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Puree sirasoontorn

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Faculty of economic Thammasat University
ertc@econ.tu.ac.th

Tariff Regulation in Electricity Supply Industry in Thailand

Puree Sirasoontorn*

Faculty of Economics, Thammasat University, Bangkok 10200, Thailand

Abstract— Under the enhanced single buyer model of electricity supply industry in Thailand, tariff regulation is needed to prevent unfair pricing for consumers. Retail electricity tariff, being separated into base tariff and automatic tariff adjustment mechanism, has been regulated by multiple regulatory bodies. Findings reveal that Thai electricity base tariff regulations tended to favor electric utilities rather than consumers, basing on rate of return regulatory approach. In addition, the automatic tariff adjustment mechanism attached greater importance to operators than to the consumers, enabling the former to fully pass the fuel and power purchase burdens through to the consumers. The results of adoption of current regulatory regime are excess capacity in electricity supply industry and excessive profits for electric utilities. This paper, thus, proposed tariff regulatory alternatives that could enhance efficiency of operators while simultaneously sharing these benefits with consumers.

***Keywords*— Electricity Supply Industry, Incentive Regulation, Thailand**

* Tel: 66-8-9778-4227; fax: 66-2-564-2896; email: puree.sirasoontorn@econ.tu.ac.th.

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1. INTRODUCTION

Electricity supply industry (ESI) in Thailand has essentially operated in a monopolistic manner. It consists of four main activities: generation, transmission, distribution and retailing. Transmission and distribution activities are characterized by natural monopoly, thus prompting regulation (Gans and King, 2000). Although generation and retailing can technically be competitive business, they are operated by the state-owned monopolists. From this structure together with its importance as backbone industry needed for economic and social development, tariff regulation to prevent unfair and unrealistic tariffs set by monopolistic operators is needed.

In general, there are four economic goals in tariff regulation, of which two goals are for consumers which are rent extraction and demand-side efficiency goal, and two are for operators which are capital attraction and supply-side efficiency goal (Joskow, 1998). Practically, it is difficult to achieve all goals at the same time. Setting goals in favor of either consumers or operators is not economically desirable. For instance, if the regulators set too high tariff to attract investment (capital attraction goal), it would be unfair for consumers (rent extraction goal). In most of the cases, the regulators prefer to employ a supply side approach. For example, if the regulation could ensure efficient operation, resulting in lower costs of power generation, transmission and distribution (supply-side efficiency goal), it would indirectly benefit the consumers by charging fair and reasonable price (rent extraction goal). Hence, the regulators would be able to achieve two goals of both sides at the same time.

In practice there are two principal regimes of tariff regulation, namely ‘rate of return regulation’ and ‘incentive regulation’. While incentive regulation is best known for providing incentive for operators to improve supply-side efficiency, rate of return regulation guarantees operators that all of the costs incurred will be covered. Under

rate of return regulation, the rate of return is regulated to ensure that it exactly matches the cost of capital. According to Averch and Johnson (1962), this type of regulation provides a firm with incentives to overcapitalization or over-investment because the firms are guaranteed of the return for any investment they have made. In this regulatory approach there is no incentive for the firms to pursue supply-side efficiency whereas capital attraction goal is achieved.

At the other extreme, under incentive regulation the regulators provide incentive to the firms to reduce costs and increase supply-side efficiency. There is no earning guarantee in this regulatory regime. In the real world, both pure regulatory regimes are not feasible. All known regimes lie somewhere between the two extremes ranging from high-powered incentive regulation such as pure price cap and revenue cap regulation to low-powered one such as rate case moratorium and banded rate of return regulation (Rothwell and Gomez, 2003). The regulators in the developed and developing countries employ a combination of incentive regulatory methods in different way. Some developing countries have adopted the incentive regulation, in particular price cap regulation (Jamasb, 2006). Increasing popularity of this approach is due to the successful experiences found in the UK and to the support of such international organization as the World bank (Kirkpatrick et al., 2005).

Thailand employed rate of return regulation for decades and restructured electricity tariff with the attempt to apply a combination of rate of return and incentive regulation approach on its tariff in 2000 and again in 2005.

The idea of electricity tariff restructuring was based on goodwill. However evidence shows that since 2000 on average the electricity tariff has increased through time. Also Thai electricity state-owned enterprises have enjoyed profit resulting from

efficiency improvement. Question arises whether current electricity tariff in Thailand is regulated for social benefits.

This paper aims to study and evaluate the electricity tariff regulation in Thailand since 2000, separating into base tariff and automatic tariff adjustment mechanism (F_t). It starts with brief background of ESI and tariff regulation in Thailand. Then evaluations of tariff regulations, including of their problems and achievements, are discussed separating into base tariff and F_t. Next, the regulatory alternatives will be proposed. The last section concludes the paper.

2. BACKGROUND OF ELECTRICITY SUPPLY INDUSTRY IN THAILAND

The current structure of ESI in Thailand since December 2003 is called the enhanced single buyer model. In this model, the state-owned enterprise (SOE), Electricity Generating Authority of Thailand (EGAT), is a major power producer, a single buyer or monopsonist of electricity from private power producers and a natural monopolist in transmission business.

With an attempt to promote competition in this industry, the government has promoted private sector participation in the generation business in the form of Small Power Producers (SPPs) and Independent Power Producers (IPPs) since 1992. Under the power purchase agreements both SPPs and IPPs are required to sell electricity to EGAT that subsequently transmits to the distributors.

The distribution and retailing activities are the responsibility of other two SOEs, namely the Metropolitan Electricity Authority (MEA) and Provincial Electricity Authority (PEA), in the areas under their jurisdiction. Essentially EGAT generates and supplies electricity to the MEA and PEA for further distribution to consumers. With the current structure, the majority of consumers nationwide have to depend on the services of the three utilities: EGAT, MEA and PEA, as there is no direct

competition in their activities. The structures of operation and of business of ESI in Thailand are in a monopolistic manner.

3. ELECTRICITY TARIFF REGULATION IN THAILAND

Due to monopolistic nature of ESI in Thailand, tariff regulation is needed to prevent unfair pricing for consumers. In Thailand, retail electricity tariff is separated into base tariff and F_t. Base tariffs have been restructured and revised for a number of times without any standard regulatory period but for various reasons, including of economic, financial, social or even political reasons. The most recent base tariff restructuring was conducted in 2000 and 2005. Since firstly employed in 1992 the formulas of F_t were revised occasionally. The recent ones were conducted together with base tariff in 2000 and 2005. Currently rate of F_t is reviewed every four months. This section will firstly discuss on roles of multiple regulatory bodies and stakeholders in tariff determination processes. Then electricity tariff structure and determination will be described.

Multiplicity of regulatory bodies and stakeholders in tariff determination process

By the time of writing, in Thailand there is no single, formal and independent regulatory body for ESI. There are a number of authorities acting as regulators at the policy and operational levels. On the one hand, there is Ministry of Energy (MOE) and National Energy Policy Council (NEPC) responsible for energy policy including setting the policy principle in determining the power tariff structure. NEPC is also in charge of approval for new tariff structure developed in 2000 and 2005. On the other hand, there is the Energy Policy and Planning Office (EPPO) under MOE (formerly the National Energy Policy Office (NEPO) under the Office of the Prime Minister) responsible for tariff restructuring, tariff determination and tariff review of both base

tariff and F_t. Later in this paper, multiple regulatory authorities will collectively be called 'regulators'.

Apart from permanently assigned authorities in charge of tariff setting, some committees, in which members are from governmental agencies, electricity state-owned enterprises and various stakeholders, are appointed occasionally and temporarily to commission a particular regulatory tasks.

For example, Committees on Electric Power Tariff Restructuring in 2000 comprised of representative from NEPO, the Office of National Economic and Social Development Board (NESDB), the Comptroller-General's Department, the Public Debt Management Office, the Federation of Thai Industries, the Thai Chamber of Commerce, academicians, EGAT, MEA and PEA.

Later in 2005, in order to restructure electricity tariff, the MOE appointed a Sub-Committee on Electricity Tariff Restructuring, chaired by Deputy Permanent Secretary of Energy. The Sub-Committee members comprised representatives from EPPO; NESDB; the State Enterprise Policy office and the Public Debt Management Office under Ministry of Finance; three public utilities: EGAT, MEA, PEA; the Federation of Thai Industries; the Thai Chamber of Commerce; academics and consumers.

The combination of representatives from governmental agencies, public utilities, industrial and residential consumers and academics has shown the good attempt to allow participation from various interest groups in tariff determination process. However, the question, to what extent of their involvements should be to balance the utilization of their expertise and the avoidance of regulatory capture, arises.

Objectives of electricity tariff structure

Tariff restructuring in 2000 and 2005 attempted to achieve the same objectives. As well stated in 2005 tariff restructuring reports:

> The objectives of the current electricity tariff structure determination are: (1) to have a tariff that best reflects the economic costs and to promote efficient use of electricity, in particular to encourage less consumption during the peak period of the power system, which will help reduce generation and distribution costs in the long run; (2) to secure the financial status of the three power utilities, which will enable future expansion of their operations; (3) to provide greater fairness for all power consumer categories by reducing cross subsidization from one consumer category to another; and (4) to devise a mechanism for the electricity tariff adjustment that is flexible and automatic, to be more in line with the changing fuel prices under the competitive market.

To achieve those objectives, electricity tariff structure has been separated into base tariff and F_t. The base tariff consists of bulk supply tariff representing wholesale tariff which EGAT charges MEA and PEA and retail tariff which MEA and PEA charge power consumers on the fixed basis during each regulatory period. In addition power consumers have to pay for F_t which are reviewed and adjusted in every three months.

Base tariff determination

In determining the base tariff, two main models: long run marginal cost (LRMC) model and financial model of each activity and each state enterprise are estimated for base tariff.

Essentially the long run marginal costs of each activity, taking into account of different time of use, losses in transmission, voltage levels and geographical locations,

loss of load probability, to determine the capacity costs of generation, transmission and distribution systems. The costs of service provision for each individual customer category are also calculated. They are estimated under the main assumption that the generating capacity will be expanded to satisfy increasing power demand. This model relies on various assumptions such as the fuel costs, EGAT PROSCREEN marginal generation costs, investment plan, and operating expenses.

The resulting marginal cost based tariff which will vary by the voltage levels and geographical locations comprises of energy charge and demand charge. While energy charge is calculated from the costs of generation and transmission businesses plus loss in the system and transmission cost is also apportioned to the peak and off-peak period, demand charge is calculated from the distribution costs.

In financial model, the search for base tariff at the level to fully compensate three utilities financial burden incurred from investment and operating expenditures is conducted under operational and financial assumptions.

In this model, base tariff are derived from revenue requirement of each activity and each state utilities to ensure financial viability and capability to expand power business in the future. In order to estimate revenue requirement, explicit assumptions, particularly on fuel prices, inflation rates or consumer price index (CPI), efficiency improvement of each activity (X factor), investment plan, financial criteria, lump sum financial transfer, and remittances to the government are imposed.

Load forecast prepared by the Load Forecast Sub-Committee is employed to develop power development plan and transmission system expansion plan for EGAT and distribution system investment plan for MEA and PEA. Load forecasting for moderate economic growth scenario was used for investment and operational plans in 2000. Owing to change in demand, in 2005 the load forecast was scaled down at an average

of 700 GWh per year from those forecast under MEG scenario. Hence the investment plans for transmission and distribution activities are readjusted accordingly.

In addition, the cash-based financial criteria are employed to estimate revenue requirement to ensure that sufficient revenue would be generated to enable the utilities to make further investments and to pay back loans together with interests. The financial criteria since 2000 are shown in Table 1. Debt equity ratio (D/E ratio) has been capped at 1.5 times for all state utilities. Debt service coverage ratio (DSCR) are set at least 1.3 times for EGAT and 1.5 times for MEA and PEA. Before 2005 self-financing ratio (SFR) was set at least 25% for all three firms. Then in 2005 return on invested capital (ROIC) was introduced and set at 8.39% for EGAT and 4.8% for MEA and PEA. There are several reasons why ROIC for EGAT is higher than those for MEA and PEA. Firstly, by the time of conducting 2005 tariff restructuring EGAT planned for the initial public offering in the Stock Exchange of Thailand within the year 2005 so the ROIC should be attractive to investors. Secondly, investment in the public service obligation such as PEA's investment in remote rural areas or MEA's investment in relocating the distribution lines to underground will be directly subsidized from the government.

Revenue requirements are estimated to include the remittance rates to the government, income tax and dividends in the base tariff for various circumstances. As for 2005 tariff determination, if the power utilities remain non-corporatized and non-privatized, the remittance rates would be set at 35% of the net profit for EGAT and 40% for distribution utilities. However, if three state utilities were privatized, the income tax would be set at 30% of the net profit and dividends at 50% of the after tax net profit.

One important operational assumption is the X factor. In 2000, the X factors for the generation, transmission, and distribution and retail business are set at the rate of

5.8%, 2.6% and 5.1% per year, respectively. These X factors are also employed for 2005 tariff determination together with the coefficient of cost volume elasticity (CVE) of 0.8[1]. The ratio of operating costs in the portion of non-fuel cost and power purchasing prices to which these X factors and CVE are applied has increased from 40% in 2000 to 48% in 2005.

Macroeconomic and market assumptions such as inflation rate, interest rate, exchange rate, and fuel prices, are also imposed in both LRMC and financial model.

Thailand has adopted uniform tariff approach being applied nationwide for each customer category for social and political reason. To implement the uniform tariff, subsidization for certain customer categories, especially residential consumers, is required. This type of cross subsidization is implemented through direct financial transfers from MEA to PEA and sometimes from EGAT to PEA as shown in Table 2. From marginal cost and financial model, marginal cost based tariff are rescaled to meet the estimated revenue requirements derived from financial models of three utilities. For example, as for 2000 tariff determination, energy charge was scaled to 115% of marginal costs to ensure that generation business meets its financial requirements whereas the transmission charge was scaled to 70% of marginal cost of transmission activity. The overall impact of these scaling was to increase tariffs relative to marginal costs at higher voltages and during off-peak hours and to reduce tariffs below marginal costs at lower voltages during peak hours.

The estimated tariff consists of bulk supply tariff (BST) that EGAT sells to both MEA and PEA and retail tariff. As a result, the average BST for October 2005-December 2008 has been set at 1.6648 baht/kWh, which is lower than the previous BST by 3.54%.

[1] It means that for each increasing sale unit, only 0.8 time the incremental costs per unit is allowed to be passed on to consumers.

Automatic tariff adjustment mechanism

The base tariff was estimated based on a number of assumptions hence it cannot reflect the timely actual cost of electricity business. Moreover, with long regulatory lag for five years, longer than the international standards, there is potential for significant cost shocks to occur; potential for unanticipated demand growth leading to significant abnormal profits; and potential for unanticipated shocks affecting investment requirements that could have impact on the utility operations.

In order to have the actual costs reflected by the power tariffs and to reduce impact of the fuel price volatility on the power utilities' financial status, the F_t was firstly introduced in 1991 and firstly implemented in 1992.

Over the years the F_t formula has been revised from time to time to be more appropriate for the changing economic situation, financial conditions of state utilities and regulatory objectives in Thailand. In 2000 the F_t was unbundled into generation, transmission and distribution and retailing businesses.

At that time, F_t formula included of fuel costs and power purchasing prices from private power producers and foreign countries, changes in foreign exchange rate, changes in non-fuel operating expenditures, changes in marginal revenue, discrepancy charge between the expected and actual collection of F_t in previous period, and accumulated discrepancy of energy adjustment charge.

In 2005, F_t formula was revised and simplified. It composes of two components: constant F_t at 0.4683 baht/kWh and change in F_t or ΔF_t due to fuel costs and power purchasing prices differing from the constant F_t. The costs of fuel and energy purchase include fuel expenses of EGAT power plants, power purchase from private producers and neighboring countries such as Laos and Malaysia.

The revised F_t formula is claimed to be more beneficial to power consumers than the previous one because the consumers are passed through only the fuel cost and power purchasing prices and do not have to bear the other financial burden from the other factors.

4. KEY ISSUES IN TARIFF REGULATION

Electricity tariff regulation in Thailand was specially designed to fit with the current structure of ESI. Hence both natural monopoly activities (transmission and distribution) and competitive activities (generation and retailing) are heavily regulated in order to ensure that consumers are least affected from the monopoly power of state utilities.

As discussed above, the base tariff and F_t structure are based on the various assumptions. They have changed occasionally but still relied on the hybrid regulatory approach between the rate of return regulation and incentive regulation.

The objectives of both electricity tariff determinations since 2000 are simultaneously to satisfy the rent extraction goal (ie. to have tariff that genuinely reflects the economic costs); demand-side efficiency goal (ie. to promote efficient use of electricity); capital attraction goal (ie. to secure the financial status of three utilities); consumer-consumer distribution goal (ie. to provide fairness across all power consumer categories by reducing cross subsidization from one category to another); and tariff flexibility goal (ie. to achieve a mechanism of the electricity tariff adjustment). The tariff determination since 2000 has neglected the supply-side efficiency goal.

It is a big challenge for regulators to achieve the aforementioned goals at the same time. For instance, in order to secure the financial status of three utilities the regulators need to set tariff high enough to attract investment but unable to achieve

rent extraction goal. Prioritizing these objectives and setting tariff regulatory regimes accordingly by taking stage of development concerning regulation are needed (Laffont, 2005).

The observations on the tariff restructuring approach including base tariff and F_t are made in the following section.

Rate of return regulatory approach and base tariff regulation

It could be seen that the current base tariff regulation, which attaches much importance to the financial status of the three utilities, is dominated by the rate of return regulatory approach. Such regulation favors the power utilities and works toward the capital attraction goal. The fact that the Thai regulators attach more importance to this kind of regulation than the incentive regulation deserves a scrutiny. First, the current practice of assuring the investors of the high return has not provided powerful enough incentives for them to improve performance efficiency and cost reduction. It might encourage overcapitalization, leading eventually to higher tariffs. The second consideration is the appropriateness of the financial criteria and other assumptions governing tariff determination. One of the most important financial criteria is ROIC. EGAT was allocated a higher ROIC rate than its distribution counterpart. Moreover the ROIC for EGAT was set at 8.39% higher than the weighted average costs of capital (WACC) for each business, 7.24% for power generation and 6.85% for the transmission business. The ROIC was adopted as a financial criterion rather than WACC. In fact, WACC could clearly reflect the cost of capital, consisting of the cost of debt and equity. Adopting WACC as financial criterion will give utilities reasonable return to compensate for cost incurred. An observation here is whether employing ROIC had given an unrealistic return to state utilities.

Another observation is that the ROIC calculation was based on the return of the average invested capital. The regulators used historical costs as the basis for calculation of assets. The valued assets could be more than necessary or not directly related to the electricity businesses and led to asset overvaluation. To reduce the problem of excess capacity and over-engineering, the widely adopted method for asset valuation, called the depreciated optimized replacement cost method by which the assets actually used in the operation are optimized, leaving out the excess capacity and unrelated assets, would be more appropriate.

Another financial issue is whether it is appropriate to include the remittance or dividend to the government in the calculation of the base tariff. The current base tariff model incorporates remittances to the government and dividend into revenue requirement of state utilities. Consequently the consumers are charged higher tariff so as to enable the three power utilities to send their remittances or dividend to the government.

Application of incentive regulation to base tariff regulation

Incentive regulation was incorporated into tariff determination through the X factors and CVE. The X factors applied with non-fuel and non-power purchasing controllable operating costs for the generation, transmission, and distribution and retail businesses are 5.8%, 2.6% and 5.1%, respectively. These X factors have been employed since 2000. The only difference between imposition of X factors in 2000 and 2005 is that the proportion of non-fuel and non-power purchasing controllable operating costs have been increased from 40% in 2000 to 48% in 2005. This warrants a number of comments.

First, the electricity business entails a huge investment and high uncontrollable operating expenses. Applying efficiency improvement parameters to non-fuel and

non-power purchasing controllable operating costs create negligible effects on operating cost reduction and subsequently total cost reduction. Table 3 exhibits a proportion of controllable operating costs applied with CVE and X factors to total operating costs are 4.9%, 3.2% and 3.8% of EGAT, MEA and PEA respectively.[2] Therefore, although the regulators expected the operators to increase their efficiency in line with CVE and X factors, the gains from efficiency improvement were limited and unlikely to reduce the operating expenses as a whole.

These observations lead to a conclusion that the attempt to apply incentive regulation to operating expenses has not been effective enough. Besides, in spite of the significant success stories of the incentive regulation elsewhere, the regulators still lacked mechanism that would enable the benefits, derived from the supply-side efficiency in form of reduced costs or greater profits, to be carried over to the consumers in the form reduced tariff, thus achieving rent extraction goal. As a consequence, only the operators reap benefits from efficiency improvement.

Another noteworthy issue is concerned with the method to determine X factor. Ideally, it needs to be up-to-date, incentive-oriented. In Thailand the X factors has remained the same as those of 2000. With no revised estimation, they are unable to reflect the current efficiency level and cannot provide strong incentive for efficiency improvement to power utilities. In addition, it might assist firms to play regulatory game by overestimating the operating expenses before being imposed by efficiency improvement parameters.

[2] They are calculated on the basis of 48% of EGAT operating costs applied with efficiency parameters, including operating expenses, transmission expenses and administrative expenses, representing 10.16% of its total operational costs; of MEA operating costs, representing 6.65% of its total operational costs; and of PEA operating costs consisting of distribution and supply costs, representing 7.85% of its total operational costs.

Full cost pass through and F_t regulation

F_t was designed to pass through uncontrollable costs from operators to consumers. Although F_t formula has been changed occasionally, the concept of full cost pass through is still intact.

As for F_t review in 2005, the constant F_t was set at 0.4683 baht/kWh so the F_t would not be lower than 0.4683 baht/kWh except the ΔF_t being negative. In addition, the practice guarantees the operators that they could transfer the burden of fuel costs and power purchase to the consumers, resulting in a full-cost pass through, through ΔF_t. The F_t regulation should ideally be designed in a way to encourage the operators to enhance supply-side efficiency and power purchase efficiency. The full-cost pass-through ΔF_t failed to achieve the supply-side efficiency. It might pay the way to collusion between EGAT and private power producers and between the fuel buyers and sellers (Arizu et al., 2004).

Excess capacity

As discussed in previous sections, the current tariff regulation in Thailand is biased toward rate of return regulatory regime rather than incentive regulatory regime. The classic result of this rate of return regulatory regime is overcapitalization or overinvestment in electricity sector, sometimes called Averch and Johnson effect. Since the utilities are guaranteed with certain levels of rate of return, they might have more incentives to invest and expand their business.

Considering the case of Thailand, as shown in Table 4 the level of excess capacity maintained by EGAT and private power producers in Thailand is well above the 25% international standard. It reflects the underutilization of installed capacity at 34.36% on average since 1997. Although the higher excess capacity provides more reliable

and secured electricity system, the reliability is accomplished by a very high cost of excess capacity.

The further observation is that the levels of excess capacity has significantly been increasing since 1997 and declining after 2000. The abrupt changes in excess capacity can be explained by the fact that the huge power plant projects were required planning few years ahead. Before financial crisis in 1997 to serve the high growth rate electricity demand in Thailand, several power plant projects were approved. It took several years to finish building up the plants whereas the growth rate of demand after financial crisis was unexpectedly and significantly declining. As a result, the excess capacity was increasing following the old investment plan.

The regulators have attempted to readjust the forecast demands from time to time to reflect the actual demand as much as possible in order to avoid the unnecessary investment. As a result, the excess capacity has declined significantly from 41.06% in 2002 to 28.69% in 2006.

Electricity tariff

As shown in Table 5 under current regulatory regime, since 1997 Thai electricity base tariff and F_t has fluctuated from time to time whereas CPI has increased through time. Considering only period of 2001-2006 in which the new tariff restructuring was in place, the evidence showed that on average the growth rate of CPI was 2.66% whereas the growth rates of indexed base tariff, F_t and total tariff were 3.97%, 16.77% and 4.99%, respectively. These numbers evidently show that during that time on average the growth rates of tariff have been marginally higher than the growth rate of CPI. It implies that the electricity users have paid for electricity at the marginally higher rate than their cost of living. The higher rates were induced not only by

applying rate of return regulatory regime but also by adopting discretionary price setting regime.

The multiple regulatory bodies, particularly Committees on Electric Power Tariff Restructuring and F_t Sub-Committee, have discretionary power in setting both electricity base tariff and F_t. For example, in October 2000, they agreed to incorporate F_t in previous month into new restructured base tariff while new F_t was zero for three months. As a result, base tariff jumped up from 1.6567 baht/kWh in September 2000 to 2.2751 baht/kWh in October 2000. However the total tariff declined due to zero F_t. Discretionary tariff setting regime allowed politics to be involved in electricity tariff determination. The recent example is when government planned to partially privatize EGAT, the tariff restructuring in 2005 was urgently needed to prepare EGAT for initial public offering (IPO). As a result of this restructuring, total tariff has gone up from 2.9151 baht/kWh in September 2005 to 3.0014 baht/kWh in October 2005.

When comparing Thai electricity tariff with developed countries adopting incentive regulation, as shown in Table 6, Thai electricity tariff was relatively high. These countries have undertaken ESI restructuring and their regulatory frameworks and institutions have been established and developed for quite some times. Incentive regulation is applied to tariff setting for natural monopoly activities while wholesale tariff is not directly regulated but is determined by various electricity market mechanisms such as power pool, or bilateral contract.

Nevertheless, Table 7 shows that when comparing Thai electricity tariff with those of ASEAN member countries, in 2005 Thai residential, commercial and industrial electricity tariffs were lower than those in other countries at the same level of development such as Philippines, Malaysia and Singapore but higher than such countries as Indonesia and Lao in which electricity tariffs are still heavily subsidized.

Performance of state utilities

The current mixture of regulatory regimes in Thailand also has some implications on financial performances of state utilities. On one hand, that utilities earn excessive profits can be expected under rate of return regulatory regime. On the other hand, due to political intervention and adoption of discretionary tariff setting, utilities might experience losses.

As shown in Table 8, three utilities have reaped huge net income from their operation since 2000. Only in 2005, EGAT's net income reduced significantly because it was prepared for IPO. MEA and PEA are also financially healthy.

However, although the regulatory framework was put in place at beginning, sometimes regulators exercised discretionary power to freeze F_t. For example, during February-May and June-September 2003 in order to freeze F_t at 0.2612 baht/kWh, EGAT was requested to absorb fuel costs by the amount of 1.7 and 3 billion baht, respectively. That adversely affected EGAT financial status.

Moreover, as SOEs, three utilities are required to remit their income to government. Apparently only profitable EGAT has capability to do so. In 2005 EGAT's remittance to government was the highest among all SOEs, amounting to 16.93 billion baht. Undoubtedly that would have unfavorable impact on EGAT's financial status.

5. TARIFF REGULATORY ALTERNATIVES

From the above analysis, it is obvious that the current tariff regulatory regime have created certain concerns. These concerns range from regulatory governance due to the lack of single regulatory body responsible for tariff setting, possibility of regulatory capture due to high degree of electricity operators' involvement in tariff determination process, and regulatory substance in tariff setting biased to rate of return regulatory approach, leading to excess capacity and high profit for state utilities.

Application of incentive regulation will be more effective if ESI is restructured by unbundling competitive activities from natural monopoly activities and only tariffs of transmission and distribution network are regulated. However, this paper does not aim to discuss solutions or alternatives for all of concerns but aims to propose only alternatives for tariff regulatory approach under current ESI model.

To ensure that state utilities only benefit from their efficiency improvement through controllable cost saving, it is appropriate to make uncontrollable cost a pass-through F_t. Consideration should be given to formula of F_t based on the full-cost pass-through approach. The formula should be revised, using incentive regulation, to encourage operators to increase their efficiency in fuel supply, investment and power purchase. Instead of limiting controllable cost, 'revenue cap regulation' can be employed to control revenue. CPI-X revenue cap can be applied to correct any over or under recovery of revenue. The simple way as re-basing an element of the control to capture costs diverging from levels forecast *ex ante* can be adopted.

Evidence shows that under current tariff regulation, three utilities earn excessive profits, which may result from their own efficiency in cost reduction or high tariff, particularly a continuously increasing base tariff. By all mean, as state agency concerning not only its own profit but also consumer welfare, they should share their excessive or abnormal profits to the consumers through what so called 'profit-sharing or sliding-scale regulation'. Sliding-scale regulation is a compromise between rate of return regulation and a price cap or revenue cap regulation (Parker and Kirkpatrick, 2005).

Under this regulatory approach, the new round of tariff will be adjusted according to the returns or *s* in the following formula:

$s = r_t + h(r^* - r_t)$

when h is a constant between 0 and 1, r_t is the realized rate of returns for the investors in year t, and r^* is the target of return (Joskow and Schmalensee, 1986).

If h=1, the tariff will be adjusted according to s, which is equal to the target rate of return.

If h=0, the tariff will be adjusted according to s, which is equal to the realized rate of return in year t. All the profits and loss will fall on the shoulder of the utilities only.

If h is between 1 and 0, say, h=0.5, the profit or loss that occurs will be equally shared by the investors and the consumers.

It should be noted that h can be readjusted when the new base tariff readjustment is made. The value of r^* can be determined by WACC. Thus, the rate of return that the investors could use to calculate the revenue requirement in the next round will be lower, leading to the lower tariff in the new round of base tariff calculation. In this way, the determination of h will have a substantial impact on the profit sharing between the operators and consumers.

To avoid taking undue advantage of the operators, the regulators may introduce the rate of return bands in advance. For instance, in an event of the expected rate of return being set at 12%, if the realized rate of return is between 12% and 15%, h will be set at 0.25. In other words, the operators will give the consumers 25% of the net profit after tax. However, when the realized rate of return goes as high as 15-18%, they will give the consumers 50% of the net profit after tax (h=0.5). When the realized of return is higher than 18%, the consumers should receive 75% of the net profit after tax (h=0.75). It can be seen from the examples that the higher the realized of return, the higher the profit shared by the consumers should be (h is greater). The profit could take the form of a lower base tariff in the next round of base tariff determination. In order to ensure that the sliding-scale regulation does not remove all

incentive for the firm to increase efficiency and to invest and maintain service of quality, it is practical that *h* is set at not more than 50%.

6. CONCLUDING REMARKS

This paper studies and analyzes the electricity tariff regulation in Thailand since 2000, separating into base tariff and F_t.

The analysis exhibits that base tariff determination relies on the hybrid regulatory approach biased toward rate of return regulation. The attempt to employ incentive regulation has been made, however its effect on tariff setting is negligible. The consequences of adoption of rate of return regulation are excess capacity, increase in base tariff through time and excessive profits of state utilities. This study recommends some tariff regulatory alternatives such as sliding scale regulation to provide incentive for efficiency improvement to state utilities and to ensure that consumers share part of benefits from efficiency improvement through reduction in tariff in the next period. However, given the Thai unique ESI, the current tariff regulatory regime has merit of its own. It was successful to provide stable, reliable and adequate electricity supply, particularly during period of high and unpredictable demand growth and was main factor contributing to favorable economic and investment environment in Thailand. Nevertheless, as economic condition changes, tariff regulatory regime should occasionally be re-evaluated and redesigned.

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Table 1. Financial Criteria

	2000			2005		
	EGAT	MEA	PEA	EGAT	MEA	PEA
SFR (%)	≥25	≥25	≥25	-	-	-
DSCR (times)	≥1.3	≥1.5	≥1.5	≥1.3	≥1.5	≥1.5
D/E Ratio (times)	≤1.5	≤1.5	≤1.5	≤1.5	≤1.5	≤1.5
SM/L Debt (%)	-	-	-	-	-	-
ROIC (%)	-	-	-	8.39	4.8	4.8

Source: Electricity Tariff Restructuring Reports, NEPO, February 2001 and EPPO, 17 October 2005

Table 2. Financial Transfers between State Electric Utilities during 2000-2008

(Million Baht)

Year	MEA to PEA	EGAT to PEA	Total
2001*	8,153	-	8,153
2002*	8,589	-	8,589
2003*	9,041	-	9,041
Oct-Dec 2003	1,677	880	2,557
Jan-Dec 2004	7,165	3,936	11,101
2005	9,083	-	9,083
2006	10,507	-	10,507
2007	10,728	-	10,728
2008	11,014	-	11,014

Source: Electricity Tariff Restructuring, NEPO, February 2001 and EPPO, 17 October 2005

Table 3. Operating Expenses Ratios of the Three Utilities

Operating expenses	Operating expense ratio (%)
EGAT	
Total expenses	100
Fuel expenses	25.07
Operating expenses	74.93
Power purchase	57.73
Operating expenses*	4.11
Transmission expenses*	1.32
Administrative expenses*	4.73
Amortization of land right	0.17
Depreciation	6.55
MEA	
Operating expenses	100
Power purchase	80.89
Cross subsidy	8.14
Operating expenses*	6.65
Depreciation	4.33
PEA	
Operating expenses	100
Power purchase	93.14
Cross subsidy	-5.96
Distribution and supply cost*	7.85
Depreciation	4.97

Note: * represents operating expenses using the X factor in the estimation

Table 4. Peak Demand, Installed Capacity and Excess Capacity in Thailand

Year a/	Peak demand (MW)	Installed capacity (MW) b/	Excess capacity (%) c/
1997	14,506.3	16,964.9	16.95
1998	14,179.9	17,936.3	26.49
1999	13,712.4	19,100.7	39.3
2000	14,918.3	22,269	49.27
2001	16,126.4	22,004.8	36.45
2002	16,681.1	23,529.8	41.06
2003	18,121.4	25,422	40.29
2004	19,325.8	26,349.3	36.34
2005	20,537.5	26,450.2	28.79
2006	21,064	27,107.2	28.69

Source: EGAT

Note: a/ 1997-2004 is budget year whereas 2005-2006 is calendar year. b/ Installed capacity of both EGAT and private power producers who sell and transmit electricity to EGAT transmission network. c/ Excess capacity is calculated from percentage of difference between installed capacity and peak demand to peak demand

Table 5. Electricity Tariff and Tariff Index in Thailand

Year	CPI	BaseTaiff (baht/kWh)	Base tariff index	Ft (baht/kWh)	Ft Index	Tariff (baht/kWh)	Tariff Index
1997	88.8	1.7	75.44	0.2793	126.86	1.9793	80.02
1998	96	1.6961	75.27	0.5023	228.14	2.1985	88.88
1999	96.2	1.6708	74.15	0.4088	185.67	2.0796	84.08
2000	97.8	1.8174	80.66	0.4534	205.92	2.2708	91.81
2001	99.4	2.273	100.87	0.2288	103.92	2.5018	101.14
2002	100	2.2533	100	0.2202	100	2.4735	100
2003	101.8	2.2475	99.74	0.2577	117.05	2.5052	101.28
2004	104.6	2.2426	99.53	0.3852	174.93	2.6278	106.24
2005	109.3	2.2428	99.53	0.4785	217.32	2.7213	110.02

Source: Bank of Thailand, EPPO and author's calculation

Table 6. Electricity Tariffs in Major Countries

(US dollar/kWh)

Country	Industrial users	Residential users
Australia	0.0609	0.0985
Canada	0.049	0.0676
South Africa	0.0218	0.0592
United Kingdom	0.1322	0.2205
United States	0.0613	0.1002
Thailand a/	0.2329	0.2367

Source: Key World Energy Statistics 2007 by IEA

Note: a/ Average tariff in baht from EGAT being converted by PPP conversion rate at 12.896 baht per US dollar in 2007.

Table 7. Average Basic Electricity Tariff in ASEAN Member Countries in 2005

(US dollar)

Country	Residential users	Commercial users	Industry
Brunei Darussalam	8.92	7.47	7.441
Cambodia	12.02	15.015	12.975
Indonesia	2.81	3.76	2.715
Lao PDR	1.56	3.37	2.52
Malaysia	7.07	6.42	6.42
Myanmar	7.32	7.32	7.32
Philippines	7.25	7.075	7.42
Singapore	9.82	6.175	5.78
Thailand	**5.51**	**5.265**	**5.09**
Vietnam	5.19	8.525	7.865

Source: ASEAN Centre for Energy

Table 8. Financial Performances of State-Owned Electric Utilities

EGAT				
Year	Net income from operation (Billion baht)	Return on equity (%)	Return on asset (%)	Debt equity ratio (%)
1999	-13.02	-20.62	-6.12	1.98
2000	31.29	16.49	4.64	1.77
2001	26.21	12.1	3.96	1.37
2002	36.13	19.52	6.91	1.09
2003	38.55	19.26	7.93	0.78
2004	35.52	16.16	7.52	0.59
2005	4.78	na	-0.04	1.05
2006	42.71	na	10.05	0.87
MEA				
Year	Net Income from Electric Operations (Billion baht)	Return on equity (%)	Return on asset (%)	Debt equity ratio (%)
1999	3.51	-3.83	-1.18	1.02
2000	3.58	8.38	2.54	1.09
2001	5.05	11.94	3.68	1.06
2002	3.93	10.54	3.48	0.91
2003	3.19	7.21	2.6	0.87
2004	5.68	9.86	3.86	0.77
2005	5.89	9.56	3.78	1.52
PEA				
Year	Net Income from Electric Operations (Billion baht)	Return on equity (%)	Return on asset (%)	Debt equity ratio (%)
1999	8.13	-14.30	-4.96	1.5
2000	7.42	12.52	4.26	1.56
2001	5.72	10	3.51	1.94
2002	6.06	10.07	3.53	1.92
2003	6.01	9.41	3.34	1.9
2004	5	7.48	2.61	1.98
2005	13.63	18.28	6.67	1.81

Source: Annual reports of EGAT, MEA and PEA