March 21-23, 2013

DOUBLETREE HOTEL
ANNAPOLIS, MARYLAND

Proceedings of the 54th Annual Transportation Research Forum

www.trforum.org

U.S. ENERGY INDEPENDENCE: AN ASSESSMENT OF MECHANISMS TO HELP PROMOTE DOMESTIC ENERGY SECURITY

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ABSTRACT

The two primary objectives of recent energy initiatives and/or policies are the reducing of both domestic emissions of greenhouse gases (GHG) and our dependence on foreign oil commodities. Republican senators Richard Lugar, Lindsay Graham, and Lisa Murkowski introduced the "Primary Energy Plan Act of 2011" with plans of: (1) reducing U.S. dependency on foreign oil; (2) increasing investment in more diverse, cleaner energy producing technologies; and (3) better utilizing domestic fossil fuel resources. The bill hoped to accomplish such goals through increases in existing fuel economy standards for light-duty vehicles and improvements in the energy efficiency standards for residential, commercial, and federal buildings. It also established incentives for the production. President Obama in that same year expressed plans for a clean energy standard (CES) requiring 80% of total produced electricity to be generated from a select group of clean energy sources (e.g. coal with carbon capture and storage (CCS), nuclear, solar, wind, etc.). He later proposed a tightening of current Corporate Average Fuel Economy (CAFE) regulations, doubling the average fuel efficiency of the light-duty fleet. These initiatives highlight our nations' efforts to curb our dependency on non-domestic energy sources. Increases in energy independence refer to reductions in domestic need for foreign oil products. In 1975, U.S. oil imports composted roughly 37% of total domestic oil consumption – rising to 57% in 2008. In a little over thirty years, we have witnessed a 20% increase in oil imports, indicative of our growing addiction for foreign oil. Severe volatility in oil prices, not to mention that several reserves are located within politically unstable nations, drive policymakers' concerns that our increasing reliance on foreign is becoming ever more dangerous. Petroleum in 2010 composed almost 37% percent of overall energy consumption here in the U.S. Almost 70% of that came from the transportation sector alone. Thus, there lies a direct correlation between the growing consumption of oil by the transportation sector and our rising need for imported oil.

There are existing mechanisms in place targeting transportation emissions and energy usage. The CAFE standard was initially developed under the Energy Policy and Conservation Act of 1975 (EPACT) as a direct result of the 1973 Arab oil embargo. It reduced sector emissions and fuel demands through improvements in the fuel economy of cars and light-duty trucks. Market-based fuel taxes like gasoline and diesel taxes are other alternatives that dampen the appeal of using dirtier, conventional fuels. The federal excise tax on gasoline today is 18.4 cents per gallon and 24.4 cents per gallon of diesel. State and local taxes average 30.5 cents and 29.4 cents per gallon for gasoline and diesel, respectively. Considering both the federal and state level taxes, the average U.S. fuel taxes are roughly 49 cents per gallon of gasoline and 54 cents per gallon of diesel. Relative to other nations, U.S. fuel tax levels are more on the lower end.

Our work builds upon previous studies which have taken a look at the impacts of different transportation-based policies geared towards lowering GHG emissions and curbing our country's appetite for foreign oil. The policies analyzed will be compared based on their ability to strengthen domestic energy independence and reduce GHG emissions. We use the recent 2010 US EPA MARKAL dynamic, partial equilibrium model, which uses a detailed structure of the US energy system, to model and observe each policy. In addition, we will observe how these mechanisms stand to affect the largest contributor to our country's energy security problem, the transportation sector.

METHODOLOGY

For this study we use the U.S. EPA MARKAL model (elastic version). MARKAL (MARket ALlocation) is a bottom-up, partial equilibrium model. It is demand-driven and uses linear optimization to simultaneously minimize overall system costs and maximize total surplus by finding the most-efficient, least-cost combination of resources and technology usage rates to satisfy system energy service demands over the course of the policy horizon. Its framework is based on a Reference Energy System (RES) which captures the interrelated relationships amongst the five major model components (energy service demands, commodities, primary energy sources, service exports, and system technologies). The more recent 2010 EPA National MARKAL Database provides data for the five primary U.S. sectors (i.e. transportation, commercial, residential, industrial, and electricity generation). It also provides specific data on all of the technologies that make up the MARKAL energy system. Generated model outputs include emission levels, technology mixes, and energy commodity prices. Because our interest lies in transportation sector impacts, we base the own-price elasticities for end-user demands for all of

the transportation modes on the approximations from a number of studies. Our assessment is conducted across five scenarios. The first being the Reference case which includes existing CAFE regulations and fuel tax regulations. It reflects current and anticipated market behavior given no changes to current policies. The ES_HTAX scenario places an oil tax of $1.27 per gallon of gasoline equivalent (GGE) in year 2007 dollars and increase annually by 1.54 percent eventually reaching $2.53 per gallon in 2055. The third scenario, ES_VH_TAX, assumes that the tax rate of $2.90 (in constant year 2007 dollars) remains constant in real terms over the policy horizon. All tax rates in this study are applicable to crude oil products produced domestically and imported oil commodities. The fourth case (ES_CAFE) includes only the presidents' proposed increases to existing fuel economy mandates. This requires an increase to 54.5 miles per gallon (mpg) by year 2025 for all cars and light-duty trucks. However, we will model only the fuel economy aspects introduced under CAFE. So the 54.5 mpg requirement in 2025 actually corresponds to roughly 37 mpg . The annual increases in fuel economy will be reflected as such. The final scenario (ES_CAF_HTAX) combines the high tax rates with the required increases in CAFÉ regulations. We also take a look at a fifth scenario, ES_CAFETAX_EQUIV, which incorporates oil tax rates which generate similar reductions in total energy consumption by the transportation sector as the CAFE standard. There are implicit or "hidden" costs that correspond to higher CAFE regulations. Our tax-equivalent is an attempt to account for many of these hidden costs.

RESULTS/DISCUSSION

Simulation results suggest that higher fuel economy regulations (ES_CAFE) produce the least amount of reductions in both system-wide and transportation sector emissions. All policies that tax oil products have a greater impact on emissions. The combined case (ES_CAF_HTAX) produces the largest set of reductions. Most of which is attributed to the tax counterpart. Costs of lowering emissions are highest under CAFE increases, as it proves to be the least cost-effective approach. Our combined case ends up being the cheapest per ton of abated CO2. A majority of the policies evaluated improve domestic energy security levels through reductions in oil imports. CAFE increases overall crude oil imports while simultaneously increasing oil exports – resulting in rather substantial decreases in net crude oil imports. This should bring to policymakers' attention that updates in CAFE regulations are helpful in reducing US dependency on foreign oil. However, reasonable increases in oil taxes are still the best alternative for cutting oil imports. Our analysis shows that in general increased oil taxes (high and very high tax) create the most substantial reductions in overall oil use and net imports next to the combined CAFE/oil tax scenario. This study signals the efficiency of higher oil tax rates for reducing oil imports and GHG emissions. Even though increases in CAFE do in fact lower total oil use through reductions made in the transportation sector, an oil tax is a much more efficient, cost-effective approach to achieving these policy goals. CAFE increases are a much more expensive, inefficient approach. The benefit of a tax is that it targets oil consumption across all sectors establishing greater incentives to cut back its use. And if policymakers still choose to ignore the use of more efficient pricing mechanisms and push for higher fuel economy regulations instead, they will be subjecting the economy to a significant amount of hidden costs.