Thailand

Power Distribution System Reinforcement Project (3-2) (3-3)

Report Date: October, 2002
Field Survey: July, 2001

1. Project Profile and Japan's ODA loan

Site Map：Thailand

Site Photo: Ang Thong 1 Substation

1.1 Background

In the fifth (1982-86) and sixth (1987-91) five-year plan of the Government of Thailand, rural development was addressed as one of the highest priority national policies. Rural electrification was considered vital to sustaining the development. In this context, the Provincial Electricity Authority (PEA)[1] set the goal of raising the village electrification rate[2] to 95% by 1991, from 50.3% in 1982.

In addition, it was estimated that electricity demand in Thailand would increase, on average, by 7-10 % annually during the 1980s and early 1990s. Serious operating problems, such as electricity loss in the system, were also needed to be solved. In order to assure a stable and efficient power supply under these conditions, reinforcement of the power distribution system was considered indispensable. Under these circumstances, "Third Stage of Power Distribution System Reinforcement Project (PDSR)" was initiated with the objective of extending electricity supply in 56 substation areas in total, and implemented in three phases.

1.2 Objectives

Objectives of Phase II and III of Third Stage of PDSR (3-2, 3-3) are to improve the efficiency and reliability of electricity service and extend electricity supply in 43 substation areas out of 56 substations areas targeted by entire Third Stage of PDSR, ultimately to promote the rural development.

[1] PEA is a governmental enterprise and operates and maintains power transmission and distribution lines in non-metropolitan areas.

[2] The number of electrified villages / the total number of villages

1.3 Project Scope

<A. Third Stage Phase II>

1) Procurement and installation of the following items for 18 substation areas:
   ① 22 kV, 33 kV and Low Tension Distribution Lines
   ② 115 kV Circuit Breakers, Transformers, Capacitators, Switch Gears and Reclosers
   ③ High and Low Tension Meters

2) Location of 18 substations areas are:

Region	Construction of New Substation areas	Reinforcement of Existing Substation areas
North Region (NR)	Nan, Lop Buri 2, Chai Baden, Takhli 2,	Lop Buri 1, Manorom, Nakhon Sawan 1,
Northeast Region (NER)	Bung Kan, Khon Kaen 2	Udon Thani 1, Yasothon, Nakhon Ratchasima 1,
Central Region (CR)	Wathana Nakhon, Trat,	
South Region (SR)	Phuket 2, Satun, Pattani.	Nakhon Si Thammarat

<B. Third Stage Phase III>

1) Procurement and installation of the following items for 25 substation areas:

   ① 22kV, 33kV and Low Tension Distribution Lines,
   ② 22kV and 33kV Distribution Transformers, Capacitators, Switch Gears, and Reclosers
   ③ High and Low Tension Meters

2) Location of 25 substation areas are:

Region	Construction of New Substation areas	Reinforcement of Existing Substation areas
North Region (NR)	Nakhon Sawan 2	Mae Hong Son, Tak, Sing Buri
Northeast Region (NER)	Ubon Ratchathani 2	Udon Thani 2, Chum Phae, Na Kae, Nakhon Phanom, That Phanom, Mukdahan, Sirindhon, Pak Chong
Central Region (CR)		Ayutthaya, Ang Thong 1, Rayong 1, Bang Pong 2
South Region (SR)	Lang Suan	Ratchanburi, Prachub Khirikhan, Lamphura, Phuket 1, Phunphin, Krabi, Phattalung

1.4 Borrower/Executing Agency

Provincial Electricity Authority (PEA)

1.5 Outline of Loan Agreement

	Third Stage Phase II	Third Stage Phase III
Loan Amount	8,440 million yen	6,820 million yen
Loan Disbursed Amount	8,372 million yen	6,787 million yen
Exchange of Notes	July, 1984	September, 1987
Loan Agreement	September, 1984	September, 1987
Terms and Conditions		
Interest Rate	3.5% p.a.	3.0% p.a.
Repayment Period (Grace Period)	30 years (10Years)	30 years (10Years)
Procurement	General Untied	General Untied
Final Disbursement Date	September, 1989	September, 1992

2. Analysis and Evaluation

2.1 Relevance

At the time of appraisal, the Thai Government placed importance on the role of the power sector in promoting the development of rural areas and new industrial and commercial areas . Reinforcement of the power distribution system, in order to meet growing demand and to improve reliability, was considered a prerequisite for promoting both rural development and industrial development. The needs to expand electricity supply and to improve the distribution system were addressed in the 5th (1982-86) and 6th (1987-91) National Economic and Social Development Policy (NESDP). Thus, the project objective was relevant to national policy at the time of appraisal.

Under current national policies -- the 8th (1997-2001) and 9th NESDP (2002-06) -- the importance of regional dispersion industry zone and of promoting a better quality of life is given priority. The need for expanding electricity to rural areas and for increasing the reliability of power distribution remains a concern of the Government and thus the project objective remains relevant.

2.2 Efficiency

< A. Third Stage Phase II>

A 2.2.1 Project Scope

The actual scope of project was essentially same as originally planned, except for an increase in the number of Low Tension Meters. The number of the meters was increased to 337,000 sets from 141,352 sets in line with a 1987-89 government policy to accelerate rural electrification through the expansion of the electric system to rural villages.

A 2.2.2 Implementation Schedule

Project completion was delayed one year overall, because, in some areas, the Department of Highways (DOH) was expanding road surfaces, and PEA was forced to delay project implementation until DOH's

construction work was completed.

A 2.2.3 Project Cost

There wasn't a significant difference between planned and actual project cost for either the foreign currency or the local currency portion. The actual amount of loan disbursement was slightly less than the original plan.

< B. Third Stage Phase III>

B 2.2.1 Project Scope

The number of target substation areas increased from 25 to 28 in accordance with Thai Government policy, which promoted the development of industrialized zones in the Central Area (for example, Samut Sakhon, Chacheoengsao and Nakhon Prathom, near Bangkok) in the 6th NESDP (1987-91). These areas were expected to become industrial centers, with foreign investment for promoting exportation-oriented industries. Their growth caused additional demand for electricity in the Central Area of the country, so PEA added to the project scope three substations areas in these industrial areas.

B 2.2.2 Implementation Schedule

Project completion was delayed for two years overall. The delay was due to the expanded project scope, which caused set backs both in the procurement process and in construction work. Procurement was further delayed when a supplier in Yugoslavia could not deliver the switchgear due to the Civil War. As a result, it was necessary to open a new bid. As to the civil work, under the Thai Government policy to develop Central Area, various development projects were undergoing in the area, and, as a result, PEA had to coordinate the project schedule with road projects implemented concurrently by Department of Highways (DOH) as well as with two other electrification projects carried out simultaneously in the area. PEA needed to coordinate with DOH because the construction of the steel towers for transmission lines required that the road project in the same area be completed beforehand, as explained earlier

B 2.2.3 Project Cost

The total project cost ran over the estimated figure slightly due to the expansion of the project scope. The total disbursement amount of Japan's ODA, however, was less than the estimated amount because of depreciation of the Thai Baht against the Yen, which occurred when disbursing ODA loan for the expenditures in local currency.

2.3 Effectiveness

During implementation of these projects, there were several other development projects being carried out for the improvement of the power distribution system in the country[3]. This section discusses the effect of the Projects (Phase II and III) by verifying, in some cases, national aggregated indicators of PEA, which covers almost whole country expect metropolitan areas and vicinal two prefectures, and consequently, include effects of projects other than Phase II and III project.

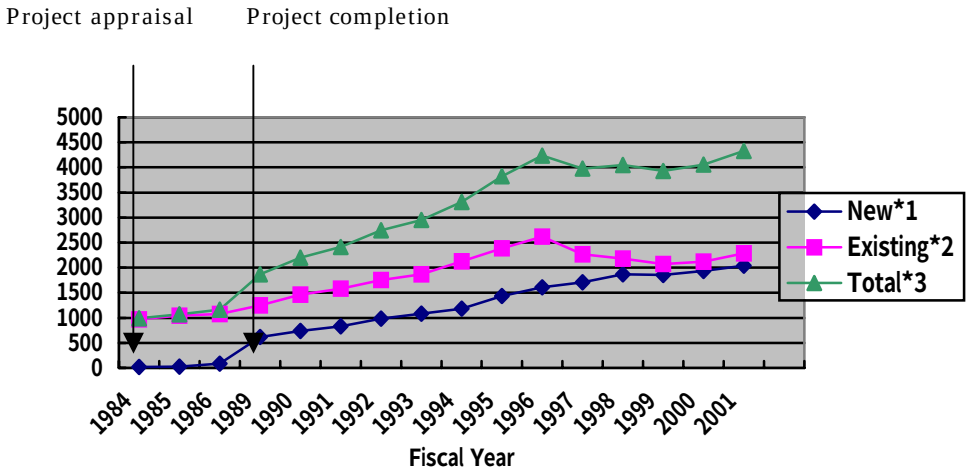
[3] For example, total expenditure of the Phase II accounts for some 6% of the total investment realized by PEA during the period from 1989 to 1993 for the sector.

2.3.1 Electricity Supply

<Third Stage Phase II>

The volume of electricity supplied to 18 areas is shown in Figure 1. The figures indicate a constant, sharp increase in annual power supply to the 11 new substation areas. The volume supplied to the 7 pre-existing substation areas is now doubled from that at the time of appraisal.

Figure 1: Electricity Supply (GWh/year) Distributed to 18 Substation Areas



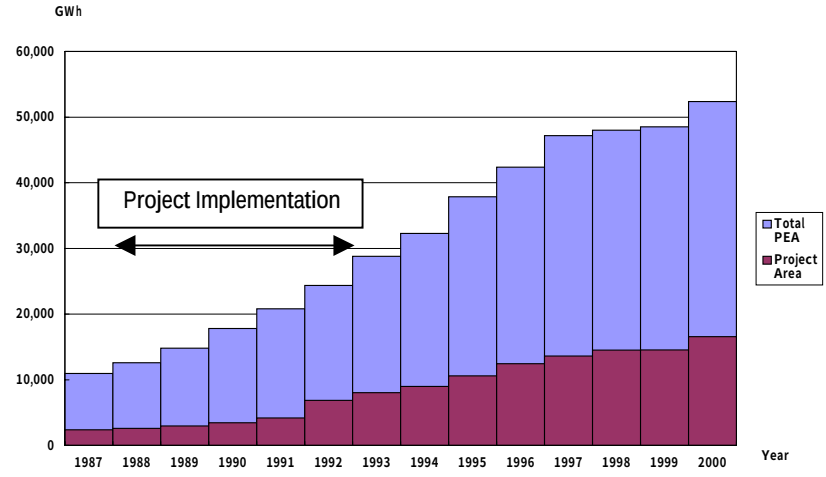
Note *1: Volume Distributed to 11 new substations
*2: Volume Distributed to 7 pre-existing substations
*3: *1 + *2 + other substations

Source: PEA

<Third Stage Phase III>

There was a constant increase in annual power supply in the project area (28 substation areas), from project implementation (1988-1992) until the year 2000, as seen in Figure 2. During project implementation, power supply in 28 substation areas increased to as much as 2.7 times the level at appraisal time.

Figure 2: Electricity Supply in Total PEA Service Area and 28 Substation Areas



Source: PEA

2.3.2 Reliability of Power Distribution System

Because of the limited availability of related indicators, this section evaluates the reliability of the power distribution system by examining national aggregated indicators of PEA after completion of Phase III. As seen in Table 1, transmission and distribution losses decreased from 7.5% at the time of appraisal to 6.33% at the completion of Phase III, and continued to decrease until 1996. The system average interruption frequency index has decreased for the last five years for which there are records available. The annual power factor[4], which was 89.10% in 1993, has gradually increased each year, and was 93.0% in 2000. All of these figures indicate that the reliability of PEA's system has been improved due to some attribution of project implementation.

Table 1: Indicators for Reliability of Electricity of PEA

Year	appraisal year 1987	completion year 1992	1993	1994	1995	1996	1997	1998	1999	2000
Transmission and Distribution Loss (%)	7.50	6.33	5.58	5.45	5.32	5.32	5.48	5.94	5.78	5.79
System Average Interruption Frequency Index (times/consumer year)	N / A	N / A	N / A	N / A	N / A	19.12	19.62	19.37	17.71	18.11
System Average Interruption Duration Index (minute/consumer year)	N / A	N / A	N / A	N / A	N / A	1,611.63	1,557.95	1,549.99	1,298.18	1,188.13
Power Factor (%)	N / A	N / A	**89.10**	**88.50**	**89.90**	**89.90**	**91.20**	**92.50**	**92.70**	**93.00**

Source: PEA

2.4 Impact

2.4.1 Electrification Rate

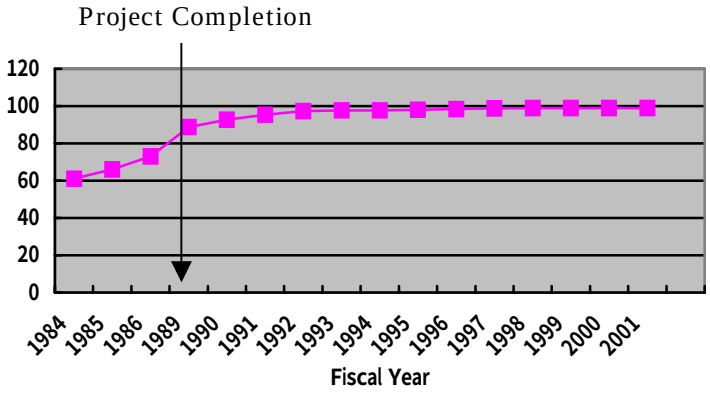
The nationwide village electrification rate reached to 97% in 1993, and a target of 95% was set for 1991 under the 6th Five-year Development Plan. The contribution of each phase of the Projects is reviewed below.

<A. Third Stage Phase II>

At the time of appraisal (1984), there were 2,098 un-electrified villages in the 18 substation areas and 3,285 electrified villages; the village electrification rate was 61.0%. During project implementation, from 1984 to 1989, the village electrification rate increased gradually, reaching nearly 90% in 1990, as illustrated in Figure 3. As of 2001, there were 89 un-electrified villages and 8,929 electrified villages; the electrification rate was 99.0%. Together with other projects, this project is considered to have contributed to improving the electrification rate in the 18 substation areas.

[4] The power factor is the ratio of KW:KVA, where KW is the actual load power and KVA is the apparent load power. This figure measures how effectively the current is being converted into useful work output and, more particularly, is a good indicator of the effect of the load current on the efficiency of the supply system.

Figure 3: Village Electrification Rate (%) in the 18 Substation Areas



Source: PEA

<B. Third Stage Phase III>

According to PEA, 4,953 villages were electrified when they were connected to the distribution systems constructed or reinforced under the Project; electrification for 6,172 villages was planned. Table 2 shows the number of newly electrified villages and households in the project area (28 substation areas) for each year after project completion (Year 1992). From 1993 to 2000, on average, 341 villages and 31,775 households were connected each year to the distribution systems constructed or reinforced under the Project.

Table 2: Electrification Rate & Newly Electrified Villages and Households In 28 Substation Areas

Year		1993	1994	1995	1996	1997	1998	1999	2000	Annual Average (1993-2000)
Electrification Rate (%) (Total PEA)		*97*	*97.7*	*98.1*	*98.4*	*98.7*	*98.9*	*98.9*	*98.9*	–
Newly electrified villages (No.)	Total PEA	*1,029*	*1,164*	*316*	*1,011*	*1,083*	*1,100*	*1,035*	*1,018*	970
	Project Area	*381*	*423*	*114*	*356*	*380*	*379*	*351*	*340*	341
Newly electrified house-holds (No.)	Total PEA	*500,603*	*412,757*	*574,650*	*543,121*	*562,254*	*442,807*	*317,884*	*327,854*	460,241
	Project Area	*34,533*	*28,473*	*39,641*	*37,466*	*38,786*	*30,546*	*21,928*	*22,830*	31,775

Source: PEA
Note: Indicator for year 2000 is as of September.

2.4.2 Economic Impact

Some substation areas were selected for the Project targets in accordance with the governmental economic development policy for the Central Area in the vicinity of Bangkok. In 2000, the industrial sector consumed about 62% of the total supply of electricity in the country, the largest share by far. Of the industrial share, 62% goes to the Central Area.

The number of commercial and industrial enterprises in 18 substation areas (Phase II) also increased after the Project[5]. Before project implementation (1984), there were 23,143commercial enterprises and

[5] Due to data availability, it was impossible to review this aspect in Phase III area.

426 industrial enterprises in the 18 Substation Areas. In 1989, after project completion, these numbers risen to 58,378 and 1,300, respectively. And as of 2001, there were 141,234 commercial enterprises and 4,571industrial enterprises. The Project is considered one of the factors contributing to sustaining the promotion of commerce and industry in these areas.

2.5 Sustainability

2.5.1 Operation and Maintenance (O&M)

The service area PEA covers includes 73 provinces, excepting metropolitan areas, and accounts for 99 % area of the country. The PEA service area is divided into 4 regions -- Central, North, Northeast, South -- each of which is managed by an Electric Administration Regional Office. Under the Regional offices, there are 12 Area offices and 1,007 sub-offices (Year 1999), scattered throughout the country.

The total number of personnel at PEA increased to 28,993 (Year 2000), from 24,397 at the time Phase III was appraised (Year 1987). There was an increase in the number of personnel in operation-related sections, in accordance with the expansion of distribution networks.

The 12 Area offices, which are in charge of their respective service area, manage the project-related system. At PEA's main office, the Power System Control & Operation Dept. is in charge of the overall system related to the project.

PEA conducts maintenance on the system according to its operation manual. Inspection on the distribution line is conducted once a year. In some areas, PEA patrols the distribution system every month. Such patrolling work includes the inspection of the pole and pole top assembly. Circuit breakers, reclosers and switches are inspected twice a year. Tree trimming is conducted as needed, depending on the type of tree; generally it is conducted once every three months. Spare parts are stocked at warehouses in each Area office and in Bangkok.

2.5.2 Technical Capacity

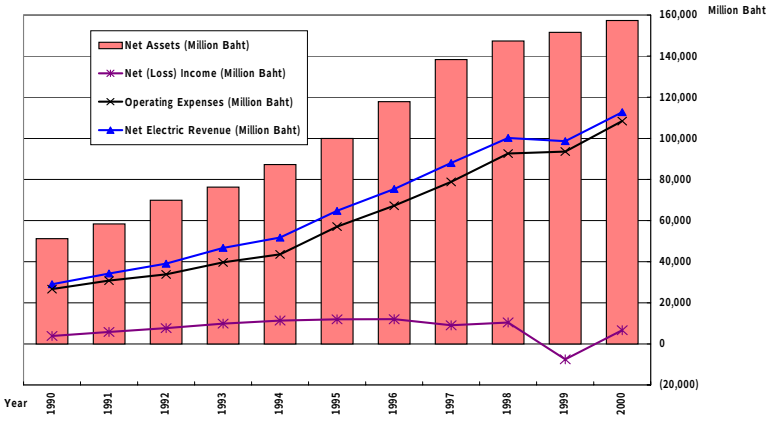
Currently PEA has a total of 15,608 employees in charge of O&M; 41% of these employees are operation workers, 49% are technicians, and 10 % are either Engineers or hold a Bachelor's or more advanced degree. PEA considers the ratio of Engineers to the total number of employees relatively small. PEA considers training an important factor in increasing productivity. PEA conducted an in-house training program for 40% of its employees and provided outside training (including overseas training) for about 4 % during year 1999.

Overall, there seems no serious problem with the organizational and technical aspects of operation and maintenance.

2.5.3 Financial Status

PEA's revenue from electricity sales and its total assets has increased since 1990. In 1999, net profit decreased sharply, turning negative, due to losses resulting from the foreign exchange rate and to decreases in electricity sales revenue from industrial sector, which was affected by the economic recession. Net profit, however, turned positive again in 2000 as revenue increased.

Figure 4: Highlight of Some Financial Indicators



Source: PEA

In 1999, the rate of return on total assets and the return on sales were negative, as net-profit was negative for this year. In 2000, all of PEA's financial indicators except the current ratio improved.

Table 4: Financial Indicators

Items	1998	1999	2000
1.Rate of Return on Total Assets	7%	-12%	4%
2.Return on Sale	10%	-17%	6%
3. Equity to Assets Ratio	39%	35%	34%
4.Current Ratio	173%	167%	114%
5. Total Asset Turnover (times)	0.70	0.67	0.74

Source: PEA

In conclusion, it can be expected that the project effect will be sustained because there is no serious problem that might noticeably impede the operation of the system. It is, however, necessary to pay attention to how operations will be affected by the future privatization of PEA.

3. Lessons Learned

In the projects related to large-scale network construction such as power distribution system, close coordination with other public work agencies at planning and implementation stages is essential to avoid delays in the project implementation.

Comparison of Original and Actual Scope

<A. Third Stage Phase II>

Item	Plan	Actual
Project Scope		
1) 22 and 33 kV Distribution Lines	1,279 cct-km	1,302 cct-km
2) Low Tension Distribution Lines	213 cct-km	220 cct-km
3) 115 kV Circuit Breakers	10 sets	16 sets
4) Transformers	106,300 kVA	106,300 kVA
5) Capacitors	32,690 kVAR	33,000 kVAR
6) Switchgears	57 sets	57 sets
7) Reclosers	44 sets	50 sets
8) High Tension Meters	2,098 sets	2,600 sets
9) Low Tension Meters	141,352 sets	337,000 sets
Implementation Schedule		
1) Specification Approval	Dec.1984 – Apr.1985	Mar 1985 – Jan.1989
2) Bid Selling	Jan 1985 – Jun 1985	May 1985 – Jan.1989
3) Bid Opening	Mar.1985 – Aug.1985	Jul.1985 – Feb. 1989
4) Bid Evaluation	Apr.1985 – Aug.1985	Sep.1985 – Mar.1989
5) Purchasing Approval	May 1985 – Sep.1985	Nov. 1985 – Apr.1989
6) Signing Letter of Intent	May 1985 – Nov. 1985	Dec.1985 – May 1989
7) Awarding Contract & L/C	Jul.1985 – Nov.1985	Dec.1985 – Jun.1989
8) Delivery Period	Sep.1985 – Mar.1987	Jan.1986 – Jun.1989
9) Acceptance	Feb.1986 – Apr.1987	Feb.1986 – Sep.1989
10)Construction	Jan.1985 – Sep.1988	Apr.1985 – Sep.1989
Project Cost		
Foreign Currency	8,440 million yen	8,372 million yen
Local Currency	5,222 million yen	2,601million yen
	(517million Baht)	(491 million Baht)
Total	13,662 million yen	10,973 million yen
ODA Loan Portion	8,440 million yen	8,372 million yen
Exchange Rate	1 Baht =10.1 yen	1 Baht = 5.3 yen
	(1984)	(1989)

<B. Third Stage Phase III>

Item	Plan	Actual
Project Scope		
1) 22 and 33 kV distribution line	1,964cct-km	2,345cct-km
2) Low Tension distribution line	194cct-km	452cct-km
3) Transformers	97,000kVA	144,485kVA
4) Capacitators	29,820kVAR	50,505 kVAR
5) Switchgears	48 sets	185 sets
6) Reclosers	35 sets	35 sets
7) HT. Service meters	1,720 sets	900 sets
8) LT. Service meters	127,117 sets	166,300 sets
Implementation Schedule		
1) Specification Approval	Oct.1987 - Jun.1988	May. 1988 – Apr. 1992
2) Bid Selling	Jan. 1988 – Oct. 1988	Jun. 1988 – May 1992
3) Bid Evaluation	Apr. 1984 – Dec. 1988	Sep. 1988 – Jun.1992
4) Purchasing Approval	May.1988 –Jan. 1989	Sep. 1988 – Jun.1992
5) Signing Letter of Intent	May.1988 –Jan. 1989	Sep. 1988 – Jun.1992
6) Awarding Contract & L/C	Jul. 1988 – May. 1989	Sep. 1988 – Jun. 1992
7) Delivery Period	Aug. 1988 – July. 1990	Jan. 1989 – Jun.1992
8) Acceptance	Nov. 1986 – Dec. 1989	Oct. 1989 – Apr.1992
9) Construction	Jan. 1988 – Dec.1990	Jan. 1988 – Dec. 1992
10) Completion	Dec. 1990	Dec. 1992
Project Cost		
Foreign Currency	4,774 million yen	4,935 million yen
Local Currency	3,751 million yen	4,020million yen (804 million Bahts)
Total	8,525 million yen	8,955 million yen
ODA Loan Portion	6,820 million yen	6,787 million yen
Exchange Rate	B1 =5.5 yen (1987)	B1=5.0 yen (1992)

Independent Evaluator's Opinion on
Power Distribution System Reinforcement Project (3-2, 3-3)

Kanda Paranakian
Associated Professor, Faculty of Social Science, Kasetsart University

1. Relevance

The project objective was relevant to the National Economic and Social Development Policy in expanding electricity to rural areas and increasing the reliability of power distribution in order to promote respectively rural development and industrial development. Electricity Generating Authority of Thailand (EGAT) is to generate and supply electricity for further distribution to consumers. The Provincial Electricity Authority (PEA) is responsible for power distribution for consumers in the provinces except those in Bangkok Metropolitan areas which are restrictedly under the responsibility of the Metropolitan Electricity Authority (MEA) The electricity supply and service systems are operated in a monopolistic manner.

2. Impact

Prior to January 1997, the electricity tariff was on a flat rate basis. EGAT sold electricity to the PEA at a wholesale rate which was lower than the rate of EGAT sale to MEA. Whereas the distribution cost for consumers in the PEA areas is higher, therefore a cross – subsidy from MEA to the PEA is required via bulk supply tariffs.

In 1996, the Energy Policy Committee (EPC) approved the modification of the bulk supply tariff from the flat rate to the Time of Use (TOU) rate and a more explicit approach regarding subsidization for the PEA was established.

In 2000, the cabinet concurred with the resolution of the National Energy Policy Council regarding the electricity tariff restructuring which became effective from October 2000 onwards. Under the new tariff structure, although power consumers still have to buy electricity from PEA, the impact on customers can be cited as follows.

Residential customers with consumption less than 150 kWh/month still pay for electricity under the existing rate. The former minimum charge of 4.68 Baht/month is replaced by the monthly standing charge of 8.19 Baht/month.

Residential customers with consumption over 150 kWh/month : the existing minimum charge of 83.18 Baht/month is replaced by the monthly standing charge of 40.90 Baht/month. The monthly standing charge for larger customers is cheaper. The small residential customers (consumption less than 150 kWh/month) are subsidized by larger customers.

3. Sustainability

Due to the high growth rate of power demand in the country, the lack of efficiency in the organizational and human resources management become a major problem affecting the operation and management of the three state enterprises in the power sector (i.e. EGAT, MEA and PEA). The government therefore has been promoted greater role of the private sector in power generation since 1992. The purchase of power from the private sector would help reduce EGAT's investment burden in power generation by approximately Baht 300,000 million.

In 1998, the cabinet approved the Master Plan for State Enterprise Sector Reform, while served as a framework in determining the scope and direction of restructuring and privatization of the four main economic sectors, including the energy sector. The main underlying principle of the reform plan is to increase competition on power generation sector. However for power transmission and distribution system, they are subject to regulation so as to protect consumers' benefits.

In 2000, the cabinet concurred with the National Energy Policy Council (NEPC) resolution on the electricity tariff restructuring. Its objectives are (1) to have a tariff that genuinely 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 ; (2) to secure the financial status of EGAT, MEA and PEA which enable future expansion of their operation ; (3) to provide fairness to all power consumer categories by reducing cross subsidization from one category to another; and (4) to achieve a mechanism of electricity tariff adjustment that is flexible and automatic, corresponding with changing fuel prices in the competitive market.

4. Recommendation

To promote rural development and industrial development, subsidy should be provided to maintain lower price and to be incentive for industrialization in the rural areas.