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THE RESTRUCTURING OF THE ELECTRIC POWER INDUSTRY IN TAIWAN

GEORGE J. Y. HSU

OCCASIONAL PAPER SERIES No.9601
May 1996

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The Restructuring of the Electric Power Industry in Taiwan

by

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GEORGE J. Y. HSU*

The Restructuring of the Electric Power Industry in Taiwan**

Abstract

The purpose of this paper is to investigate the restructuring of the electricity industry in Taiwan. We first outline the current situation in Taiwan. Second, we analyze the government policy for promotion of cogeneration, the opening of the market for power generation to independent power producers and the revision of the Electricity Act. Third, some implications of the government deregulation policy and difficulties in relation to future regulatory reform of the electricity industry in Taiwan are discussed. Finally, a brief conclusion and several recommendations are presented.

Introduction

After years of ideological contest and new breakthroughs in technology, the world has now embarked on the path of market-driven

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economic development. Many industries in industrialized countries have shifted from a conventional regulated system to a more liberalized one. The electricity industry is one which is rapidly evolving toward a more competitive market. For example, the electricity industries in the United Kingdom, New Zealand, and Norway have faced drastic changes over the past few years. This international trend in the electricity industry has inevitably influenced Taiwan's electricity industry, currently monopolized by the vertically integrated Taiwan Power Company (Taipower), which is run by the government, to move gradually toward a more open and liberalized market system.

Taiwan, unlike many other countries, has an isolated power system with power shortage problems in the summer peak load period. The causes of such shortages are mainly the NIMBY (not in my backyard) complex of people who are actively against new power development projects. In addition, the descending trend of primary energy prices, and rapid economic and load growth in Taiwan have worsened the power shortage situation. The strategy adopted by the government to ease the tensions caused by the power shortages has been to introduce deregulation to the power industry with several measures. All these are contributing to the reform of the electricity industry in Taiwan, and in particular importance is the revision of the Electricity Act, now under review by the Legislative Yuan.

The purpose of this paper is to investigate some of the issues involved in the reform of the electricity industry in Taiwan. In order to achieve this objective, we first outline the current situation in Taiwan. The government's policy for promotion of cogeneration, the opening of the market for power generation to IPPs and the revision of the Electricity Act are then analyzed. Third, some implications of the government deregulation policy and difficulties in relation to future regulatory reform of the electricity industry in Taiwan are discussed. Finally, a brief conclusion and recommendations are presented.

The Current Electricity Industry In Taiwan

By the end of 1994, the total number of power plants in Taiwan was 58, of which 37 were hydroelectric, 18 were thermal, and 3 were nuclear

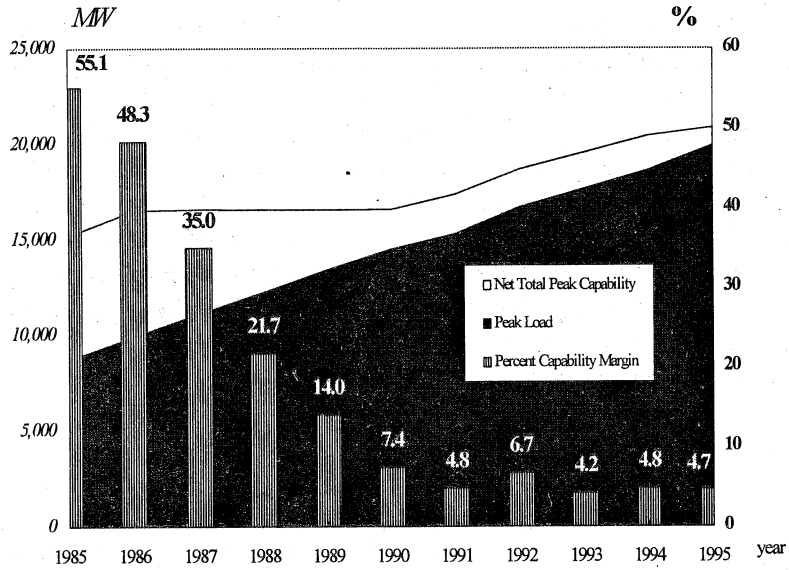
plants. The total installed capacity was 20,983 MW, of which 17% was hydroelectric, 28% coal-fired, 24% oil-fired, 6% gas-fired, and 25% nuclear. The peak load was 18,610 MW in 1994, a 5.3% increase over that in 1993, and the average load was 12,441 MW, an 8.4% increase over 1993. Power generation totaled 113.3 TWh in 1994, an 8.2% increase over the previous year. Of this 1994 total, 8% came from hydroelectric, 35% from coal-fired, 21% from oil-fired, 5% from gas-fired, and 31% from nuclear plants. The installed capacity of selfgeneration systems, mainly cogeneration, reached 1,826 MW, with power generation at 11.3 TWh. Total installed capacity of power generation, including selfgeneration, reached 22,809 MW, with power generation at 124.6 TWh. On the other hand, total electricity consumption in 1994 amounted to 113.4 TWh, of which 56% was for industrial use, 2% for agriculture and transportation, 21% for residential use, and 10% for commercial uses. Power generation growth is behind that of GDP and is even lower than that of power demand in Taiwan in the last decade. From 1980 to 1994, average growth of GDP was 7.8% and the growth of power demand was 8%, while the growth of power supply was only 4.9%. If shown in real numbers, the net total peak capability in July 1985 was 13,519 MW and peak load was 8,716 MW, which gave a percent reserve margin of 55.1%. On the other hand, the net total peak capability was up to 19,503 MW in 1994, however, peak load boomed at the same period of time up to 18,610 MW. That is, the system percent reserve margin had declined to 4.8% in July of 1994 from 55.1% in July 1985 (Hsu 1995). Such figures clearly indicate the serious power shortage in Taiwan, as shown in Figure 1.

Furthermore, the outlook for 1996 and 1997 is not optimistic. The peak load of 1995 was 19,678 MW while peak loads of 20,960 MW for 1996 and 22,170 MW for 1997 have been predicted. The percent reserve margin will be 9.1% in 1996 and 10% in 1997. Only if there is no breakdown in any power plant can a power shortage be avoided.

The Reform of The Electricity Industry

Power industry reform in Taiwan is mainly motivated by two factors: the aforementioned power shortage and deregulation of overall economic

Figure 1 Power Supply Profile in Taiwan 1985-1995



Source: *Annual Statistical Report of Taiwan Power Company*, Taiwan Power Company, 1995.

policy. Since the early 1980s, the Taiwan government has promulgated a series of deregulation policies, dealing, for example, with interest rates, foreign currency exchange rates, international trade, aviation, and so forth. Accordingly, the government is promoting deregulation of the electricity industry through three means: promotion of cogeneration, the introduction of private power producers, and vertical disintegration of Taipower. These changes have led to a revision of the Electricity Act. Hence, this section first describes the government's policy and measures regarding cogeneration development. Second, the introduction of private power producers is explained. Third, discussion of the disintegration of Taipower will illustrate its potential difficulties. Finally, important points of the proposed Electricity Act revision are summarized.

Development of Cogeneration

The initial step in the reform of the electricity industry in Taiwan could be said to have been taken in 1988 when the Ministry of Economic Affairs first promulgated the Measures for Promoting Cogeneration Applications in 1988, based on the Energy Management Law and Electricity Act.

The highlights are:

- The measures apply to "qualified cogeneration systems" only. These are cogeneration systems with compliance to certain conditions: the operating standard for thermal output has to be no less than 20% of the total energy output of the facility; and the efficiency standard has to be no less than 50%.
- Natural gas is the fuel given highest priority for cogeneration systems.
- Consumers are encouraged to invest in cogenerators by installing qualified cogeneration systems to meet their own needs, including steam and electricity. Taipower is obligated to purchase any surplus electricity from the cogenerators.
- Third-party investments are encouraged to install qualified cogeneration systems for selling produced heat and electricity to either users or electric utilities.
- Purchase prices of surplus electricity can be based on either Taipower's avoided cost or the time-of-use rate which Taipower uses for generation, transmission, and distribution. Qualified cogeneration system owners have the right to select the more favorable from the two above.
- Taipower has to serve as the back-up and supplementary power for the maintenance of qualified cogeneration systems.

Other than the above-mentioned regulations, the government also provides financial and tax incentives for setting up cogeneration systems as below:

- Loans with low interest rates. Chiao Tung Bank[1] will provide loans with regular interest minus 2.125 to 2.25 percent.
- Accelerated depreciation. Cogeneration facilities may apply for two-year accelerated depreciation.
- Profit-oriented enterprises may receive a credit of 5 to 15% of the income tax payable in the current year. Such credit may accumulate for the following four years once the deductible amount is more than the income tax payable in the current year.
- Qualified cogeneration systems may set their prices to favor natural gas use, with 2.5% off for industrial use.

In 1994, the total installed capacity of cogeneration systems was 1,980 MW, which represents 9.44% of Taipower's installed capacity (20,983 MW). Table 1 shows the allocation of cogeneration facilities among various major industrial sectors.

Industries are expected to implement about 2,035 MW more in cogeneration facilities in the next 6 years. The total installed capacity will sum up to 4,015 MW in 2000. Table 2 summarizes the outlook for such growth in the 6 years following 1994. This increase in cogeneration will promote energy efficiency in terms of the total energy consumed. Additionally, cogeneration can ease the problems of power shortages for energy users. The most common size of cogeneration units is currently from 10 to 30 MW in Taiwan, accounting for roughly 47% of overall installed cogeneration unit capacity. Oil is the dominant fuel, which powers about 62% of all new facilities. Among all the facilities installed, steam turbines are the most common type.

Introduction of Private Power Producers

Private power producers in Taiwan are somewhat different from independent power producers as they are generally known. In most countries, say the United Kingdom, establishment of a power plant is just like establishment of a manufacturing facility and does not require some special permission or franchise. However, according to the Taiwan

[1] A government-owned bank that mainly helps provide investment loans to the commercial and industrial sectors in Taiwan.

government's regulations, these private power producers are defined as "public utilities" and require the Ministry of Economic Affairs' permission with a franchise. Therefore we call these power producers "private" instead of "independent, " although in this paper we refer to them as IPPs, in conformity with international practice.

The history of private power producers is very short in Taiwan. If we date their existence from the time they were approved by the government, it is just about half a year.[2] The first group contains 7 companies that were selected through a bidding process out of 22 applicants at the end of June 1995, representing generation capacity of 7,050 MW. The second group contains 4 companies out of 20 competitive bidders at the end of 1995, representing 3,250 MW generating capacity.

There are several points which should be considered by the government regarding its policy on the introduction of private power producers. One is that such an introduction should be phase-oriented.

Table 1 Existing Installed Capacity of Cogeneration in Taiwan

Year	1986		1990		1992		1994	
Industry	MW	%	MW	%	MW	%	MW	%
Petrochemicals	116.1	24.0	278.3	30.0	505.0	29.2	630.2	31.8
Oil Refineries	90.0	19.0	100.0	11.0	130.0	7.5	142.4	7.2
Metals	80.0	17.0	235.8	25.0	355.0	20.5	374.3	18.9
Paper	67.4	14.0	142.8	15.0	205.0	11.9	205.5	10.4
Textiles	59.5	13.0	110.2	12.0	413.0	23.9	424.6	21.4
Food	56.0	12.0	60.0	6.0	60.0	3.5	65.7	3.3
Cement	6.0	1.0	6.0	1.0	60.0	3.5	86.6	4.4
Others							50.8	2.6
Total	475.0	100.0	932.9	100.0	1728.0	100.0	1980.1	100.0

Source: Liang (1995).

[2] The first batch of 7 private power producers was announced by the Ministry of Economic Affairs on Aug. 17, 1995.

Table 2 Estimated Installed Capacity of Cogeneration in Taiwan

Item/Year	1994	1995	1996	1997	1998	2000
Additional Capacity (MW)	110	335	392	940	254	113
Total (MW)	1,980	2,316	2,708	3,648	3,902	4,015
Cogen/Taipower System (%)	9.4	10.3	10.8	13.8	14.6	14.9

Source: Liang (1995).

The first step to liberalize the generation sector is the establishment of new private power producers which should be defined as IPPs and not public utilities, while Taipower on the other hand should remain a public utility, responsible for the reliability of the power supply, i.e., obligated to serve. Second, the authorities should divide up the generating sector of Taipower to form several power-generating companies in order to further enhance competition for power generation.

Restructuring the Taiwan Power Company

The power industry in Taiwan has been vertically integrated and monopolized by a single company (Taipower) for over fifty years. In this moment of deregulation, the key issue is whether the vertical integration of the existing power company should be dismantled. The argument in support of disintegration of the power industry in Taiwan can be summarized as follows.

Monopoly is subject to regulation, which is difficult to conduct perfectly. According to regulations set by the Taiwan government in 1969, the allowed rate of return for Taipower ranges from 9.5% to 12%. Costs and proposed rates for Taipower are first reviewed and approved by the Ministry of Economic Affairs and then by the Council for Economic Planning and Development, the Public Utility Regulatory Committee, and DGBAS (Directorate-General of Budget, Accounting and Statistics) of the Executive Yuan. After Taipower's costs and rates are approved, they must be confirmed by the Legislative Yuan before the new rates can be implemented. Compared with the procedure of regulation in the U.S., where the public utility commissions use "prudence reviews" and "used and useful" tests (i.e., are capital assets actually "used and useful" in the company's production effort?) before allowing a capital investment to enter the rate base, the Taiwan case is different in at least two aspects. One is that the members of Taiwan's Public Utility Regulatory

Committee are primarily government officials: there are no consumer representatives and no public hearings. The other is that "used and useful tests" are not applied with regard to the determination of rate base.

According to Averch and Johnson (1962), under a constrained rate of return on capital, such as the above-mentioned case in Taiwan, a utility tends to over-utilize capital in maximizing its profit. This is termed the "A-J effect." Indeed, the neoclassical theory of the optimal regulation of natural monopolies, as developed in Hotelling (1938) and Dupuit (1952), is based on the assumption that the regulator is in possession of perfect information on the regulated entity. However, the assumption is unrealistic in real life, since the regulatory agency obtains a good deal of the information it gets on the regulated entity from the entity itself. And, given the possibility of conflicts of interest, the obtained information could lead to the manipulation or misrepresentation of the facts. Therefore, the more realistic assumption of asymmetric information between the regulator and the regulated entity should be made.[3] If the vertical integration of Taiwan's power industry remains, the government will have to make strenuous efforts to regulate and monitor such a monopoly. If disintegration is pursued, much of such administration cost will be saved in the power generation market.

In addition, cross-subsidies among various sectors can be prevented and operation efficiency can be improved by competition. Without disintegration, the operation and management performance in each sector will be difficult to assess realistically. Moreover, a vertically integrated power company may act against other power generation suppliers when the former is the sole buyer of power generated by the latter. This kind of potential unfair competition is another reason for dismantling the vertical power company.

Some argue that disintegration will hamper synthetic management efforts, known as "management synergy." This may be true to some extent. However, without much competition from the market, such synthetic efficiency might be quite limited anyway. Furthermore, according to Gilsdorf (1994), integration will not essentially reduce the

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[3] See Hsu and Chen (1991a; 1991b).

aggregate cost of operation. That is, from the viewpoint of efficiency and power supply cost, it is not necessary to maintain vertical integration of the power industry.

Revision of the Electricity Act

It is clear that the Electricity Act, first passed in 1947, with minor modification in 1965, can no longer meet the current needs of Taiwan's power market. For example, the roles of cogenerators and independent power producers have not been fully clarified, the rules for monitoring the electricity industry and related regulations are not well-considered, and the franchises for power generation, transmission, and distribution are also not clearly defined. All of the above-mentioned issues should be addressed in a revision of the Electricity Act in the near future so as to meet the needs of a healthy power market. The new draft of the Electricity Act revision, which was approved in the Executive Yuan in August 1995 and has been submitted to the Legislative Yuan for passage, contains most of the points described above. Important aspects of this revision are listed below:

- The power industry is classified into three categories: generation companies (gencos), transmission companies (transcos), and distribution companies (discos).
- One company can operate in no more than 2 of these 3 categories of the power industry.
- Licensing permission from the government is required for company establishment in any category.
- Transmission and distribution business is territory-specified. Only one firm is allowed in a given region.
- Licensing permission will expire after 20 years. A 10-year extension is allowable, subject to the government's review.
- Non-utility generators (NUGs) are defined to include independent power plants, cogenerators, renewable energy suppliers, and others, such as back-up generators owned by electricity consumers.
- Power generated from a company's cogeneration system can be sold to electricity users in the same industrial park or building; power generators using renewable energy sources can supply electricity to electricity users directly. The above conditions

are all subject to the permission of the government.

- Power generated by independent power plants, cogeneration, and renewable energy, can be "wheeled" by transcos and discos to the end-users, with the permission of the government regulatory authority.

In short, this new revision tries to introduce deregulation and disintegration to the current electricity industry. Legal definition of NUGs will have a positive effect on the development of these generators and will reinforce the progress of deregulation in the electricity industry in Taiwan.

Policy Implications And Discussion

Deregulation of the Generation Sector Is a Priority

Deregulation mainly focuses on relaxing or removing regulations to stimulate competition, while privatization seeks to transfer ownership and rights of management and operation from the government to the private sector in order to promulgate entrepreneurship and promote operation efficiency. In other words, deregulation concentrates on market competition, while privatization is centralized on the control of the management mechanism. Usually deregulation is a necessary condition for privatization if the power industry is publicly owned originally. Hence, not every country begins from similar conditions and, for Taiwan, we recommend that deregulation of the power market should precede the privatization of Taipower.

In terms of the deregulation policy planned for Taiwan's electricity industry, the generation sector will be the first part to be deregulated. This policy is quite appropriate because the generation sector, in contrast to the transmission and distribution sectors, represents the largest fraction of total power supply cost. If the generation cost can be effectively reduced through the mechanism of competition, the overall electric rate can be expected to be reduced significantly.

However, it should be noted that IPPs in Taiwan currently have been given approval by the government to install total generation facilities of

10,300 MW, which is expected to be on-line by the year 2002. All together, this will represent roughly a quarter of the power generation market, a proportion which is relatively higher than those of the U.S. and U.K. Given these circumstances, it is important to ensure the reliability of IPP operations. The current Electricity Act revision proposed by the government allows IPPs to be taken over by others in case of bankruptcy or poor performance. In addition, the vulnerability of the Taipower transmission system should be recognized, i.e. the northern region has a serious shortage of power supply in peak periods and needs to have long-range power transmitted from the southern power plants' generators. This is because land for power plants is scarce, and northern Taiwan consumes more than 50% of the load demand of Taiwan due to intensive economic activities in the northern area. This situation will be exacerbated by having IPPs sited in southern Taiwan. Therefore, for the security of the power system, regional balancing is a critical issue in Taiwan. These problems could be mitigated by strengthening and expanding the power transmission system in Taiwan. However, the problem of obtaining the rights-of-way for establishing or expanding transmission has become more and more difficult to deal with. Citizens who live along the proposed transmission routes tend to obstruct such engineering work. As a result, the cost of rebalancing among different regions and achieving a reserve margin for the whole electricity supply system should be allocated between IPPs and Taipower in an equitable manner. In terms of cogeneration and renewable energy, the deregulation policy should continue to promote both types of power generation because they are comparatively more beneficial to the society than conventional steam-turbine power generation.

Relaxing the Limitations on Foreign Capital Investment

According to the current regulations, foreign capital investment is not allowed to exceed 30% of the total amount in any IPP project. This restriction should be lifted for three reasons. First, Taiwan, being a small island, should encourage more foreign capital to flow in and more domestic capital to flow out for investment so as to increase the total amount of international trade of capital. This can enhance the influence of Taiwan in the world economy. Second, owing to Taiwan's ongoing diplomatic difficulties, having more foreign investors will improve the

ties between Taiwan and other countries. Also, in case of any political entanglement or confrontation with other countries, more support from abroad could be expected because those investors will try to protect their local investment with the help of their home countries. Third, by owning and operating the IPPs, foreign investors will enthusiastically transplant relevant technology and management skills to improve the performance of local IPPs.

Relaxing the Limitations on IPP Participation

It should be noted that the current process for installing IPP capacity is controlled by the government and non-periodically open to potential entrants. So far, generation of 7,050 MW has been opened in the first round of bidding (in June 1995) to 7 IPPs, and permission to generate another 3,250 MW was bid on by 4 IPPs at the end of December 1995. However, it is believed that a more liberal policy should be implemented because having more suppliers will stimulate competition through entrepreneurship which will in turn lower the power supply cost and thus benefit the end consumers. Furthermore, many other advanced countries do not have this kind of limitation.

Compared with the problems encountered by IPPs in other countries, the acquisition of land is much more difficult in Taiwan mainly because Taiwan is densely populated and land resources are scarce. Although creating reclaimed land along the west coast is an alternative for sites for IPPs, it normally takes more time to complete the necessary tasks than to simply buy land. Moreover, it is extremely difficult to establish the connections between IPPs and the Taipower transmission grid. The rights-of-way for these connections are difficult to obtain because local citizens frequently obstruct the necessary engineering work and even seek court injunctions to halt the work. A solution to this problem needs to be found as soon as possible.

Another controversial issue is that wheeling is not allowed and Taipower is the sole buyer of the power generated by IPPs. The contract price between the two parties is to be based on bidding with a ceiling of Taipower's "avoided cost." However, Taipower's "avoided cost" is confidential according to the current regulations. In contrast, the "avoided cost" for the contract price in many other countries is deemed public information, and available to all IPPs in advance of bidding.

Currently, many IPPs have complained that the price for bidding the contract is too low. This problem deserves the attention of the government, because pricing signals are indicators for optimal resource allocation.

Conclusion And Recommendations

Taiwan's thriving economy has been clamoring for internationalization and deregulation since the early 1980s. This paper has discussed the deregulation of the electricity industry in Taiwan. After more than 50 years of Taipower monopoly, the current power market in Taiwan is heading toward more deregulation and competition. There are at least three aspects of deregulation which will benefit Taiwan's economy. First, opening the market for power generation can be expected to solve the power shortage problem effectively in Taiwan. Introducing IPPs and promoting distributed generation systems such as cogeneration and renewable energy sources could also help alleviate urban power shortages caused by metropolitan development, where large peak load demand derives from high-rise commercial buildings and where there are difficulties with installing and expanding the distribution network and electric transformers. Second, the level of competition will be essentially improved by a more liberalized market mechanism. Accordingly, the efficiency of operation as well as management will be enhanced and necessary cost will then be reduced. All these will contribute to a reduction in the electricity rate charged to end users. Third, as the electricity market becomes more and more liberalized and diversified, it is expected that new schemes for electricity rates will be developed and introduced to customers, such as priority service rates (i.e., higher reliability sources can charge higher rates while lower reliability sources can charge less). Future and spot markets for electricity sales will also be realized. Customers can utilize the above to hedge their risks in market transactions and to maximize their benefit. In other words, the market will become more customer-oriented and profit-driven.

Private power producers and cogenerators have been encouraged by the government so as to create more competition in the power generating sector. For the past few years, the Taiwan government has promoted the

installation of cogeneration facilities. This strategy seems like it will be the most successful among all the strategies for solving the power shortage problem because of the attractive nature of the cogeneration system: short lead time, better energy efficiency and the possibility for on-site construction. Yet, related regulations and laws are quite incomplete, and the existing legal system which regulates the power market has many deficiencies. The Electricity Act has not been revised for more than thirty years, so revision is essential. The new draft of the Electricity Act was approved by the Executive Yuan in August 1995 and submitted to the Legislative Yuan for final legislation. However, the length of time necessary for review and debate by the Legislative Yuan is quite uncertain.

Finally, it should be emphasized that the deregulation of power generation is just the first step in liberalizing the power market in Taiwan. The deregulation of power transmission and distribution are equally important. In many advanced countries, power wheeling is implemented and transmission and distribution companies are required by law to comply. Therefore, the government should officially announce a plan for the reform of the electricity industry and set up a timetable for the subsequent measures for future deregulation. Of course, in order to carry out all those measures effectively, the education of the public is necessary and communication between related parties, such as government officials, IPPs, utility managers, cogenerators, and electricity users, should be strengthened so as to construct the consensus to successfully complete the overall reform of the electricity industry in Taiwan.

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