and unit acquisition values in Queensland Government departments and agencies. • Achieve annual savings of $20 million by June 2008. The first target of $2 million is to be achieved by 30 June 2005.	Energy use reduction targets, financial incentives, implementation assistance
Greenhouse Industry Partnerships	EPA Qld	Commenced February 2001; discontinued June 2002	Queensland businesses, local governments and industry associations (focus on agri-business, food processing, manufac-turing, tourism and urban development projects)	Provided grants of up to $100 000 to support the identification of 'eco-efficiency' opportunities, implementation of findings and the diffusion of findings across the relevant sectors to encourage wider uptake. Offered 'eco-efficiency' assessments for businesses and local government facilities, and a regional sustainability project. The program included several components: • the Industry Partnerships Program • the Local Government Greenhouse Partnership Program • the Greenhouse Building Rating Tool was used to encourage 4 star standard buildings • the Gladstone Large Industry Program.	• Support energy efficiency in Queensland business, government and residential sectors.	Financial incentives, partnerships

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Table C.6 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Guidelines Toward a More Sustainable Subdivision	DPW	Commenced December 2002; ongoing	Building industry	Provides information on: better practice site development; building and landscape design; material selection; and energy efficiency (including building design and appliance selection).	• Encourage better practice site development, building and landscape design and material selection.	Information provision
Industry Partnerships Program	EPA Qld	Commenced July 2002; ongoing	Local government, commercial sector and peak industry associations	Offers firms training, workshops and education programs that support the diffusion of business-level innovations in 'eco-efficiency'. Provides grants of up to $100 000 to support the diffusion of innovative approaches across sectors to encourage wider uptake. Particular focus on agribusiness, food processing, and urban development projects.	• Improve capacity for sustainability within priority sectors. • Achieve improved business competitiveness through 'eco-efficiency' and brand differentiation.	Financial incentives, training
Power for a Sustainable Future	EPA Qld	Commenced July 2000; ongoing	Schools (upper primary and lower secondary students)	Provides schools with material to enable upper primary and lower secondary students to explore ideas and issues relating to sustainable energy.	• Meet objectives in the Queensland Science and Studies of Society and Environment curriculum.	Teaching materials

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Table C.6 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Queensland Sustainable Energy Innovation Fund	EPA Qld	Commenced May 1999; ongoing	Queensland-based businesses and research organis-ations	Provides grants of up to $200 000 to support the development of new sustainable energy products or technologies, new process improvements or the creation of centres of expertise. Funds are focused on innovative projects dealing with research, development, demonstration or commercialisation of energy efficiency or renewable energy. Part of the cost of each project is offset, with the applicant or project partners expected to provide a significant input of cash, expertise, facilities, intellectual property and/or other in-kind contributions.	• Promote innovation in energy efficiency and renewable energy technology and practices. • Establish Queensland as a market leader in energy innovation and sustainable energy. • Support the commercialisation of new sustainable energy products or technologies by Queensland-based companies. • Support wide adoption of process improvements that reduce energy consumption and environmental impacts. • Support expertise and capability to commercialise sustainable energy technologies. • Reduce adverse environmental impacts resulting from fossil fuel use.	Financial incentives
Smart Housing	DOH	Commenced July 2002; ongoing	Residential building industry, home buyers, renovators and investors	Offers good practice guidance to all stakeholders involved in the design and construction of residential dwellings. Energy efficiency measures, including site planning and orientation, building design and appliance selection, are included in the advice to those planning to build, buy or renovate a house.	• Advance a set of principles embodying good practice in housing design, building and renovation. • Establish a common understanding of sustainability in terms of the 'triple bottom line' and a shared vision across State and local government and the housing industry. • Ensure there is a consistent and complementary message across all arms of Government in regard to good practice housing design and construction. • Influence supply and demand, bringing about a change in practice.	Information provision, voluntary arrangements

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Table C.6 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Sustainable Housing	EPA Qld, DLGPSR	Commenced 2003; ongoing (to 2005)	Residential building industry, households	Proposes measures (in addition to the energy efficiency standards in the Building Code of Australia) to make housing more sustainable. Proposals include mandatory measures to reduce energy and water use in new houses. A discussion paper on the proposed measures is to be made available for public comment.	• Reduce energy and water use in new houses.	Regulation (most likely to be included under the *Building Act 1975* and/or the *Plumbing and Drainage Act 2002)*
Towards Healthy and Sustainable Housing Research Project (Research House)	DPW, DOH	Commenced March 2001; ongoing (to June 2007)	Residential building industry, consumers, educators, students	Incorporates the design, construction, and public display of a four-bedroom family home in Rockhampton to demonstrate sustainable design. A family of two adults and three teenage children lives in Research House. Data are collected on heating, cooling, performance of appliances, insulation, glazing and lighting technologies.	• Facilitate research in ecological building design and construction. • Demonstrate social sustainability principles such as universal design, safety and security.	Technology demonstration, information provision
TravelSmart	Queensland Transport	Commenced 1997; ongoing	Households, businesses, local government, schools	Encourages the use of environmentally-friendly transport such as public transport, cycling, walking and car pooling. Supports voluntary change in the behaviour of individuals and organisations. Uses awareness campaigns, providing tailored information and improving access to 'TravelSmart' modes of transport.	• Achieve a 14 per cent reduction in single-occupancy car use. • Reduce vehicle kilometres travelled. • Reduce carbon dioxide emissions in the period 2008–12.	Information provisions, incentives

Sources: Adapted from Queensland Government response to Commission request for information (unpublished); EPA (2005a); EPA (2005b).

Table C.7 **Western Australian Government energy efficiency programs**

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Australian Building Greenhouse Rating	SEDO	Ongoing	Commercial building constructors, architects, managers, owners and tenants	Provides training and accreditation for the use of energy rating software for new and existing commercial buildings.	• Increase the energy efficiency of commercial buildings.	Training and accreditation
Brochures	SEDO	Ongoing	Households, businesses and local government	Provides brochures dealing with energy efficiency themes in homes and commercial business, either online or in hard copy through the Energy Smart Line.	• Provide access to information on energy savings in homes and commercial businesses.	Information provision
Cogeneration	SEDO	Ongoing	Commercial and industrial sectors	Encourages industry to consider electricity cogeneration. Provides information, including reports on cogeneration and case studies of cogeneration projects.	• Contribute to the development of the Western Australian sustainable energy industry sector.	Information provision
Community Seminars	SEDO	Ongoing	Community groups	Invites industry experts to present seminars to the community. Seminars are designed around key areas of SEDO community programs and topics including energy efficiency.	• Enable easy access for the community to experts in the essential SEDO program areas of energy efficiency.	Information provision

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Table C.7 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Energy Smart Business Seminars	SEDO	Ongoing	Small to medium sized businesses	Provides seminars on a range of key topics on sustainable energy solutions for small to medium sized businesses, including lighting, air conditioning and energy audits.	• Provide the business community with easy access to information on key areas of energy efficiency.	Information provision
Energy Smart Directory	SEDO	Ongoing	Consumers and businesses	Provides a web-based search engine for finding Western Australian businesses that provide sustainable energy products and services.	• Facilitate access within Western Australia to sustainable energy products and services, for business and the community.	Information provision
Energy Smart Government	SEDO	Commenced June 2002; ongoing	Western Australian Government agencies, business and community	Obliges State Government agencies to reduce their energy consumption by 12 per cent by 2006-07 compared to their 2001-02 consumption. Sets incremental targets of 5, 6, 8, 10 and 12 per cent over five years. Provides grants ($350 000 each year) to fund energy audits and studies to encourage energy management projects, and capital advances ($16 million over four years) to fund identified financially viable energy efficiency projects. Awareness raising and training are also undertaken. Financial penalties are applied to agencies that fail to reach their reduction targets.	• Instil energy management as an ongoing element of the operation of Western Australian Government agencies. • Provide an example to businesses and the community of the potential of good energy management practices.	Mandatory audits, energy use reduction targets, financial incentives and penalties, information provision
Energy Smart Line	SEDO	Ongoing	Households	Provides expert energy efficiency and renewable energy advice via a telephone service which responds to more than 5000 calls each year and provides brochures on request.	• Provide access to independent, expert advice to facilitate the adoption of energy efficiency and renewable energy in the home.	Information provision

(Continued next page)

Table C.7 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Government Office Accommoda-tion Guidelines	DHW	Ongoing	Government property managers, commercial building developers, owners and managers	Sets energy performance requirements for government buildings and tenancies.	• Reduce government energy costs and greenhouse gas emissions. • Raise the profile of energy efficiency in the commercial building sector. • Drive market transformation and improve the energy efficiency of Western Australian commercial office building stock.	Government procurement policy
House Energy Rating Software program	SEDO	Ongoing	Residential building industry	Involves accredited assessors, who use house energy rating software to rate the relative thermal energy performance of house design, either during design and construction or for existing homes.	• Improve the energy efficiency of houses in Western Australia.	Training, house energy rating software
Reach for the Stars	SEDO	Ongoing	Producers, consumers and retailers of home appliances	Raises industry and consumer awareness of the energy rating label and the benefits of high efficiency appliances.	• Reduce energy costs and greenhouse gas emissions associated with the use of energy labelled appliances. • Increase the promotion and sale of energy-efficient appliances.	Information provision
Regional Energy Efficiency Pilot Project	SEDO	Commenced December 2004; ongoing (to June 2005)	Regional households, businesses and local government	Offers residents of regional towns: information on energy efficiency; free energy audits to business; free compact fluorescent lights to households; and rebates for the purchase of energy-efficient air conditioners, refrigerators, freezers and insulation.	• Reduce average and peak electricity demand in regional areas resulting in savings for consumers and government.	Information provision, voluntary audits, financial incentives

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Table C.7 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
SEDO Grants Committee	SEDO	Ongoing	Community groups, education institutions, businesses and local government	Provides grants for research, demonstration and education projects that increase the uptake and understanding of energy efficiency.	• Increase the uptake of energy efficiency and renewable energy measures. • Assist the development of the sustainable energy industry.	Financial incentives
Subiaco Sustainable Demonstration Home	SEDO, City of Subiaco	Construction commenced November 2002; open to public until 2006	Households and residential building industry	Uses a purpose-built house in the Perth suburb of Subiaco as a tool to educate the community about energy-efficient house design. For two years the house will be open to the public to demonstrate the technology behind such developments. During that time data on the thermal performance of the home will be collected.	• Show that an environmentally friendly and energy-efficient home can also be architecturally impressive, aesthetically pleasing and functional.	Technology demonstration, information provision

Sources: Adapted from Western Australian Government response to Commission request for information (unpublished); SEDO (2005).

Table C.8 **South Australian Government energy efficiency programs**

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Building Tune-Ups	Adelaide City Council, Office of Sustainability, DAIS and Energy SA	Commenced October 2003; ongoing (to late 2005)	Private and Government CBD office building owners and operators	Provides audits and ratings of energy and water use of 10 office buildings in the Adelaide CBD (three government and seven private sector buildings). Informs building owners of the results of the audits and of strategies to improve the performance of their buildings. Encourages building operators to achieve a one star Australian Building Greenhouse Rating (ABGR) improvement.	• Demonstrate cost-effective opportunities to improve the energy and water efficiency of commercial office buildings. • Reduce greenhouse gas emissions from the city of Adelaide.	Voluntary audits, information provision
Business energy efficiency opportunity identification	Energy SA	Ongoing	Small to medium businesses, government agencies	Provides 30 businesses in Adelaide with subsidised energy efficiency assessments and assists them to formulate action plans to reduce their energy consumption. Results from the first 19 energy audits show the potential to reduce energy use by an average of 10 per cent with an average payback of 3.3 years (including the audit costs).	• Reduce greenhouse gas emissions. • Improve SA business competitiveness.	Financial incentives
Cities for Climate Protection	Energy SA	Ongoing	Local government, businesses, community groups	Provides information and assistance to South Australian councils involved in the Australian Government Cities for Climate Protection program.	• Assist South Australian local councils to reduce greenhouse gas emissions in line with the 108 per cent Kyoto Protocol target.	Funding, information

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Table C.8 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Demonstration home SA Energy Home at Northfield	Energy SA, ETSA, AGL and Jennings	Commenced 2001; discontinued 2004	Home owners	Involved retrofitting a standard three bedroom house with energy-efficient appliances, high levels of insulation to walls and ceilings and other initiatives. The public were able to walk through the house to observe energy efficiency technologies, and collect information brochures about the products and services in the home.	• Demonstrate to the public the energy-saving techniques available for their own houses.	Technology demonstration, information provision
Eco-efficiency program	EPA SA	Commenced July 1998; ongoing	Small businesses	Involves the provision of information, voluntary agreements and assistance with funding and expertise for projects that demonstrate ecologically sustainable development principles. Addresses the objectives of the Environment Protection Act, 1993.	• Promote the benefits of 'eco-efficiency' to small business and to provide tools for implementing 'eco-efficiency' changes	Information provision, financial incentives, voluntary agreements
Eco-Renovation Home in Whyalla	SAHT, Whyalla City Council, Energy SA	Commenced July 2001; ongoing (to the end of 2006)	Whyalla residents and visitors	Involves the retrofit of one ‘double unit’, with one unit operating as an information centre open to the public. Information is available about the retrofit, and the energy and water use is monitored. The information is made available through the website.	• Demonstrate how the energy efficiency of existing housing can be improved.	Technology demonstration, information provision

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Table C.8 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Energy Efficiency Program For Low Income Households	Energy SA	Commenced January 2004; ongoing (to December 2005)	Low income households	Provides voluntary audits to identify opportunities for energy efficiency in the home. Following the audits, households receive energy-efficient light bulbs, a shower head and a draught-excluder, and may be eligible for buy-back schemes to 'retire' inefficient refrigerators. Some households receive interest-free loans to enable them to purchase energy-efficient appliances.	• Assist low income households reduce energy use and costs without reducing their comfort.	Voluntary audits, financial incentives, information provision
Energy Friends	Energy SA	Commenced 2002; ongoing	Community groups, households	Provides training to community groups to enable them to take action in their local community. The program may involve home energy audits, community forums or other information programs.	• Reduce house energy use and bills without reducing comfort. • Raise awareness of energy management at home	Training, voluntary audits, information provision
Energy SA Advisory Service	Energy SA	Ongoing	South Australian community (including households, businesses, schools and local government)	Provides information on greenhouse gas abatement and energy efficiency measures via visitor centres, telephone advice lines, the Energy SA website, literature distribution, seminars and workshops.	• Provide independent information, advice, and resources to motivate the target audience to implement sustainable energy practices.	Information provision

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Table C.8 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Energy Services Industry Development	Energy SA	Ongoing	Businesses, government	Operates an annual Energy Efficiency Conference and Trade Fair. Attendees include: representatives of the energy services industry from the commercial, industrial and residential sectors; government representatives; and interested members of the public. Attendees can visit trade booths to learn about specific energy efficiency related products and services.	• Provide an opportunity for companies involved in the energy services industry and potential customers in the commercial, industrial and domestic sectors to exchange information. • Highlight the key issues of relevance to the energy services industry such that attendees are up to date and informed, and appreciate where the industry can add value.	Information provision, awareness raising
Government Energy Management Plan	Energy SA, Department of Premier and Cabinet	Commenced 1998; ongoing	Government	Sets the South Australian Government's targets for reduced energy use by Government agencies and proposes strategies for achieving those targets. Sets a target of a 15 per cent reduction in energy use in Government buildings before 2010 (against 2000-2001 levels). This target has been extended to 25 per cent by 2014.	• Reduce energy use, energy costs and greenhouse gas emissions from public sector operations. • Maintain a comprehensive inventory of greenhouse gas emissions from public sector operations. • Provide leadership in addressing climate change issues.	Mandatory reporting, energy use reduction targets
Installation of LED Equipped Traffic Signals	DTEI	Ongoing	Government	Involves replacement of globes in traffic signals equipped with energy-efficient light emitting diodes (LEDs).	• Reduce energy use and greenhouse gas emissions associated with the operation of traffic signals across the Adelaide metropolitan area.	Technology and innovation

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Table C.8 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Local government support	Energy SA	Commenced January 2002; ongoing	Local government, residential, commercial and industrial sectors	Offers assistance to South Australian local governments to implement sustainable energy initiatives, both within their own operations and within their communities. Assistance includes: information provision; promoting Energy Performance Contracts and other energy management tools; and assistance with staff training.	• Assist local governments to reduce the energy use, energy bills and greenhouse gas emissions associated with their own operations and those of local businesses and households.	Information Provision
Reach for the Stars	Energy SA	Commenced September 2002; ongoing	Consumers and retailers of appliances	Raises industry and consumer awareness of the energy rating label and the benefits of high efficiency appliances.	• Reduce energy costs and greenhouse gas emissions associated with the use of energy-labelled appliances. • Increase the promotion and sale of energy-efficient appliances.	Information Provision
Remote Area Energy Efficiency Rebates Scheme	Energy SA	Commenced February 2002; discontinued May 2003	Households and businesses in regional and remote South Australia	Provided targeted rebates on compact fluorescent lamps and insulation to households and businesses in off-grid communities in regional and remote South Australia.	• Assist off-grid communities to reduce their energy use, energy costs and greenhouse gas emissions. • Reduce Government expenditure on electricity subsidies provided to communities participating in the Remote Area Energy Scheme.	Financial incentives, information provision
Schools Program	Energy SA	Commenced January 2000; ongoing	Primary and secondary school students and teachers	Encourages a focus on sustainable energy in the South Australian school curriculum and provides field demonstrations using the Energy SA solar powered caravan and trailer.	• Provide teachers with resources to use in their sustainable energy curriculum in order to raise awareness of energy efficiency and sustainable energy generation.	Information provision

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Table C.8 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Small Business Energy Savers Kit	Energy SA	Ongoing	Small businesses	Provides information to small businesses advising them how they can save money and reduce greenhouse gas emissions by adopting energy efficiency measures. This may include recommending that businesses implement energy management programs and purchase energy-efficient appliances and equipment.	• Provide businesses with strategies to reduce their energy consumption and bills.	Information provision
Solar Hot Water Heater Rebates	Energy SA	Commenced July 2001; ongoing	Households	Provides rebates of up to $700 for the installation of solar hot water systems that meet eligibility criteria.	• Promote sustainability and reduce greenhouse gas emissions.	Financial incentives
South Australian Housing Trust Environmental Management Framework	SAHT	Ongoing	Tenants of SAHT properties	Involves developing and promoting programs and initiatives in line with broader government directions in energy efficiency. Includes measures to: renovate and upgrade existing housing stock to improve energy efficiency; construct new properties with a minimum four star energy rating; develop and implement awareness programs for SAHT tenants on how to reduce energy use; identify opportunities to create energy efficiencies in properties where the SAHT provides landlord power; develop a low-cost, low energy, roof integrated solar heating system; and install solar hot water systems in selected SAHT properties.	• Place clients of SAHT in energy-efficient housing which they can afford to run.	Information provision, housing retrofits, technology and innovation

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Table C.8 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Sustainable Energy Research Grants	SENRAC	Commenced 1994; ongoing	Industry, universities	Provides research and development grants to sustainable energy projects that have strong prospects of commercialisation, achievement of environmental benefits and the potential to reduce energy costs for South Australian consumers. Focuses on grants for sustainable and renewable energy technologies, and on demand-side management technologies.	• Enable more efficient use of energy, reduce peak energy demand and reduce energy-related greenhouse gas emissions.	Financial incentives
TravelSmart SA	DTEI	Ongoing	Schools, workplaces and households	Encourages voluntary travel behaviour change including increased walking, cycling and public transport use.	• Reduce energy use and greenhouse gas emissions by changing travel behaviour.	Information Provision

Sources: Adapted from South Australian Government response to Commission request for information (unpublished); Energy SA (2005); SENRAC (2005).

Table C.9 **ACT Government energy efficiency programs**

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
ACT Energy Wise	Office of Sustainability	Commenced December 2004; ongoing	Households	Provides audits to identify home energy efficiency improvements that will reduce household greenhouse gas emissions. Offers rebates of up to $500 to householders who make energy efficiency improvements identified in the audit. Subsidised products may include insulation, window treatments, weather stripping, pelmets, lined curtains or blinds, fluorescent lights and permanent external shading.	• Increase the energy efficiency of existing homes in the ACT and reduce their greenhouse gas emissions. • Leverage expenditure by homeowners in energy efficiency upgrades of their homes beyond normal maintenance and renovation programs. • Encourage the development of a local energy efficiency services sector. • Raise awareness among homeowners of the greenhouse issue and the potential to increase their home's energy efficiency. • Complement other residential greenhouse gas abatement measures. • Complement and eventually subsume the existing cavity wall insulation and solar hot water rebate programs.	Voluntary audits, financial incentives

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Table C.9 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
ACT House Energy Rating Scheme	ACT Planning and Land Authority	Commenced July 1995; ongoing	Residential building industry, home owners and buyers	Requires developers of new residential properties to use the energy rating software, FirstRate, to rate the energy efficiency of their proposed designs. New residential buildings must achieve a minimum 4 star energy efficiency rating. Requires vendors of existing homes to undertake an energy efficiency rating assessment and to disclose the rating in all advertisements for sale and to include the rating statement as part of the contract for sale.	• Increase the energy efficiency of all new homes in the ACT. • Foster awareness in the community and building industry of the benefits of energy efficiency.	Mandatory standards, mandatory assessment and disclosure Regulation (*Civil Law (Sale of Residential Property) Act 2003*)
Cavity Wall Insulation Subsidy	Office of Sustainability	Commenced February 2001; discontinued December 2004	Households	Provided a total of $360 000 in discounts to ACT residents over three years. A 25 per cent discount was offered to 900 households that installed cavity wall insulation. The subsidy was offered on a 'first come, first served' basis. Environment ACT asked those taking up the scheme to complete a survey to measure dollar and energy savings from installing cavity wall insulation.	• Increase the energy efficiency of existing homes in the ACT and reduce their greenhouse gas emissions. • Leverage expenditure by homeowners in energy efficiency upgrades of their homes, beyond normal maintenance and renovation programs.	Financial incentives
Ecobusiness	ACT NoWaste Urban Services, Office of Sustainability	Commenced 2002; ongoing	Commercial sector	Offers workshops which address waste management, energy efficiency and water efficiency in the commercial sector.	• Encourage commercial businesses to develop and implement water and energy conservation measures and minimise solid and liquid wastes via reuse and recycle systems. • Encourage businesses to implement environmental management systems.	Information provision

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Table C.9 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Energy Performance in Commercial Buildings	Office of Sustainability, Chief Minister's Department	Commenced September 2002; discontinued	Commercial sector	Promoted the uptake of Energy Performance Contracts (EPCs) by ACT businesses, and provides limited subsidies. Participating owners and occupiers of commercial buildings entered into contracts with energy performance contractors. The contractors undertook energy efficiency improvements in the buildings and guaranteed a level of energy savings over the project pay-back period. This was to reduce the risk to business that the energy efficiency measures would not be cost effective.	• Demonstrate the cost effectiveness of EPCs to the commercial sector. • Reduce greenhouse gas emissions from the commercial sector.	Information provision, financial incentives
Energy Use in ACT Government Operations	Greenhouse and Energy Policy, Office of Sustainability	Commenced July 2002; ongoing	ACT Government agencies	Collects energy use data from all ACT Government agencies (including electricity and gas use and transport fuel consumption) using an internet-based program called EDGAR (Energy Data Gathering And Reporting). Tracks progress against greenhouse targets set in the ACT Greenhouse Strategy 2000.	• Accurately measure energy use in ACT Government operations. • Enable abatement measures to be implemented where appropriate.	Government reporting requirements
Environment-ally Sustainable Procurement Guideline	ACT Procurement Solutions	Commenced June 2004; ongoing	ACT Government agencies	Mandates ACT Government agencies to consider environmental sustainability, including energy efficiency, in the procurement of goods, services and works.	• Add value to procurement outcomes through a number of requirements, including energy efficiency.	Government procurement policy

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Table C.9 (Continued)

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Home Energy Advice Team	Office of Sustainability	Commenced 1998; ongoing	Households and consumers	Provides free advice on home energy efficiency, energy appliances, service providers and products. Provides the services of technical advisers for new home buyers and renovators.	• Increase the energy efficiency of existing homes in the ACT and reduce their greenhouse gas emissions. • Encourage the development of a local energy efficiency services sector. • Raise awareness among home owners of the greenhouse issue and the potential to increase their home's energy efficiency.	Information provision, technical assistance
Sustainable Infrastructure	ACT Treasury, ACT Procurement Solutions Branch	Commenced 2004-05; ongoing	ACT Government agencies	Allocates $4 million to supplement the ACT Government capital works program to enhance environmental performance (including energy efficiency).	• Provide supplementary funding to projects that have value as demonstrations of energy efficiency, but may not have been undertaken in the absence of the additional funding.	Government procurement policy
Water and Energy Savings in the Territory	Office of Sustainability, Essential Services Consumer Council, YWCA of Canberra	Commenced 2003; ongoing	Low income households	Trial program to provide energy audits, information, advice, refit work and access to no-interest loans for low income households having difficulty paying their utility bills.	• Raise household awareness of the key contributors to high energy and water use. • Assist low income households to address key issues around energy and water consumption. • Reduce energy and water consumption of low income households. • Reduce the potential for at-risk households to accumulate large utility debts. • Assist households to move out of utility debt.	Information provision, financial incentives

Source: Adapted from ACT Government response to Commission request for information (unpublished)

Table C.10 **Northern Territory Government energy efficiency programs**

Program name	*Agency*	*Start date and status*	*Target audience*	*Description*	*Objectives*	*Policy instrument*
Energy Management Services	DIPE	Commenced 1985; ongoing	Northern Territory Government agencies	Provides energy audits, energy awareness materials, building design advice, technical investigations, project brief and tariff analyses, energy efficiency and energy management advice and some implementation funding to NT Government agencies. Encourages reductions in government energy consumption, energy expenditure and associated environmental impact.	• Reduce NT Government energy expenditure and environmental impact. • Develop and implement whole-of-government energy management policies. • Provide professional energy management services and tools to NT Government agencies. • Promote energy-efficient and ecologically sustainable building infrastructure developments.	Information provision, audits

Source: Adapted from Northern Territory Government response to Commission request for information (unpublished).

D Australian energy efficiency standards for buildings

D.1 The Building Code of Australia

In Australia, the building industry has traditionally been regulated by State and Territory Governments, with some responsibility delegated to local governments. Since at least the 1960s, there have been moves toward cooperation and consistency of building regulation across jurisdictions. The main instrument used to encourage consistency is the Building Code of Australia (the Building Code) (PC 2004a).

The first edition of the Building Code was released in 1990. Since then, it has been progressively refined and amended. The Building Code covers technical aspects of building design and construction, including building structure, fire safety and certain aspects of building amenity. The provisions in the Building Code have recently been extended to include energy efficiency standards for some classes of buildings.

Administrative arrangements

In 1994, the Australian, State and Territory Governments signed the Inter-Government Agreement to establish the Australian Building Codes Board (ABCB). This made the ABCB the peak body responsible for the development of nationally consistent building regulation through the Building Code. The ABCB seeks to maintain and upgrade the Building Code to ensure that its provisions are cost effective, easily understood and do not impose standards that go beyond the public interest.

The ABCB is made up of the chief executives responsible for building matters in the Australian, State and Territory Governments, one local government representative and four representatives of the building industry. A chair is appointed by the Australian Government.

A number of project committees and working groups also exist to inform and assist the ABCB in its administration of the Building Code. Among them is an Energy

Efficiency Steering Committee. The stated objectives of the Energy Efficiency Steering Committee are:

> … to assist the Australian Building Codes Board (ABCB) to develop cost-effective energy efficiency measures suitable for introducing under building law and in so doing, assist the Australian Governments to reduce greenhouse gas emissions. (ABCB 2004c, p. 1)

The roles of the Energy Efficiency Steering Committee include:

- providing policy advice on cost-effective building energy efficiency standards to the ABCB, Australian Greenhouse Office (AGO) and Department of Industry, Tourism and Resources (DITR);
- coordinating and expediting the development of energy efficiency standards for inclusion in the Building Code;
- facilitating the communication, understanding, acceptance and adoption of proposed changes to the Building Code; and
- assisting the ABCB to facilitate the training of builders and energy rating practitioners (ABCB 2004c).

The Energy Efficiency Steering Committee consists of:

- a Chair nominated by the ABCB;
- the Executive Director of the ABCB;
- three representatives of State and Territory statutory bodies responsible for building regulation;
- a representative from the AGO;
- an ‘eminent person’ as a community advocate;
- a representative from the DITR;
- a representative from the Australian Local Government Association; and
- three industry representatives (ABCB 2004c).

Implementation of the Building Code

The Building Code is given legal effect only when it is adopted by the individual State and Territory Governments. It has been adopted by each State and Territory as a technical standard for the design and construction of buildings. For example, in Victoria, all building work must comply with the *Building Act 1993* (Vic.) and the *Building Regulations 1994* (Vic.). The *Building Regulations 1994* (Vic.) ‘call up the

BCA [the Building Code] as a technical reference … thereby giving it legal status' (Victorian Building Commission 2003, p. 2).

There is no compulsion for any State or Territory to adopt the Building Code in full, or as the exclusive instrument of building policy. In practice, State and Territory Governments adopt additional or alternative legislation and regulations relating to building matters.

The Building Code includes appendices for each State and Territory. The appendices detail any provisions that apply in individual jurisdictions. These may be in addition to the standards in the main text of the Building Code, or may override them. Energy efficiency is one policy area in which State and Territory Governments have made policies in addition, or as an alternative to, the main text of the Building Code. For example, the Victorian appendix to volume two of the Building Code contains the energy efficiency requirements for new houses in Victoria, which are more stringent than the requirements in the main text.

Enforcement of building regulations is primarily the responsibility of State and Territory Governments, but they have delegated some of the regulatory tasks to local councils. The relevant administrative and compliance issues have tended to be a lower priority for the ABCB than the technical aspects of the Building Code, although the early 1990s saw the introduction of model building legislation that included reforms to administration and certification (PC 2004a). States and Territories have adopted the model legislation to varying degrees, leading to jurisdictional inconsistencies in the administration of the Building Code. In its review of building regulation, the Productivity Commission noted that:

> There are concerns that the current compliance and enforcement systems for building regulation may be deficient, to varying degrees across jurisdictions. (PC 2004a, p. 191)

Overview of the Building Code

The Building Code comprises two volumes, with each volume covering particular classes of buildings. In essence, volume one covers commercial and multiple-occupancy buildings while volume two deals with single dwellings (detached or attached). The contents of the Building Code specify minimum standards for both building practices and for building performance.

The Building Code is amended annually. Proposed amendments are subject to an extensive consultative process including regulatory impact assessments and public comment. Amendments are formally adopted on 1 May each year (ABCB, sub. 7, p. 4).

Following an extensive review of building regulations in 1991, the Australian, State and Territory Governments agreed that the ABCB should specify performance-based building codes (PC 2004a). Performance-based codes specify a desired outcome, rather than prescribing the means by which that outcome is to be achieved.

D.2 The Building Code and energy efficiency of housing

On 1 January 2003, the ABCB introduced energy efficiency standards into volume two of the Building Code. The standards cover new houses and additions to existing houses. The ABCB chose to incorporate energy efficiency standards for houses before commercial buildings because:

> … industry had expressed concern at the proliferation of residential 'energy codes' being implemented at a regional level and called for the expedient development of mandatory measures in the BCA [Building Code]. (ABCB 2004b, p. C2)

The introduction of energy efficiency provisions into the Building Code followed an announcement in July 2000 that the Australian Government had reached an agreement with State and Territory Governments to 'develop suitable national energy efficiency provisions for domestic and commercial buildings, through the introduction of minimum mandatory requirements in the BCA [Building Code].' (ABCB 2004d, p. 4).

To progress the development of energy efficiency standards in the Building Code, the AGO provided $2.3 million to the ABCB from 2001 to 2005. The ABCB also financed the project from its own budget. Total funding amounts to $4.75 million to 30 June 2005 (PC 2004a).

The stated objective of the energy efficiency standards for houses is 'to reduce greenhouse gas emissions by efficiently using energy' (Building Code of Australia 2004 (volume 2), s.O2.6, p. 87). The standards cover the building fabric and domestic services. Domestic services are defined as the basic engineering systems of a house that use energy or control the use of energy. The standards apply to central heating water piping, and heating and cooling duct work. They do not include water heaters, space heaters, air conditioners and cooking appliances. These are subject to mandatory appliance energy performance labelling schemes and minimum energy performance standards (MEPS) (appendix E).

Compliance with the energy efficiency standards

Buildings must meet performance requirements to satisfy the technical standards in the Building Code. The performance requirements relating to energy efficiency state that:

- a building must meet a level of thermal performance to 'facilitate the efficient use of energy for artificial heating and cooling' (Building Code of Australia 2004 (volume 2), s. P2.6.1, p. 87); and
- domestic services must have features that 'facilitate the efficient use of energy' (Building Code of Australia 2004 (volume 2), s. P2.6.2, p. 88).

Builders have a number of options available to meet the performance requirements:

1. use the 'deemed-to-satisfy' construction methods and materials prescribed in detail in the Building Code (box D.1); or
2. formulate an 'alternative solution' that:
   (a) complies with the performance requirements; or
   (b) is shown to be at least equivalent to the deemed-to-satisfy provisions; or
3. apply a combination of options 1 and 2 (Building Code of Australia 2004 (volume 2), s. 1.0.5, p. 25).

Box D.1 **Deemed-to-satisfy provisions**

Although the Building Code is performance-based, it includes extensive 'deemed-to-satisfy' provisions. These provisions detail building techniques that are considered to be acceptable forms of construction that meet the legislative requirements for complying with the performance requirements. Builders who use these forms of construction are deemed to have met the requirements of the Building Code.

There is no obligation to adhere to these forms of construction. Other construction practices may be used if they are preferred by the builder, provided they satisfy the performance requirements.

Proof that an alternative solution complies with the performance requirements can be demonstrated by:

- providing documentary evidence (for example, from an accredited testing authority or an appropriately qualified person) that the solution meets the performance requirement or a deemed-to-satisfy provision; or

- using a verification method such as:
  - the verification methods in the Building Code; or
  - some other verification method that is accepted by the appropriate State or Territory authority; or
- comparison with the deemed-to-satisfy provisions; or
- the judgement of a qualified expert that the solution satisfies the performance requirement (Building Code of Australia 2004 (volume 2), s. 1.2.2, p. 41).

Deemed-to-satisfy provisions in the Building Code for house energy efficiency

Builders can satisfy the energy efficiency standards for houses if they adhere to the forms of construction prescribed in s. 3.12 of the Building Code, which includes a range of 'acceptable construction practices' relating to the:

- building fabric (including insulation, roofs, walls and floors);
- external glazing (including shading);
- building sealing (including construction of roofs, walls, floors, windows, doors and chimneys);
- air movement; and
- services.

Builders who do not follow the deemed-to-satisfy provisions must use an alternative solution to demonstrate that their building complies with the energy efficiency standards. The Building Code allows two verification methods for builders to prove that their buildings meet the energy efficiency standards:

- use a software package to model the energy consumption of the building, which is compared to a regulated maximum energy consumption or star rating; or
- model a 'reference building' to which their proposed design is compared.

In practice, 'most building designers choose to develop a solution following the Deemed-to-Satisfy Provisions' (ABCB, sub. 7, p. 3).

Verification using calculated building energy load

The two approved verification methods in the Building Code require that builders calculate the 'energy load' of the building. The energy load is the amount of energy that will be added to the building (by artificial heating) and removed from the building (by artificial cooling) in order to maintain the desired temperature.

The ABCB (2005d) has published a Protocol for House Energy Rating Software that details the method for calculating the house energy load. Software packages that are considered to comply with the Protocol are NatHERS (Nationwide House Energy Rating Scheme) (and its successor AccuRate), BERS (Building Energy Rating Scheme) and FirstRate (box D.2). These packages calculate the annual energy load of the house. The energy load can be used to assign a star rating. The higher the star rating, the more energy efficient the building.

While the Building Code recognises NatHERS, BERS and FirstRate as complying with the Protocol:

> … the individual State and Territory jurisdictions take responsibility for the identification of suitable software and operator accreditation. While the BCA [Building Code] provides information about software options, it neither makes recommendations nor imposes requirements in that regard. (ABCB 2002, p. 7)

In Victoria, for example, two packages are in use (NatHERS and FirstRate) (box D.2). The Victorian Government imposes restrictions on the use of the two packages. For example, FirstRate may not be used if:

- the total area of glazing is greater than 60 per cent of the net conditioned floor area; and
- the glazing of any one orientation is greater than 35 per cent of the net conditioned floor area.

Verification using a star rating or stated value

The energy efficiency standards introduced into the Building Code in January 2003 divided Australia into eight climate zones. One verification method requires that houses built in the northern zones (climate zones 1–3) achieve a 3.5 star rating, and houses built in the southern zones (climate zones 4–8) achieve a 4 star rating.

The Building Code allows builders of houses in the northern climate zones to use an alternative approach when using energy modelling software. Instead of being required to achieve a certain star rating, they may refer to a table of allowable house energy load. The table prescribes the allowable energy load (in megajoules per square metre of floor area per year). Energy load predicted by the energy modelling software must not exceed this value. The maximum allowable energy load is set at a level that is equivalent to the required star rating in each climate zone.

The allowable energy load depends on the location of the proposed house. Houses that install either solar or heat pump hot water systems are permitted to consume an additional 20 megajoules per square metre per year.

Box D.2 Energy rating software

NatHERS

The Nationwide House Energy Rating Scheme (NatHERS) is an Australian Government program administered by the Department of the Environment and Heritage. As part of the scheme, a NatHERS software package has been developed to rate the energy efficiency of residential buildings.

Assessors must input data relating to the building fabric, including building dimensions; insulation levels; roof and wall colour; window sizes; and overshading by buildings or trees. Building characteristics, hourly local climate data and user occupancy patterns are analysed to simulate the operational energy use in the home. From this information, the software generates energy ratings which range from 0 to 5 stars. The higher the star rating, the more energy efficient the building.

BERS

The Building Energy Rating Scheme (BERS) software package was developed by the Australian renewable energy consultancy firm Solar Logic. BERS is based on the same software engine as NatHERS, and like NatHERS, it uses hourly local climate data to simulate household energy use. The simulation data is used to calculate star ratings.

In addition, BERS allows the assessor to select whether mechanical cooling is to be used in the house, and can assess the performance of natural ventilation. These options are not available in NatHERS. BERS also uses a different method of data entry to NatHERS, which its designers claim is easier to use.

While BERS is designed for use in areas ranging from alpine to tropical, it is currently used mainly in Queensland.

Star ratings calculated by BERS are the same as those calculated by NatHERS, except when the house is located in Queensland. Ratings within Queensland are similar to NatHERS ratings, but not identical.

FirstRate

The FirstRate package was developed by the Sustainable Energy Authority of Victoria. FirstRate does not simulate household energy use. Instead it takes the energy load predictions in NatHERS and combines them with building element properties entered by the assessor. The software then assigns points for individual building elements. A star rating is calculated from the total points scored. FirstRate has been designed so its ratings are consistent with the ratings produced by NatHERS.

FirstRate is considered particularly useful at the sketch design stage because of its simplicity.

Sources: Reardon (2001); SEAV (2004a); Solar Logic (nd); WA Department of Housing and Works (nd).

The different requirements adopted in the 2003 edition of the Building Code for different climate zones reflected the inability of the then available energy rating software to adequately account for the benefits of natural ventilation in hot climates. NatHERS has been revised (and relabelled as AccuRate) to overcome this problem.

Verification using a reference building

The second verification method set out in the Building Code requires builders to use energy modelling software to model the proposed building and a 'reference building'. The reference building is a hypothetical building that is similar to the proposed building, but is modelled with building features that may be different to the proposed design.

The building features that must be included in the modelled reference building do not necessarily represent the most energy-efficient building features. Some features are based on the deemed-to-satisfy provisions. For example, roof insulation must be modelled to adhere to the deemed-to-satisfy provisions in table 3.12.1.1 of the Building Code. Other features are mandated in table V2.6.2 of the Building Code. For example, reference buildings must be modelled with a 2.4 metre high horizontal ceiling, regardless of the type of ceiling in the proposed design.

The builder must model the energy load of both buildings for heating and cooling. The proposed design will only be verified as compliant with the performance requirements if the predicted energy load of the proposed building does not exceed the predicted energy load of the reference building.

When calculating the energy loads of reference buildings, the requirements regarding energy modelling software are less restrictive. As stated previously, only three packages are currently approved for calculating a star rating or comparison with a stated value (NatHERs, BERS and FirstRate). When modelling a reference building, builders are not restricted to these three packages. Instead, the Building Code permits builders to use 'a broad range of Australian and international energy analysis software' (Building Code of Australia 2004 (volume 2), s.V.2.6.2, p. 89). The same calculation method must be used to model the proposed and reference buildings.

It is anticipated that the reference building method would be applied mainly to more complex designs.

Stringency of the energy efficiency standards for houses

When the ABCB first began considering including energy efficiency standards in the Building Code, Victoria, South Australia and the ACT already had energy efficiency provisions in their State and Territory building regulations. At that time, there were no explicit measures in the Building Code that dealt with energy efficiency.

The decision to adopt 3.5 stars as the minimum rating was based on the fact that the Energy Smart Homes policy adopted by some local councils in New South Wales set a minimum 3.5 star standard for energy efficiency (ABCB 2002).

By September 2003, Victoria had imposed a five star energy efficiency rating requirement on all new homes and apartments, exceeding the stringency of the Building Code energy efficiency standards. The New South Wales Government had announced requirements that new residential buildings meet certain sustainability criteria that included energy efficiency standards. In light of this and 'to facilitate a nationally consistent approach …' (ABCB 2004d, p. 1), the ABCB agreed that the energy efficiency provisions in the Building Code should be reviewed and tightened where appropriate.

In November 2004, the ABCB released a regulatory proposal to raise the energy efficiency standards in the Building Code for houses. This did not constitute a change in the technical aspects of the energy efficiency standards, merely a proposal to increase their stringency to 5 stars on the NatHERS scale, and to provide greater consistency between the star rating approach and the deemed-to-satisfy provisions (ABCB 2004d). This would involve strengthening the deemed-to-satisfy provisions to meet the new, more stringent standards. The intention is to incorporate the changes into the 2006 version of the Building Code.

D.3 The Building Code and energy efficiency of other buildings

Energy efficiency standards for buildings other than houses are being incorporated into the Building Code in two phases. Standards for multiple-occupancy buildings (class 2–4 buildings) such as apartment buildings, hotels and motels were introduced into the main text of the Building Code on 1 May 2005. Regulations for non-residential buildings (class 5–9 buildings) will be finalised during 2005 for inclusion in the 2006 version of the Building Code. In addition, some jurisdictions (New South Wales, Victoria and the ACT) have energy efficiency standards for class 2–4 buildings in their appendices to volume one of the Building Code.

Compliance with the energy efficiency standards

The standards for class 2–4 buildings cover building fabric and building services. Building services are engineering systems that use energy for heating, cooling, water heating, lighting and vertical transport. Lighting and vertical transport are not included in the definition of domestic services that applies to the existing energy efficiency standards for houses.

Energy efficiency standards for building services

Provisions for building services apply only to class 3 buildings and the communal areas of class 2 buildings. The section sets the performance requirement that:

> A building's services must continue to perform to a standard of energy efficiency no less than that which they were originally required to achieve. (ABCB 2004b, p. A8)

The deemed-to-satisfy provisions in the Building Code state that to satisfy this provision, services must be maintained in accordance with Australian and New Zealand Standard 3666.2 (Building Code of Australia 2004 (volume 1), s. I1.2, p. 428).

Energy efficiency standards for building fabric

The performance requirement for building fabric is that:

> A building, including its services, must have, to the degree necessary, features that facilitate the efficient use of energy appropriate to:
>
> (a) the function and use of the building and service;
>
> (b) the internal environment;
>
> (c) the geographic location of the building;
>
> (d) the effects of nearby permanent features such as topography, structures and buildings;
>
> (e) solar radiation being:
>
> (i) utilised for heating; and
>
> (ii) controlled to minimise energy for cooling; and
>
> (f) the sealing of the building envelope against air leakage;
>
> (g) the utilisation of air movement to assist heating and cooling; and
>
> (h) the energy source of the service. (ABCB 2004b, p. A10)

The text includes extensive deemed-to-satisfy provisions that builders may follow to meet the performance requirement. For builders proposing an alternative solution, three verification methods are available to demonstrate compliance with the performance requirement:

- a star rating scheme

- comparison to a maximum allowable energy consumption
- comparison to a reference building.

Verification using a star rating scheme

For class 2 buildings (buildings containing two or more separate dwellings) and class 4 parts of buildings (dwellings in commercial buildings, provided it is the only dwelling in the building), the star rating scheme will apply. For these buildings or parts of buildings, each unit must achieve a minimum 3 star rating and the average star rating for the building must be 3.5 stars in tropical areas and 4 stars in temperate zones (ABCB 2004b).

Verification using a stated value

Buildings in class 3 (a residential building that is a common place of long term or transient living for a number of unrelated persons, for example, boarding houses, hotels, motels, residential sections of schools or hospitals) must not exceed a maximum allowable annual energy consumption. The value is taken from a table that sets out the allowable energy consumption in megajoules per square metre of floor area. The allowable energy use depends on the:

- type of building
- location of the building
- energy source used for heating (gas or electricity).

The builder must prove that the energy use of the building under their proposed design will not exceed this target (ABCB 2004b).

Verification using a reference building

The reference building verification method that is available to builders of houses is also available to builders of class 3 buildings who choose not to use the stated value method. Builders must model the energy load of the proposed building and the hypothetical reference building. The reference building must be modelled according to a set of criteria set out in table JV3 of the proposed text of the Building Code.

If the predicted energy load of the proposed building does not exceed the predicted energy load of the reference building, the proposed design will be verified as compliant with the performance requirements.

It is anticipated that the reference building method will be of particular use for more complex designs.

Energy efficiency standards for class 5–9 buildings

Energy efficiency standards for class 5–9 buildings are currently under development. These building classes include buildings such as offices, retail outlets, industrial buildings and buildings of a public nature (such as health and aged care buildings). It is proposed that two verification methods will be approved to demonstrate compliance with the energy efficiency standards for class 5–9 buildings:

- the maximum allowable annual energy consumption method
- the ‘reference building’ method (ABCB 2004b).

The text of the proposed changes applies the same technical standards as are applied to class 2–4 buildings, but extends their coverage to class 5–9 buildings.

D.4 State-based energy efficiency building schemes

In New South Wales, Victoria, Queensland and the ACT, additional or alternative requirements are placed on builders of new homes, and in some cases, on those planning to sell or renovate existing homes.

New South Wales

The NSW Building Sustainability Index (BASIX) scheme provides the sole set of guidelines relating to sustainability for residential development in New South Wales. The BASIX scheme is designed so that new dwellings meet the NSW Government’s targets of up to a 40 per cent reduction in mains potable water consumption and a 25 per cent reduction in greenhouse gas emissions, compared with the average home. The greenhouse gas emission target will increase to 40 per cent from July 2006.

BASIX covers a range of ‘sustainability indices’ for:

- energy use
- water use
- thermal comfort.

From 1 July 2004, all new homes in Sydney have been required to have a BASIX certificate. On 1 July 2005, the scheme was extended to include new single and dual occupancy dwellings built anywhere in New South Wales. It will apply to multi-unit dwellings from 1 October 2005 and residential alterations and additions from 1 July 2006.

Under the BASIX certificate application process, a proposed building is compared with statewide per person benchmarks for water and energy use:

- 90 337 litres per person per annum of water
- 3292 kilograms of carbon dioxide emissions per person per annum.

Occupants of all dwelling types in all regions are assessed against these benchmarks. Prior to July 2005, buildings were benchmarked against a dwelling of the same type in the same area. For example, for a proposed three bedroom detached house in Sydney to receive a BASIX certificate, the water consumption and greenhouse gas emissions of the proposed house were compared to the average water consumption and greenhouse gas emissions for all existing three bedroom detached houses in Sydney.

To get a BASIX certificate, data about a building's design must be entered into an internet-based software package available at http://www.basix.nsw.gov.au. The software then calculates whether the design meets the reduction targets. Once the design complies, a BASIX certificate can be printed.

The energy-related information required for a BASIX certificate includes information used to assess thermal comfort. This can be provided using either a 'simulation method' or 'deemed-to-comply method'. The simulation method involves providing predictions of the building's heating and cooling loads from the NatHERS simulation software (NatHERS is described in box D.2). The deemed-to-comply method involves compliance with a prescriptive list of building materials and methods that are considered to be energy efficient. At the time of writing this report, the deemed-to-comply method was only available for basic single storey dwellings. The NSW Government intends to eventually make the deemed-to-comply approach available to a wider range of building types.

If the internet-based BASIX software cannot calculate the water and energy indices required for a BASIX assessment, then an 'alternative assessment' option is available. This enables qualitative as well as quantitative assessment of development proposals by the NSW Department of Infrastructure, Planning and Natural Resources. Similarly, if a building's heating and cooling loads cannot be simulated (for a thermal comfort index) by the NatHERS software (and the deemed-to-comply option is not used), then designers have access to an 'expert opinion' compliance option.

Proposed buildings are assessed against a list of criteria relating to the household fixtures, fittings and appliances. Points are awarded for the use of:

- energy-efficient fittings, technologies and appliances;
- technologies that use renewable energy (for example, solar hot water systems); and
- energy sources that produce lower greenhouse gas emissions (for example, natural gas).

BASIX is enacted through the *Environmental Planning and Assessment Amendment (Building Sustainability Index: BASIX) Regulation 2004* (NSW) and the *State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004* (NSW). The Policy includes the condition that it 'prevails over any other environmental planning instrument, whenever made, to the extent of any inconsistency' (p. 4).

A BASIX certificate may include obligations to:

- plant a certain area of indigenous vegetation;
- install a rainwater tank of a prescribed minimum size, and to configure the house's plumbing system to use the rainwater for prescribed tasks;
- use roofing materials of a prescribed colour;
- install certain types of fittings (for example, shower heads, taps, toilets);
- install prescribed areas of glazing and shading (for example, eaves);
- install prescribed types of insulation;
- install ceiling fans, and *not* install ducting that could be used to accommodate any other cooling system;
- install gas heating, and *not* install ducting that could be used to accommodate any other heating system;
- install fluorescent lighting; and
- install clothes drying lines (inside and outside) or drying cupboards (inside) (NSW DIPNR 2004c).

The BASIX program was justified by the New South Wales Government on the grounds that it would lead to significant reductions in water consumption and greenhouse gas emissions, and that this would reduce the demand on existing infrastructure and increase affordability of energy and water to consumers.

A benefit–cost study prepared by the Allen Consulting Group for the NSW Government concluded that implementing the BASIX scheme for houses with targets of a 25 per cent reduction in energy use and a 40 per cent reduction in water use would lead to:

- a reduction in water consumption of 287 gigalitres over 10 years (value estimated at $287 million);
- a saving of 9.5 million tonnes of greenhouse gases over 10 years (value estimated at $47.5 million);
- combined energy and water savings of $300–$600 per annum for an 'average family in an electric household'; and
- compliance costs of $3878 for the energy and thermal comfort target and $5110 for the water target for a 3 bedroom, 2 bathroom detached house with a gross floor area of 250 square metres on a 550 square metre site (NSW DIPNR 2004a).

In a separate study, the NSW Department of Infrastructure, Planning and Natural Resources advised that:

> In general, estimates for BASIX compliance range from $3000 to $9000 depending on size, location and available options … (NSW DIPNR nd2, p. 2)

The Allen Consulting Group concluded that implementation of the BASIX scheme for houses would lead to benefits to the community in net present value terms of between $193 million and $339 million over the first ten years of the program (NSW DIPNR 2004a). The size of the benefits would depend on the stringency of the program. The more stringent target was found to lead to higher benefits.

A more recent study undertaken for the NSW Department of Infrastructure, Planning and Natural Resources estimated that imposing BASIX requirements on multi-unit residential buildings would raise the cost per dwelling (excluding GST) by:

- $7571 for a 5 unit townhouse development
- $9078 for a 190 unit high-rise building
- $6773 for a 49 unit medium-rise development (BMT and Associates 2005).

However, the sample of buildings examined were not intended to be representative of all multi-unit buildings in New South Wales.

Victoria

Since 1 July 2005, most new houses in Victoria have been required to both:

- achieve a 5 star rating for building fabric; and
- have either a solar hot water heater system or a rain water tank connected to all sanitary flushing systems (Victorian Building Commission 2005).

The exceptions are houses of timber floor or earthwall construction, which until 30 April 2006 can be constructed to achieve either:

- a 5 star rating for building fabric; or
- a 4 star rating and have either a solar water heater system or a rain water tank connected to all sanitary flushing systems (Victorian Building Commission 2005).

From 1 May 2006, houses with timber floor or earthwall construction will have to satisfy the more stringent requirements mentioned above for other houses.

For class 2 buildings (those containing two or more separate dwellings), an average 5 star rating is required for the whole building, and each sole occupancy dwelling within the building must not achieve a rating of less than 3 stars.

In most cases, a software package is used to demonstrate whether a building achieves the required star rating. The exception is the interim 4 star option for houses of timber floor or earthwall construction, which can be satisfied by following the deemed-to-satisfy provisions of the Building Code.

Two software packages have been approved for use in Victoria (FirstRate and NatHERS). The rating scores generated by FirstRate are based on the energy loads predicted by NatHERS, and so the two packages are closely related. The relevant regulations allow software other than FirstRate or NatHERS to be used to demonstrate compliance. The Victorian Building Commission (2005) recommends that if other software is used, it should meet the ABCB (2005d) Protocol for House Energy Rating Software and Sustainable Energy Authority of Victoria (SEAV) accreditation requirements for software training.

The Allen Consulting Group (2002) conducted a benefit–cost analysis of the building energy efficiency standards for the SEAV and the Victorian Building Commission. The MMRF-Green economic model was used to model the impact of the proposed measures on the Victorian economy. The analysis relied on a number of assumptions about consumer behaviour. Two possible scenarios were modelled:

- a 'forward-looking' scenario that assumed that consumers are rational and that once they are aware of the net financial benefits of higher cost but more energy-efficient housing they will not reduce their level of consumption of housing; and
- a 'myopic' scenario under which buyers of houses react to the higher prices of more energy-efficient houses by consuming less. Such buyers would not take into account the potential benefits of more energy-efficient housing (Allen Consulting Group 2002).

The authors of the study asserted that their 'forward-looking' scenario was more realistic.

The study found that the introduction of 4 or 5 star energy efficiency standards would lead to gains in Victoria's Gross State Product (GSP), and that these gains would be higher under the more stringent 5 star standard.

The size of the gains differed depending on how consumers were assumed to behave. Under the 'forward-looking' scenario, GSP increased by between $233 million and $566 million. Under the 'myopic' scenario, GSP increased by between $30 million to $67 million. These gains represent between 0.001 per cent and 0.016 per cent of Victoria's GSP over the 15 year period 2002–2017. The gains were estimated by comparison with a base case under which the energy efficiency standards were not imposed (Allen Consulting Group 2002).

The study also concluded that the standards would lead to significant abatement of greenhouse gas emissions. Under the 4 star scenario, the reduction would amount to 500 kilotonnes of carbon dioxide equivalent by 2021. The imposition of a 5 star standard would lead to a reduction of 700 kilotonnes over the same period (Allen Consulting Group 2002).

The study recommended the adoption of a 5 star standard for new housing in Victoria, which it described as:

> … one of very few regulations designed to increase an individual's consumption of a product in their own best interests. (Allen Consulting Group 2002, p. 21)

As well as welcoming the economic and greenhouse gas benefits identified in the Allen Consulting Group study, the Victorian Government justified the more stringent energy efficiency compliance program by claiming that houses that meet the new standard will be better quality, more comfortable and consume less energy, resulting in lower energy bills for households (SEAV 2004b).

Queensland

In December 2004, the Queensland Government released a discussion paper and a regulatory impact statement dealing with proposed changes to building regulations in Queensland. The changes were designed to encourage sustainable housing development. The discussion paper defined sustainable housing as 'planning, designing and building dwellings that are more socially, environmentally and economically sustainable' (Queensland Government 2004b, p. 3).

The aims of the proposed policy changes are to increase water and energy efficiency and to reduce greenhouse gas emissions. These aims come in the context of concerns about potential water shortages (particularly in the rapidly growing south east of Queensland), the impact on peak electricity demand of air conditioning, and the desire to reduce greenhouse gas emissions. Intervention was justified by the Queensland Government on the grounds that the issue is 'too important to leave solely to market forces'(Queensland Government 2004a, p. 5).

In the regulation impact statement, the Queensland Government confirmed that in September 2003 it had adopted the energy efficiency provisions in the Building Code, but noted that 'there is no nationally consistent approach to [the broader issue of] sustainable housing' (Queensland Government 2004a, p. 9). It then indicated its intention to go beyond the provisions of the Building Code (which deals only with the fabric of the building and indirectly with heating and cooling), and to introduce measures dealing with household fixtures and appliances.

This would be achieved by amending the *Standard Plumbing and Drainage Regulation 1993* (Qld) and the *Standard Building Regulation 1993* (Qld) to incorporate mandatory energy and water efficiency measures. The proposed regulations would apply only to new residential buildings.

The regulation impact statement included calculations of the net present value of the total costs and benefits of the various measures over a 15–20 year period. Below is a list of the proposed Queensland Government regulations and the net benefit of each measure as calculated in the regulation impact statement (Queensland Government 2004a). The net benefits were estimated as changes from a base case of no change. They are expressed in net present value terms and benefits are assumed to accrue over 15 or 20 years. The value of the reduction in greenhouse gas emissions is included as a benefit. Proposals under consideration include requirements for the installation of:

- solar electric hot water heaters in all new homes (net benefit of $184 million);
- solar gas hot water heaters in all new homes (net cost of $375 million);
- energy-efficient lighting in all new homes (net benefit of $18 million);

- AAA-rated shower roses in all new homes (net benefit of $92 million);
- dual-flush toilets in all new homes (net benefit of $2 million);
- require the installation of water pressure limiting devices in all new homes (net benefit of $52 million); and
- (under local council regulations) rain water tanks in all new homes (net cost of $28 million).

The regulation impact statement also estimated that local councils would face recurrent annual costs of between $1 million and $3 million for administration of the scheme. The impact on Queensland industry was predicted to be neutral.

The ACT

The ACT House Energy Rating Scheme (ACTHERS) has been operational since 1 July 1995. Under ACTHERS, anyone intending to build a new residential property in the ACT must obtain an energy efficiency rating assessment. All new residences must meet a minimum 4 star standard. The star rating is calculated using the FirstRate software model. This part of the scheme is consistent with the energy efficiency standards for new houses in the Building Code.

In addition to the requirements for new homes, ACTHERS places conditions on the sale of existing homes. From 31 March 1999, anyone wishing to sell an existing property has had to obtain an energy efficiency rating assessment. There is no minimum energy efficiency standard for existing dwellings, but sellers must disclose the energy rating of the home in all advertisements and the contract for sale. This element of the program was implemented by the *Energy Efficiency Ratings (Sale of Premises) Act 1997* (ACT).

The aim of the ACT Government in implementing ACTHERS was to adopt a scheme that would:

- encourage awareness in the community and building industry of the benefits of energy efficiency;
- demonstrate the Government's commitment to the National Ecologically Sustainable Development and Greenhouse Strategies, the COAG’s agreement on residential energy efficiency of 1993 and the ACT Greenhouse Strategy; and
- conform to the national benchmark program NatHERS.

D.5 Self-regulatory building energy efficiency schemes

In addition to the mandatory building energy efficiency standards, there are several energy efficiency programs currently operating that are based on self regulation. These programs include:

- voluntary building practice programs
- voluntary energy ratings for residential and commercial buildings
- policies to reduce energy use in government buildings.

Voluntary building industry initiatives (Australian Government)

The AGO sponsors a range of initiatives to encourage building and construction practitioners to adopt practices that will reduce building-related greenhouse gas emissions. Programs funded under this initiative include:

- Window Energy Rating Scheme — windows are rated on a 5 star scale. Windows that minimise unwanted heat gain or loss are awarded higher star ratings.
- Environmental Design Guides — the Australian Council of Building Design Professions Ltd (BDP), the peak body for architects, engineers, quantity surveyors, landscape architects and planners, produces a series called the BDP Environmental Design Guide. The AGO has assisted the BDP to produce a series dealing with greenhouse gas emission minimisation.
- BDP Making Energy Pay — the AGO funded a series of seminars in which building design professionals were encouraged to reduce building energy use by applying new technologies and energy efficiency principles into building designs.
- Building Design Association of Australia (BDAA) Marketing Sustainable Design Workshops — the BDAA is the peak body for building designers. The AGO has funded a series of workshops to encourage over 700 building designers to incorporate good environmental design principles into their building designs.
- Housing Industry Association Limited (HIA) Greensmart Professional Accreditation Course — the HIA is Australia's peak building, renovating and development industry association. The AGO provided funding for the HIA’s GreenSmart Training and Accreditation program. The program trains builders in energy efficiency, waste minimisation and soil and sediment pollution reduction.
- Master Builders Australia (MBA) Energy Wise–Dollar Wise Training Course — the MBA is Australia’s peak body for commercial and industrial builders. The

AGO provides funding for a program to train commercial building contractors in energy efficiency practices.

- Lighting Best Practice Project — aims to reduce the amount of energy used for lighting by encouraging the use of natural light and energy-efficient lighting products. (AGO nd)

Voluntary building energy efficiency schemes

Owners and tenants of residential and office buildings are able to use the voluntary schemes outlined below to rate the energy performance of their buildings, and to identify opportunities for reducing building energy use, including by improving energy efficiency. Two of the schemes operate nationally, one operates only in New South Wales.

Australian Building Greenhouse Rating scheme

The Australian Building Greenhouse Rating (ABGR) scheme promotes voluntary audits of office buildings to determine the greenhouse gas emissions resulting from energy consumption. The program promotes energy efficiency as one strategy to reduce building greenhouse gas emissions. The ABGR scheme was developed and is administered nationally by the New South Wales Department of Energy, Utilities and Sustainability (DEUS). In Victoria, the scheme is administered by SEAV; in Western Australia by the Sustainable Energy Development Office; and in Queensland by the Environmental Protection Agency. In other jurisdictions the scheme is administered by DEUS.

The scheme consists of two elements:

- Internet-based tools for calculating energy use and identifying opportunities to reduce energy consumption; and
- star ratings calculated by ABGR accredited assessors.

Buildings that have undergone accredited assessments are eligible to use the ABGR logo and star rating to advertise their greenhouse performance. The scheme promotes the ABGR logo and ratings as tools for attracting tenants who are concerned about the greenhouse performance of the buildings they occupy.

National Australian Built Environment Rating System

The Australian Government Department of the Environment and Heritage has developed a voluntary building rating scheme called the National Australian Built

Environment Rating System (NABERS). NABERS can be used to rate the performance of existing commercial office buildings and residential buildings against a number of criteria. The system is based on self assessment using spreadsheets made available on a website by the Department of the Environment and Heritage. The spreadsheets use data on building usage to calculate performance in a number of areas and assign a rating out of five. Building characteristics assessed by NABERS are:

- energy use
- greenhouse gas emissions
- refrigerant use
- water use
- stormwater runoff
- stormwater pollution
- sewage outfall volume
- transport (including building location and modes of transport used)
- landscape diversity
- toxic materials
- waste
- indoor air quality
- occupant satisfaction.

It is possible to calculate building performance with respect to one or all of these characteristics.

Energy Smart Home Rating (New South Wales)

In New South Wales, DEUS runs the Energy Smart Home Rating website. Two tools are available on the program website — a star rating tool, and a virtual home audit. The star rating tool calculates a star rating (out of five) for existing houses, while the virtual audit compiles personalised 'energy action plans' which identify opportunities for reducing household energy use. Access to the tools is not restricted to New South Wales residents.

E Framework for appliance labels and standards

Domestic and commercial appliances are subject to a range of energy performance standards, both mandatory and voluntary. Many of the current requirements evolved from those originally established by State and Territory Governments, and have been expanded so that their coverage is now national. Other programs were developed overseas and have been adopted in Australia.

E.1 National Appliance and Equipment Energy Efficiency Program

The National Appliance and Equipment Energy Efficiency Program (NAEEEP) is an initiative of the Australian, State and Territory Governments. The aim of the program is to develop and oversee measures to improve the energy efficiency of appliances and equipment used by households and firms. The program is administered by the National Appliance and Equipment Energy Efficiency Committee (NAEEEC), which is ultimately directed by the Ministerial Council on Energy (MCE) (NAEEEC 2004a).

Currently, NAEEEP only covers electrical appliances. Gas appliances are managed by an industry body, the Australian Gas Association (AGA). However, the MCE has recently set up new arrangements for gas appliances (AGO 2005f). This change is in line with the National Framework for Energy Efficiency (NFEE) Stage One measures, which include a commitment to broaden the scope of NAEEEP to incorporate mandatory energy performance labelling and minimum energy performance standards (MEPS) for gas appliances (MCE 2004a).

Electrical appliances covered by NAEEEP are subject to mandatory labelling and/or MEPS.

Mandatory labelling schemes make it compulsory to affix energy performance rating labels to specific domestic appliances at the point of sale. The labels are designed to enable consumers to easily compare the energy performance of appliances. They include a star rating, which enables a comparative assessment of the model's energy efficiency and an estimated annual energy consumption of the appliance.

MEPS prescribe a minimum allowed energy performance for specific appliances. Appliances that are less efficient than the relevant standard are excluded from the market.

History

The origins of the NAEEEP labelling scheme can be traced to the late 1970s, when the New South Wales and Victorian Governments proposed energy labelling for appliances. The Australian Government first raised the issue in 1982, and it was met with considerable resistance from the appliance industry. Instead, the appliance industry favoured a voluntary program over mandatory labelling and wanted any program introduced to be nationally uniform (NAEEEC 2004a).

No such national program was established. In 1986, New South Wales and Victoria introduced their own labelling schemes. Initially, these schemes covered refrigerators and freezers. Room air conditioners were included in 1987 and dishwashers in 1988. Victoria introduced labelling requirements for clothes dryers in 1989 and clothes washing machines in 1990. In 1991, South Australia introduced labelling requirements for the five appliance types regulated in Victoria (NAEEEC 2004a).

Two documents released by the Australian Government during the 1990s — the *National Greenhouse Response Strategy* (1992) and the *National Greenhouse Strategy* (1998) — included proposals to extend and strengthen the existing energy labelling and MEPS schemes. NAEEEC was established under the auspices of the *National Greenhouse Strategy* (IEA 2000; NAEEEC 2004a).

In October 1999, nationally consistent MEPS and labelling schemes were adopted across Australia. Since then, mandatory labelling has been extended to include other classes of appliances (table E.1)

In 2000, rating scales for all electrical appliance labels were recalibrated, leading to most products receiving a lower star rating than they had previously. This was intended to provide an incentive for manufacturers to increase the efficiency of their appliances, and to avoid the problem of appliances clustering around the high end of the star ratings (thus making labels less useful for comparing appliances).

Table E.1 **Mandatory energy performance standards (MEPS) and labelling for electrical appliances**

	Introduction of current requirements	
Appliance/equipment type	*Labelling*	*MEPS*
Household		
Refrigerators	October 1999	January 2005
Freezers	October 1999	January 2005
Clothes washers	October 1999	na
Clothes dryers	October 1999	na
Dishwashers	October 1999	na
Electric water heaters	na	October 1999
Single phase air conditioners	October 2001	October 2004
Three phase air conditioners (up to 65 kilowatt cooling capacity)	na [a]	October 2001
Commercial and industrial		
Three phase electric motors	na	October 2001
Ballasts for linear fluorescent lamps	na [b]	March 2003
Linear fluorescent lamps	na	October 2004
Commercial refrigerators	na	October 2004
Distribution transformers	na	October 2004

na Not applicable. [a] Energy labelling is voluntary for three phase air conditioners. [b] Fluorescent lamp ballasts subject to MEPS must be marked with an energy efficiency index.

Sources: Harrington and Holt (2002); AGO (2004a); AGO (2005d).

Administrative arrangements

NAEEEC is responsible for the administration of the mandatory energy performance labelling and MEPS programs, and reports to the MCE. The MCE was established by the Council of Australian Governments in June 2001. It comprises all Australian, State and Territory Government energy ministers, and a New Zealand representative.

Role of State and Territory legislation and regulation

NAEEEC has no regulatory powers of its own. For the regulations developed by NAEEEC to become mandatory, they must be adopted by State and Territory Governments. The State and Territory legislation is based on ‘model regulation’. The relevant State and Territory legislation and regulations are detailed in table E.2.

Table E.2 **Legislation and subordinate regulations relating to appliance energy performance**

Jurisdiction	*Title of legislation and regulations*
New South Wales	*Electricity Safety Act 1945*
	Electricity Safety (Equipment Efficiency) Regulation 1999
Victoria	*Electricity Safety Act 1998*
	Electricity Safety (Equipment Efficiency) Regulations 1999
Queensland	*Electricity Act and Regulation 1994*
South Australia	*Electrical Products Act 2000*
	Regulations under the Electrical Products Act 2000 (No. 224 of 2001)
Western Australia	*Electricity Act 1945*
	Electricity Regulations 1947
Tasmania	*Electricity Industry Safety and Administration Act 1997*
	Electricity Industry Safety and Administration Regulations 1999
ACT	*Electricity Act 1971*
	Electricity Safety Regulations 1971
Northern Territory	*Consumer Affairs and Fair Trading Act 2004*
	Consumer Affairs (Product Information) Regulations 1993

Source: NAEEEC (2004a).

Testing arrangements

Appliances that are required to carry an energy performance label or to meet MEPS must be registered before they can be sold in Australia.

Manufacturers must apply to have their appliance (or family of similar models) registered in one of four jurisdictions:

1. New South Wales
2. Victoria
3. Queensland
4. South Australia.

A registration accepted in any of these jurisdictions is valid throughout Australia, and remains valid for up to five years, after which the product must be re-registered.

Applications for registration must include a test report or other data to demonstrate that the appliance meets the relevant Australian Standard. The Australian Standards for products that are required to carry energy-performance labels or meet MEPS generally consist of two parts:

- Part One relates to the testing procedure (including the test method, ambient conditions, performance measures and test materials).

- Part Two contains the detailed technical requirements for energy labelling and MEPS, including algorithms for the calculation of star ratings and comparative energy consumption that appears on the energy-performance label.

This approach to regulating the labelling and MEPS schemes has been operating since 1991 (NAEEEC 2004a). Because the testing procedures and technical requirements for appliances are incorporated into the applicable Australian Standards, the State and Territory legislation simply refer to the relevant Australian Standards. This approach simplifies the State and Territory legislation, and makes it relatively straightforward to maintain national consistency of appliance and equipment energy efficiency standards, even when standards are continually being revised.

Australian Standards are developed by committees that are part of Standards Australia, and must be jointly approved by State and Territory regulatory agencies before they are published. When adopting Australian Standards for appliance energy efficiency, State and Territory Governments:

> … support a policy of adopting international standards and contributing to international standards development wherever appropriate. This support is intended to minimise the prospect of Australian Standards becoming unintended trade barriers and to reduce business compliance costs in meeting differing standards in differing markets for the same appliance. (NAEEEC 2004a, p. 7)

The approach to labelling and MEPS was originally based on 'no regrets' measures (Harrington and Holt 2005). 'No regrets' policy options have been defined as measures that have net private benefits (or at least no net cost) in addition to the social benefits associated with decreased energy use (such as lower greenhouse gas emissions) (IC 1997).

The overarching concern for climate change shifted the basis for NAEEEP to 'world's best regulatory practice' (NAEEEC 2004c; Harrington and Holt 2004, p. 2). The Department of the Environment and Heritage (DEH) noted:

> … [the aim of] the Australian approach is to match, for each appliance regulated, best practice levels imposed by Australia's major trading partners. This approach overcomes arguments regarding the technical feasibility of meeting the proposed MEPS levels and avoids elaborate and expensive testing procedures being conducted locally. (sub. 30, p. 15)

The 'world's best practice' basis for labelling and MEPS was reviewed in December 2004 by the MCE. After the review, the Council decided to extend the mandate to 'lead the world if that option … [is] cost-effective for the Australian community and … [has] widespread stakeholder support' (DEH, sub. DR146, p. 2). However, if a particular option is *not* cost-effective, then MEPS will be set to ‘match, for each appliance regulated, best practice levels imposed by Australia’s major trading partners’ (DEH, sub. 30, p. 15).

The DEH (sub. DR146) claimed that the current policy setting has widespread support from interested parties.

NAEEEC plays an active role in the development of standards. For instance, in 2002, NAEEEC committed over $350 000 to standards development work, including:

- funding of testing designed to develop industry competency with a new or developing standard;
- funding of testing programs designed to inform the process of the setting of MEPS levels;
- commissioning of round robin testing programs designed to ensure that enforcement programs are based on robust and reproducible test methods;
- provision of technical expertise to Standards Australia’s standards committees;
- assistance to Standards Australia to maintain representation on key international standards committees;
- assistance in the development and maintenance of the supply of materials used in testing; and
- providing (with Standards Australia) financial support to Australian delegates attending international standards meetings (AGO 2003d).

Evidence that an appliance meets the requirements set out in the relevant Australian Standard can be obtained from a laboratory that is accredited by the National Association of Testing Authorities (NATA), or another body that is recognised by NATA, or by an independent third-party laboratory.

Check testing

Check testing is a quality assurance measure that:

> … provides consumers with confidence that performance characteristics are correctly identified and protects the investments made by manufacturers in developing more energy-efficient products. (SEAV 2003, p. 27)

Appliances that have been registered and are available for sale are purchased anonymously. NATA accredited laboratories are then commissioned to test that the appliances meet the claims made on the energy-performance label and that they satisfy any applicable MEPS.

Failing a check test can lead to a range of consequences:

- The laboratory that conducted the pre-registration tests may be barred from preparing test reports in the future.
- The registration holder may have to show cause why the appliance should not be deregistered.
- The registration holder may be required to pay for further testing.
- The model may be withdrawn from sale, either permanently or until the registration holder can demonstrate that alterations have been made to all units to ensure compliance with the relevant standards (NAEEEC 2004a).

In 2004, NAEEEC conducted check tests on seven appliance types. Out of 58 appliances tested, 28 were found not to meet the claims made on the energy-performance labels. Eleven products were deregistered, and action was pending on the remaining 17 products (NAEEEC 2005b).

Other regulatory actions undertaken in 2003 included fines of $3000 and $8000 against two Western Australian retailers who were found to have sold appliances without energy-performance labels. Queensland and Victorian retailers received infringement notices and fines totalling $10 000 (AGO 2003c).

Information provision

NAEEEC, in conjunction with Australian, and State and Territory Government agencies, provides information about appliance labelling and standards. General information is made available on the Energy Rating website (http://www.energyrating.gov.au). More recently, NAEEEC, as part of a joint initiative, has set up another website detailing all of the top energy-performing appliances (http://energyallstars.gov.au). The Energy Allstars website provides product listings that can be used to compare appliances, work out how much the appliances cost to buy and run, and how much energy and water they will use.

Planned future changes to NAEEEP labelling and MEPS

Stage One of NFEE included a commitment to expand the scope of NAEEEP:

> … through the introduction of new or more stringent MEPS for residential, commercial and industrial products, with a key focus on increasing the number of commercial and industrial products regulated. (MCE 2004e, p. 2)

The NAEEEC work program includes plans to regulate some classes of appliances that are not currently subject to MEPS or mandatory labelling, and to revise the regulations on some appliances that are already covered. Table E.3 outlines the planned changes.

Table E.3 **Planned changes to NAEEEP mandatory energy performance standards (MEPS) and labelling**

Appliance/equipment type	*Labelling*	*MEPS*
Small mains pressure electric storage water heaters (< 80 litres) and low pressure and heat exchanger type water heaters	No planned change	To be introduced October 2005
Oil-fired boilers	Investigated but no action to be taken	Investigated but no action to be taken
Single phase air conditioners	No planned change	Revised MEPS to be introduced October 2007
Three phase air conditioners up to 65 kilowatt cooling capacity	No planned change	Revised MEPS to be introduced October 2007
Televisions	Mandatory labelling proposed for introduction October 2006	MEPS proposed for introduction April 2006
Digital set top boxes	No planned change	MEPS proposed for introduction April 2006
Computers	No planned change	MEPS under consideration for possible introduction in 2007
Computer monitors	No planned change	MEPS proposed for introduction April 2006 Revised, more stringent MEPS proposed for introduction April 2008
External power supplies	No planned change	MEPS proposed for introduction April 2006 Revised, more stringent MEPS proposed for introduction April 2008
Swimming pool and spa equipment	Further investigation proposed	Further investigation proposed
Ice makers and ice storage bins	No planned change	MEPS proposed for introduction October 2006
Wine storage cabinets	Investigated but no action to be taken	Investigated but no action to be taken
Three phase electric motors	No planned change	Revised MEPS proposed for introduction April 2006

Source: AGO (2002c, 2004b, 2004c, 2004d, 2004e, 2004f, 2004g, 2004j, 2004k).

Regulation impact assessments

Proposed revisions to mandatory labelling requirements and MEPS for electrical appliances have to be accompanied by a regulation impact statement that specifies the likely benefits and costs of the proposal. These are prepared for, and must be formally approved by, the MCE. The benefit–cost assessments have often been undertaken by consultants that have relevant expertise in appliance energy performance (for example, George Wilkenfeld and Associates and Energy Efficient Strategies 1999; Syneca Consulting 2003a, 2004).

E.2 Energy efficiency standards for gas appliances

The current minimum standards and labelling requirements for gas appliances are administered by the AGA. The administrative arrangements are currently being revised to meet the NFEE Stage One commitment to broaden the scope of NAEEEP to include mandatory energy-performance labelling and MEPS for gas appliances.

History

In 1981, the Gas and Fuel Corporation of Victoria introduced energy labelling for gas water heaters. This was the first labelling scheme for gas appliances in Australia, and was taken over by the AGA in 1985. In 1988, a six star energy-performance label was introduced. This label was intended to be visually consistent with the star rating labels already familiar to consumers of electrical appliances.

Domestic nonducted gas heaters have been subject to labelling since 1993, and domestic ducted heaters since 1994 (SEAV 2003). Currently, only gas water heaters and domestic space heaters (ducted and nonducted) are subject to mandatory energy labelling.

As with electrical appliances, labelling schemes for gas appliances are reviewed from time to time. Water heater label scales were revised in 1988 and modified in 1999 to include half star rating increments. The labels for domestic space heaters (ducted and nonducted) were reviewed in 1998 and 2003 (SEAV 2003).

Gas appliances have been subject to minimum standards since the 1960s. Currently, gas water heaters, gas space heaters and gas cookers are subject to minimum standards. The current minimum standards levels were set in 1983 and ‘the majority of models currently on the market appear to exceed current requirements by a comfortable margin’ (SEAV 2003, p. 23).

Administrative arrangements

The greatest difference between the minimum standards and labelling programs for gas and electrical appliances is that the gas appliance scheme is administered by an industry body. Before any mass-produced gas appliance can be made available for sale or installation in any State or Territory, it must receive AGA certification. To receive certification, the appliance must meet certain standards of safety, reliability and energy efficiency.

As is the case with electrical appliances, the technical standards that define minimum standards and energy labelling requirements are incorporated into Australian Standards. In 2000, the AGA gained accreditation as a Standards Development Organisation, meaning that it was permitted to write Australian Standards for gas appliances (SEAV 2003). Since July 2003, the section of the AGA responsible for developing gas appliance standards has been incorporated into Standards Australia.

Testing and compliance

Manufacturers of gas appliances must currently submit a specification of their appliance to the AGA. The AGA then develops a test program for the appliance, and the appliance is tested at an independent laboratory that is accredited by NATA and registered with the AGA. If the laboratory report indicates that the appliance is compliant with the relevant Australian Standard, the manufacturer receives a certificate that permits them to affix the AGA Maker's Warranty Badge to the appliance, and make it available for sale and installation.

The requirement for the test to be conducted at a laboratory accredited by NATA is similar to the requirements for electrical appliances (which also permit testing at laboratories accredited by bodies recognised by NATA).

Product verification audits

Certified gas appliances are periodically subject to product verification audits (PVAs). The audit program typically involves annual product inspections, although inspections may be more or less frequent. The aim of PVAs is to help confirm that an appliance adheres to the currently certified design specifications and regulatory requirements (AGA 2004b). If the audit identifies noncompliance with the relevant standard, the product's certification may be cancelled.

The aim and potential consequences of PVAs are similar to those for check testing of electrical appliances, although the process is slightly different. Whereas check testing is conducted on appliances purchased anonymously, PVAs are conducted on the manufacturer's premises. In addition, check testing is carried out on only a few products annually, whereas all gas appliances are subject to periodic PVAs.

Planned changes to gas appliance labelling and MEPS

The administrative arrangements for the regulation of gas appliances are currently undergoing transition (AGO 2005f). The *National Greenhouse Strategy*, released in 1998, included a commitment to:

> … working with industry to improve gas appliance minimum energy performance standards (MEPS) and labelling programs. (AGO 1998, p. 48)

The AGA (2004a, pp. 1–2) recognised that 'there is a clear need for a nationally consistent approach [to gas appliance MEPS and energy labelling]', and that the existing scheme 'is in need of updating and the Standards and MOTs [methods of test] need to be updated and modernised'. The AGA proposed that any new scheme, if it is mandated through legislation, should be nationally consistent and should be based on the existing MEPS and labelling schemes administered by the AGA, rather than being completely new schemes.

The NFEE Stage One measures announced in August 2004 included plans for NAEEEP to be:

> … broadened in scope to include mandatory minimum energy performance standards (MEPS) and labelling for gas products. (MCE 2004e, p. 2)

In April 2005, the Australian Greenhouse Office (AGO) published a work plan which outlined the introduction of mandatory gas labelling and MEPS (table E.4) (AGO 2005f; 2004m).

It is proposed that the new arrangements will:

> … steadily incorporate those products already subject to energy labelling and standards under the existing industry scheme. It will expand to include any product that consumes mains pressure natural gas or LPG gas within the domestic, commercial and industrial sectors, subject to economic analysis and community consultation. (AGO 2004m, p. 5)

The proposed scheme for gas appliances:

> … will match, or where viable and economically feasible, lead the world in regulatory standards. (AGO 2004m, p. 5)

Table E.4 **Proposed changes to gas appliance mandatory energy performance standards (MEPS) and labelling**

Appliance/equipment type	*Proposed changes*
Domestic gas water heaters and space heaters (ducted and nonducted)	New MEPS and labelling standards to be introduced in 2008
Domestic gas cookers (ovens and cook tops) Commercial gas water heaters Commercial gas space heaters Industrial gas boilers	New MEPS and/or labelling standards to be developed 2008–11 and introduced 2012–15
Gas clothes dryers Some priority gas catering equipment	New MEPS and/or labelling standards to be developed 2012–15 for introduction at a later date

Source: AGO (2005e).

Officials from the AGO, Sustainable Energy Authority of Victoria (SEAV), and Victorian Office of Gas Safety have taken key roles on the Implementation Committee charged with establishing the new gas labelling and MEPS arrangements. The Committee will initially focus on the formal establishment of the Gas Appliance and Equipment Energy Efficiency Program (GAEEEP) as part of the NAEEEP (AGO 2005f). In the longer term, representatives from all jurisdictions will be involved in maintaining, updating and administering the GAEEEP arrangements (George Wilkenfeld and Associates 2004a).

E.3 Voluntary programs

In addition to the mandatory energy performance labelling and MEPS requirements that apply to some gas and electrical appliances, voluntary labelling and standards programs also operate in Australia. The Energy Star and Top Energy Saver Award programs use voluntary endorsement labels to identify appliances and equipment that meet particular standards of energy efficiency. The Standby Power program focuses on reducing the energy consumed by appliances when they are not in use.

Energy Star

Energy Star is a voluntary endorsement labelling program developed by the US Environmental Protection Agency (US EPA). It has been operating since 1992, and has been adopted by a number of countries, including Australia. Energy Star sets voluntary standards for reducing the electricity consumption of electronic equipment when it is not performing its core function.

This can be accomplished by:

- switching the appliance into a 'sleep' mode after a period of inactivity; and/or
- reducing the amount of electricity consumed by the appliance in 'standby' mode (box E.1).

In 1996, the New South Wales Sustainable Energy Development Authority implemented part of the Energy Star program under licence from the US EPA. In 1999, the Authority was commissioned by NAEEEC to expand its scheme into a national program to cover home entertainment and office equipment (AGO 2002b). State and Territory environment and energy agencies now promote Energy Star in their jurisdictions.

Box E.1 Standby power

Standby power is the energy drawn by an electrical appliance when it is not performing its core function. Many appliances consume energy constantly, including when they are not in active use. In this mode they may be performing non-core functions such as sensing remote control signals or keeping the appliance's internal clock running. These non-core functions are valued by many consumers.

In 2000, standby power was estimated to constitute 11.6 per cent of Australia's residential electricity use, costing households over $500 million and leading to the emission of over 5 million tonnes of carbon dioxide equivalent (AGO 2002b). Holt and Harrington (2004) estimated that standby power consumption in Australia could be reduced by 56 per cent by 2020.

Currently, the Australian Energy Star program covers:

- photocopiers
- printers and fax machines
- scanners
- multi-function devices (combined photocopying, fax and scanner functions)
- computers and monitors

- consumer audio products
- consumer DVD products and VCRs
- televisions.

Manufacturers of appliances that comply with the technical requirements of the Energy Star program are permitted to use the Energy Star logo on their products and in promotional material. Retailers are encouraged to sell and promote the benefits of Energy Star compliant appliances. Australian, State and Territory Government agencies promote the purchase of appliances that meet the requirements of Energy Star. In addition, Australian Government departments and agencies:

> … are required to purchase only office equipment that complies with the US EPA Energy Star standard, where it is available and fit for purpose. (DISR 2000, p. 477)

The US Energy Star program has been extended beyond electronic appliances and currently covers over 40 categories of products, including:

- heating and cooling products
- refrigerators and freezers
- water coolers
- clothes washers
- lighting products
- commercial food preparation equipment
- insulation
- windows, doors and skylights (US EPA 2005).

Many of these products are not covered by the Australian Energy Star program, although some are subject to mandatory energy-performance labelling or MEPS, and others are covered by other voluntary programs, such as the Window Energy Rating Scheme. The US EPA has agreed in principle to the extension of the Australian Energy Star program to cover products included in the US program (AGO 2002b).

One Watt program

In addition to their support for the Energy Star program, the Australian, State and Territory Governments have agreed to adopt the International Energy Agency's One Watt program. The One Watt initiative was first mooted in 1997. Its aim is to reduce the standby power consumption of all appliances to less than one watt by 2010 (IEA 2002).

In 2000, the MCE agreed to:

> … pursue efficiencies in standby power consumption of energy-consuming products, through support for the International Energy Agency's One Watt program, and endorse its incorporation into the … program of work. (AGO 2002a, p. 7)

Australia was the first country in the world to endorse the initiative (IEA 2002). Since then, Australia has actively participated in international forums on standby power, and has funded work done by the International Electrotechnical Commission on the measurement of standby power consumption (Holt and Harrington 2004).

Currently, the standby power program is based on voluntary compliance and information. To further the program, NAEEEC has developed product profiles that assess the standby power performance of particular classes of appliances and equipment. The profiles include targets for the standby power consumption of the product (generally expected to be in line with the Energy Star levels of consumption). The profile is circulated for comment, and the voluntary target is then included in the relevant Australian Standard, to ensure industry familiarity. NAEEEC collects data on standby power consumption, and these data will be monitored to assess the performance of the industry against the voluntary target (AGO 2002a).

If the voluntary targets do not accomplish the desired reductions in standby power use, mandatory measures, including MEPS, may be considered. This would only be done with the approval of the MCE, and would be accomplished by changing the relevant Australian Standard to incorporate a mandatory target for standby power use (AGO 2002a).

Top Energy Saver Award

The Top Energy Saver Award program awards manufacturers of specific models of electrical and gas appliances that meet high standards of energy efficiency. Each year NAEEEC releases documents developed in consultation with manufacturers that set benchmarks for electrical and gas appliance energy efficiency (for example, a certain star rating). Appliances that meet or exceed this level of efficiency are awarded a Top Energy Saver Award (AGO 2004n). Electrical appliances are automatically assessed for eligibility when they are registered. Manufacturers of gas appliances must apply to the AGA for consideration.

Winners of the awards are permitted to use the Top Energy Saver Award label on the appliance and in promotional material for one year. They may then reapply for the award, and the appliance will be assessed against the revised energy efficiency benchmark for that year.

F Discount rates

Energy efficiency investments often involve an upfront capital cost, while the benefits are realised in increments in the future. In order for benefits and costs to be compared, both for a given investment and across different investments, they should be converted to a common unit of measurement that removes the effects of timing differences. This conversion is done by using a discount rate.

Discounting the benefits and costs of a project allows them to be compared in present value terms. That is, what they are worth today. If the net present value for a project (present value of benefits *less* present value of costs) is positive, the investment is expected to be financially rewarding for the investor. When assessing multiple investments, the investment with the highest net present value would be the most financially rewarding (assuming the investor does not face a capital constraint) (Feldstein 1972).

This appendix outlines key issues that have to be considered in selecting a value for the discount rate:

- whether it is based on the rate of time preference or cost of capital;
- whether the investment evaluation is undertaken from the perspective of an individual or society as a whole;
- how to account for investment risk; and
- whether it is appropriate to assess private cost effectiveness using a social discount rate.

F.1 Time preference versus cost of capital

In undertaking an investment, an investor may have to forgo:

- consumption today in return for consumption in the future
- investment in other projects.

Forgoing consumption has a cost because people generally prefer to receive a dollar today, rather than a dollar in the future. The rate at which an investor is willing to exchange current consumption for (higher) future consumption is their rate of time preference (RTP).

Forgoing investment in other projects also has a cost if at least one of those projects is expected to have a positive rate of return. The highest rate of return that could be earned from another investment (after adjusting for differences in risk) is the opportunity cost of capital (OCC).

A discount rate could therefore be based on either an RTP or an OCC (or a weighted combination of both). They will only be the same under very restrictive conditions, including perfect competition in capital markets, no transaction costs and an absence of distortionary taxes (Layard 1977; Department of Finance 1991; Layard and Glaister 1994; Boardman et al. 2001).

In practice, the OCC is typically used as a discount rate for investment evaluations in Australia, particularly those undertaken in regulation impact assessments, because it is easier to implement and less prone to measurement error (Department of Finance 1991; Partnerships Victoria 2003).

F.2 Social versus private investment evaluations

The appropriate discount rate to use in an investment evaluation depends on whose perspective is being considered.

If an investment is assessed from a public perspective (taking account of all benefits and costs to society), the discount rate should reflect the perspective of society as a whole. Thus, the guidelines for public sector investments and regulation impact statements in Australia recommend using the social OCC as a discount rate (for example, Department of Finance 1991; Partnerships Victoria 2003; COAG 2004).

If an investment is assessed from a private perspective, the discount rate should reflect this. An appropriate discount rate would be the relevant party's private OCC.

A similar distinction between social and private analyses applies when the discount rate is based on an RTP.

In summary, there are four possible discount rates, depending on whether an RTP or OCC is used, and whether a private or societywide perspective is taken (table F.1)[1].

[1] Assuming that a weighted combination of both an RTP and OCC is not used.

Table F.1 **Discount rates that could be used in an investment evaluation**

	Whose perspective	
Unit of measurement	*Individual*	*Society*
Forgone investment	Private opportunity cost of capital[a]	Social opportunity cost of capital[b]
Forgone consumption	Private rate of time preference[c]	Social rate of time preference[d]

[a] The rate of return that an individual investor forgoes from the next best investment. [b] The rate of return that society forgoes from the next best investment. [c] The rate at which an individual investor is willing to exchange current consumption for (higher) future consumption. [d] Society's preference for present as opposed to future consumption.

F.3 Accounting for investment risk

Most energy efficiency investments involve an element of risk because, among other things, benefits depend on future energy prices, which are uncertain, and implementation costs can vary from expectations.

In order to take account of risk, investment evaluations often use a risk-adjusted discount rate. This is calculated by estimating the investor's weighted average cost of capital, with weights based on the relative magnitude of the investor's debt and equity (assuming an OCC-based discount rate is used).

The cost of an investor's debt finance is usually transparent. This is not the case for the cost of equity, which is typically estimated by using the Capital Asset Pricing Model (CAPM) (box F.1).

Ideally, the CAPM would be used to estimate project-specific discount rates. However, this can be difficult to implement in practice due to data limitations. In light of this problem, the Department of Finance (1991) has recommended a general-purpose 'benchmark' social OCC rate of 8 per cent (in real terms) for government investment evaluations. This rate is loosely based on an application of the CAPM framework:

> This rate is reconciled with the CAPM framework, which might suggest a discount rate in the order of 10–11 per cent, on the presumption that many activities in the general government sector are characterised by less than average market risk in the sense that their returns are not significantly increased or decreased when economic activity is respectively strong or weak. (Department of Finance 1991, p. 57)

Box F.1 The capital asset pricing model (CAPM)

The CAPM assumes that investors are rational in the sense that they eliminate all asset-specific risk by holding a diversified portfolio. As a result, the theory asserts that investors only need to be compensated for risks that affect the whole market of risky investments. Examples of such nondiversifiable risks are those arising from macroeconomic policy, recessions, and political unrest.

The CAPM attributes differences in returns between investments to the divergent responses that investments have to risks that affect the whole market. Accordingly, the CAPM specifies that an investment's expected return depends on how its returns vary relative to the total market of risky investments:

$$E\left[R_i\right] = R_f + \beta_i\left(E\left[R_m\right] - R_f\right)$$

where $E\left[R_i\right]$ is the expected rate of return on equity; R_f is the rate of return on the risk-free asset (typically interpreted as a government bond); β_i is an investment's equity 'beta' (a measure of how returns vary in response to nondiversifiable risk, relative to how the market for all risky assets responds to such risk) and $\left(E\left[R_m\right] - R_f\right)$ is the expected risk premium for the market of all risky investments.

Finding values for the variables in the above equation so as to determine the required return on equity $E\left[R_i\right]$ is not straightforward. R_f is usually based on the return on government bonds. But it is unclear what maturity should be used and whether it should be the return on a particular day or an historical average. If it is an historical average, it is unclear what time period should be used. The Department of Finance (1991) recommended that the risk-free rate should be based on a ten year average of the Treasury ten-year bond rate. In contrast, Partnerships Victoria (2005) currently uses a five-year average of the ten year bond rate.

There is no single widely agreed estimate for the market risk premium $\left(E\left[R_m\right] - R_f\right)$. Indeed, this premium might be changing over time and hence be difficult to estimate econometrically. Nonetheless, a recent study has estimated the market risk premium to be 6 per cent (Dimson et al. 2003). A rate of 6 per cent is commonly used in practice (Department of Finance 1991; Partnerships Victoria 2003).

Estimating beta is a complex task. Betas differ across industry sectors as well as projects within sectors. Atech Group (2003) claimed that energy efficiency investments have substantially less risk than general investments in a particular sector (that is, the sectoral beta should be adjusted downwards for energy efficiency investments). In contrast, Greely et al. (1989) found that very few predictions of energy savings came within 20 per cent of measured results. Sutherland (1991) argued that energy efficiency investments were quite risky given that the actual savings cannot be predicted accurately.

Sources: Bruce et al. (1989); PC (2004c).

Similarly, the Victorian Government has set three benchmark discount rates for infrastructure projects (Partnerships Victoria 2005). They have been specified in order to allow for differences in risk across the following sectors:

- accommodation and related services (social OCC of 5.5 per cent in real terms)
- water, transport and energy (6.5 per cent)
- telecommunications, media and technology (9 per cent).

Despite the widespread use of the CAPM, it has significant deficiencies. This can be largely attributed to the many questionable assumptions used in the model. For example, the CAPM assumes that asset returns are normally distributed, and so the standard deviation of returns is a valid measure of risk. In practice, an investment may have a skewed distribution of possible returns.

The weaknesses of the CAPM have been extensively documented in the financial literature, including empirical tests that have found that the model has a poor record in quantifying the relationship between risk and returns (for example, Fama and French 2004). Thus, the validity of CAPM-based discount rates is questionable.

F.4 Use of social discount rates to assess private cost effectiveness

Regulation impact assessments typically use an estimate of the social OCC to determine whether a policy is privately cost effective. This could be justified on the grounds that private cost effectiveness is assessed for the 'average individual', and their cost of capital — the average private OCC across all members of society — will equal the social OCC.

However, the social OCC used in regulation impact assessments is not derived by calculating the average private OCC across all individuals. Instead, it is usually a general-purpose rate that is loosely based on an application of the CAPM approach to a limited number of firms. The previously-mentioned benchmark rates recommended by the Department of Finance and the Victorian Government are examples of this. Given how such estimates are derived, it is doubtful that they are an accurate measure of the average private OCC.

The average private OCC could be much higher than the discount rates used in regulation impact assessments. For example, contrary to CAPM assumptions, many individuals face constraints on how much they can borrow and this will tend to raise their opportunity cost of using capital. In addition, many people do not have highly diversified investment portfolios that eliminate asset-specific risk.

A further problem is that the average private OCC (even if accurately measured) may not be representative for many individuals. This would be the case if the diverse circumstances of individual producers and consumers causes many of them to have a private OCC that is very different from the average.

At the extreme, poor households may have to forgo basic needs (such as for food and clothing) if they are to invest in an energy efficiency measure. The private OCCs for such households are probably much higher than the social OCC estimates used in regulation impact assessments (Treasury Board of Canada Secretariat 1998; Dubin and McFadden 1984; Brill et al. 1999). Similarly, the private OCC for small businesses may tend to be higher than that for larger businesses, given differences in access to capital and borrowing costs.

One way to take account of diversity among individuals would be to carry out a disaggregated analysis that assessed private cost effectiveness for different groups and tested the sensitivity of the disaggregated results to a wide range of discount rates. The disaggregation could, for example, be based on socioeconomic characteristics for consumers and turnover for businesses.

The COAG guidelines for regulation impact assessments recommend distributional analyses in order to identify the extent to which different groups would be affected by a proposed regulation:

> Distributional implications can be obscured by the aggregating character of the cost–benefit process. Analyses should include all the information available to ensure that decision-makers are aware both of the identity of the groups likely to gain and to lose as a result of government action, and of the nature and size of the gains and losses. This information should be carefully presented, most usefully in the form of a distributional incidence chart or matrix. (COAG 2004, p. 33)

Similarly, the Department of Finance (1991) has noted that a distributional analysis should be included in investment evaluations where the distributional effects are unclear.

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