7.3 POWER MARKET OVERVIEW IN GMS COUNTRIES

7.3.1 PRINCIPAL MARKET FOR POWER EXPORT FROM LAO PDR

The Greater Mekong Sub-Region (GMS) countries includes Cambodia, Lao PDR, Myanmar, Thailand, Vietnam and the Yunnan Province of the PRC.

The principal electricity markets for export of power from Laos for next 10-20 years are Thailand and, to a lesser extent, Vietnam. The other neighboring countries are unlikely to have import needs for power from Laos during the next decade, except possibly for supplies on a small scale to Cambodia in the border area.

Yunnan Province of the PRC has abundant coal and hydropower resources and could be an exporter of electricity to Lao PDR. Supply of areas in the Northern Provinces of Lao from Yunnan has been considered in the past, but EDL (Electricite du Laos) is not currently pursuing this project. Export of electricity from Lao PDR to Yunnan, on the other hand is unlikely.

The situation in Myanmar is somewhat similar. The country has large resources in gas and hydropower and is currently an exporter of gas to Thailand. Myanmar has probably no needs to import electricity from Lao in the foreseeable future.

Cambodia also has a relative large hydropower potential, but generation costs are currently unfavorable. Power for export may thus be limited, but hydropower for the domestic market is an important option. Cambodia is a small electricity market comparable in size to that of Lao (maximum demand about 150 MW in 2000, expected to reach 480 MW by 2010). Electricity generation in Cambodia is currently based mainly on diesel plants, with hydropower still to be developed. Power costs are thus high which could make import of hydropower from Laos feasible. Nevertheless, due to the structure of the system (three separate grids) and the location of the main load centers, power export from Lao to Cambodia is expected to remain limited to possibly small scale supply to areas near the border.

The Table 7.3.1 summarizes the estimated electricity load growth in the GMS countries, as obtained from recent projections.

Table 7.3.1 Load Forecasts for GMS Countries

Country	Peak Demand, MW			Energy, GWh/year		
	2000	2005	2010	2000	2005	2010
Thailand (PDP 2001)	14,918	21,222	28,912	96,781	134,794	184,213
Vietnam	4,487	7,802	11,653	26,000	46,459	70,437
Yunnan, China	3,371	4,715	6,362	21,857	30,569	41,241
Myanmar	1,125	1,628	2,124	6,905	9,627	12,094
Lao PDR	**172**	**321**	**464**	**649**	**1,527**	**1,963**
Cambodia	150	304	477	678	1,200	1,900

The load projections for the two main potential purchasers of hydropower from Lao, Thailand and

Vietnam, are further discussed in separate sections of this Chapter.

7.3.2 EXISTING POWER TRADE AGREEMENTS IN GMS AREA

(1) Agreements between Thailand and Lao PDR

The Government of Thailand and the Government of Lao PDR (GOL) had entered into two Memorandum of Understanding (MOU), dated June 4, 1993 and June 19, 1996 expressing their intention to cooperate on the development of 3,000 MW of electric power in Lao PDR for sale to Thailand by the year 2006.

Each Government had appointed a committee to deal with this cooperation under the MOU, namely the Coordinating Committee on Electricity Cooperation and Development in Lao PDR (CECD-L) for Thailand and the Committee for Energy and Electric Power (CEEP) for Lao PDR. CEEP was subsequently replaced with the newly established Lao National Committee for Energy (LNCE) in late 1999.

A list of 8 power projects, 1 of thermal and 7 of hydro, was proposed by Lao PDR for power export to Thailand under the MOU. The present power purchase scheme is as follows:

Projects with Achieved COD (Commercial Operation Date)

i)	Theun-Hinboun Hydropower Project	187 MW
ii)	Houay Ho Hydropower Project	126 MW
	Total	313 MW

The Power Purchase Agreements (PPA) of Theun Hinboun HEPP and Houan Ho HEPP were executed in June 1996 and June 1997 for period of 25 and 30 years respectively. Theun Hinboun started supplying electric energy to the Electricity Generation Authority of Thailand (EGAT) power system on March 31, 1998 and Houay Ho on September 3, 1999 as scheduled.

Projects with Scheduled COD

Six other projects are included in the Thai-Lao Power Purchase Program. According to EGAT latest power development plan (PDP 2001), their Scheduled Commercial Operation Dates (SCOD) are listed below:

First Stage SCOD on Dec. 2006		*Second Stage SCOD on Mar. 2008*	
i) Nam Theun 2 Hydropower Project	920 MW	i) Lignite-fired Power Plant Project	608 MW
ii) Nam Ngum 2 Hydropower Project	553 MW	ii) Xe Pian-Xe Namnoy Hydropower Project	365 MW
iii) Nam Ngum 3 Hydropower Project	430 MW	iii) Xe-Kaman 1 Hydroelectric Project	407 MW
Total	1,903 MW	Total	1,380 MW

EGAT has entered into the Tariff/MOU with the First Stage projects and is now finalizing the Power Purchase Agreement with the Nam Theun 2 (NT2) Project Developer. The remaining projects after NT2 will be invited to participate into direct bidding of the power pool, scheduled for operation around 2003 or after.

The GOL has reviewed status of the projects of the first and second stages in January 2002. As a result, beside NT2 which will start its operation in 2008, three projects of Nam Ngum 2 & 3 HEPPs and the Lignite-fired power plant project are counted as the second stage projects which expected to commence operation in 2010. The other two projects has run out of concern for PPA. There is a high possibility that the Nam Ngiep-I HEPP will be nominated as one candidate for this second stage projects.

(2) Agreements between Thailand and Myanmar

The Government of Thailand and the Government of the Union of Myanmar had entered into the MOU on July 4, 1997 expressing their intention to cooperate on the development of electric power in the Union of Myanmar for sale to Thailand of up to 1,500 MW by the year 2010.

Three hydro power projects, namely Nam Kok (55 MW), Hytgyi (400 MW) and Tasang (3,600 MW) and one combined cycle project, Kanbauk (1,500 MW) have been proposed by the Union of Myanmar as potential projects for power export to Thailand under the MOU. Negotiation on individual projects will be commenced after the completion of their feasibility studies by the Myanmar authorities.

Due to the current power shortage in the Union of Myanmar, the Myanmar Committee has recently proposed the idea of early interconnection to import from Thailand about 100-200 MW of electric power. In the short term, this interconnection will be used to transmit energy from Thailand to relieve the power shortage of Myanmar and later to export electric energy to Thailand when the power projects in Myanmar are ready for sale.

(3) Agreements between Thailand and China

The Government of Thailand and the Government of the People's Republic of China entered into the MOU on November 12, 1998 expressing their intention to cooperate in the development of energy resources in China for sale to Thailand of up to 3,000 MW by the year 2017. The MOU also stated the intention of the two countries to interconnect the power systems as well as to acquire the transmission system's right of way from the third country (Lao PDR, etc).

The first cooperative project for power transmission from China to Thailand will be the joint development of hydropower resources and construction of the Yunnan Jinghong Hydropower Station. This 1,500 MW project is located on the downstream reach of the Lanchang River, near the Jinghong City of Yunnan Province, and is approximately 300 Km from the Thai boarder at Chiengrai.

Under the updated power purchase scheme from the PRC, EGAT will incorporate the purchase of

1,500 MW of power from the Yunnan Jinghong Hydropower Station around the year 2013 and another 1,500 MW from Yunnan Province around the year 2014 into the EGAT's Power Development Plan.

(4) Agreements between Lao PDR and Vietnam

The GOL reached an MOU with the Government of Vietnam to supply 1,500 to 2,000 MW by the year 2010. Subsequently specific discussions were held concerning power purchase agreements in July 1998 and in March 1999. According to the most recent information, planned purchases by Vietnam from Lao PDR will be 1,000 MW between 2005 and 2010; and a further 1,000 MW between 2010 and 2015.

7.4 POWER SECTOR DEVELOPMENT IN LAO PDR

7.4.1 GENERAL

The basic power policy of Lao PDR stresses self-sufficiency of electricity for internal demand, rural electrification and increase in earning from electricity sales to abroad.

Energy consumption in the country relies on wooden fuel (90%) and consumption of fossil fuel (5%) with electricity contributing only 5%. Consequently, development of hydropower potential in the country is also important from Lao PDR's point of view of mitigation of environmental impact and conservation of national forestry.

In 1986, the New Economic Mechanism was introduced under which particular urgency at power sector development was given to the following:

(i) Increase in export earnings from electricity sales,

(ii) Encouragement of private participation in power sector development,

(iii) Expansion of the domestic grid system to increase the domestic customer base, and

(iv) Consolidation of the long-term financial viability of the national power utility, EDL.

Improvement has been made to provide a sound legal and regulatory framework, and new laws, including Contract Law (1990), Foreign Investment Law (1994), and Electricity Law (1997) have been enacted. During the same period, the government opened up the banking and financial sector for private and foreign banks to operate in Lao PDR.

The GOL has attached high priority to hydropower expansion in pursuit of its macroeconomic and social objectives. The power sector policy calls for the development of power projects at two levels to meet the different market requirements:

(i) **Domestic Generation Projects:** The primary purpose of domestic projects is to supply the national market. EDL builds and operates these plants with

concessionary finance and their availability of capital usually limits their size to around 100 MW.

(ii) **Export Generation Projects:** Export projects are primarily implemented by IPP developers specifically to meet commitments under the inter-governmental MOUs. The projects are large, generally in excess of 100 MW.

As mentioned above the Government of Thailand anticipates the GOL's commitment on 1,900 MW of power capacity by the year 2006 and 1,400 MW by 2008, and the GOL reached an MOU with the Government of Vietnam to supply 1,500 to 2,000 MW by the year 2010. The GOL's plan is to expand the installed capacity to over 3,000 MW, most of which will be implemented by IPP projects and dedicated to export.

7.4.2 POWER SECTOR INSTITUTION

The institutional organization of the power sector in Lao PDR is shown in Figure 7.4.1. The roles and functions of principal institutions involved in IPP projects are summarized in Table 7.4.1.

Under the electricity law, MIH has primary responsibility for policy formulation and strategic planning which is undertaken jointly with STEA, FIMC and other agencies. MIH also has responsibility for preparing and implementing legislation and regulations and for overseeing the performance of electricity enterprises.

Department of Electricity (DOE) is one section of MIH. DOE's duties are mainly divided into the Hydropower Division responsible for generation, transmission planning and development, Environmental Division for environmental issues on power system and the Rural Electrification Division (RED) responsible for off-grid electrification.

Hydropower Division has primary responsibility for strategic power planning, project identification and evaluation of IPP project proposals. It provides technical support for projects of 2 MW or less.

RED coordinates and implements projects generally not intended for connection to the main grids. It does this in accordance with jurisdiction of the Provincial and District Offices.

MIH has no direct responsibility for operating and maintaining power projects. For projects connected to main grids, this is borne by EDL. For off-grid projects, it is the responsibility of provincial, district, prefectural, or special zone administrative authorities, as applicable, or of a concessionaire who is awarded a concession.

EDL develops, owns and operates the country's main generation, transmission and distribution assets, and manages electricity imports to its grids and exports from its stations. It is a state-owned corporation reporting through its own board of directors. Under GOL policy to date, EDL is the

implementing agency for Government power projects and has been the agency nominated by GOL as its shareholder where GOL participates in the ownership of IPP projects.

All foreign investment in Lao PDR is channeled through and coordinated by the Foreign Investment management Committee (FIMC) within the Prime Minister's Office. FIMC provides a "one-stop shop" service for developers seeking a mandate to build power projects in the country.

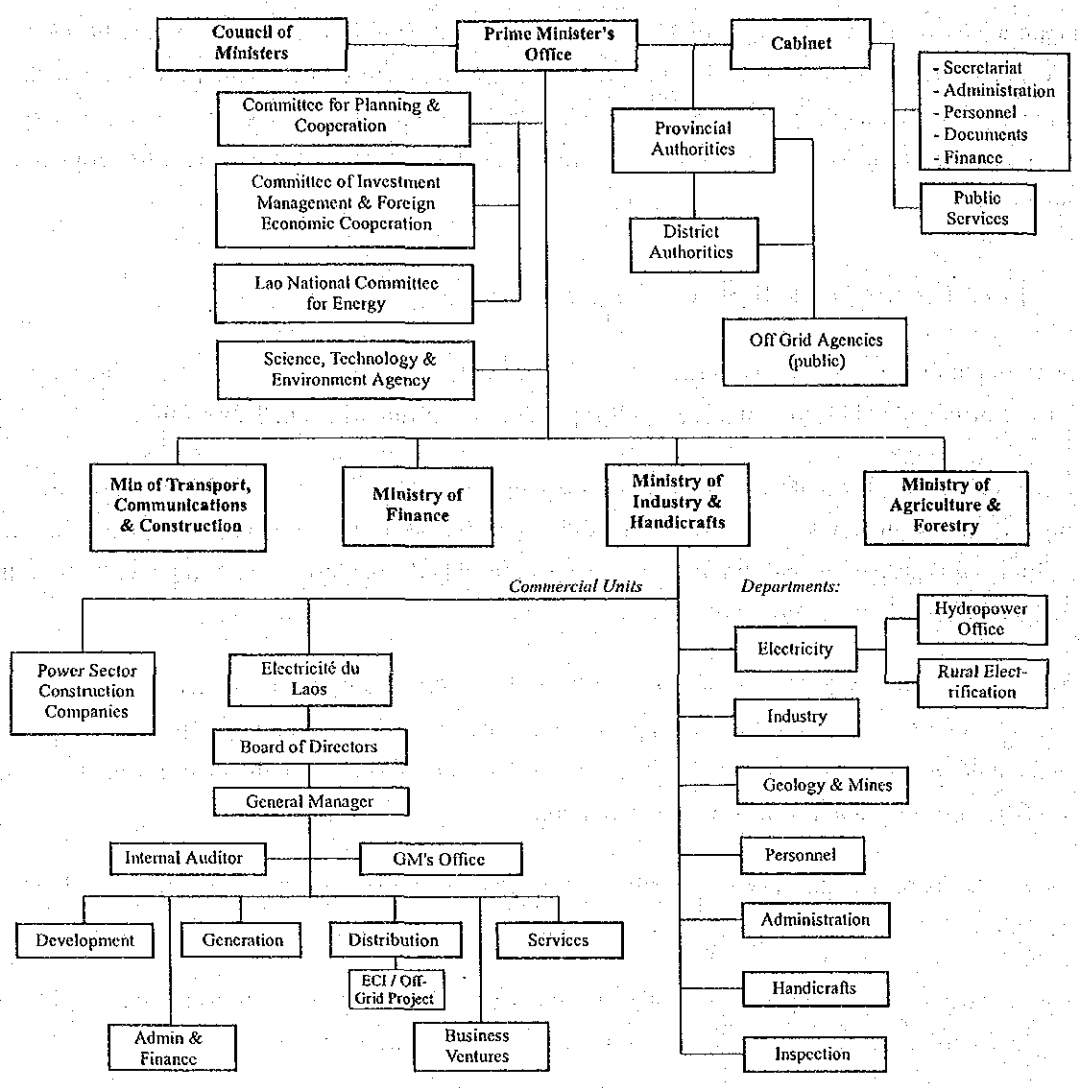


Figure 7.4.1 Organization of Power Sector in Lao PDR

Table 7.4.1 Roles and Functions of Principal Institutions

1. Committee for Investment & Economic Cooperation (FIMC)
   - High level committee within Prime Minister's Office responsible for administration and regulation of foreign investment. Provides an initial "one-stop-shop" service to foreign investors.

2. *Ministry of Industry & Handicrafts (MIH)*
   - Ministry (incl. Department of Electricity) is responsible for policy formulation and strategic power sector planning which are undertaken jointly with line Ministries and Agencies.

3. Electricite du Laos (EdL)
   - EdL develops, owns and operates the country's main generation, transmission, and distribution assets, and manages electricity imports to its grids and exports from its stations. It is a state owned corporation reporting through own board director.

4. Science, Technology & Environment Agency (STEA)
   - Main coordinating agency for environmental planning and management across all sectors. Its responsibilities under the Environmental Protection Law include developing strategies for implementing environmental policy, coordinating environmental management at a national sectoral level. It has authority over the licensing of organization engaged in providing environmental service

5. Lao National Committee for Energy (LNCE)
   - GOL agency with powers to manage the development and marketing of power projects for export to ensure effective implementation of strategic plans for energy and electric power development in Lao PDR

(Source) MIH/DOE

7.4.3 STATUS OF PRIVATE SECTOR PARTICIPATION IN POWER DEVELOPMENT

The Government of Lao PDR, has a principle policy to promote development of hydropower projects to increase export of electric energy to neighboring countries with participation of private investors (IPPs) in the form of BOT (Build, Operation, and Transfer) and with the transfer period of 20 to 30 years after commissioning.

Foreign investment into the country is controlled by the Foreign Investment Management Committee (FIMC) of the Prime Minister's Office. The FIMC is the only organization to render services to development investors who have acquired licenses to execute development of electric power projects. A Memorandum of Understanding (MOU) for development of a project is issued when the Government accepts a proposal from an investor. After that, the investor is allowed to study, design, construct, and operate the project.

The GOL policy is to hold a certain equity in each IPP project, usually a minority stake (typically 20% to 30%), but in the case of the Theun-hinboun HEPP, the GOL has taken a majority 60% of the shares.

The IPP procedure includes four principal agreements of MOU, PDA, CA and PPA in their order as shown in Figure 7.4.2.

(i) MOU is an agreement concluded between the GOL and the developer to grant exclusive rights for development as well as to carry out a feasibility study.

(ii) PDA sets out actions to be taken by the parties concerned to develop and implement the project in accordance with MOU.

(iii) CA sets out detailed arrangements between the GOL and concessionaire in relation to the development and operation of the project.

(iv) PPA concluded between the power purchaser (like EGAT) and the project company is the key document in any IPP project. The PPA is also the starting point of the project development and financing effort. Financiers generally begin to take the project seriously only when it has succeeded in obtaining a signed PPA. Once obtained, the PPA is the driving force behind the structuring of succeeding project contracts and the financing.

Projects are generally financed on a project finance basis by consortiums using their internal funds for the equity portion of the financing package and a combination of commercial banks and/or export credit agencies for debt finance.

A multilateral agency could be sought to participate in financing the GOL equity contribution. The Asian Development Bank (ADB) is equity-financing the Theun-Hinboun HEPP, and the World Bank is currently considering being involved in the Nam Theun 2 HEPP.

A number of IPP projects are being developed according to the above procedure. The status of project agreements as of the end of year 2001 is presented in Table 7.4.2. So far the GOL has signed and maintained 12 MOUs, 3 PDAs and 5 CAs. Three PPAs have been concluded of which Theun-Hinboun and Houay Ho HEPPs are under operation. The provisional PPA for Nam Theun 2 was concluded in February 2002. The finance close for NT 2 is expected to be made within 18 months from the final PPA date scheduled to be within 2002.

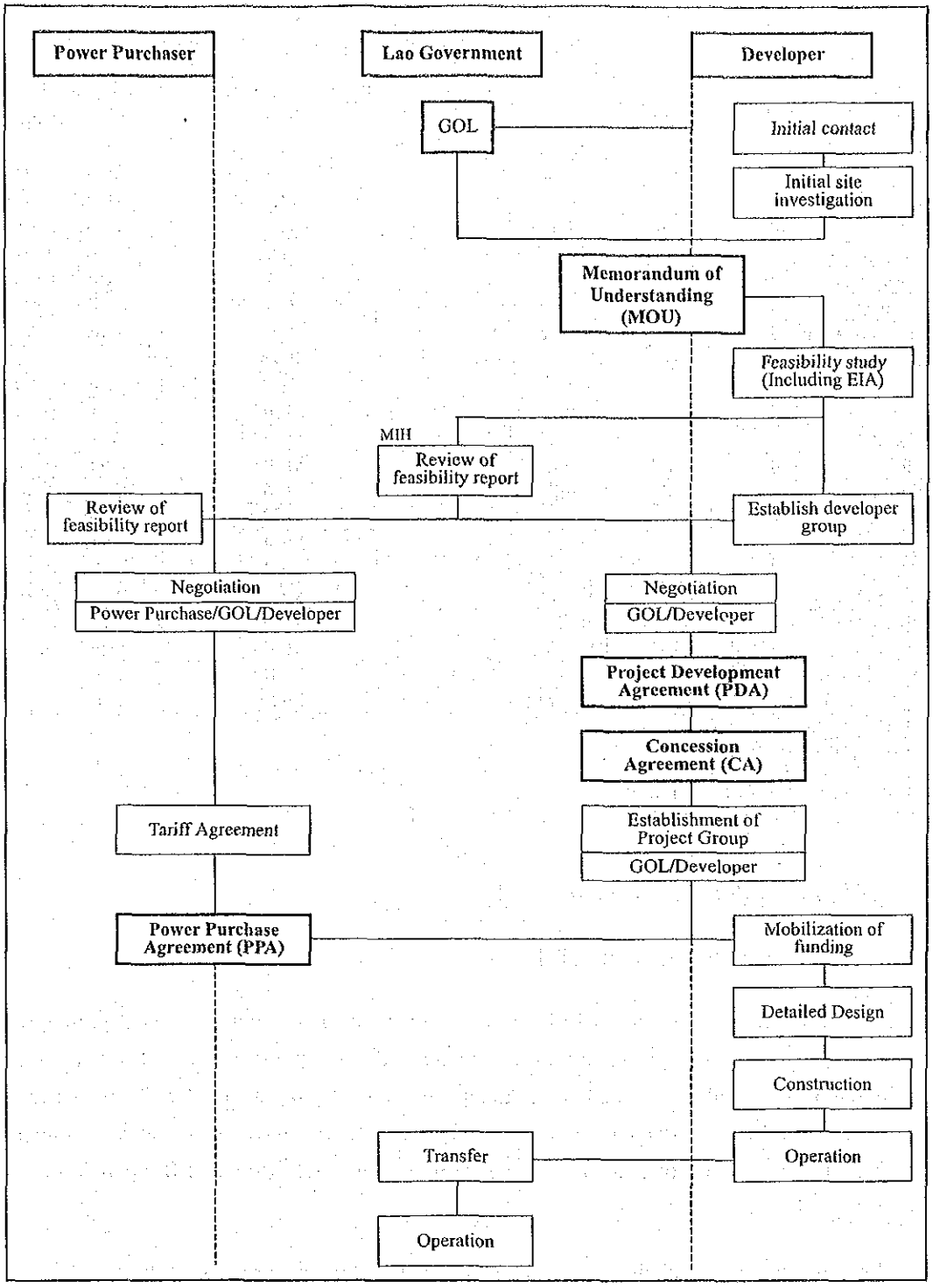


Figure 7.4.2 IPP Project Implementation Process in Lao PDR

Table 7.4.2 Status of IPP Projects in Lao PDR as of end of 2001

Project	Capacity (MW)	Project Sponsor	Type of Agreement [1]	Signing Date
Theun-Hinboun	210	THPC	PPA	June 1996
Houay Ho	150	Daewoo	PPA	June 1997
Hongsa Lignite	720	Thai-Lao Lignite	CA	June 1994
Nam Theun 2	980	NTEC	PPA (prov.)	(Feb. 2002)
Nam Ngum 2	615	Shlapak	CA	Mar. 1998
Nam Ngum 3	440	GMS Power	PDA	Nov. 1997
Xe Pian-Xe Namnoy	390	Dong Ah	CA	Aug. 1994
Xe Kaman 1	468	ALP Mgt (HECEC)	CA	Nov. 1997
Southern Laol Trans.	-	ALP Mgt (HECEC)	CA	Nov. 1997
Nam theun 3	237	Heard Energy	PDA	Aug. 1994
Nam Mo	105	Mahawongse	PDA	Nov. 1999
Nam Tha 1	263	SPS	MOU	Oct. 1995
Nam Theun 1	540	SUSCO	MOU	Mar. 1994
Nam Lik	100	Hainan SIT	MOU	Feb. 1994
Nam Ngum 5	90	Melkyma	MOU	Sep. 1996
Nam Ou	600	Pacific Rim	MOU	Nov. 1994
Xe Katam	100	Hydro Power	MOU	Oct. 1994
Nam Khan 2	126	Hydro Quebec	MOU	June 1994
Nam Suang 2	190	VKS	MOU	Mar. 1995
Nam Nhiep 2+3	565	VKS	MOU	Mar. 1995
Xe Kong 5	250	Sondel	MOU	Apr. 2000
Phapheng (Thakho)	30	True Assess Ltd	MOU	n.a.
Nam Bak (Cha) 2B	120	Nisho Iwai	MOU	n.a.

Note: MOU Memorandum of Understanding
PDA Project Development Agreement
CA Concession Agreement
PPA Power Purchase Agreement
Source: ADB "Power Sector Strategy Study: Draft Final Report" Feb. 2001

7.4.4 EXISTING POWER FACILITIES

(1) Generation Facilities including IPP

More than 97 % of total generating facilities in the country are hydropower. Nam Ngum 1 power station has been supplying energy for domestic demand in the Vientiane area and Thailand since its commissioning in 1971, and also to the Luang Prabang area after 1994. More recently, the large-scale Theun Hinboun (210 MW) and Houay Ho (150 MW) power stations have been completed under IPP form and export their energies to Thailand. The existing power plants including IPP plants for export purpose are listed in Table 7.4.3.

Micro-hydro and diesel power plants are operated only for small off-grid rural supply.

IPP's plants of Theun Hinboun 210 MW and Houay Ho 150 MW are export-oriented power plants, and their guaranteed capacity at the border points is 187 MW for Theun Hinboun and 126 MW for Houay Ho. These power plants also have domestic off-take arrangements equivalent to 5% of output (both energy and load).

Table 7.4.3 Existing Power Plants

Plant (H: Hydropower)	Location (Province)	Max. Output (MW)	Production (GWh/year)	Owner	Year of Commission
Theun Hinboun (H)	Khammouane	210	1,620	IPP	1998
Nam Ngum 1 (H)	Vientiane	150	960	EDL	1971
Houay Ho (H)	Attapeu	150	617	IPP	1999
Nam Leuk (H)	Vientiane	60	245	EDL	2000
Xeset 1 (H)	Saravane	45	181	EDL	1991
Selabam (H)	Champask	5	34	EDL	1969
Nam Phao (H)	Bolikhamxay	1.6	7	Province	1995
Nam Ko (H)	Oudomxay	1.5	8	Province	1996
Nam Dong (H)	L. Prabang	1	5	EDL	1970
Micro-hydro	(24 locations)	1.3	-	Province	-
Diesel	(11 locations)	15.2	-	Province	-
Total		640.6	3,677		

Source: EDL

The Nam Ngum and Nam Leuk power plants (210 MW in total) supply their energy to the Central 1 region and a part of the Northern region, while the Xeset 1 and Selabam power systems (50 MW in total) are operated for supply of energy to the southern region. Surplus energy from these two systems is exported to Thailand through a 115 kV line from Bang Yo (Pakse) substation.

Two small hydropower plants are operated for supply to off-grid systems of provincial authorities, while one plant near the EDL grid is connected into the grid. Micro-hydropower plants and off-grid diesel plants are individually operated by provincial or district authorities.

(2) Transmission Line and Substation Facilities

Main transmission system voltage for domestic supply in the country is 115 kV. Currently, there are 3 separate 115 kV transmission systems in operation which are not interconnected to each other (see Figure 7.4.4 below).

(i) Nam Ngum 115 kV System

The system has 2 major hydropower plants (Nam Ngum 1 with 150 MW and the Nam Leuk with 60 *MW). This 115 kV system is the largest system in the country at present and supplies energy to* Vientiane/Pakxan area and Vangvieng/Luang Prabang area. Energy delivery to the Vientiane area is achieved through the Phone Tong and Thanaleng, and other substations. Energy to the Vangvieng/Luang Prabang area is delivered through Vangvieng and Luang Prabang substations. In addition, new transmission lines have commenced tdelivery of energy directly from the Nam Leuk power plant to Pakxan area in Bolikhamxay province through the new Pakxan substation.

(ii) Savannakhet 115 kV System

The Savannakhet 115 kV system with 115/22 kV Pakbo substation is receiving power from the EGAT system of Thailand through a 115 kV line for energy import to Savannakhet town because of unavailability of any domestic power supply system at present.

(iii) Xeset 115 kV System

There are two power plants in this system; Xeset 1 (45 MW) and Selabam (5 MW). Power is supplied to rural areas in Sravane province and Pakse town in Champasak province. Surplus energy from this system is exported to Thailand. The Xeset power plant is a run-of river plant, and a considerable import of energy from Thailand is required in the dry season, for which this 115 kV line is utilized.

The above transmission system are operated by EDL for domestic energy supply and partially for export to Thailand. Existing 115/22 kV substations are summarized in Table 7.4.4.

Table 7.4.4 Existing 115/22 kV Substations (as of 2001)

Substation	Supply Area	Number and Capacity	Total Capacity
Luang Prabang	Central 1	1 x 12.5 MVA	12.5 MVA
Vangvieng	Central 1	1 x 12.5 MVA	12.5 MVA
Phonesoung	Central 1	1 x 10 MVA	10 MVA
Tha Ngon	Central 1	1 x 22 MVA	22 MVA
Phonetong	Central 1	3 x 30 MVA	90 MVA
Thanaleng	Central 1	1 x 22 + 1 x 10 MVA	32 MVA
Pakxan	Central 1	1 x 5 MVA	5 MVA
Pakbo	Central 2	2 x 10 MVA	20 MVA
Bang Yo	Southern	1 x 16 + 2 x 8 MVA	32 MVA
		Total	236 MVA

Source: EDL System Planning Office)

Besides the domestic-use 115 kV systems, two 230 kV double circuit lines are operated to export the generated power of the two IPP power plants, Theun Hinboun and Houay Ho, to Thailand. The transmission lines from the power plants to the international border points were constructed and are operated by the IPP of each power plant. These two lines are used exclusively for power export, and are not connected with the EDL power grid.

(3) Distribution Facilities

EDL's medium voltage (MV) distribution is principally 22 kV. Those 22 kV distribution feeders are extended to urban and rural areas from the 115/22 kV substations in the EDL grid or from diesel and small hydropower plants in provincial areas on overhead lines or underground cables.

The low voltage distribution systems for supply to general consumers are generally of 380/220 V, 3 phase and 4-wire.

(4) International Connecting Lines

There are interconnecting lines between Lao PDR and Thailand and Vietnam for energy export and import. In addition to the aforementioned 115 kV lines, 22 kV systems are operated by EDL branch offices for energy import from Thailand at Huayxai in Bokeo province, Ken Thao in Xayabuly province, Thakhek in Khammouan province, and Pakbo in Savannakhet province, and 35 kV systems are used for energy import from Vietnam at Xam Nua in Houaphanh province.

Table 7.4.5 shows connecting lines including the two IPP lines (Theun Hinboun and Houay Ho Power Station) from Lao PDR to Thailand as of October 2001.

Table 7.4.5 Inter-connection Transmission Lines

Section		Voltage (kV)		Circuit		Conductor
Lao PDR	Thailand or Vietnam	Facility	Operation	Design	Inst.	(mm^2)
Theun Hinboun P/S	Nakon Phanom (EGAT)	230	230	2	2	644
Houay Ho P/S	Ubon rachani 2 (EGAT)	230	230	2	2	644
Phonetong S/S	Udon Thani 1 & 2 (EGAT)	115	115	2	2	240
Thanaleng S/S	Nong Khai (EGAT)	115	115	1	1	95
Pakxan S/S	Bounkan (EGAT)	115	22	2	1	240
Thakhek S/S	Nakhon Phanom (EGAT)	115	22	2	2	169
Savannakhet S/S	Mukdahan 2 (EGAT)	115	115	2	1	240
Bang Yo S/S	Sirindikhorn P/S (EGAT)	115	115	1	1	240
Xam Neua S/S	Pahang (EVN)	35	35	1	1	150
Bokeo	Xieng Khong (PEA)	22	22	1	1	n.a
Kenthao	Thali (PEA)	22	22	1	1	n.a
Bolikhamxay	Vietnam (EVN)	22	22	1	1	n.a
Savannakhet	Vietnam (EVN)	22	22	1	1	n.a

Note: EGAT : Electricity Generation Authority of Thailand
PEA : Provincial Electricity Authority in Thailand
EVN : Electricity of Vietnam
Source: EDL

7.4.5 PAST RECORD OF ELECTRICITY DEMAND AND SUPPLY SITUATION

(1) Energy Consumption

Energy consumption and peak loads of each supply area and the whole country are tabulated in Table 7.4.6. Energy consumption shown in the table means the aggregated energy sales measured at consumer ends.

Table 7.4.6 Summary of Energy Consumption and Peak Load

Descriptions	1992	1993	1994	1995	1996	1997	1998	1999	2000	Ave. Growth Rate (%) 92-2000	95-2000
Annual Energy Consumption (GWh)											
Northern	-	-	-	-	1.0	2.8	4.4	5.5	7.0	-	-
Central 1	204.6	200.9	213.2	258.9	287.8	323.1	375.4	402.1	462.0	10.7	12.3
Central 2	33.1	38.2	45.0	53.2	61.7	72.1	87.1	102.2	114.2	16.7	16.5
Southern	15.1	17.8	21.2	25.3	29.4	36.1	47.7	57.3	65.4	20.2	20.9
Whole country	252.7	256.9	279.4	337.5	379.9	434.1	514.5	567.0	648.6	12.5	14.0
Peak Load (MW)											
Northern	-	-	-	-	0.4	1.0	1.2	2.7	4.2	-	-
Central 1	51.4	50.5	55.7	64.0	70.6	77.0	90.1	102.7	119.9	11.2	13.4
Central 2	8.7	10.4	11.7	13.8	16.9	20.7	21.2	25.5	29.4	16.5	16.3
Southern	4.3	5.1	6.1	7.2	7.5	10.3	13.6	16.5	18.6	20.1	20.8
Whole country	64.4	66.0	73.4	85.0	95.4	109.0	126.2	147.4	172.1	13.1	15.2

Source: EDL, System Planning Office

The table shows:

(i) Total energy consumption in the country was 648.6 GWh in 2000, and increased from 337.5

GWh in 1995 (annual average rate of growth 14%).

(ii) An average growth rate of energy consumption in the whole country in a period of 1992 to 2000 was 12.5%, while that in the latest five years of 1995 to 2000 was 14.0%. The southern region growth showed a remarkable increase in energy consumption with 20.9% growth rate in the last five years.

(iii) In 2000, the share of the Central 1 region was 71% of total energy consumption, followed by the Central 2 region at 18%, the Southern region at 10%, and the Northern region at 1%. In the period of 1992 to 2000, there was a small change of shares of each region, Central 1 region decreased its share and the Central 2 and Southern regions increased their shares.

(2) Peak Load

Historical trend of peak demand of each area and whole country is shown also in Table 7.4.6.

The 2000 peak load of the whole country was 172 MW, and increased from 85 MW in 1995.

The average annual growth rate of peak load was 13.1% during the period from 1992 to 2000, while the rate during the recent five years (1995 to 2000) was 15.2%. The growth rate of peak load was slightly higher than that of energy consumption.

(3) Gross Generation

The gross generation of the country in 1990 to 2000 is tabulated in Table 7.4.7. The total generated energy in the country was 1,579 GWh in 2000, increased from 833 GWh in 1990 at an annual rate of 6.6% in 1990 to 2000. Almost all generated energy is supplied by hydropower stations, with around 87% generated by Nam Ngum 1 (150 MW) and Nam Leuk (60 MW).

As discussed in Section 7.4.4, the EDL is exporting surplus power to Thailand from the Nam Ngum 115kV system (Central 1 region) and from the Xeset 115kV system (Southern region). Meanwhile, the EDL is importing electricity mainly from Thailand and partly from Vietnam at several points over the country. Xeset 115kV system needs to import energy during the dry season due to the shortage of inflowing water. The balance of import and export of energy is shown in Table 7.4.7. In the year 2000, EDL exported 863 GWh and imported 163 GWh of energy, with a net export of 700 GWh.

The summary of energy balance is illustrated in Figure 7.4.3.

More than 90% of the required energy including that exported is generated by EDL's own power stations and the remainder is imported from abroad or generated by IPP power plants. In terms of energy consumption, 49% of the available energy is exported to Thailand and the rest for domestic consumption including system losses.

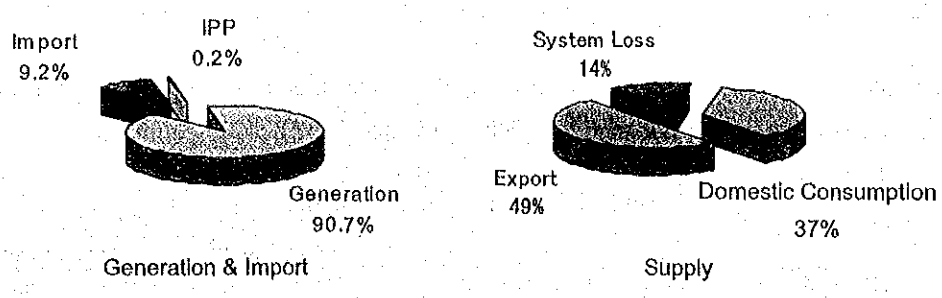


Figure 7.4.3 Energy Balance in 2000

Table 7.4.7 Energy Generation and Trade Balance

No.	Year	Capacity	Energy	Power Supply (GWh)			
		(MW)	(GWh)	Domestic	Export	Import	Net Export
1.	1990	163.56	833	165	595	28	567
2.	1991	209.21	834	221	563	35	528
3.	1992	209.9	752	253	460	41	419
4.	1993	211.75	920	265	596	48	548
5.	1994	217.39	1,199	279	829	57	772
6.	1995	218.25	1,085	338	676	77	599
7.	1996	218.6	1,248	380	792	88	704
8.	1997	221.8	1,219	434	710	102	608
9.	1998	415.0	948	513	405	142	263
10.	1999	580.6	1,169	566	598	173	425
11.	2000	640.6	1,579	640	863	163	700

Source: EDL

7.4.6 EDL'S EXPORT AND IMPORT TARIFFS

Tariffs for energy export and import have been determined through regular negotiations with the related authorities of Thailand and Vietnam. The common export and import rates are applied to the power trade with EGAT for the Nam Ngum/Nam Leuk, Savannakhet and Thakek systems.

The tariffs were agreed in "Power Purchase/Sale Agreement between EGAT and EDL" on December 13, 1999 and are effective from October 1, 1999 to September 30, 2003.

It is noted that no upper limits of peak load and energy for trading are specified in the agreement, but trading is based on what EDL is able to deliver and what EGAT is able to utilize.

Table 7.4.8 Trading Tariffs for Export and Import

Hours	Export	Import
Peak Time (18:30-21:30)	1.22 Bahts/kWh	Export Tariff plus 0.5 US Cent/kWh =1.41 Bahts/kWh
Off-Peak Time (21:30-18:30)	1.14 Bahts/kWh	Export Tariff plus 0.5 US Cent/kWh =1.33 Bahts/kWh

Note: - Tariffs of the off-peak time are applied for the whole day on Sunday.
- Payment is made in US dollar. (50% by a fixed rate of US$ 1 = Bahts 38, 50% by an exchange rate on paying date)

Source : EDL, System Planning Office)

As seen in Table 7.4.8, the import tariffs from EGAT are set at approximately 16 % to 17 % higher rates than those for export to EGAT.

As seen in Table 7.4.9, the import tariffs from PEA (Provincial Electricity Authority) of Thailand and Vietnam are set at further higher rate than EGAT by 30 % and 5 to 58 %, respectively.

Table 7.4.9 Other Import Tariffs

Hours	Energy Tariff	Demand Charge
Import from PEA of Thailand to Bokeo and Ken Thao		
Peak Time (09:00-22:00)	2.6950 Bahts/kWh	132.93 Bahts/kW
Off-Peak Time (22:00-09:00)	1.1924 Bahts/kWh	132.93 Bahts/kW
Import from Vietnam to Huoaphanh and Bolikhamxay	0.04-0.06 US$/kWh	-

Source: EDL, System Planning Office

7.4.7 IPP TARIFFS FOR EXPORT TO EGAT AND EDL

Power rates for IPP projects are determined project by project through negotiation between EGAT and respective IPPs. Upon conclusion of negotiations, a Power Purchase Agreement (PPA) is signed.

(1) Theun Hinboun IPP

The PPA of Theun Hinboun IPP and EGAT stipulates their trading tariffs in the following manners:

(i) Pre-commercial operation : 0.0341 US$/kWh

(ii) After 1st unit commissioned : 0.0390 US$/kWh compounded annually by 3 % increase

(iii) After fully commissioned to 10th contract year : The rate of the year being compounded annually by 1 % increase

(iv) After 11th contract year : To be negotiated

EGAT pays IPP for its imported energy 50 % by US$ currency and 50 % in Thai Baht currency which is fixed by EGAT at 25.35 Bahts/US$.

EDL's purchasing tariff from the IPP for domestic supply is set at a lower rate than that for EGAT with some discount. The tariffs since commencement of its commercial operation to date were as below:

Table 7.4.10 Historical Tariff (Theun Hinboun IPP)

Year	Tariff to EGAT	Tariff to EDL
1998	4.84 US cent/kWh	3.86 US cent/kWh
1999	4.88 US cent/kWh	3.97 US cent/kWh
2000	4.92 US cent/kWh	4.08 US cent/kWh
2001	4.97 US cent/kWh	n.a
2002	5.02 US cent/kWh	n.a

Source: EDL System Planning Office

(2) Houay Ho IPP

Trade is made under the similar conditioned agreement between EGAT and IPP. Payment by EGAT is made in Thai Baht currency and US$ currency. In the PPA of Houay Ho IPP, escalation of both tariff for Baht and US$ currencies is to be determined in proportion to Consumer Price Indexes in Thailand and US. The 35% of the tariff is subject to the escalation clause.

EDL explains that the final agreement for PPA between the IPP and EDL has not been finalized although energy has been purchased by EDL at a tentative rate since 1999.

The following are actual and estimated tariffs tabled in ADB report for Power Sector Strategy Study.

Table 7.4.11 Historical Tariff (Houay Ho IPP)

Year	Tariff to EGAT	Tariff to EDL (*)
1999	4.89 US cent/kWh	4.96 US cent/kWh
2000	4.98 US cent/kWh	3.83 US cent/kWh
2001	5.06 US cent/kWh	n.a
2002 (est.)	5.15 US cent/kWh	n.a
2003 (est.)	5.24 US cent/kWh	n.a

Source: ADB, Power Sector Strategy Study, March 2001

(3) Nam Theun 2 IPP

Exact details of the PPA between the project company and EGAT have not been made public yet as agreement has only recently (as of end of February 2002) been reached. The trading tariffs are thought to be as follows:

(i) Levelized tariff during concession period (25 years) : 0.04664 US$/kWh (primary energy)
0.02332 US$/kWh (secondary energy)
0.04176 US$/kWh (weighted average)

(ii) Tariff at COD : 0.042~0.043 US$/kWh (average)

(iii) During 10 years after COD : The rate of the year being compounded annually of 1.383% increase

(iv) After 11th year of COD : To be negotiated

The tariff for domestic supply is not yet finalized, but it is thought to be similar to the export tariff with a small discount of about 5%.

7.4.8 EDL'S OWN POWER DEMAND FORECAST

EDL has prepared its own power demand forecast based on the past record of energy sales and peak load at substations. Energy consumption including all categories by each province level is considered as a basis. Power demand forecasts are prepared for each province and include the estimated growth rate for energy consumption and peak load. The growth rates applied to the demand forecast are

estimated from the past trend of growths of energy consumption and peak load for each province. Table 7.4.12 shows power demand forecast prepared by EDL, where average growth rate of energy demand and peak load is estimated at 13 to 14 % for the period of 2001 to 2005 and 5 to 9 % for 2006 to 2020.

Table 7.4.12 Summary of Power Demand Forecast by EDL

Item	Unit	2000	2005	2010	2015	2020
Energy Consumption	(GWh)	648.6	1,257.4	1,963.3	2,754.6	3,681.1
Average growth rate	(%)		14.2	9.3	7.0	6.0
Peak Load	(MW)	172.1	321.4	464.2	612.2	791.0
Average growth rate	(%)		13.3	7.6	5.7	5.3
Load Factor	(%)	43.0	44.7	48.3	51.4	53.1

Source: EDL, October 2001

7.4.9 FUTURE POWER DEVELOPMENT PLAN

To meet the future power demand for domestic use and export market MIH/EDL has prepared its latest power development plan as of March 2002 summarized in Tables 7.4.13 and 7.4.14. The plan reflects the recommendations made by preceding studies of HDSS[1] and PSSS[2] as well as IMPPI[3].

Table 7.4.13 Medium Sized Hydro-power Plants for Domestic Supply

Plan (Location)	Capacity	Annual Energy	SCOD
Nam Mang 3 (Central 1)	30 MW	140 GWh	2004
Xeset 2 (Southern)	76 MW	309 GWh	2005
Nam Ngum Expansion (Central 1)	100 MW	430 GWh	2006
Nam Beng (Northern)	45 MW	175 GWh	2006
Tha Kho (Southern)	36 MW	215 GWh	2008
Xeset 3 (Southern)	20 MW	85 GWh	2008
Xepong (Central 2)	60 MW	350 GWh	2010
Nam Ngum 4B (Central 1)	54 MW	268 GWh	2012
Houay Lamphan (Southern)	65 MW	354 GWh	2014
Nam Pot (Central 1)	23 MW	97 GWh	2014
Nam Kong 3 (Soutehrn)	34 MW	156 GWh	2016
Nam Bak 2B (Central 1)	116 MW	583 GWh	2016
Nam Ngum 4A (Central 1)	54 MW	250 GWh	2018
Xexou (Southern)	59 MW	277 GWh	2020
Nam Sane 2 (Central 1)	60 MW	279 GWh	2020
Total	832 MW	3,968 GWh	-

Source: System Planning Office of EDL

Total construction cost of the above plants is roughly estimated to be US$ 1,337 million at the 2000-year price level according the study results for HDSS and PSSS.

Total construction cost of the above IPP plants is roughly estimated to be US$ 9,000 million at the 2000-year price level according to the study results of HDSS and PSSS.

[1] HDSS: Hydropower Development Strategy Study by World Bank (Jan. 2000)
[2] PSSS: Power Sector Strategy Study by ADB (March 2001)
[3] IMPPI: Indicative Master Plan on Power Interconnection in GMS Countries by ADB (April 2002)

Table 7.4.14 Large Sized Power Plants for Export Purpose (IPP)

Plant (Power Region)		Capacity (MW)	Year of Commission	Export to	Power to Domestic	Energy to Domestic
Nam Mo	(Central 1)	105	2007	Vietnam	5 MW	29 GWh
Nam Ngum 2	(Central 1)	615	2008	Thailand	31 MW	105 GWh
Nam Ngum 3	(Central 1)	460	2008	Thailand	23 MW	93 GWh
Nam Theun 2	(Central 1)	1,088	2008	Thailand	75 MW	275 GWh
Hongsa Lignite	(Northern)	720	2010	Thailand	36 MW	213 GWh
Xe Pian-Xe Nammoy	(South)	390	2010	Thailand	20 MW	100 GWh
Xe Kaman 1	(Southern)	468	2010	Thailand	23 MW	96 GWh
Nam Theun 1	(Central 1)	400	2014	Vietnam	20 MW	95 GWh
Nam Kong 1	(Southern)	240	2012	Vietnam	12 MW	40 Gwh
Xe Kaman 3	(Soutehrn)	218	2012	Vietnam	11 MW	67 GWh
Nam Ngiep 1	(Central 1)	240	2011	Thailand	12 MW	71 GWh
Sekong 4	(Southern)	440	2014	Vietnam	22 MW	87 GWh
Sekong 5	(Southern)	253	2014	Vietnam	13 MW	59 GWh
Nam Theun 3	(Central 1)	236	2016	Vietnam	12 MW	39 GWh
Nam Ngiep 2	(Central 2)	495	2016	Thailand	25 MW	124 GWh
Nam Ou	(Northern)	500	2018	Thailand	25 MW	131 GWh
Nam Khan 2	(Northern)	145	2018	Thailand	7 MW	36 GWh
Total		7,013	-	-	372 MW	1,660 GWh

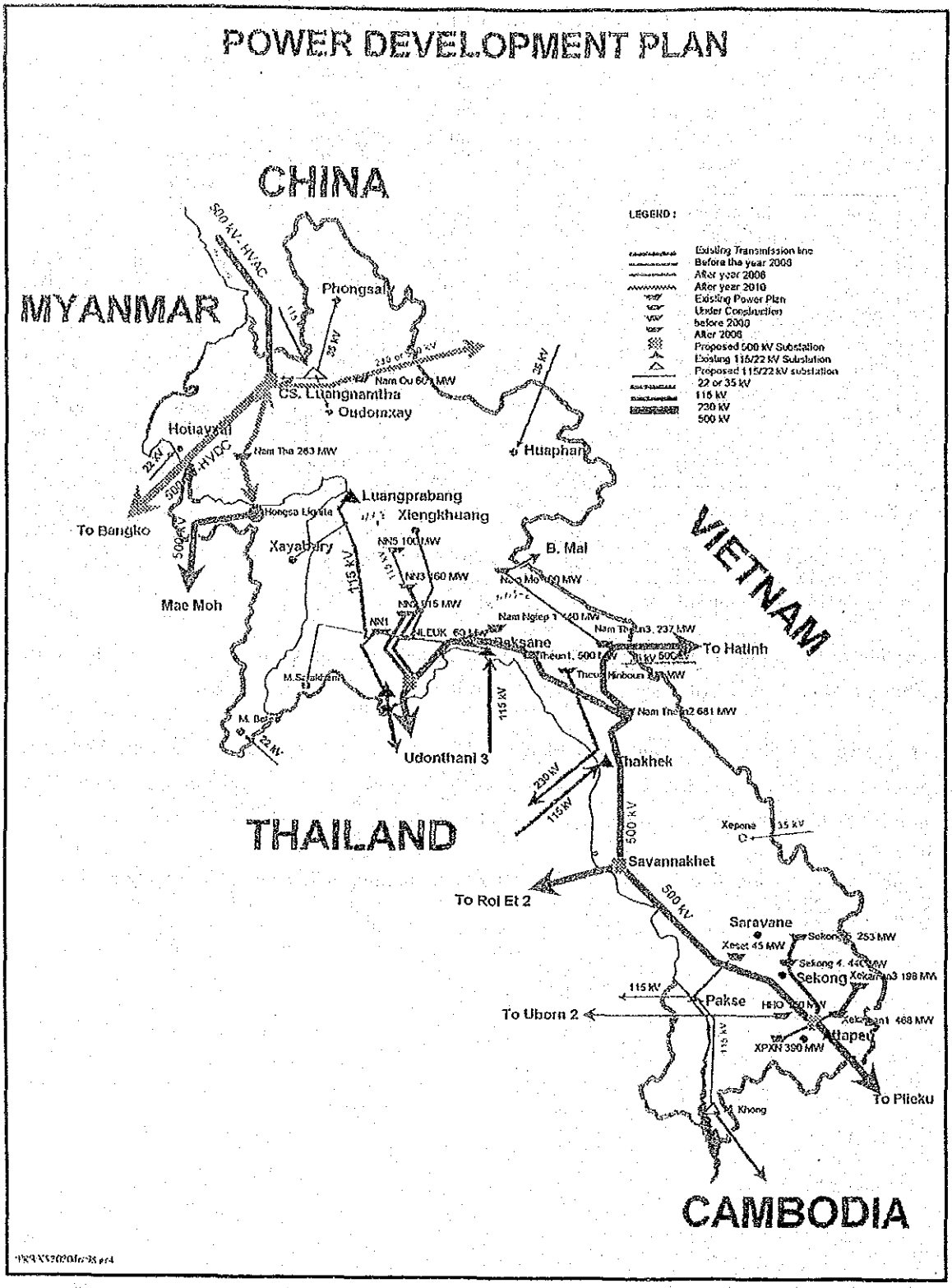
Note : 1. Peak power and energy for domestic supply are estimated at 5% of total production of each power plant.
2. Locations of proposed power plants are shown in Figure 7.4.4

Source: System Planning Office of EDL

According to the program Nam Ngiep-I HEPP is expected to be commissioned in year 2011 with a capacity of 240 MW. Out of this capacity 12 MW will be allocated for domestic use.

There are various plans being studied by MIH and EDL for the future transmission networks for the export of power from Lao PDR. Figure 7.4.4 shows the proposed future national grid of Lao PDR and Figure 7.4.5 shows the proposed route of a 500 kV line between Pakxan G.S and Nabong S.S.

A 230kV transmission line, approximately 110 km in length, will connect Nam Ngiep-1 P.S to Nabong S.S.



Source: MIH

Figure 7.4.4 Power Development Plan in Lao PDR

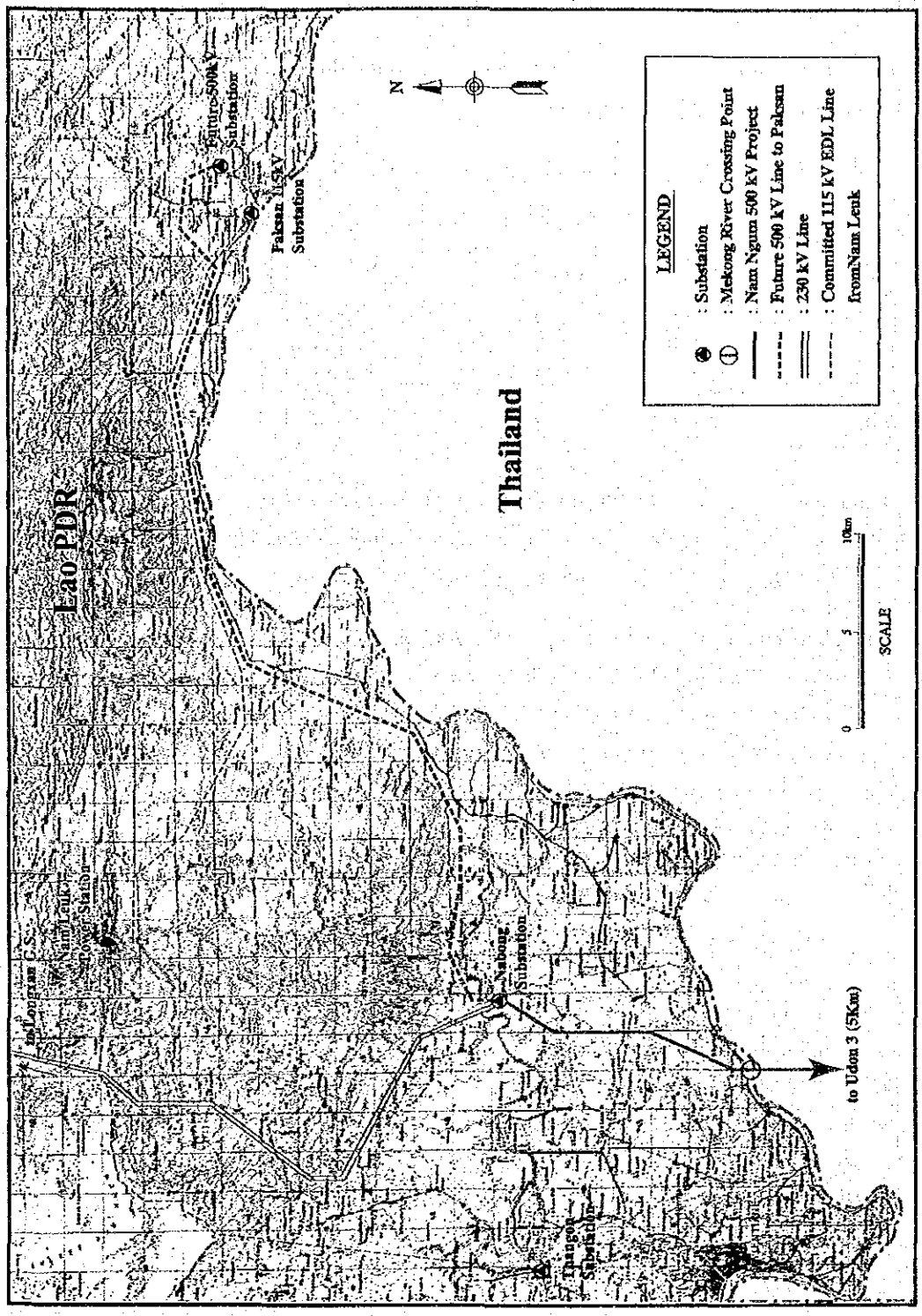


Figure 7.4.5 Tentative Route of 500 kV Line between Ban Nabong S.S and Paksan G.S

7.5 EXPORT POTENTIAL TO THAILAND

7.5.1 POWER DEMAND AND SUPPLY SITUATION

The following table states the peak demand and energy generated during the five years following the currency crisis (1997 through 2001) in Thailand.

Table 7.5.1 Power Demand and Energy Generation in Thailand

Fiscal Year (October of the preceding year through the following September)	Peak Demand		Energy Generated	
	MW	Percent change against previous year	GWh	Percent change against previous year
1997	14,506	9.0	92,725	7.9
1998	14,180	(2.3)	92,134	(0.6)
1999	13,712	(3.3)	90,414	(1.9)
2000	14,918	8.8	96,781	7.0
2001	16,126	8.1	103,165	6.6

Peak demand and energy generated fell during the two years of 1998 and 1999 following the currency crisis, but picked up in 2000 with the economic recovery, showing increases in the 8% range for peak demand and 7% in energy generated (See Figure 7.5.1 and 7.5.2).

The total installed capacity as of the end of September 2001 was 21,939 MW, of which the Electricity Generating Authority of Thailand (EGAT) produced 18,526 MW, or 84.4%. The details by type of power source of EGAT installed capacity are 2,886 MW of hydropower (15.6%), 7,875 MW of combustion powered power from oil, natural gas and lignite (42.5%), 6,981 MW produced by combined cycle (37.7%), and 784 MW produced by diesel and gas turbines (4.2%). The remaining 3,413 MW of power (15.6%) of power other than that produced by EGAT consist of 1,673 MW produced by SPPs 1,400 MW by IPPs and 340 MW imported from Laos (see Table 7.5.2).

7.5.2. LONG TERM POWER DEVELOPMENT PLAN

In October 2001 EGAT prepared its most recent long-term power development plan (PDP 2001) which applies to the years 2001 through 2016 (see Table 7.5.3). According to this plan, the EGAT will add a total 33,077 MW in new capacity by the end of September 2016 at the end of its 11th five year economic development plan. This is in addition to the 21,939 MW in existing capacity as of the end of September 2001, and projects which are currently under construction. The total generating capacity in 2016 is expected to be 48,272 MW after decommissioning 7,128 MW in generating equipment which is currently in use (See Table 7.5.4).

This long term power development plan is based on the projected demand (PDP 2001) for 16 years from fiscal 2001 (beginning in October) through fiscal 2016 (ending in September) prepared by the Thailand Load Forecast Subcommittee. According to this demand forecast, the maximum load is projected to be 22,552 MW in 2006, 30,587 MW in 2011, and 40,699 MW in 2016 (see Table 7.5.5).

Average annual growth stood at 4.0% during the eighth five year plan (1997-2001), and is expected to continue to grow steadily in the future, with the corresponding figures expected to be 6.9% in the ninth five year plan (2002-2006), 6.3% in the 10th five year plan (2007-2011), and 5.9% in the 11th five year plan (2012-2016). For projected demand the average annual GDP growth rate is expected to be 4.7% over the next 10 years, and the GDP elasticity at power demand is projected to be between 1.45 and 1.33.

7.5.3 FUTURE POWER GENERATION PROJECTS AND MARKET NEEDS FOR NAM NGIEP-I HEPP

The following presents a summary of new power development projects projected to be implemented in the long-term plan (see Tables 7.5.4 and 7.5.5).

The total installed capacity of projects that will be developed during the ninth five year plan (2002–2006) is 5,091 MW of which 1,147 MW will be developed by EGAT, and the remaining 3,944 MW is scheduled to be procured from domestic IPPs.

During the 10th five year plan (2007–2011) new development of 11,976 MW will be required. EGAT plans to develop 2,893 MW, and procure 3,283 MW from Laos, while the remaining 5,800 MW in power will be purchased from domestic IPPs and neighboring countries (including Laos). The details of the 3,283 MW in commitments made by Laos consist of 1,903 MW from Nam Theun 2, Nam Ngum 3, and Nam Ngum 2 for which purchases are projected by September 2007; and a total of 1,380 MW from Hongsa Lignite, Xe Kaman 1 and Xe Pian-Xe Namnoi for which purchases are projected through March 2008. There is a projected need for new power of more than 2,000 MW per year around late 2010 when Nam Ngiep-I HEPP is scheduled to come on line, and consequently market demand for the Project will be substantial, which means that the project will be highly feasible if it is price competitive.

During the 11th five year plan (2012-2016), development of 13,160 MW is projected to occur. EGAT has only one site to develop a 660 MW pumped storage project and plans to purchase the remaining 12,500 MW from domestic IPPs and SPPs, as well as neighboring countries.

Consequently ten years from now the Thai power market will rely for its supply on domestic IPPs and purchases of power from neighboring regions, and is likely to have a freely competitive market based on the pooling of power, with many power companies entering the market as they seek to find eager markets for power.

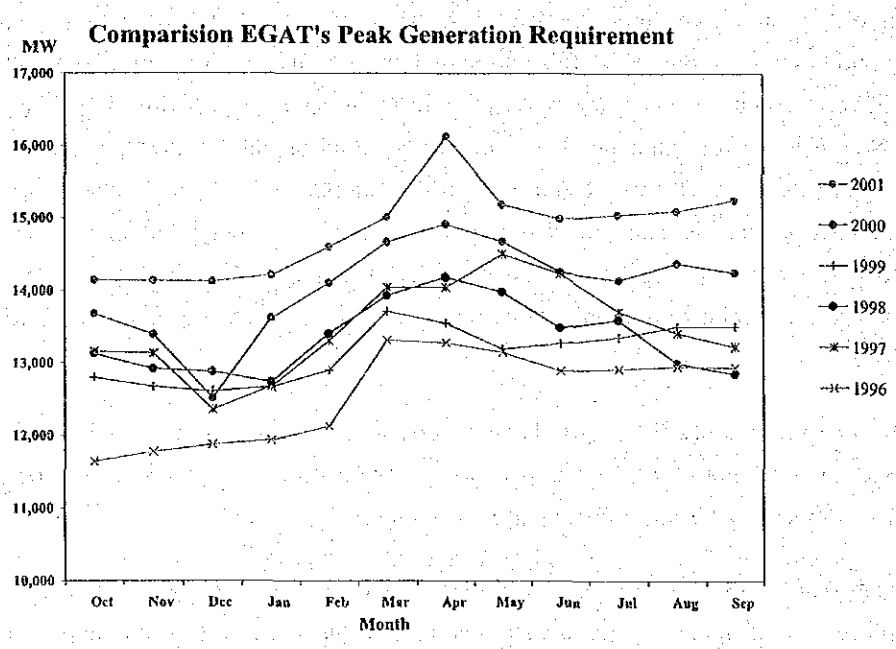
7.5.4 POSITION OF NAM NGIEP WITHIN THE POWER SYSTEM

The Nam Ngiep-I HEPP is expected to cope with peaks or intermediate peaks in the load curve. A screening curve analysis[1] has been conducted for the purpose of finding the plant factor rate at which

[1] Analysis of economic merit of each generating unit depending on the plant factor of unit operation.

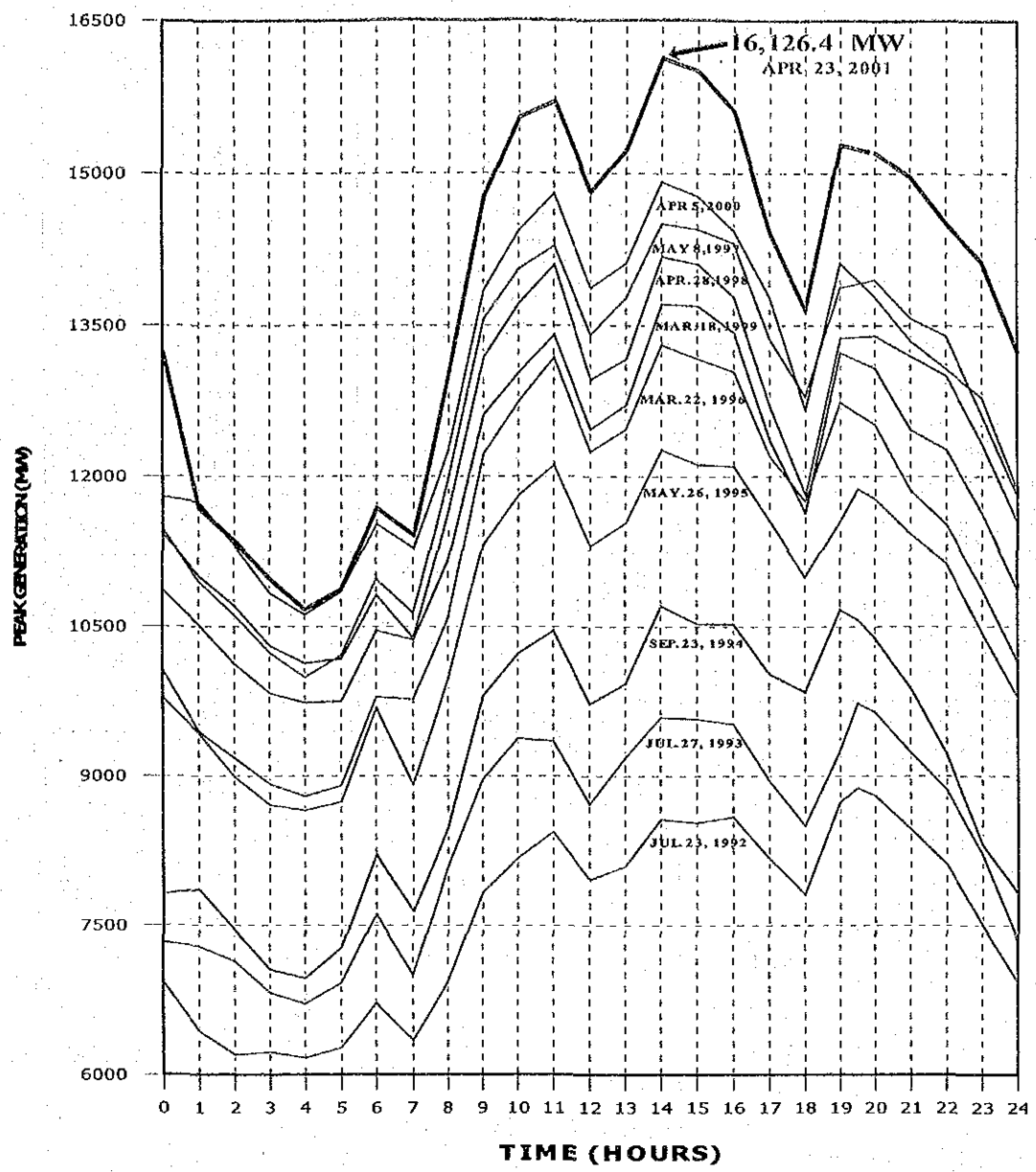
Nam Ngiep can maintain price competitiveness with competing power sources. The results of this analysis are shown in Figure 7.5.3. The X-axis in this diagram is the plant factor, while the Y-axis takes the annual average cost of generation of each alternative power source and indicates what type of generator will have price competitiveness. The cost data for both proposals of 240 MW and 334 MW in Phase 1 study have been used in connection with the cost of hydropower from Nam Ngiep 1. Three alternate power sources have been analyzed for comparison to Nam Ngiep 1: gas turbine, combined cycle, and coal fired. The most recent data available from EGAT's Optimum Power Development Plan has been used for the cost data of the alternative power sources. As seen in this diagram, a plant factor rate of at least 50% and operation of at least 12 hours per day would be desirable for Nam Ngiep-I HEPP. If utilization falls below this level, combined cycle generation would have the advantage as it could provide power more cheaply, and it would not be possible for Nam Ngiep-I to maintain price competitiveness.

Figure 7.5.4 presents the daily load curve for 2011 when Nam Ngiep is scheduled to be commissioned. This diagram indicates the desired position of Nam Ngiep. Under the proposal for 240 MW, the plant would be a marginal producer accounting for only 0.8% of the peak demand of 30,587 MW, but Nam Ngiep 1 is still expected to have an important role as an intermediate plant during peak demand.



Source: EGAT

Figure 7.5.1 Monthly Peak Demand of Thailand Power System



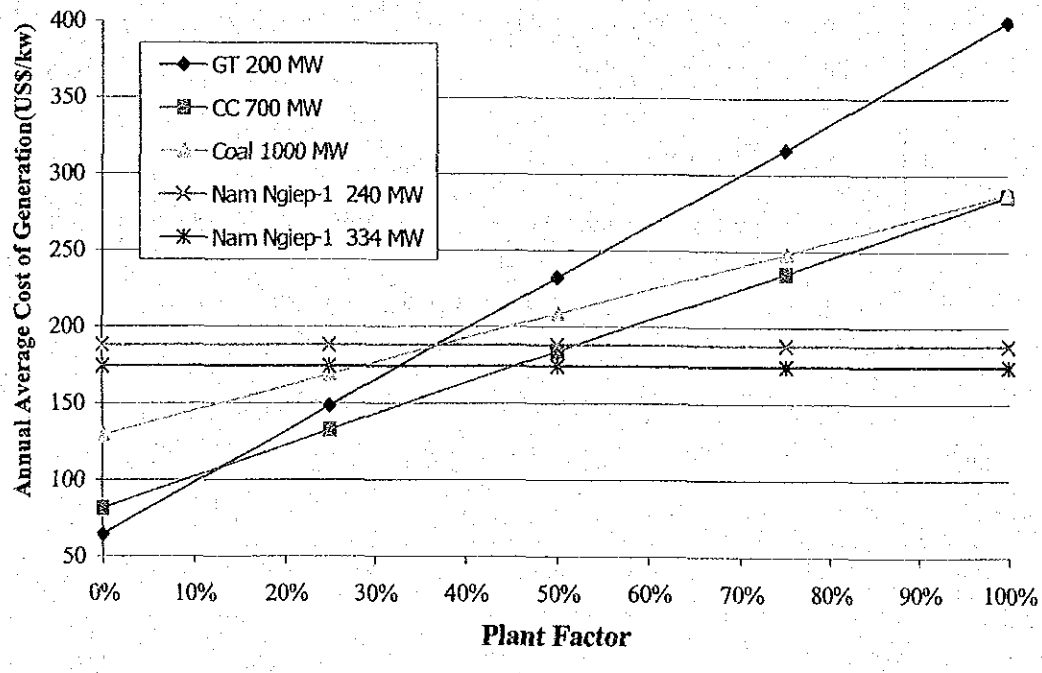
Source: EGAT

Figure 7.5.2 Typical Daily Load Curves of Thailand Power System

Table 7.5.2 Installed Capacity in Thailand at the End of September 2001

Power Plants	Fuel Types	Total Capacity (MW)
Hydroelectric	-	**2,886.264**
Conventional Thermal Plants		**7,875.0**
™ South Bangkok	Heavy Oil/Natural Gas	1,330.0
™ Mae Moh	Lignite	2,625.0
™ Bang Pakong	Heavy Oil/Natural Gas	2,300.0
™ Ratchaburi	Natural Gas	1,470.0
™ Khanom	Heavy Oil/Natural Gas	150.0
Combined Cycle		8,380.6
™ Nam Phong	Natural Gas	710.0
™ South Bangkok	Natural Gas	959.0
™ Bang Pakong	Natural Gas	1,374.6
™ Wang Noi	Natural Gas	2,031.0
™ Rayong	Natural Gas	1,232.0
™ Khanom	Natural Gas	674.0
™ IPPs	Natural Gas	1,400.0
External Purchase		**340.0**
™ Laos	-	340.0
Others		2,457.4
™ SPPs	-	1,673.4
™ Gas Turbines	Diesel/Natural Gas	778.0
™ Diesel Power Plants	Diesel Oil	6.0
Total Capacity		**21,939.264**

Source: EGAT



Source: EGAT

Figure 7.5.3 Screening Curve Analysis

Table 7.5.3 Thailand (EGAT) Load Forecast and Generation Development Plan

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Electricity Demand																	
Maximum Demand; MW	14,918	16,184	17,388	18,587	19,913	21,222	22,552	23,951	25,450	27,232	28,912	30,587	32,405	34,352	36,565	38,519	40,699
Annual Increase	14,918	1,266	1,204	1,199	1,326	1,309	1,330	1,399	1,499	1,782	1,680	1,675	1,818	1,947	2,014	2,153	2,180
Annual Load Factor	74.1	73.0	72.8	72.8	72.5	72.5	72.8	72.8	72.9	72.7	72.7	72.8	72.8	72.8	72.5	72.9	73.0
Energy Sent; GWh	96,781	103,496	110,945	118,540	126,449	134,794	143,748	152,743	162,438	173,532	184,213	194,930	206,660	219,134	232,106	245,948	260,262
Annual Increase	6,367	6,715	7,449	7,595	7,909	8,345	8,954	8,995	9,695	11,094	10,681	10,717	11,730	12,474	12,972	13,842	14,314
GDP Growth Rate	3.67	4.42	4.80	4.90	4.68	4.56	4.62	4.86	4.74	4.73	4.63	4.55					
GDP elasticity of electricity demand	2.40	1.92	1.55	1.41	1.52	1.44	1.36	1.28	1.32	1.48	1.33	1.27					
Installed Generating Capacity (end of year); MW																	
EGAT																	
Hydro Power Plant	2,220	2,886	3,386	3,386	3,386	3,386	3,386	3,386	3,386	3,386	3,386	3,386	3,386	3,386	3,386	3,826	4,046
Plant added (net)	0	0	500	0	0	0	0	0	0	0	0	0	0	0	0	440	220
Thermal Power Plant	7,238	6,255	5,855	6,155	5,845	5,845	5,225	5,225	5,225	5,075	5,075	5,075	5,000	5,000	4,450	3,600	3,300
Plant added (net)	0	-973	-400	300	-310	0	-620	0	0	-150	0	0	-75	0	-550	-850	-300
Combined Cycle Plant	5,075	5,075	5,075	5,075	5,075	5,075	5,075	5,632	5,632	6,325	7,207	7,207	7,207	6,852	6,852	6,162	5,855
Plant added (net)	0	0	0	0	0	0	0	557	0	693	882	0	0	-355	0	-690	-307
Gas Turbines	682	785	819	819	453	453	453	453	453	453	453	453	453	453	453	453	453
Plant added (net)	0	123	34	0	-366	0	0	0	0	0	0	0	0	0	0	0	0
Total Generation EGAT	15,845	15,001	15,135	15,435	14,759	14,759	14,139	14,696	14,695	15,239	16,121	16,121	16,046	15,691	15,141	14,041	13,654
Total Plant added (net)	0	-844	134	300	-676	0	-620	557	0	543	882	0	-75	-355	-550	-1,100	-387
Purchased Power																	
EGCO, IPP, RGCO																	
Thermal (Oil, Coal)	150	1,620	1,620	1,620	1,620	2,354	3,754	5,101	5,101	5,101	5,101	5,101	5,027	5,026	5,026	5,026	5,026
Plant added (net)																	
Combined Cycle	3,306	3,306	6,544	6,544	6,544	6,544	6,544	6,544	6,544	6,544	6,544	6,544	5,928	5,620	5,312	5,312	5,312
Plant added (net)																	
New Capacity	0	0	0	0	0	0	0	0	0	0	700	3,000	5,800	8,600	11,800	15,300	18,300
Plant added (net)											700	2,300	2,800	2,800	3,200	3,500	3,000
Total EGCO, IPP, RGCO	3,456	4,926	8,164	8,164	8,164	8,898	10,298	11,645	11,645	11,645	12,345	14,645	16,829	19,247	22,138	25,638	28,638
Plant added (net)	3,456	1,470	3,238	0	0	734	1,400	1,347	0	0	700	2,300	2,184	2,418	2,891	3,500	3,000
SPP	1,433	1,678	1,777	1,967	1,967	1,967	1,967	2,057	2,057	2,057	2,057	2,057	2,057	2,057	2,057	2,057	2,057
Plant added (net)	90	245	99	190	0	0	0	0	0	0	0	0	0	0	0	0	0
Import from Laos																	
Theun-Hinboun	214	214	214	214	214	214	214	214	214	214	214	214	214	214	214	214	214
Houay Ho	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126
Import 2007	0	0	0	0	0	0	0	1,903	1,903	1,903	1,903	1,903	1,903	1,903	1,903	1,903	1,903
Import 2008	0	0	0	0	0	0	0	0	1,380	1,380	1,380	1,380	1,380	1,380	1,380	1,380	1,380
Total import from Laos added in year	340	340	340	340	340	340	340	2,243	3,623	3,623	3,623	3,623	3,623	3,623	3,623	3,623	3,623
Other (TNB, Malaysia)																	
TNB	0	0	300	300	300	300	300	300	300	300	309	300	300	300	300	309	309
Added in year (net)	0	0	300	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Power Purchased	5,229	6,944	10,581	10,771	10,771	11,505	12,905	16,245	17,625	17,625	18,325	20,625	22,809	25,227	28,118	31,618	34,618
Added in year (net)																	
Total Generating Capacity (end of year)	21,074	21,945	25,716	26,206	25,510	26,264	27,044	30,941	32,321	32,864	34,446	36,746	38,895	40,918	43,259	45,659	48,272
Total Capacity added in year (net)	1,974	872	3,771	490	-676	734	780	3,897	1,380	543	1,582	2,300	2,109	2,063	2,341	2,400	2,613
Dependable Generating Capacity at System Peak in Year	20,398	21,117	21,354	25,102	24,436	24,780	26,000	27,954	31,171	30,975	33,296	35,596	37,705	39,767	39,647	44,509	47,122
Reserve Margin (% of Peak Demand); target minimum is15 %	36.73	30.48	22.83	35.05	22.97	18.28	15.29	16.88	22.48	15.31	15.16	16.38	16.36	15.76	13.61	15.55	15.78

Source : EGAT PDP 2001

Table 7.5.4 Power Development Program of Thailand (2001-2016)

	Projects	Capacity (MW)	Commissioning Schedule
Committed Projects	Lam Takong Pumped Storage	2x250	Oct 01 – Nov 01
	Ratchaburi Combined Cycle Block #1	725	Nov 01
	Ratchaburi Combined Cycle Block #2	725	Dec 01
	HVDC Link with Malaysia	300	Dec 01
	Ratchaburi Combined Cycle Block #3	725	Apr 02
	IPP (Bowin Power)	2x356.5	Apr 02
	Lan Krabu Gas Turbine	122	Jun 02
	IPP (Eastern Power)	350	Jul 02
	Krabi Thermal	300	Dec 03
	IPP (Gulf Power Generation)	2x367	Oct 04 – Apr 05
	IPP (Union Power Development)	2x700	Oct 05 – Jan 06
	IPP (BLCP Power)	2x673.25	Oct 06 – Feb 07
	Total Commited Capacity	**7,940.5 MW**	
	South Bangkok Renovation	2x693	Jan 07 – Apr 09
	North Bangkok Renovation	625	Jan 07
	Power Purchase from Laos	1,903	Sep 07
Future Candidate Projects	Power Purchase from Laos	1,380	Mar 08
	Bang Pakong Renovation	2x441	Oct 09 – Apr 2010
	New Capacity (domestic/foreign)	700	Oct 2009
	New Capacity (domestic/foreign)	2,300	Oct 2010
	New Capacity (domestic/foreign)	2,800	Oct 2011
	New Capacity (domestic/foreign)	2,800	Oct 2013
	New Capacity (domestic/foreign)	3,200	Oct 2014
	New Capacity (domestic/foreign)	3,500	Oct 2014
	Kirithan Pumped Storage	3x220	Oct 2014 – Oct 2015
	New Capacity (domestic/foreign)	3,000	Jan 2016
	Installed Capacity (As of August 2001)	21,939.8 MW	
	Capacity Additions	33,076.5 MW	
	Purchase from SPPs	383.8 MW	
	Capacity Retirements	7,128.6 MW	
	Net Capacity Increase	26,331.7 MW	
	Total Installed Capacity (at the end of 2016)	48,271.5 MW	

Source : EGAT PDP 2002 September 2001

Table 7.5.5 Forecast of EGAT's Generation and Sales

NESDP	Fiscal Year	EGAT's Generation		EGAT's Sales							
				MEA		PEA		Direct Customers		Total	
		MW	GWh	MW	GWh	MW	GWh	MW	GWh	MW	GWh
8	2001	16,184	103,496	6,140	34,817	9,263	60,580	337	1,777	15,740	97,174
	2002	17,388	110,945	6,555	37,037	9,945	65,434	356	1,915	16,856	104,386
	2003	18,587	118,540	6,879	39,078	10,679	70,584	366	1,971	17,924	111,633
9	2004	19,913	126,449	7,167	41,129	11,478	76,093	373	2,017	19,018	119,239
	2005	21,222	134,794	7,498	43,097	12,355	82,058	390	2,118	20,243	127,273
	2006	22,552	143,748	7,841	45,132	13,316	88,500	394	2,146	21,551	135,778
	2007	23,951	152,743	8,230	47,273	14,319	95,215	398	2,171	22,947	144,659
	2008	25,450	162,438	8,629	49,354	15,392	102,453	402	2,197	24,423	154,004
10	2009	27,232	173,532	8,936	51,561	16,647	111,292	376	2,032	25,959	164,885
	2010	28,912	184,213	9,314	53,770	17,847	119,407	380	2,058	27,541	175,235
	2011	30,587	194,930	9,695	55,998	19,087	127,711	384	2,083	29,166	185,792
	2012	32,405	206,660	10,084	58,116	20,433	136,834	388	2,109	30,905	197,059
	2013	34,352	219,134	10,535	60,271	21,884	146,765	392	2,134	32,811	209,170
11	2014	36,366	232,106	10,875	62,470	23,404	157,134	396	2,160	34,675	221,764
	2015	38,519	245,948	11,163	64,702	25,031	168,316	400	2,185	36,594	235,203
	2016	40,699	260,262	11,547	66,972	26,725	179,917	405	2,211	38,677	249,100
	Growth Rate (%)										
8	1997-2001	3.99	3.79	1.73	1.47	5.37	6.14	3.06	-3.31	3.81	4.11
9	2002-2006	6.86	6.79	5.01	5.33	7.53	7.88	3.17	3.85	6.49	6.92
10	2007-2011	6.28	6.28	4.34	4.41	7.47	7.61	-0.51	-0.59	6.24	6.47
11	2011-2016	5.88	5.95	3.56	3.64	6.96	7.09	1.07	1.20	5.81	6.04

Source: EGAT

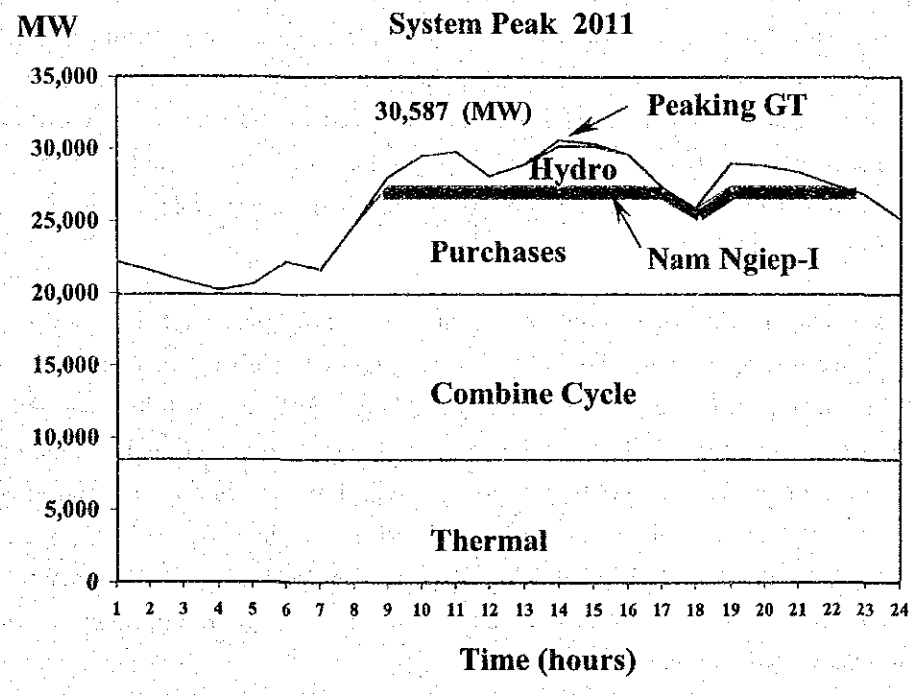


Figure 7.5.4 Position of the Nam Ngiep-I HEPP in the Daily Load Curve

7.5.5 POWER PRICE FORECAST

The projected price of power during 2011, when generation at Nam Ngiep is expected to commence, has been estimated from the sales price of three hydropower projects in Laos (Theun Hinboun, Houai Ho, and Nam Theun 2), as well as the system avoided cost of power imports from Laos to Thailand.

The sales price was 4.8 ¢ per kWh at Theun Hinboun which began operation in 1998 (price in 1998, annual rate of increase of 1%), and was 4.89 ¢ per kWh at Hoay Ho which began operation in 1999 (price in 1998, annual rate of increase of 1%). The price of Nam Theun 2 during the present PPA negotiations was estimated to be 4.2 ¢ (at COD of 2008, annual rate of increase of 1.3%). These prices were the weighted average prices, and are only indicators, since the details for primary and secondary costs by generating mode are not clear.

The low price of Nam Theun 2 is reflecting the fact that PPA negotiations had been done at the low market price conditions with EGAT having a huge reserve margins of nearly 40%. The Nam Theun 2 is still economically viable even under this low price level. During the course of PPA negotiations for Nam Theun 2, EGAT disclosed that its system avoided cost for a base load plant was 4.1 ¢ per kWh, and that for peak load primary energy was 5.4 ¢ per kWh, and secondary energy was 4.0 ¢ per kWh (all of these price levels are for the year 2001). Though Nam Theun 2 is expected to be operated as intermediate peaking plant (operating 16 hours per day at minimum), the tariff was set out to be the lower side of system cost.

It is difficult to forecast the power price 10 years from now. We can see, however, future tariffs from two relevant information sources. One is NEPO's *Thailand Power Pool and Electricity Supply* Industry Reform Study (Phase 1) report which states "the pool prices will be low in early part of 2000s reflecting large excess capacity, but pool prices will sharply increase in the period 2009-2011 as the reserve margin decreases (see Table 7.5.3) and previously uneconomic generating plants will achieve commercial levels of dispatch".

Another source is Singapore Electricity Pool price movement. Singapore started its power pool in April 1998 and power trading through this pool is becoming an established practice. The similar power pool will be put in palace in Thailand several years before 2011 of our COD year. It may be possible to see how the pool prices are likely to move in the future Thai power pool by looking at the Singapore pool prices. Figure 7.5.5 shows typical pool price profiles seen in the Singapore Electricity Pool for year 2001. We can see on weekdays the peak price at 6~7 ¢/kWh and off-peak price at 3~4 ¢/kWh; and on Saturdays the peak price 5~6 ¢/kWh and off-peak price at 3~4 ¢/kWh. These prices give us reference prices for our project since Nam Ngiep 1 is targeting to supply intermediate peak power on weekdays and Saturdays.

From this information source we estimate the intermediate peak power prices in year 2011 in Thailand will be at least 6~7 ¢/kWh. A conservative value of 6.0 ¢/kWh as an expected export tariff in financial and economic evaluations will be used in the analysis in Chapter 11.

Outline of Singapore Electricity Pool (SEP) Operation

Singapore launched its wholesale electricity market called Singapore Electricity Pool (SEP) in April 1998. It is a day-ahead market where the Pool will determine ex-ante pool prices for the next day based on demand forecast by suppliers (retailers) and offers by generating companies (Gencos). Pool operation rules are as follows. Gencos bid daily to sell electricity into the Pool. Gencos submit to the Pool offer bid packages (price and amount of electricity) for each of their generating units for each half-hourly period for the next day and the following six days. Only the offer for the next day is binding. Suppliers submit demand reservation for each half hourly period for the next day and the following six days. Again only the submission for the next day is binding. The generating unit with the lowest bid price is scheduled first to produce electricity required, followed by the next bid in ascending order, until total demand and spinning reserve requirement are met, followed by the next last generating unit scheduled to meet demand and spinning reserve requirement are met. The bid price of the half-hourly period sets the Pool price for that period. All generating units scheduled to run for that period are paid at this Pool price.

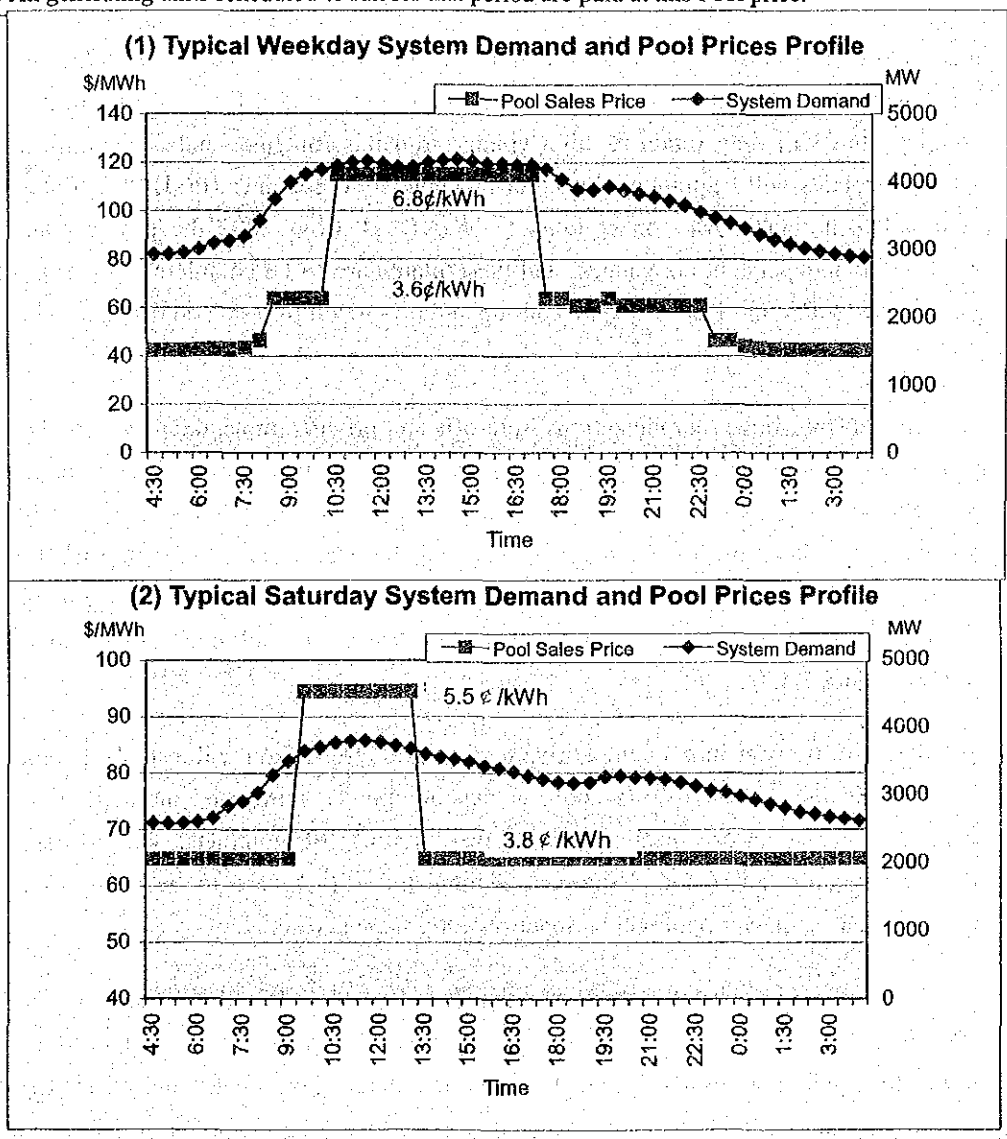


Figure 7.5.5 Typical Pool Price Profiles of Singapore Electricity Pool for Year 2001

7.5.6 IMPACT OF RESTRUCTURING OF THAI ELECTRICITY SUPPLY INDUSTRY

At the present time three government-owned companies control the Thai power sector. EGAT is responsible for generating and transmitting power, while the Metropolitan Electricity Authority (MEA) and the Provincial Electricity Authority (PEA) purchase power from EGAT. Power is distributed to MEA in the Bangkok metropolitan area, and is distributed to PEA in the remaining rural and other areas.

Thailand is currently pursuing a two-pronged structural reform of the power sector. The first prong is reorganization of the three government-owned companies, including unbundling and privatization. The second prong is liberalization and deregulation of the power market. The government-owned companies have key responsibility for their reorganization, while the government is leading the liberalization of the power market.

Reorganization of the power sector was determined by the Cabinet in February 1992. As a result, generation, transmission and delivery of power are to be unbundled. EGAT will become the central power company but will only retain its high voltage transmission lines and its hydropower plants. EGAT's thermal plants will be spun off into four independent companies (PG1, PG2, Ratchaburi and EGCO and will sell their power on contract to EGAT. During 2002 the power plants will be commercialized as independent companies, and these plants are to be completely privatized by 2003 (see Figure 4.5.6). MEA and PEA are to be split-up and privatized into several distribution companies (Disco).

At the same time as the above reorganizations, spin-offs and privatizations, the power market will also be liberalized. According to the initial plan, by the end of 2003 a fully competitive power pool will be put in place. The deregulation model envisions a power pool in the wholesale market like that of Singapore, while regulated third party access (TPA) will be introduced in the retail market. In this model, generation, wholesale supply and retail supply will rely on competition, while a monopoly will be permitted for grid functions such as transmission and distribution, although this monopoly will be regulated (See Figure 7.5.7).

During the period of transfer into a competitive market structure, EGAT will establish Debt Co as an organization to recoup stranded costs such as existing power purchase contracts, and will also establish PPA Trader as an organization to take over existing IPP contracts. The System Operator (SO), Market Operator (MO) and Settlement Administrator (SA) are to be spun off and made independent, so that the power pool will be independently managed.

This deregulation plan is an ambitious program that is to be pursued on the initiative of the National Energy Policy Office (NEPO) as the supervising agency. Although the government has stated its desire to start the power pool by 2003, EGAT is seeking a deferral on the grounds of insufficient time. Their reasoning is that it will be difficult to open this market by 2003 given that it will not be possible to ensure sufficient competition when only eight generation companies are able to participate in the

market by this date, that it is not certain that power costs will fall, and that the regulatory framework is not in place since the laws and regulations required to create a power pool system have not even been worked out.

Even if the starting date of the pool is delayed, however, the pool system will be in place by 2011 when Nam Ngiep-I HEPP is scheduled for commissioning. In principle the generators will participate in bidding for the pool, although the pool is not compulsory and consequently the plant will have the option of executing direct agreements with PPA Traders, distribution companies or major consumers (a type of PPA).

According to the Thailand Power Pool market rules (draft 2.0 dated April 2001) the wholesale electricity market will consists of a power pool comprising two spot markets (electricity and spinning reserve) and a bilateral contract market which is outside pool settlement (see Figure 7.5.8).

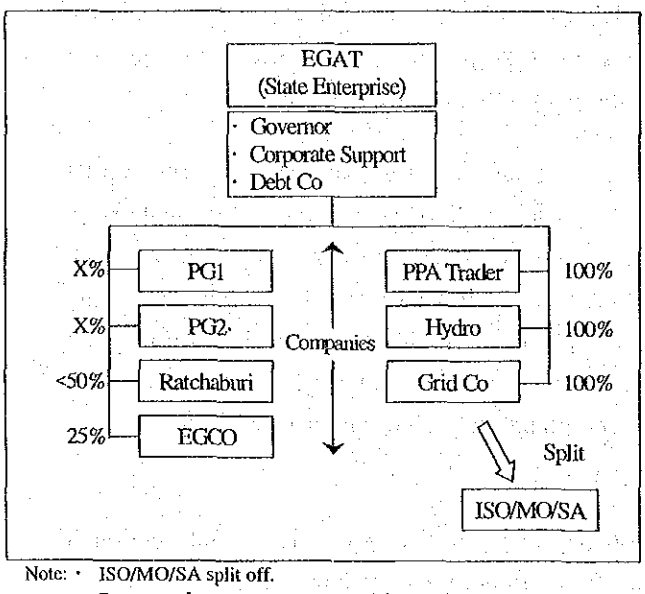
Electricity spot prices during off-peak period are as low as the short run marginal cost (mostly fuel costs) of the most efficient thermal plants like CCGT. During peak time, spinning reserve spot prices are added to the electricity spot prices to reflect new capacity charges to cope with peak demand. Generators whose capacity costs are high and operation costs are low receive a payment for providing the system with spinning reserve capacity. Hydropower plants are in this category and are on-line and can increase generation within minutes or less. The pool market also allows a bilateral long-term contract market, in which generators like hydropower plants may sign contracts with distributors, suppliers, large lot customers and even other generators.

It is difficult to predict what impact the power pool may have on electricity prices. As mentioned above much of the hydropower trade with long-term PPAs will not go through the power pool but will be on a direct bilateral contract between generators and bulk purchasers (Discos, Supplycos, etc). Essentially the same pricing mechanism will exist for the exporting IPPs as exist at present, that is the price will be dictated by the least cost alternative available to the purchaser for long term power contracts. It is expected that this will apply to most power export agreements for firm (primary) hydro power.

Normally the principle of competition operates in a pool market in which many power companies participate, leading to declines in the market price below that which existed prior to introducing the pool. Even under these conditions, however, it appears inconceivable that the market price will differ substantially from the benchmark price discussed in Section 7.5.5. The current PPA market price with EGAT is set under conditions of fierce competition between IPPs, and applicable cost minimization proposals are reflected at EGAT. It is difficult to believe that the pool market will create further downward pressure on prices; consequently even under the pool market, the benchmark price levels previously described are likely to be maintained.

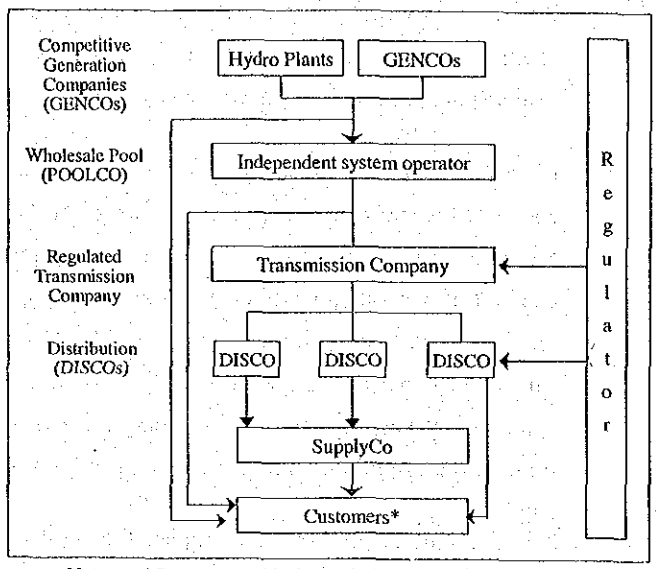
7.5.7 CONCLUSIONS

During 2011 when Nam Ngiep 1 is scheduled for commissioning, it will be necessary for Thailand to find between 2,300 MW and 2,800 MW in new power sources. This project is one of the more promising candidates for providing this power. The market will easily absorb around 240 MW, but in order to succeed in competition with other market participants the project must be able to operate as an intermediate load plant at the projected benchmark price of 6.0 ¢/kWh (and at a utilization rate of at least 50%). The decisive factors in succeeding as a private sector IPP will be whether revenues attractive to investors in the private sector can be achieved at the benchmark price levels, and whether a financing package can be created at low interest rates so profits can be earned.



Note: · ISO/MO/SA split off.
· Power pool commences commercial operation.
· Market education.
· From 2003, sell-down of PGI,PG2, Hydro, Ratchaburi to min
· DebtCo starts operation.
Source: NEPO

Figure 7.5.6 Restructuring of EGAT (After Power Pool Commencement)



Note: · *Customers with demand over a certain threshold will be able to purchase electricity directly from gencos or power pool. The regulator will be responsible for determining the detail of the qualified customers.
Source: NEPO

Figure 7.5.7 Long Term Energy Supply Structure

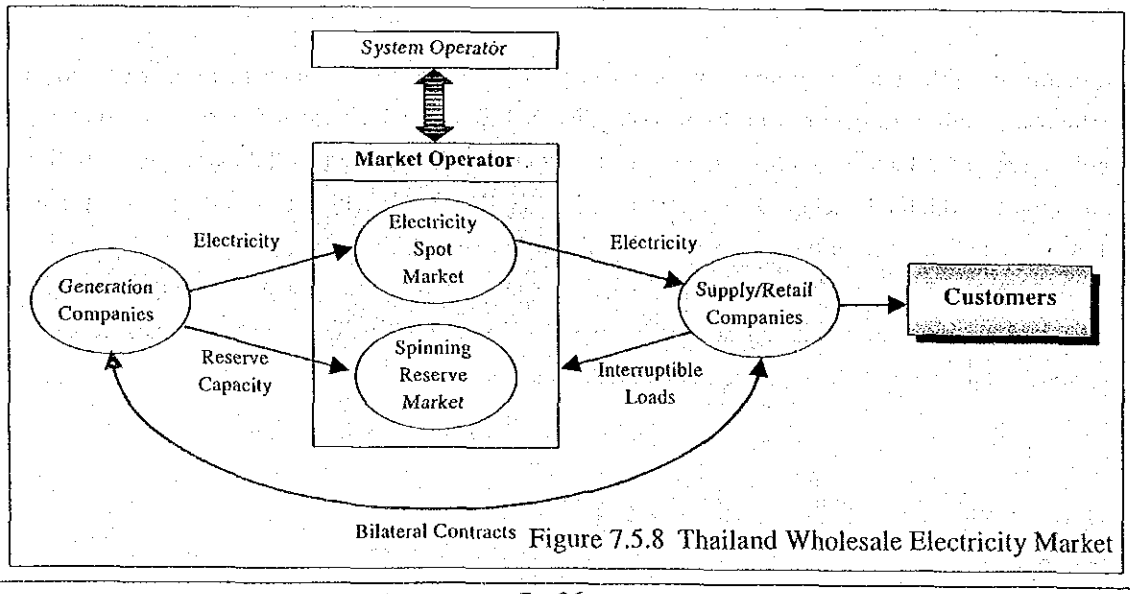


Figure 7.5.8 Thailand Wholesale Electricity Market

7.6 EXPORT POTENTIAL TO VIETNAM

7.6.1 STRUCTURE OF ELECTRICITY SECTOR

Vietnam has about 6,900 MW of installed capacity as of the end of year 2000, including hydroelectric (3,284 MW), coal thermal (843 MW), gas turbine (1,794 MW), diesel and oil (941 MW) plants (See Table 7.6.1). Total generation increased from 16,960 GWh in 1996 to 26,594 GWh in 2002 (annual growth rate 12%).

Vietnam's power system is divided into three regions – north, central and south – which were interconnected by a 1,500 km long 500 kV line in 1994 but are still dispatched separately (See Figure 7.6.1). The north hosts the 1,920 MW Hoa Binh hydro plant and a number of coal-fired units, with the regions's total installed capacity of 2,732 MW. The south includes a number of gas turbine units fired by oil and natural gas and several small hydro units, with total regional capacity of 3,415 MW. In the south two IPPs of gas turbine are operating. The central region has 715 MW of hydro and diesel plant.

The three regions are interconnected by the 500 kW line which entered service in 1994, primarily to transmit surplus power from the north to the rapidly-growing load centers in the south. The backbone of each of the three grids is a 220 kV transmission line with 110 kV systems serving as secondary transmission systems (or the main transmission network in areas outside the 200 kV system). In the central region the 110 kV lines from the main system, interconnect with load centers along the coast.

There are three principal government institutions responsible for policy planning and implementation: Ministry of Planning and Investment (MPI), Ministry of Industry (MOI) and Electricity of Vietnam (EVN) as shown in Figure 7.6.2. The MPI is responsible for formulating national energy strategy and policy including the power sector master plan as well as collaborating with relevant ministries and agencies to produce documents for submission to the Prime Minister for consideration and approval. The MOI is responsible for steering the power sector to implement the master plan, as well as directing and supervising the EVN. The EVN is a state-owned company responsible for construction, operation and maintenance of all concerned power facilities. Several power companies under the supervision of the EVN are engaged in actual operation and maintenance of the facilities. The EVN also oversees several power construction companies and transmission companies.

The record of peak demand and electricity generation in the latest 5 years (1996-2000) is as shown in Table 7.6.2. The annual average growth rates for the 5-year period were 11.4% for peak demand and 11.9% for electricity generation. Since the average GDP growth rate during the period was 6.9%, the resulting elasticity of electricity generation to GDP growth rate was 1.72.

Table 7.6.1 Vietnam's Power Generation System (2000)

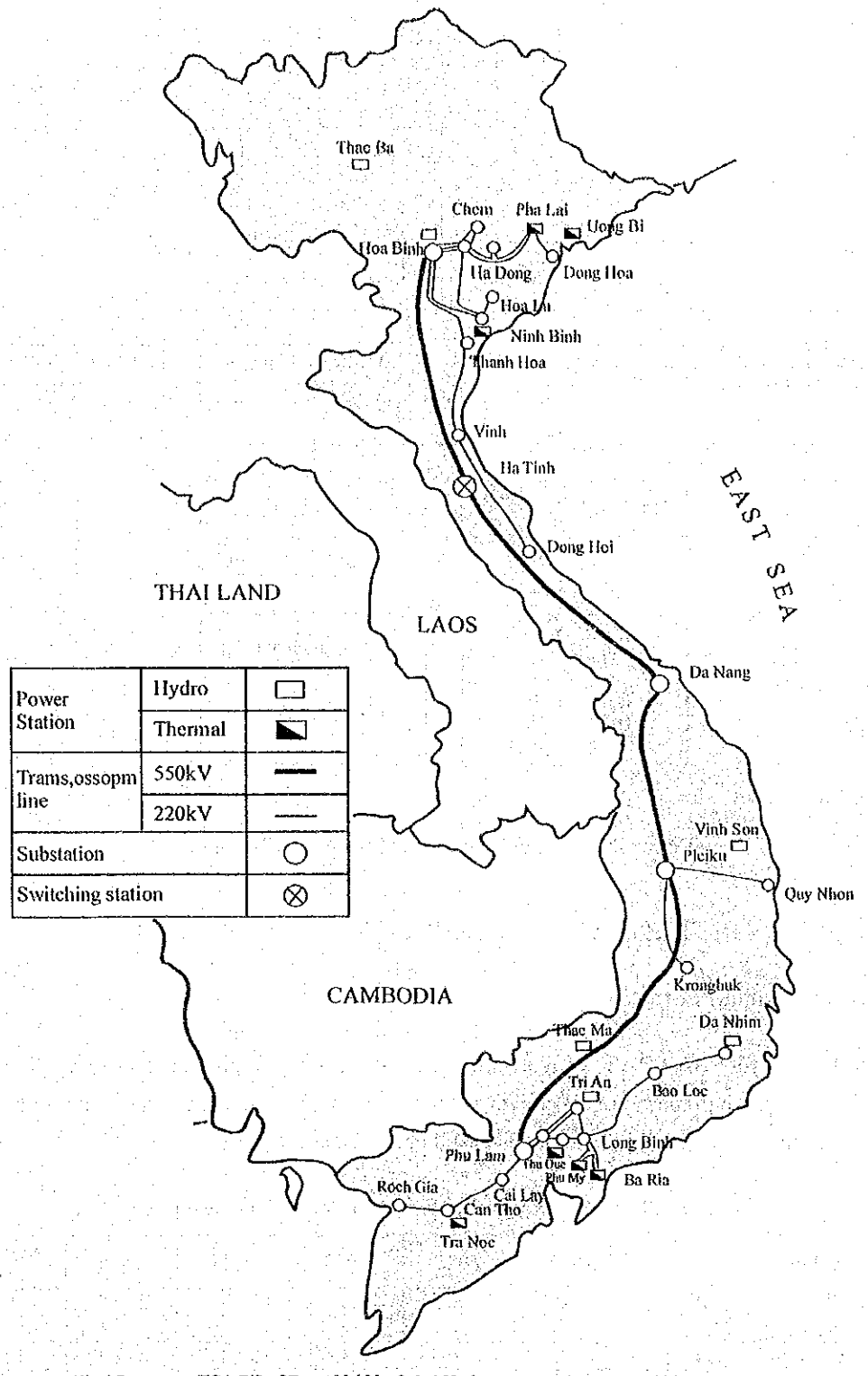
Region	Plant name	Capacity (MW)
North		2,732
Hydro	Thac Ba	108
	Hoa Binh	1,920
	Small Hydro	17
Thermal (coal)	Ninh Binh	100
	Uong Bi	105
	Pha Lai	440
Gas turbine		34
Diesel		8
Centre		**715**
Hydro	Vinh Son	66
	Yaly	360
	Song Hinh	70
	Small Hydro	29
Diesel		190
South		**3,415**
Hydro	Da Nhim	160
	Tri An	400
	Thac Mo	150
	Small Hydro	4
Thermal (coal)	Thu Duc	165
	Can Tho	33
Gas turbine	Thu Duc	70
	Ba Ria	300
	Can Tho	150
	Phu My 2.1	526
	Phu My 1	120
	Hiep Phuoc (IPP)	375
	Amata (IPP)	169
Oil & Diesel		743
Total		**6,862**

Source: EVN

Table 7.6.2 Electricity Demand for 1996-2000

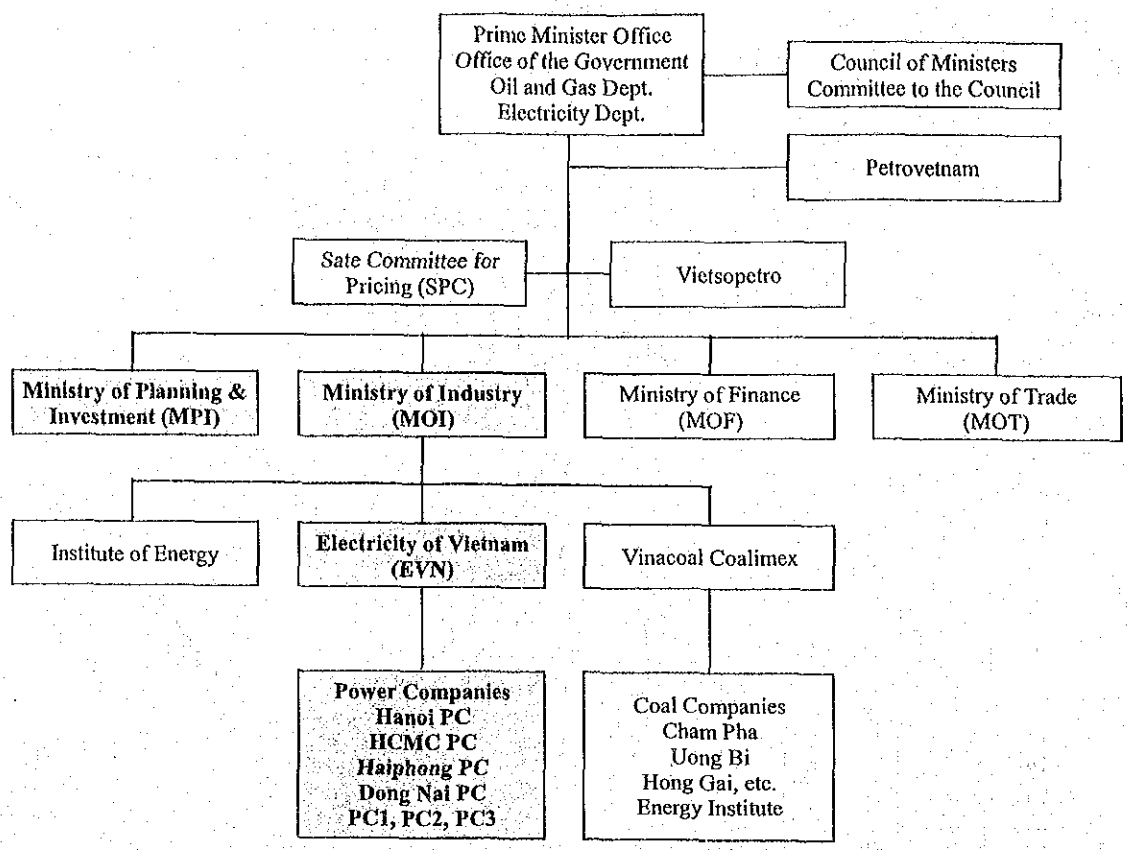
Electricity Demand	Unit	1996	1997	1998	1999	2000	Annual Growth Rate (%)
Electricity Consumption	GWh	13,374	15,305	17,739	19,592	22,405	13.8
Electricity Generation	GWh	16,960	19,151	21,654	23,740	26,594	11.9
Peak Demand	MW	3,177	3,582	3,875	4,200	4,890	11.4

Source: EVN



Source: Final Report on JICA F/S of Dong Nai No. 3 & 4 Hydropower Project, Mar. 2000

Figure 7.6.1 Diagram of Vietnam's Power System (as of end 1999)



Source: Ministry of Industry

Figure 7.6.2 Power Sector Institutions in Vietnam

7.6.2 POWER DEVELOPMENT PROGRAM

(1) Power Demand Forecast

The power demand forecast for Vietnam according to the most recent projections of EVN is shown in Table 7.6.3. EVN have prepared three growth scenarios, a low, medium (base case) and high forecast. Vietnam's current power development plan is based on the base case forecast.

Table 7.6.3 Power Demand Forecast for Vietnam (Base Case)

Items		2000	2005	2010	2015	2020	Avg. growth rate (%)
Peak demand	(MW)	4,487	7,802	11,653	17,847	26,854	9.4
- annual increase	(%)	12.4	11.7	8.4	8.9	8.5	-
Energy generation	(GWh)	26,000	46,459	70,437	109,439	167,022	10.1
- annual increase	(%)	12.9	12.3	8.7	9.2	8.8	-
GDP growth rate	(%)	7.2	7.2	7.2	6.5	6.5	6.8
GDP elasticity of energy demand		1.79	1.71	1.21	1.42	1.35	-

Note: The annual increase rates and GDP growth rates correspond to those annual average for the five year period ending at each column.
Source: EVN, Master Plan of Vietnam Power Development for the period of 2001-2020, October 2000

Economic growth (real GDP) is estimated to be 7.2% for the period 2001-2010 and 6.5% for the

period 2011 to 2020.

The peak demand will increase by 9.4% on average, from 4,487 MW to 26,854 MW over the 20 year period. The annual average increase in peak load for the period is 1,120 MW on average, which calls for annual increase in generating capacity of 1,400 MW (reserved margin assumed to be 25%).

The load forecast estimates an average annual increase in electricity sent-out of 10.1%, from 26,000 GWh in 2000 to 167,022 GWh in 2020. This corresponds to a GDP elasticity of energy demand of 1.48 on average over the 20 year period.

(2) Power Generation Plan

Table 7.6.4 shows the EVN current generation plan based on the Base Case load forecast. The plan indicates power purchase from abroad will be necessary in year 2007. The plan also indicates a total of 34,791 MW new capacity will be required by 2020: 30,791 MW will be produced within the country and 4,000 MW will be purchased from abroad.

Table 7.6.4 Power Generation Plan 2000-2020 (Base Case)

No.	Type Plant \ Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2015	2020
	CAPACITY (MW)													
1	Hydro power	3,234	3,830	4,066	4,138	4,138	4,508	4,901	5,371	5,871	6,141	6,461	10,206	12,794
2	Pump storage power												400	1,000
3	Imported power								300	300	700	1,000	2,000	4,000
4	Coal TP	640	1,240	1,340	1,440	1,890	1,890	1,890	2,190	2,490	2,640	2,940	3,340	4,840
5	Gas + Oil TP	2,252	2,701	2,521	2,953	3,823	4,777	5,137	5,497	5,857	6,217	6,517	8,737	10,857
6	Geo-thermal						50	100	100	100	100	100	100	100
7	Nuclear energy													1,200
	Total capacity	6,126	7,771	7,927	8,531	9,851	11,225	12,028	13,458	14,618	15,698	17,018	24,783	34,791
	Peal Load	4,487	5,012	5,598	6,253	6,985	7,802	8,454	9,160	9,925	10,755	11,653	17,847	26,854
	Reserve Margin													
	- Rain season	36.5%	55.0%	41.6%	36.4%	41.0%	43.9%	42.3%	46.9%	47.3%	46.0%	46.0%	38.9%	29.6%
	- Dry season	8.7%	34.9%	24.5%	20.0%	18.4%	22.7%	26.0%	30.4%	31.1%	32.1%	32.7%	30.0%	23.1%
	POWER GENERATION CAPACITY RATIO (%)													
1	Hydro power	52.8%	49.2%	51.3%	48.5%	42.0%	40.2%	40.8%	39.9%	40.1%	39.1%	38.0%	41.2%	36.8%
2	Pump storage power												1.6%	2.9%
3	Imported power								2.2%	2.1%	3.8%	5.9%	8.1%	11.5%
4	Coal TP	10.4%	16.0%	16.9%	16.9%	19.2%	16.8%	15.7%	16.3%	17.0%	16.8%	17.3%	13.4%	13.9%
5	Gas + Oil TP	36.8%	34.8%	31.8%	34.6%	38.8%	42.6%	42.7%	40.8%	40.1%	39.7%	38.2%	35.3%	31.2%
6	Geo-thermal						0.4%	0.8%	0.8%	0.7%	0.6%	0.6%	0.4%	0.3%
7	Nuclear energy													3.4%
	TOTAL	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: EVN, Electricity Market in Vietnam for Period 2001-2020, October 2000

7.6.3 EXPORT PLAN TO VIETNAM

The existing MOU between the GOL and the Vietnam Government stipulates the export of 1,000 MW of hydropower from Lao PDR to Vietnam over the next ten years. Specifically as shown in Table 7.6.4 EVN intends to import 300 MW in 2007, 400 MW in 2009 and 300 MW in 2010.

The current GOL plan provisionally list the following projects as hydro candidates for power export to Vietnam (See Table 7..5).

Table 7.6.5 Projects in Laos for Power Export to Vietnam

No.	Project	Capacity	Commissioning Schedule
1.	Nam Mo	105 MW	2007
2.	Xe Kaman 3	218 MW	2012
3.	Nam Kong 1	240 MW	2012
4.	Sekong 4	440 MW	2014
5.	Sekong 5	253 MW	2014
6.	Nam Theun 1	400 MW	2014
7.	Nam Theun 3	236 MW	2016
	Total	1,892 MW	

Price considerations are as follows:

(i) According to ADB's PSSS report, average production cost in Vietnam is fairly low, around 3 US Cent/kWh. Current price of natural gas in Vietnam is also lower than that in Thailand. The PSSS report also indicates that tariff limit for electricity import is around to 4.2 US Cent/kWh currently set for power purchase from its domestic IPPs. Connection points for power export to Vietnam are the two routes between Ban Sok in Laos and Pleiku in Vietnam, and between Nam Phao in Laos and Ha Tinh in Vietnam.

(ii) According to EDL's explanation to the study team (July 2001), GOL's recent negotiation with Vietnam on energy export has no major technical issues but made no remarkable progress. Vietnam has asked GOL to set fixed border energy price at US Cent 4.0 US ¢/kWh, because of fairly lower energy production cost in Vietnam. The negotiations are continuing.

The financial returns in exporting power to Vietnam are much lower than those involving Thailand. However, considering the rather demanding generation development plan of Vietnam, difficulties in financing and delays in national projects, a commercial arrangement with Vietnam may become a higher priority. Accordingly, it had better to keep the power selling option to Vietnam as a future alternative for the Nam Ngiep-I hydroelectric power project.

7.6.4 PRIVATE SECTOR PARTICIPATION IN POWER DEVELOPMENT

Under the current power development plan for 2001-2020 EVN estimated that 20% of the total financing requirement would be provided by private sector through IPP schemes.

IPPs in Vietnam can be divided into the following two broad categories:

(i) private generation selling exclusively to businesses in export-processing and industrial zones, and

(ii) private generation selling exclusively to EVN on a 20-year BOT basis.

Vietnam does not have an extensive history of IPP projects. The first such project was the IPP (Hiep Thuoc) falling under the first category for an industrial park which opened in 1998. The next project IPP was Nomura Corporation's captive power generator (50MW diesel) for the Hai Phong Industrial plant. Bien Hoa (Banpu, Amata Power) of 120 MW gas-fired plant is also operating. Currently, three IPP projects are under operation.

Discussions with several IPPs to operate on a BOT basis started in 1997, beginning with the Wartsila. Table 7.6.5 summarizes the state of progress of selected IPP projects. It should be noted that successful conclusion of PPAs for Phu My 2.2 and 3 have proved that complex BOT IPP deals are possible in Vietnam. A power tariff set in PPAs of both projects is around 4.0 US ¢/kWh.

For hydro by BOT, the Can Don hydropower project of 72 MW is under construction by local contractors. It is said that the Sesan hydropower project (260MW) of which feasibility study had been conducted by ADB was resigned for promotion as IPP.

Table 7.6.6 Selected Vietnamese IPP and Joint Venture Projects

Project	Type	MW	COD	Project Status	Developer
Bac Binh	hydro	52	2006+	Development	Song Da Construction
Ca Mau-1	gas	720	2005	EPC awarded	Petrovietnam
Cam Pha	coal	300	2005+	Development	Vinacoal
Can. Don	hydro	72	2003	Construction	Song Da Construction
Cao Ngan	coal	100	2005	EPC awarded	Vinacoal
Chu Linh/Coc San	hydro	77	2006+	Development	Vinaconex
Haiphong	coal	600	2006+	Development	EVN/Vinacoal/VIC
Na Duong	coal	100	2004	Construction	Vinacoal
Nam Chien	hydro	130	2006+	Development	Song Da Construction
O Mon	gas	600	2005+	Development	EVN/Uncoal
Phu My 2.2	gas	720	2004	Financing	EdF/Sumitomo/Tepco
Phu My 3	gas	720	2003+	Financing	BP/Sembcorp/Kyushu
Ha Thanh	coal	600	2007+	Development	EVN/Vinacoal
Sesan PoKo	hydro	132	2006+	Development	Song Da Construction

Source: Power in Asia #356 (24 June 2002) (EVN and company announcements)