CHAPTER 2 CURRENT SITUATIONS OF POWER DEVEPOLPMENT

Chapter 2. Current Situations of Power Development

2.1 Energy Sector

2.1.1 Organization

By 1994 power sector and coal industry were under the Ministry of Energy (MOE), while oil and gas under the government. After that, Electricity of Vietnam (EVN) was established pursuant to the Decree number 562/TTg issued by the Prime Minister on 10 October 1994 and the Ordinance dated 27 January 1995. Following that, Vinacoal was founded under the Decree number 563/TTg. Ministry of Energy merged with Heavy industry Ministry and Light Industry Ministry and became Ministry of Industry. Since then, MOI has been the relevant authority of EVN and Vinacoal. After the years of direct management by the Prime Minister, the Decree number 55/2003/ND-CP issued on 28 May 2003 prescribed that oil and gas (Petrovietnam) becomes under MOI.

By the Decree number 219/2003/QD-TTG issued on 28 October 2003 prescribed that EVN proposal on structure reform from 2003 to 2005 has been approved (Figure 2-1-1).

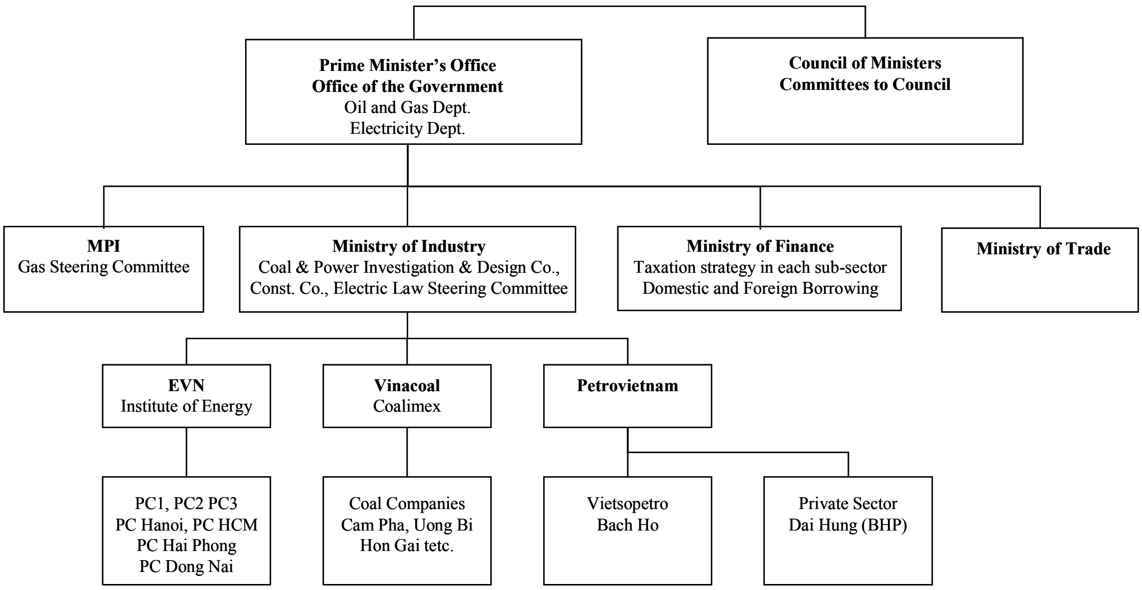


Figure 2-1-1 Organization of the Energy Sector of Vietnam

Source: Fueling Vietnam's Development – New Challenges for the Energy Sector, 1998.12, WB, partially revised

2.1.2 Energy Resources

(1) Hydropower

Theoretical hydropower potential of the whole country is estimated at about 300 TWh per year. The North possesses the biggest reserve with 180 TWh (60%), the Center 78 TWh (26%) and the South 44 TWh (14%). The feasible hydropower resource amount is 82 TWh while installed capacity is 17.7 GW (Table 2-1-1). By the end of 2002, there are eight over-100MW existing power plants with total installed capacity of 3,945MW, which is merely 22% of feasible hydropower potential.

Table 2-1-1 Feasible Hydropower Potential

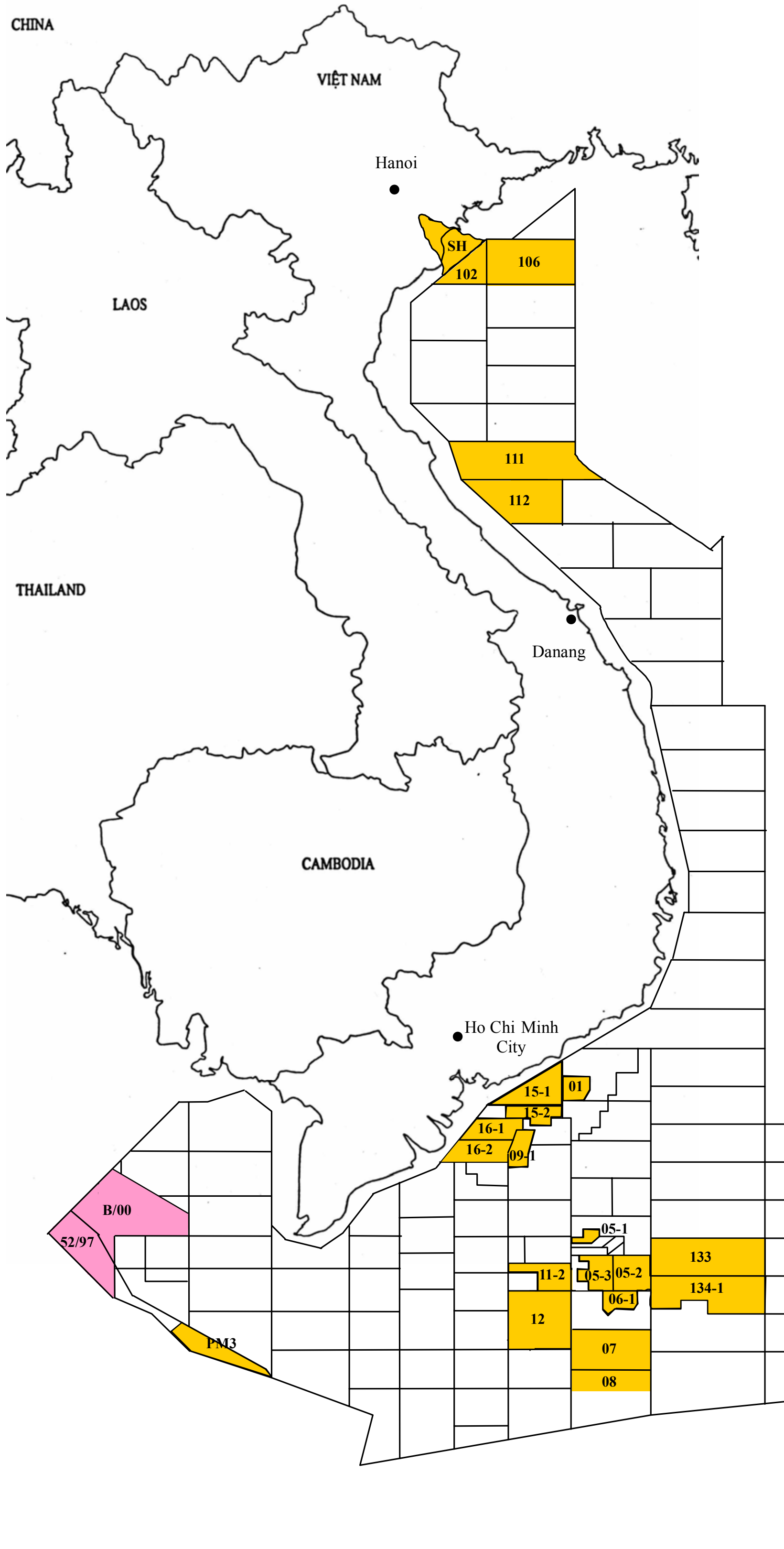
River Basin	Capacity (MW)	Energy (TWh)
Lo River	1,068	4.8
Da River	6,258	31.6
Ma River	320	1.3
Ca River	560	2.6
Vu Gia - Thu Bon River	1,194	4.6
Tra Khuc River	360	1.7
Ba River	402	2.1
Se San River	1,485	8.0
Srepok River	496	2.6
Dong Nai River	3,000	11.6
Sub Total	15,143	70.7
Total	17,700	82.0

Source: Son La PMB. 2003

(2) Oil, Gas

The Vietnam continental shelf contains an abundant reserve of hydrocarbon. In 1986 Vietsovpetro, in a joint venture of Vietnam and the former-Soviet Union, the two companies began to exploit crude oil in the Bach Ho field of Cuu Long Basin, 120 km south west of Vung Tau. After that, through investments from Western countries, more oil and gas have been explored and exploited in Rong, Dai Hung, Rang Dong and Ruby fields of Cuu Long Basin as shown in Figure 2-1-2 and Table 2-1-2. In addition to these fields, several big-reserve fields have been discovered such as Malay-Tho Chu basin in southwest offshore; Nam Con Son Basin 200 km south east offshore from Cuu Long Basin; and Song Hong Basin in the North region as well. The feasible gas potential is 328 BCM at this stage.

According to the 5th Master Plan of Vietnam Power Development, hydrocarbon reserves, which were inferred so far, were 390 million tons of oil and 617 billion m^3 of gas.



Area	Developer
SH	Maurel & Prom
01 (HN)	Carigali
05-1(DH)	VSP
05-2	BP
05-3	BP
06-1	BP
07,08	VAMEX
09-1	VSP
11-2	KNOC
12	SAMEDAN
15-1	CLJOC
15-2	JVPC
16-1	HLJOC
16-2	Conoco
112	GazProm
B/00	Unocal
52/97	Unocal
133,134-1	Conoco
PM3	CAA Talisman
102,106	ATI
111	OMV

Figure 2-1-2 Petroleum Resources

Source: Guideline for Foreign Investment in Petroleum Projects of Vietnam, Petrovietnam

Table 2-1-2 Gas Development Situation

Basin	Block	Developer	2P Reserves (BCM)	Annual Supply Capability	Supply & Development Plan	Remark
Cuu Long	9-1 (Bach Ho)	Vietsovpetro JV (PetroVietnam 50%, Nestro 50%)	20	1.5	PM 2-1, Ba ria, LPG	Associated Gas under production
	9-1 (Rong)					
	01,02 (Ruby, Emerald)	Petronas Carigali/ PVEP	25.5	1		Expected first gas in 2005
	15-2 (Rang Dong)	JVPC/ Conoco/ PVEP	9	0.5		Associated Gas under production
Nam Con Son	06-1(Lan Tay, Lan Do)	ONGC (India),BP	57	2.7	Phu My 1 Phu My 2-2 Phu My 3 Phu My 4	First gas planned 2003
	11-2 Rong Doi, Rong Doi Tay, Rong vi dai	KNOC (Korea), Mobil	30	1.3	Phu My 2-2	Under development
	05-3 (Moc Tinh)	BP/Conoco	20	1.3	No plan	Under projection
	05-2 (Hai Thach)	BP	47	1-2	No plan	Under appraisal & development
Malay-ThoChu (Southwest offshore)	B, 48/95, 52/97	Unocal MOECO PV (PVSC)	90	2-4	Depending on gas market	Under appraisal & development
	PM-3 CAA	Petrronas, PV-Co owners (50:50)	50%*52	50%*2.5	Power & Fertilizer complex in Ca Mau	First gas to VN by the end 2005
Song Hong	Thai binh (Tra Ly River), D14, Tien Hai C	Maural & Prom (France), Petro Vietnam	4	0.08	Local Industry	Operation partially
So	Total		328.5	12.6-15.6		

Source: Petrovietnam

(3) Coal

Vietnam's coal reserves lie principally in Hon Gai graben in Quang Ninh, which extends about 125km from Uong Bi in the west to Cai Bau in the east. Though the coal deposits are geologically young, intense tectonic pressure had changed bituminous coal to semi-anthracite or anthracite. In 2002, coal reserves of 300m below the surface were estimated at 3.8 billion tons as shown in Table 2-1-3, most of which are anthracite with high calorific value and low sulfur content (semi-anthracite and anthracite account for 85%, lignite 5% and peat 10%). The ratio of open-pit and underground mines is 2:8.

Moreover, significant coal deposits have been discovered in the Red river basin. According to the study of NEDO completed in Jan. 2003, 1.64 billion tons inferred potential of sub-bituminous was discovered within the area of 950 km^2 about 1,200m below the surface as shown in Table 2-1-4. Among these, potential measured reserve is 51 million tons within 400m below the surface. The average coal quality is: moisture 18%, ash 7%, volatile 36-37%, calories 5,000kcal/kg, sulfur 0.5%.

Table 2-1-3 Coal Reserves（Unit: million ton）

Mine area	Certainty of exploration				Exploitation	
	A+B+C1+C2	A+B	C1	C2	Open pit	Underground
Cam Pha	1,316.05	267.99	623	425.06	237	991
Hong Gai	526.91	37.31	247.77	241.83	54	513
Uong Bi	1,328.98	79.99	682	566.99	22	1,392
Interior	636.59	53.44	427.71	155.44	172	93
Binh Minh Khoai Chau	145.96		122.91	23.05		119
Total	**3,808.53**	**438.73**	**1,980.48**	**1,389.32**	**881**	**3,109**
Type of coal						
Anthracite	3,238.20	395.31	1,595.91	1,246.98	388	2,980
Long frame (Lignite)	215.23	42.84	149.56	22.83	97	121
Fat coal	6.91	0.58	6.18	0.15		7
Peat	348.19		228.83	119.36	396	

Source: Vinacoal M/P, 2003

Table 2-1-4 Red River Coal Reserves（Unit: 1000 ton）

Seam	K.S Syncline - Binh Ninh Anticline				F.K.Fault - K.S Syncline	Binh Ninh Anticline.-Binh	Gross Total
	Middle				West	East	
	Measured	Indicated	Inferred	Total	Inferred	Inferred	
	< 400m	400-800m	800-1200m		< 1200m	< 1200m	
V17	38,520	86,697	72,734	197,951	15,756	8,789	222,496
V15	52,369	94,889	64,671	211,929	17,573	20,030	249,532
V14	88,664	131,867	73,434	293,965	34,216	19,738	347,919
V4	88,055	86,563	53,516	228,134	14,874	21,042	264,050
V3	243,602	164,478	81,222	489,302	42,123	23,826	555,251
Gross Total	511,210	564,494	345,577	1,421,281	124,542	93,425	1,639,248

Source: Red River Delta Project, January 2003, NEDO

2.1.3 Energy Development Plan

(1) Hydropower

Hydropower is a clean and renewable energy resource. Though sizeable up-front costs are needed for development, once operated this energy is cheap and stable for more than one hundred years and out of influence of the exchange rate fluctuation because fuel cost is zero. Therefore, EVN should properly develop hydropower plants, which have economic rationale.

According to the latest power development plan, a total of 12,135MW hydropower is developed from 2003 to 2020, of which the north region cover 54%, the central 29%, and the south 17%. This results in developing 91% of the feasible hydropower potential of 16,080MW by 2020.

(2) Oil, Gas

Table 2-1-5 shows the exploitation plan of the oil and gas sector indicated in the 5th M/P. As of the end of 2002, the total capacity of oil thermal power plants excluding IPP was only 198MW, which is total of the capacity of Thu Duc Power Plant (165MW) and Can Tho Power Plant (33MW), both of which have to import FO for operation. The only planned oil thermal plant is O Mon TPP No.1 with the capacity of 600MW. However, gas will be used on completion of the pipe-line from gas potential in southeast offshore to O Mon in 2010.

On the other hand, along with the rapid increase of gas production, a total of 10,483MW gas thermal power plant is under planning between 2003 and 2020. Excluding Quang Tri power plant (720MW) in the central region, all the planned gas thermal power plants are located in the south region, and none is proposed in the north region. The current of gas supply is approximately US$1.8/mmbtu at the platform, excluding transfer costs through pipelines.

Table 2-1-5 Petroleum Exploitation Plan (Unit: million m^3 OE)

	2000	2005	2010	2020
Oil Production	16.5	17.6-18	20.6-21.6	11-18
Gas Production	1.5	6.7	11.5-13.5	14-18

Source: Institute of Energy, 2003

(3) Coal

The latest coal exploitation plan is shown in Table 2-1-6. The average coal price (ex-works price) is VND319/kg and the price for generation is as low as VND305 to 332/kg. In addition, the coal sector is a completely domestic industry, so that coal price is set up in local currency and stable out of influence of exchange rate fluctuation. Since coal is mainly used for the power and cement sectors, exhaustion of coal resources is not as much of a concern as the possibility of exhaustion of gas. Therefore, the coal thermal power plant is given high priority to develop as a base power source; plants for a total of 5,800MW of coal plants is under way from 2003 to 2020.

Due to the location of reserves, all the existing coal power plants are in the northern region. However, considering the abundant potential and stable price, the latest power development plan proposes to develop a coal thermal power plant in the south region utilizing imported and/or domestic coal. Vinacoal estimates that, with a tanker of 4,000 to 6,000 tons, the price of coal transferred to the south region is about US$5/ton to Nui Xuoc, $7/ton to HCM City, $10/ton to Kien Giang.

Table 2-1-6 Coal Exploitation Plan (Unit: 10^6 ton)

	2000	2005	2010	2015	2020
Coal Production	10.5-11.0	12-13	14-15	–	15-20
	10.5-11.0	16	24	27	30

Source: Upper: 5th Master Plan of Electric Power Development in Vietnam, Jun. 2001
Lower: Vinacoal M/P, 2003

2.1.4 Demand-and-Supply Plan of Primary Energy

Table 2-1-7 shows demand-and-supply plan of primary energy proposed in the 5th M/P. Primary energy demand is expected to increase at the AAGR of 8.2% from 2000 to 2020. Primary energy supply continues to exceed its demand by 2010. Meanwhile, due to the reduction of the rate of increase of coal and oil production, the supply is expected to fall below the demand by approximately 28% in 2020. However, if coal is produced in accordance with the Vinacoal's exploitation plan as shown in Table 2-1-6, primary energy demand could be supplied from the domestic energy resources.

Table 2-1-7 Primary Energy Demand-and-Supply Forecasts (Base Scenario)

	2000		2005		2010		2020	
		KTOE		KTOE		KTOE		KTOE
Energy Demand		18,131		27,878		44,360		88,228
Domestic Supply		27,766		37,426		50,086		63,324
Coal (mil. ton)	11.6	6,501	16.2	9,053	22.8	12,772	30.1	16,846
Oil (mil. ton)	16.3	16,564	20.0	20,324	21.6	21,989	18.0	18,324
Gas (bil. m^3)	1.6	1,440	4.5	4,050	8.8	7,939	18.0	16,200
Other (TWh)	14.6	3,261	17.9	3,999	35.1	7,386	58.4	11,954
Surplus/Shortage		+9,635		+9,548		+5,726		-24,904

Source: Institute of Energy, 2003

2.1.5 National Energy Security

Though Vietnam is endowed with abundant energy resources, the future energy security balance is estimated as shown in Table 2-1-8 based on the above each primary energy potential and exploitation plan.

If the fossil fuel consumption increases at this rate, gas can be supplied from the proven gas reserve until no longre than 2030, meanwhile coal can be supplied from the proven coal reserves until 2120. In other words, it is necessary to explore and prove more gas reserves of 300BCM so as to supply gas to the planned and existing gas thermal power plants during their service life of 25 years.

From worldwide viewpoint, primary energy demand in developing countries is expected to increase noticeably in line with their socio-economic development and Malaysia and Thailand are promoting development of coal thermal power plants in view of the long-term energy security.

Accordingly, import price of coal will be estimated to increase in future, it is, therefore, important to improve the productivity of domestic coal by modernization of facilities in order to keep the price low and meet the future coal demand.

Table 2-1-8 Security Balance of Fossil Fuel (Base Scenario)

	Potential (upper::measured) (lower:inferred)	Exploitation Volume (2000-2020)	Residual Quantity	Exploitable years after 2020
Coal (mil. tons)	4,500	435*	4,075	≧100
	10,000		9,575	≧200
Gas (bil. m^3)	330	162	168	≦ 10
	617		455	≦ 30

*:Based on the exploitation plan of Vinacoal,

2.2 Power Development

2.2.1 Organization

Under the MOI, which formulates development policy of the power sector, EVN solely manages the whole power sector from generation to transmission and distribution (Figure 2-2-1). Except the decision of large-scale investment and tariff setting, EVN possesses authority of the sector management. EVN generates electric power through the dependent units (National Load Dispatch Center, power plants, and 4 regional transmission companies), and wholesales the power to 7 regional distribution companies (Dong Nai PC, Hai Phong PC, Hanoi PC, HCMC PC, PC1, PC2, PC3), which are the independent-accounting units of EVN. The decision making in EVN is handled by the Board of Management and Board of Directors.

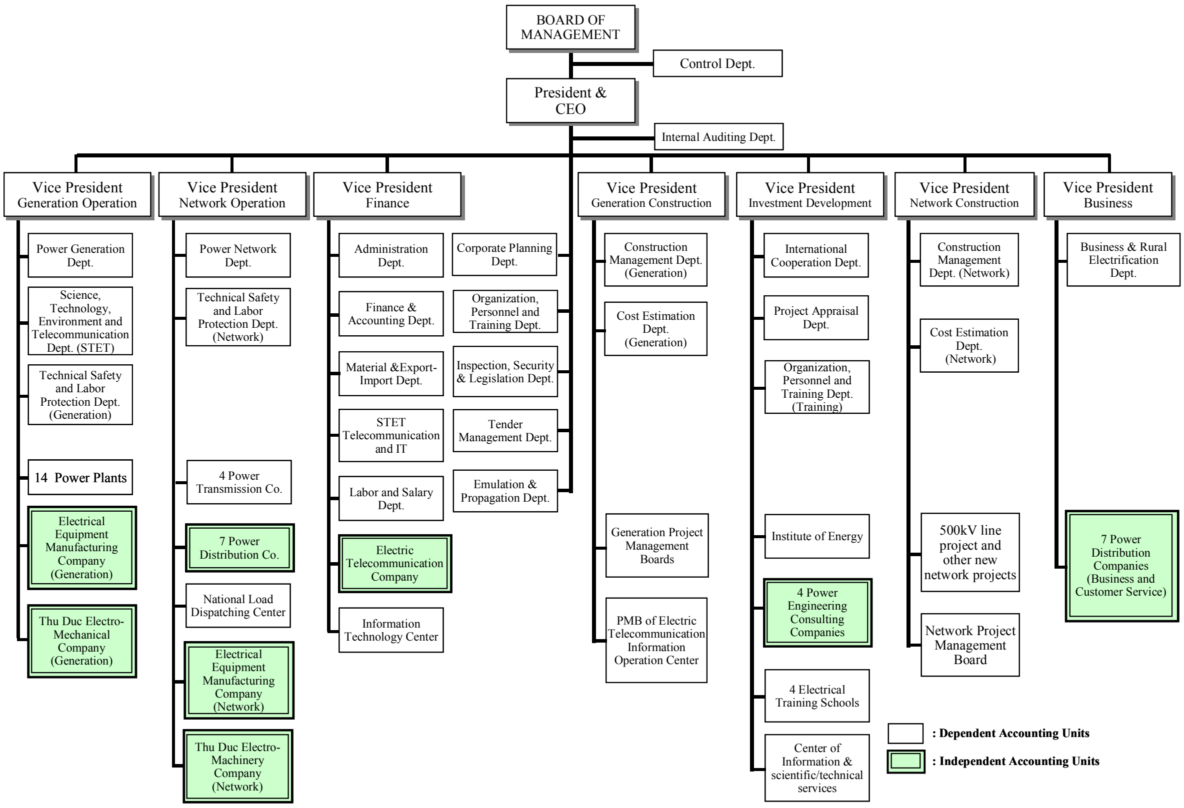


Figure 2-2-1 Organizational Structure of EVN

Source: EVN

2.2.2 Electricity Consumption, Peak Demand, and Characteristics of Consumption

Records of climate, economic situation, electricity consumption, peak demand, and characteristic of consumption pattern of the system are reviewed and analyzed.

(1) Climate

Vietnam belongs to the Asia Monsoon Zone. The climate is quite different between the north with subtropical climate and the south with tropical climate. The north has four seasons and the temperature varies with each season. Summer begins in May with an average temperature of over 25 degree. In June and July the weather gets hotter and sultry. July and August usually come with storms and heavy rain. Winter lasts from the end of December to the end of March, when it drizzles constantly and temperature is low and sometimes drops to around 10 degrees. Meanwhile the South has 2 seasons, a rainy season in May-October, and a dry season in November-April. The average temperature does not change much throughout the year (Figure 2-2-2).

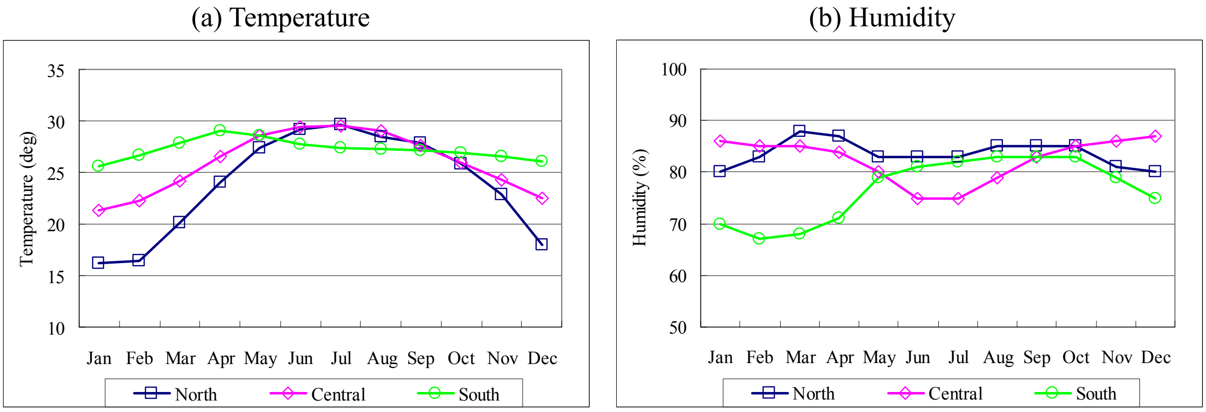


Figure 2-2-2 Regional Climate Change by Month

Source: Hydro-Meteorological Data Center, Hanoi

(2) Economy

Table 2-2-1 shows the population, real GDP, consumer price index, and commercial energy consumption of the country since 1990. The Vietnam economy has maintained steady growth with an annual average growth rate (AAGR) of 7.5% between 1990 and 2000. During the period, GDP per capita increased from US$206 to 356. The change of consumer price index is relatively stable, having the AAGR of 3.7% for 5 years from 1995. The AAGR of energy consumption remains 0.5% during 1990 to 2000.

Table 2-2-1 Historical Macro-Economic Index

Index	Unit	1990	1992	1994	1996	1998	2000
Population (10^6)	—	66.20	68.99	71.68	74.30	76.52	78.52
GDP (10^9)	1995 US$	13.61	15.67	18.44	22.08	25.27	27.93
GDP per capita	1995 US$	205.65	227.17	257.19	297.18	330.17	355.74
CPI	1995=100	na	na	na	105.68	116.99	119.72
Energy Use	10^3 KTOE	24.69	25.82	28.02	32.09	34.26	na
Energy Use per capita	KGOE	372.96	374.26	390.87	431.92	447.73	372.96

Source: World Development Indicators, WB

(3) Electric Power Demand[1]

a. Yearly Demand

1) Yearly Electricity Consumption

As shown in Figure 2-2-3, electricity consumption rapidly increased at AAGR by 15% between 1995 and 2002. As a result, the elasticity of consumption on GDP for 6 years since 1995

[1] Historical demand data in this section are based on data from IE and NLDC.

exceeded 2.0, whereas neighboring countries generally were at 1.0 to 1.5. Regarding the sector share of consumption, household and industry cover about 50% and 40% respectively.

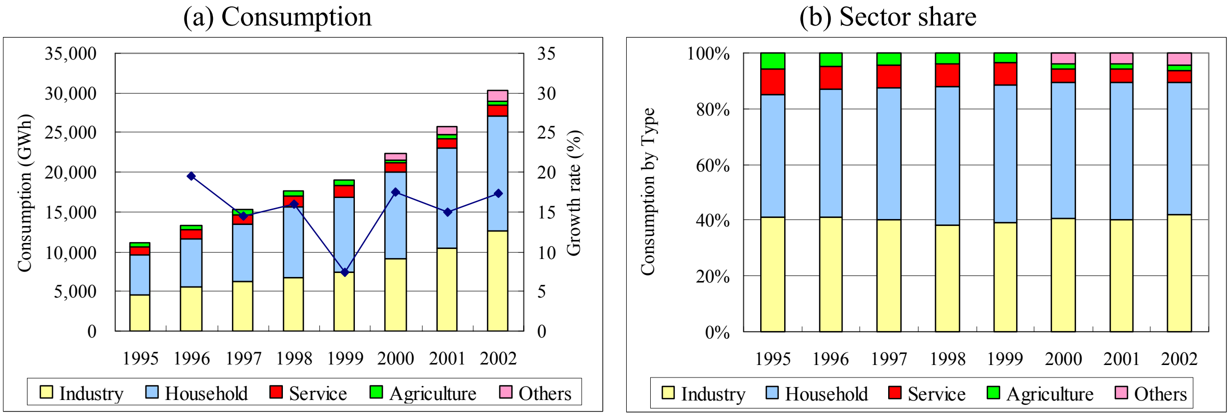


Figure 2-2-3 Historical Electricity Consumption by Sector

As shown in Figure 2-2-4 (a), the rate of consumption share among the north, central, and south region is about 4:1:5. The AAGRs of consumption by region are 13% in north, 17% in central, and 16% in the south region. Looking at the sector share, main user in the north and central region is household. In the south region, however, household and industry are competing with each other, supported by higher GDP share of industry.

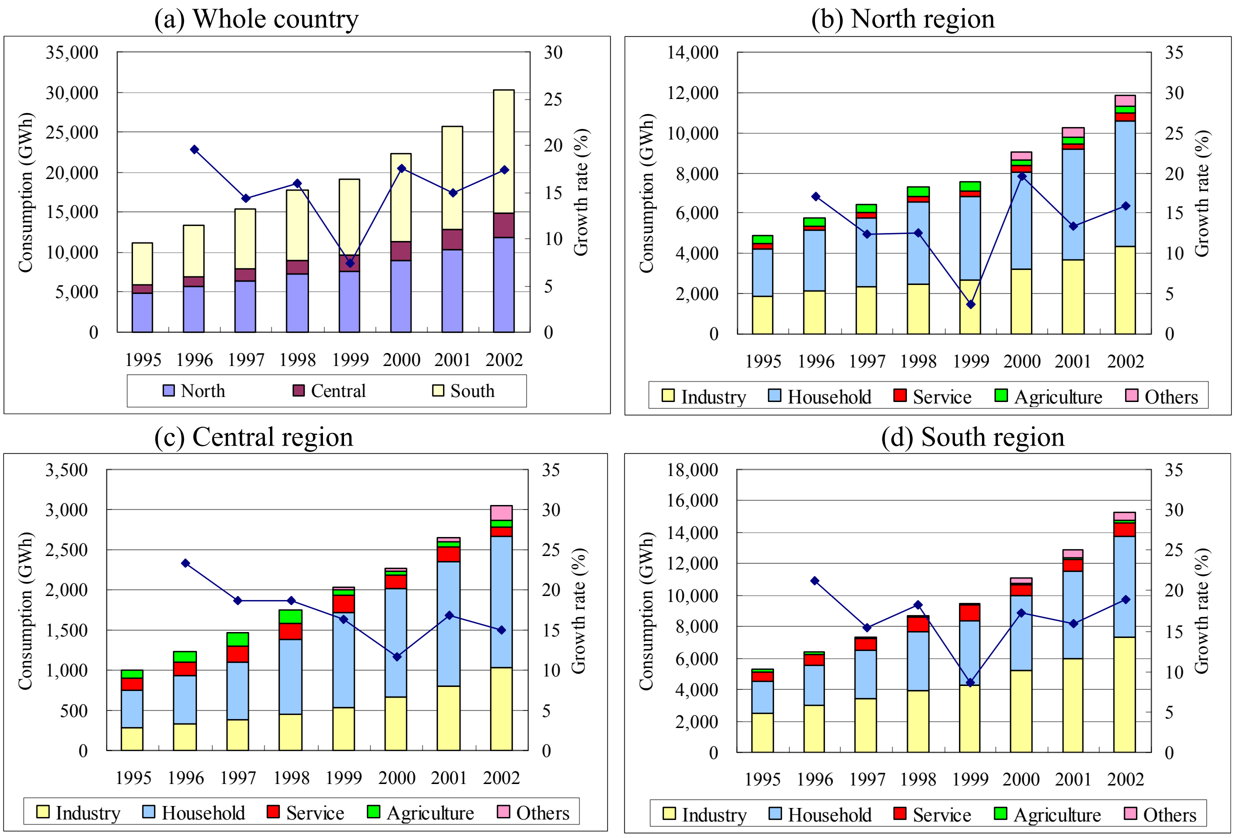


Figure 2-2-4 Historical Electricity Consumption by Region

(2) Yearly Peak Demand

Figure 2-2-5 shows historical changes of yearly peak demand and annual load factor. From 1995 to 2002, peak demand rapidly increased at the AAGR of 14%. It reached 6,554MW in 2002, which is more than double of the demand in 1995. The central region has the highest AAGR of 19%, followed by south 15% and north 12%, indicating that peak demand in every region is steadily increasing.

Annual load factors for the last 3 years have clear regional differences: about 55% in north and central region, and 69% in the south region. Major reasons for this difference are as follows.

- The biggest user in the north and central region is household, whereas that in the south region is industry, whose demand shape is relatively flat.
- In comparison, the south region has smaller fluctuations in seasonal temperature.

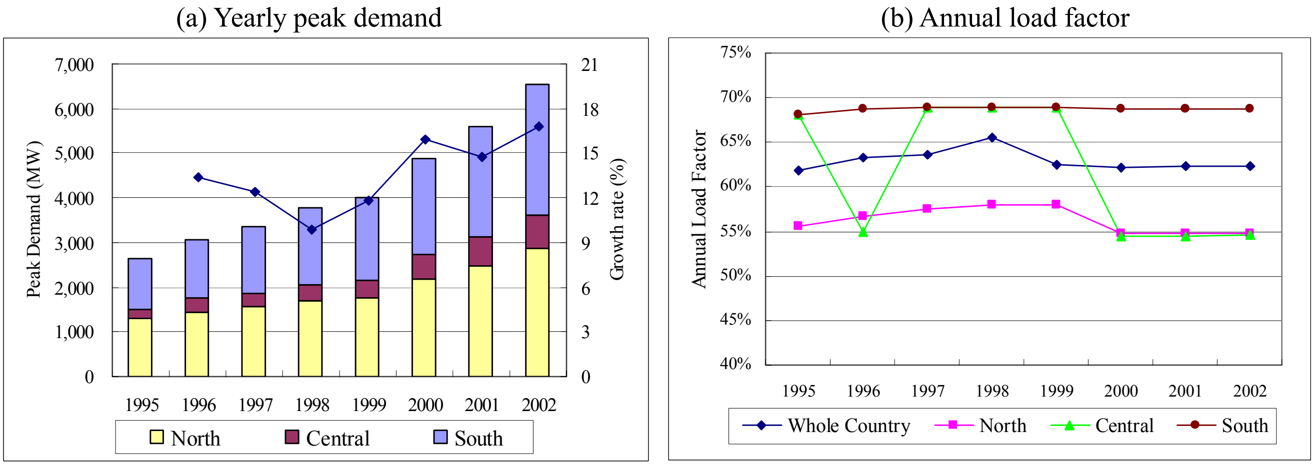


Figure 2-2-5 Historical Changes of Yearly Peak Demand and Annual Load Factor

b. Monthly Demand

1) Monthly Generation

Figure 2-2-6 shows historical monthly generation of the whole country and regional records in 2002. Monthly generation of the country normally reaches its maximum in July or August and minimum in February due to the Lunar New Year. The difference in monthly generation is larger in the north region where monthly temperature fluctuates more than the other regions.

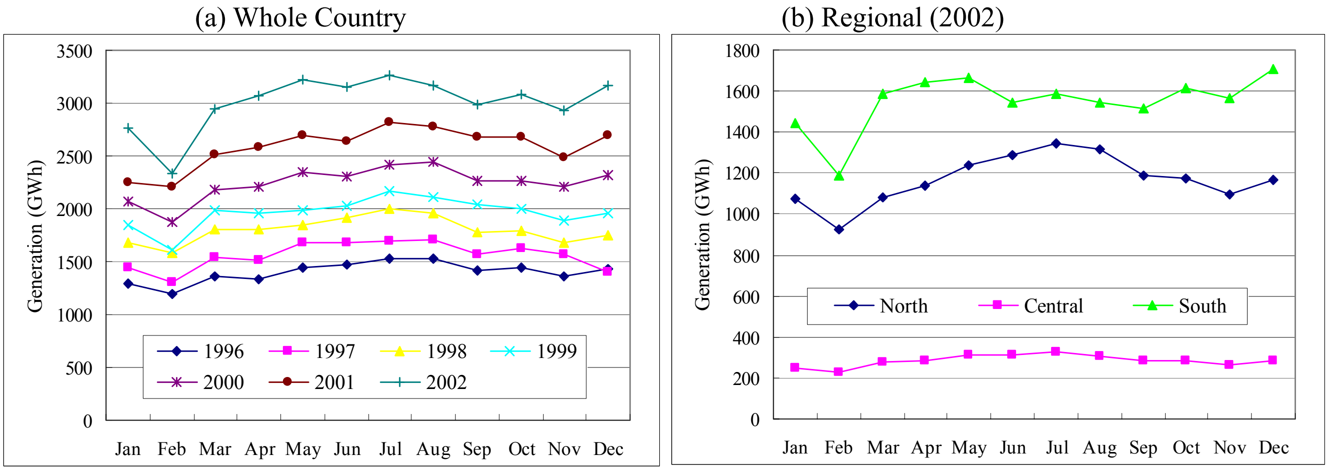


Figure 2-2-6 Historical Monthly Generation

2) Monthly Peak Demand

Figure 2-2-7 shows historical monthly peak demand of the whole country and regional results in 2002. Monthly peak demand of the country reaches its maximum in the year-end. This is a typical phenomena observed in rapidly developing countries where the trend in continuous demand growth masks monthly fluctuation caused by seasonal factors. In addition, it is assumed that the reduction of monthly peak demand in June and July is the result of planned outage due to the decrease in supply capability in the flood season (see Figure 2-2-7). Regional monthly peak demand shows a similar trend with the whole country.

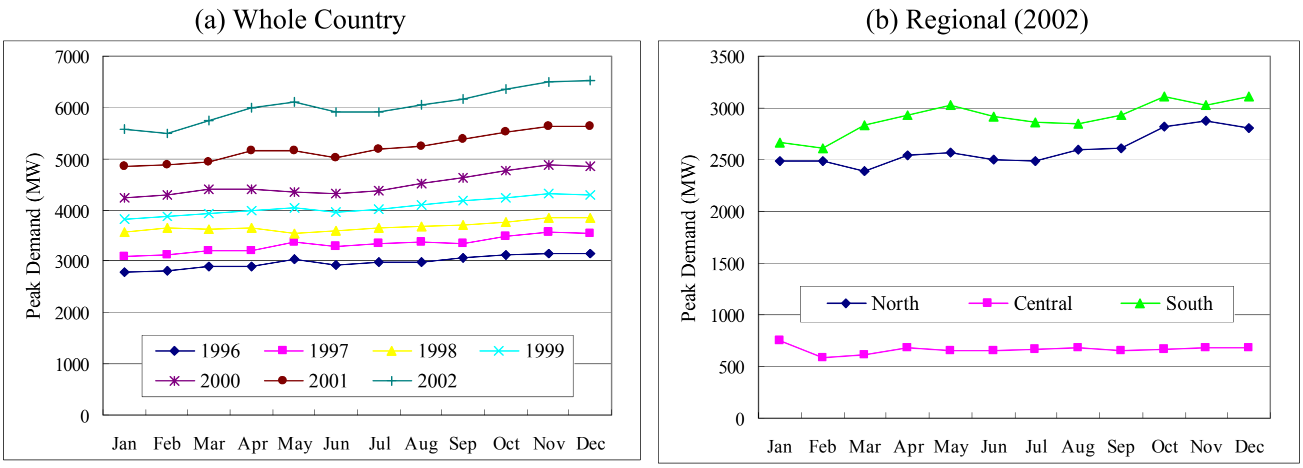


Figure 2-2-7 Historical Monthly Peak Demand

c. Daily Demand

Figure 2-2-8 illustrates changes in daily load curve (annual average) of the country and regions. The daily load curve in Vietnam currently has two peaks: daytime peak at around 11am due to industrial demand and nighttime peak at 7pm caused mainly by household use. Differences in daily maximum and minimum demand are approximately 50% in the country, 60% in the north and central, and 40% in the south region. In every region, nighttime peak exceeds daytime peak. However, a distinctive trend is that the difference between them is continuously decreasing due to the rapid growth of day peak. Particularly in the south region, where daily fluctuation is relatively small, the recent daytime peak is almost equal with the nighttime peak. Assuming that this strong trend continues, daily load curve in every region is likely to shift toward the day-peak type in future.

As shown in Figure 2-2-9, there is a difference in daily load curve on Sunday and on the other days in a week. The difference is particularly clear in the south region while that in the central region is not so significant, indicating that the contribution of industrial demand in weekday is relatively large in the south region.

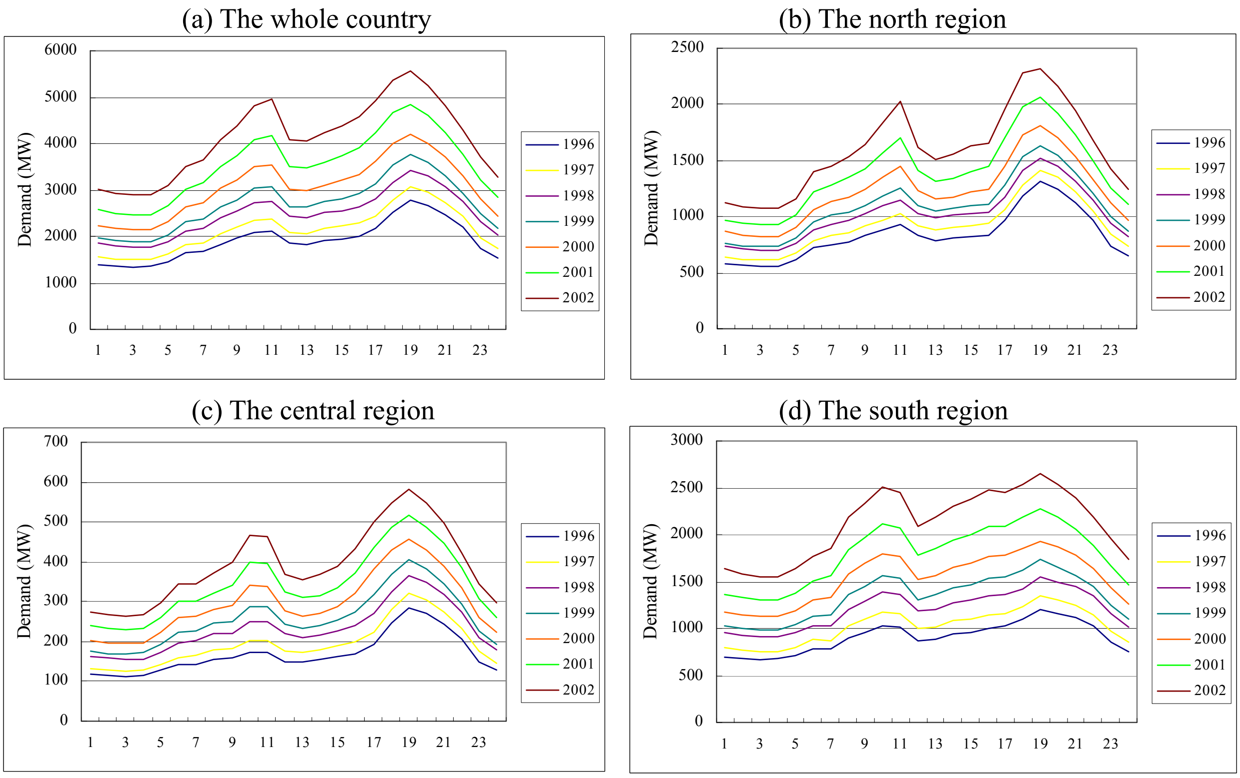


Figure 2-2-8 Changes in Daily Load Curve (Annual average)

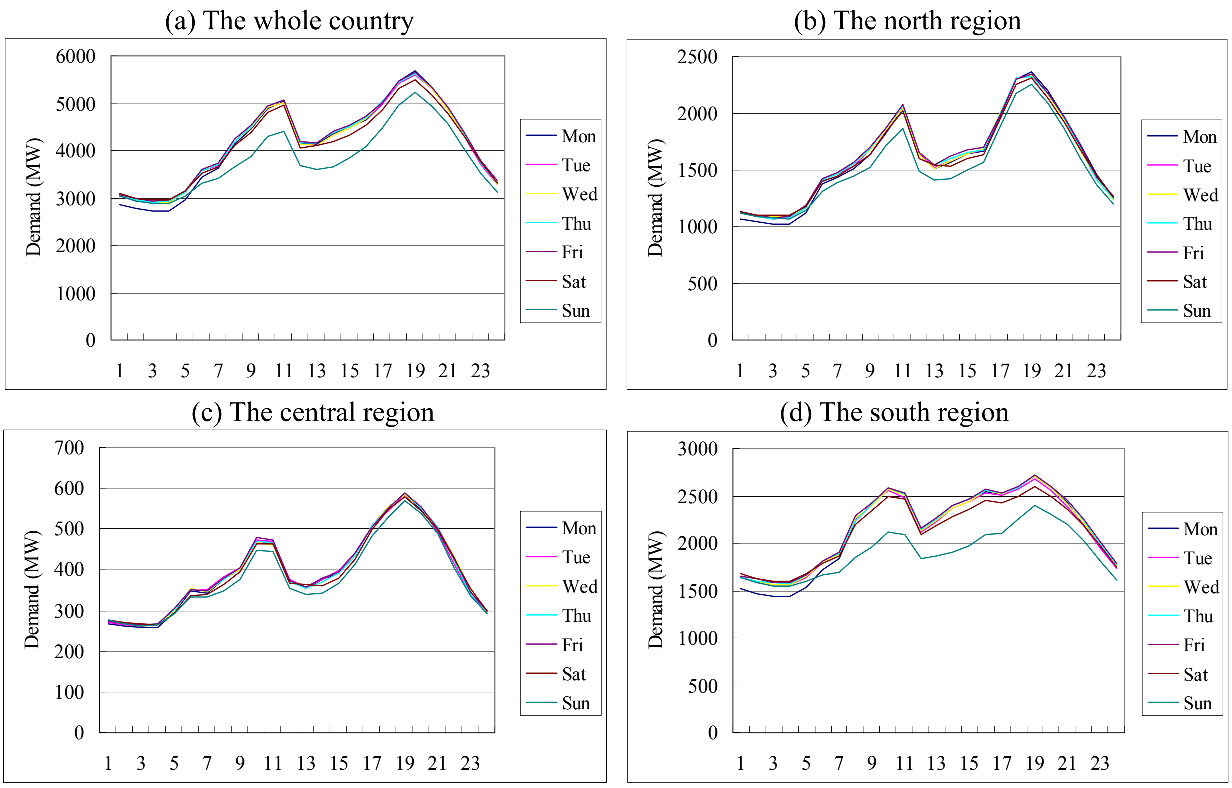


Figure 2-2-9 Daily Load Curve in a Week（Annual average, 2002）

2.2.3 Existing Power Facilities

(1) Existing Power Plants

Including IPPs, Table 2-2-2 lists the existing power plants in Vietnam as of the end of 2002. Also Figure 2-2-10 shows the existing power plants in Vietnam.

The composition of the total installed capacity of 8,505MW is: hydropower 48%, gas thermal 27%, coal thermal 15%, and others 10%. Regional power sources composition is significantly different due to the locations of energy resources. The north region, which has abundant hydro and coal potential, is composed of hydropower (62%) and coal thermal (38%). Most of the coal thermal power plants in the north region were constructed in the 1970s through the early 1980s. Hydropower is also dominant in the central region. Plentiful gas reserves, gas thermal covers 55% in the south region, followed by hydropower (28%) and oil thermal (15%).

Table 2-2-2 Existing Power Plants (as of Dec. 2002)

	Type	Name	Unit Capacity (MW)	Unit No.	Total Capacity (MW)	Year of Commissioning
North	Hydro	Hoa Binh	240	8	1,920	1989-1994
		Thac Ba	40	3	120	1970-1973
		Hydro Total			2,040	
	Coal Thermal	Pha Lai 1 (coal)	110	4	440	1983-1986
		Pha Lai 2 (coal)	300	2	600	2,002.0
		Uong Bi (coal)	55	2	110	1975-1977
		Ninh Binh (coal)	25	4	100	1974-1976
		Coal Total			1,250	
	IPP	Nomura - IPP (DO)			25	
		Sub Total			3,315	
Central	Hydro	Vinh Son	33	2	66	1994
		Song Hinh	35	2	70	2000
		Yaly	180	4	720	2001
		Small Hydro			23	
		Hydro Total			879	
	Diesel				50	
		Sub Total			929	
South	Hydro	Tri An	100	4	400	1988-1989
		Da Nhim	40	4	160	1963-1964
		Thac Mo	75	2	150	1995
		Ham Thuan	150	2	300	2001
		Dami	88	2	175	2001
		Small Hydro			12	
		Hydro Total			1,197	
	Oil Thermal	Thu Duc (DO)	33, 66 x 2		165	1966-1972
		Can Tho (FO)	33	1	33	1975
		Oil Total			198	
	Gas Thermal	Can Tho (GT)	38	4	150	1996-1999
		Thu Duc (GT)	23.4, 14.7, 37.5 x 2		113	1968-1992
		Baria (CC)	23.4 x 2, 37.5 x 6, 58 x 2		388	1991-2001
		Phu My 1(C/C)	240 x 3, 393		1,113	2000-2001
		Phu My 2-1(DO-Gas)	145 x 2, 140 x 2		570	1997-1999
		Gas Total			2,334	
	Diesel				60	
	IPP	Hiep Phuoc (FO)	125	3	375	
		Bourbon (DO)			12	
		Amata (DO)			13	
		Vedan (FO)			72	
		IPP Total			472	
		Sub Total			4,261	
Total					8,505	

Source: IE

Figure 2-2-10 Existing Power Plants (as of Dec. 2002)

(2) Situations of Power Development

Existing power development plan is identified, focusing the items that are to have significant influence in preparation of the master plan of power system development.

a. Operation of Existing Hydropower Plants

The Study Team visited Hoa Binh, Yaly, and Tri An hydropower plants and confirmed the operation of power stations and reservoirs. Data on minimum (responsible) discharge, monthly supply capability, and reservoir regulation curve of each power plant have been obtained from interview with PECC-1, IE, and NLDC.

(Priority in reservoir operation)

Hoa Binh: i) flood control, ii) power generation, iii) irrigation, iv) navigation

Yaly : i) power generation, ii) irrigation

Tri An : i) power generation, ii) irrigation, iii) protection of sea water intrusion

(Responsible Discharge)

Hoa Binh: 200 MW (10% of installed capacity)

Yaly : 60 MW (8% of installed capacity)

Tri An : 60 MW (15% of installed capacity)

(Monthly supply capability)

Changes in monthly supply capability at each power plant are shown in Figure 2-2-11. Reduction in supply capability is remarkable at Hoa Binh from June to August, reaching 2/3 of the installed capacity. This is because flood control takes precedence in operating Hoa Bin reservoir, and water level is lowered for flood control during rainy season.

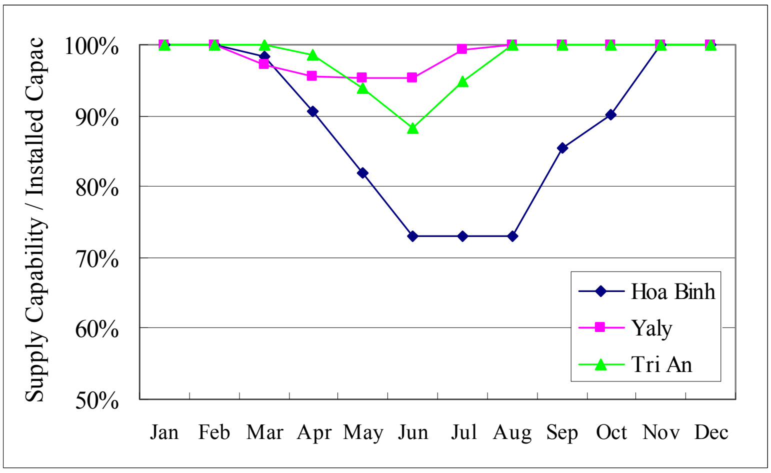
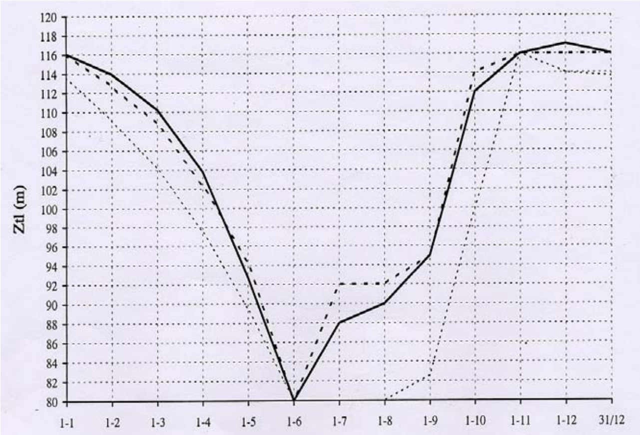


Figure 2-2-11 Monthly Supply Capability (90% dependable flow)

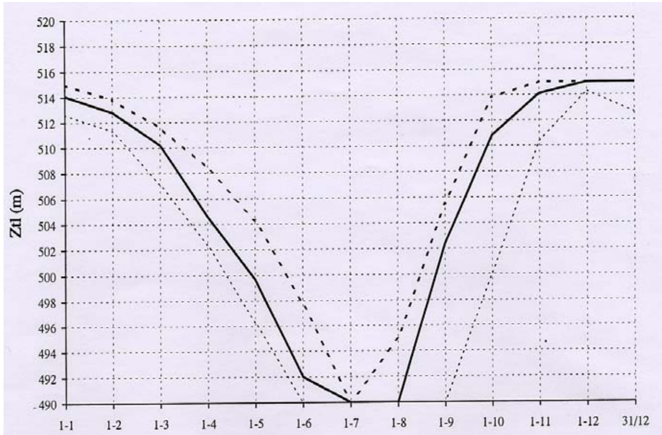
Source: Data from PECC1

(Reservoir regulation)

Hoa Binh Reservoir



Yaly Reservoir



Tri An Reservoir

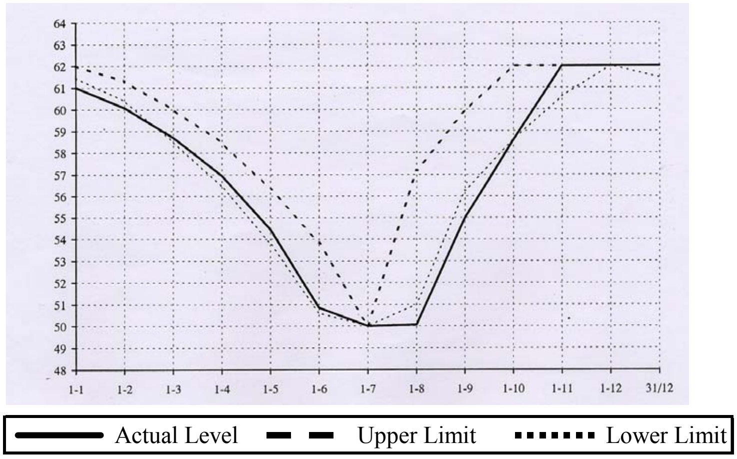


Figure 2-2-12 Reservoir Regulation Curve Source: NLDC

(2) Constraints of Hoa Binh HPP Operation

The north power demand has a big deference between peak and off-peak time. Meanwhile, there are two types of power source as coal thermal power and conventional hydropower in the North, and Hoa Binh HPP accounts for most of the hydropower sources. Then, coal thermal power plants have little daily adjustment capacity. Accordingly, as shown in Figure 2-2-13, despite of abundant river inflow in the rainy season, Hoa Binh HPP has to do the daily adjustment operation. This is one of the causes that there is a lot of invalid discharge as shown in Figure 5-1-2 of the section **5.1.1**.

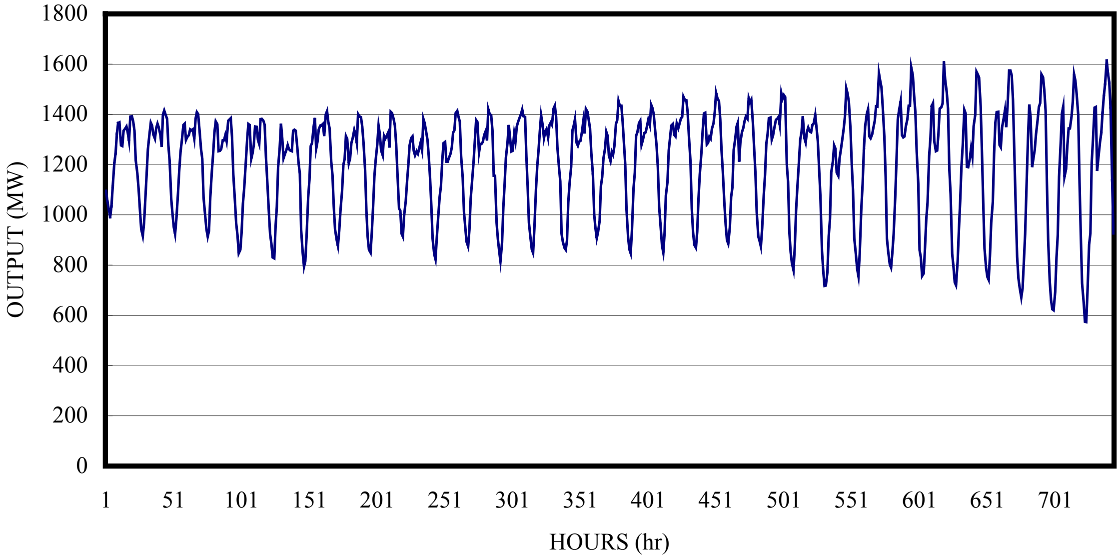


Figure 2-2-13 Operation Record of Hoa Binh HPP in August (Ave. of 1996-2001)

Source : NLDC

(3) Operation of Existing Thermal Power Plants

The Study Team visited Pha Lai and Uong Bi thermal power plants and confirmed maintenance schedule and thermal efficiency of each power plant. Data on operational characteristics of existing thermal power plants have been obtained from IE.

(Maintenance)

Table 2-2-3 Maintenance Schedule of Thermal Power Plant

Category	Span	Duration
Long-term Maintenance	4 years	75～90 days
Middle-term Maintenance	2 years	30～36 days

(Thermal efficiency)

Table 2-2-4 Thermal Efficiency

Output	100 %		75 %		50 %	
	design	actual	design	actual	design	actual
Pha Lai	39.2	35.5	38.5	35.1	36.4	33.3
Uong Bi	n.a.	26.7	n.a.	25.6	n.a.	n.a.

(Operational characteristics)

Operational characteristics of existing/planned thermal power plants are shown in Appendix 2-1.

(4) International Power Trade

Present status of the plans of international power trade is confirmed with MOI as follows.

- Under the GMS framework, transmission interconnection has been discussed with China, Laos, Cambodia, Myanmar, and Thailand. Accordingly, International Government Agreement on international power trade has been signed among 6 countries including Vietnam in November 2002 at Phnom Penh.
- Power purchases form Laos are examined in detail and incorporated in the revised 5th Master Plan.
- Although site specific F/S is not conducted yet, power purchases from China is also listed in the Master Plan starting 2018.
- Regarding power purchase from Cambodia, economic viability has been confirmed.

According to the power sources development plan on the revised 5th M/P, plans on international power trade are identified as Table 2-2-5. Countries include Laos, China, and Cambodia, and all the power is to be purchased by Vietnam. Power import from Laos starts in 2008 and reach 1,700 MW by 2017. It is planned to import 1,069MW and 1,015MW as a total from Cambodia and China respectively.

Table 2-2-5 Plans on International Power Trade

Country	Year	Capacity	Location	Notes
Laos	2008	100	North	Nam Mo
	2010	260	Central	Se Kaman 3
	2012	240	Central	Nam Kong 1
	2013	400	North	Nam Thuen 3
	2016	450	Central	Se Kong 4
	2017	250	Central	Se Kong 5
Cambodia	2013	375	Central	Ha Se San 3
	2014	100	Central	Prek Lieng 1&2
	2017	429	South	Ha Se San 2 & Srepoc 2
	2018	165	South	Sam Bor
China	2018	465	North	Ma Lu Tang
	2019	250	North	
	2020	300	North	

(5) Impacts of Son La hydropower Development on Hoa Binh Hydropower Operations;

The government of Vietnam has decided to develop Son La hydropower plant with the high water level (HWL) in the range of 205 to 215m. Although it is not officially approved, EVN has provided Son La development plan with the HWL of 215m for the JICA Master Plan Study. Based on this plan, the installed capacity of Son La is 2,400MW (300MW x 8 units), and monthly supply capability of downstream Hoa Binh is changed as shown in Figure 2-2-14. Since most of the flood control function of Hoa Binh is transferred to Son La, reduction of supply capability of Hoa Binh in the flood season is significantly alleviated (34%->14%). Accordingly, annual generation is expected to increase by approximately 30% (8.3TWh->10.8TWh).

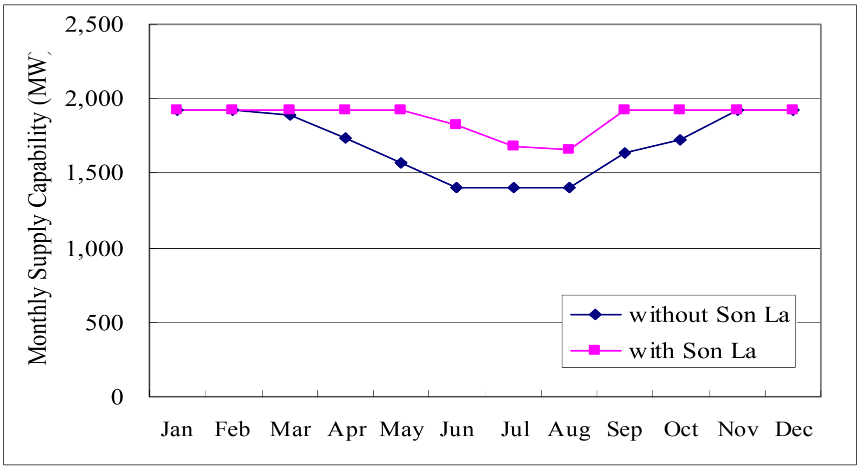


Figure 2-2-14 Change of Supply Capability of Hoa Binh (90% probability flow)

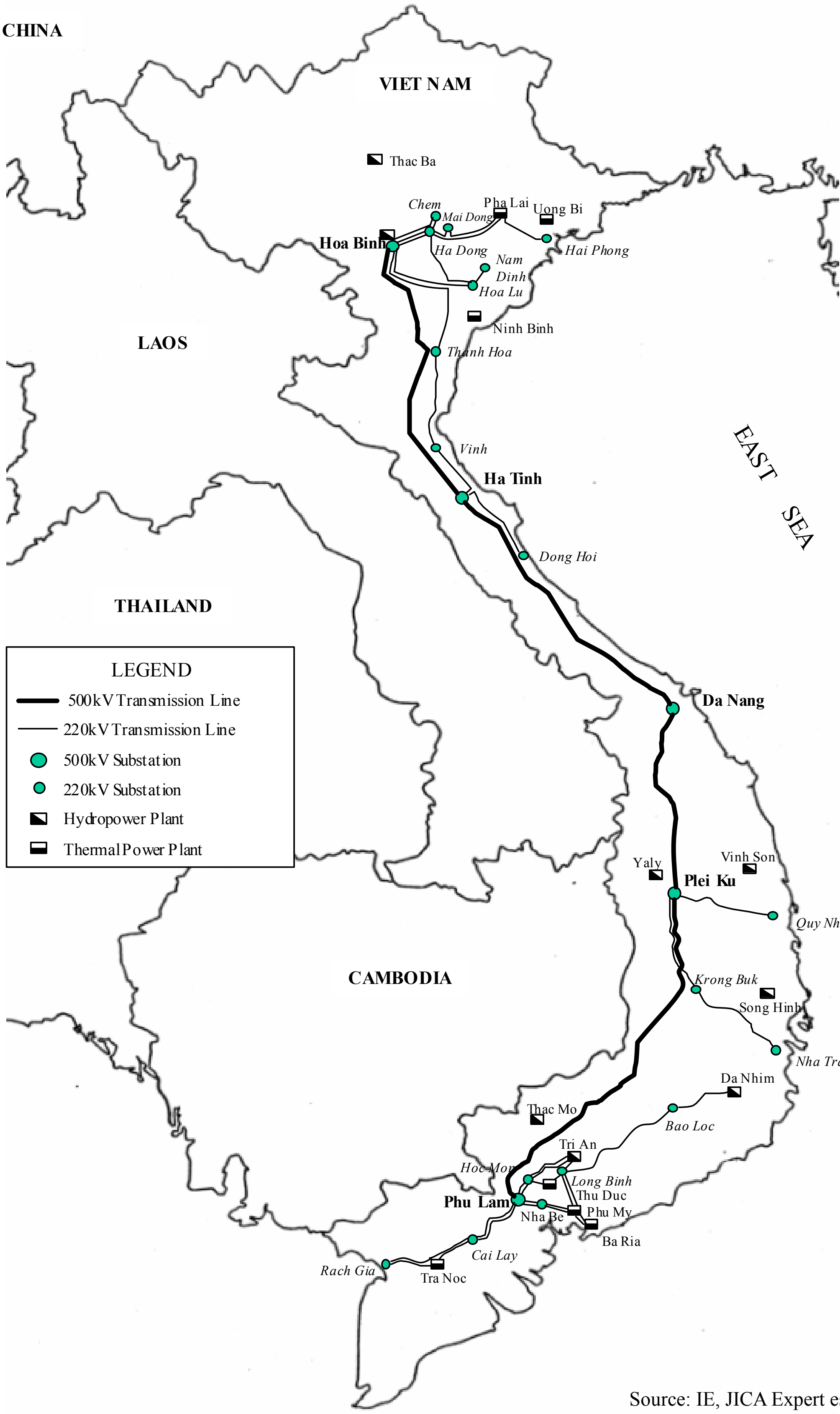
Source: PECC1

2.2.4 Situations of Transmission System Development

Figure 2-2-15 and Figure 2-2-16 show existing trunk transmission lines and systems as of the end of 2002. In order to improve operational efficiency, EVN interconnected the north and south regions by a single 500kV transmission line with the length of 1,500km in May 1994.

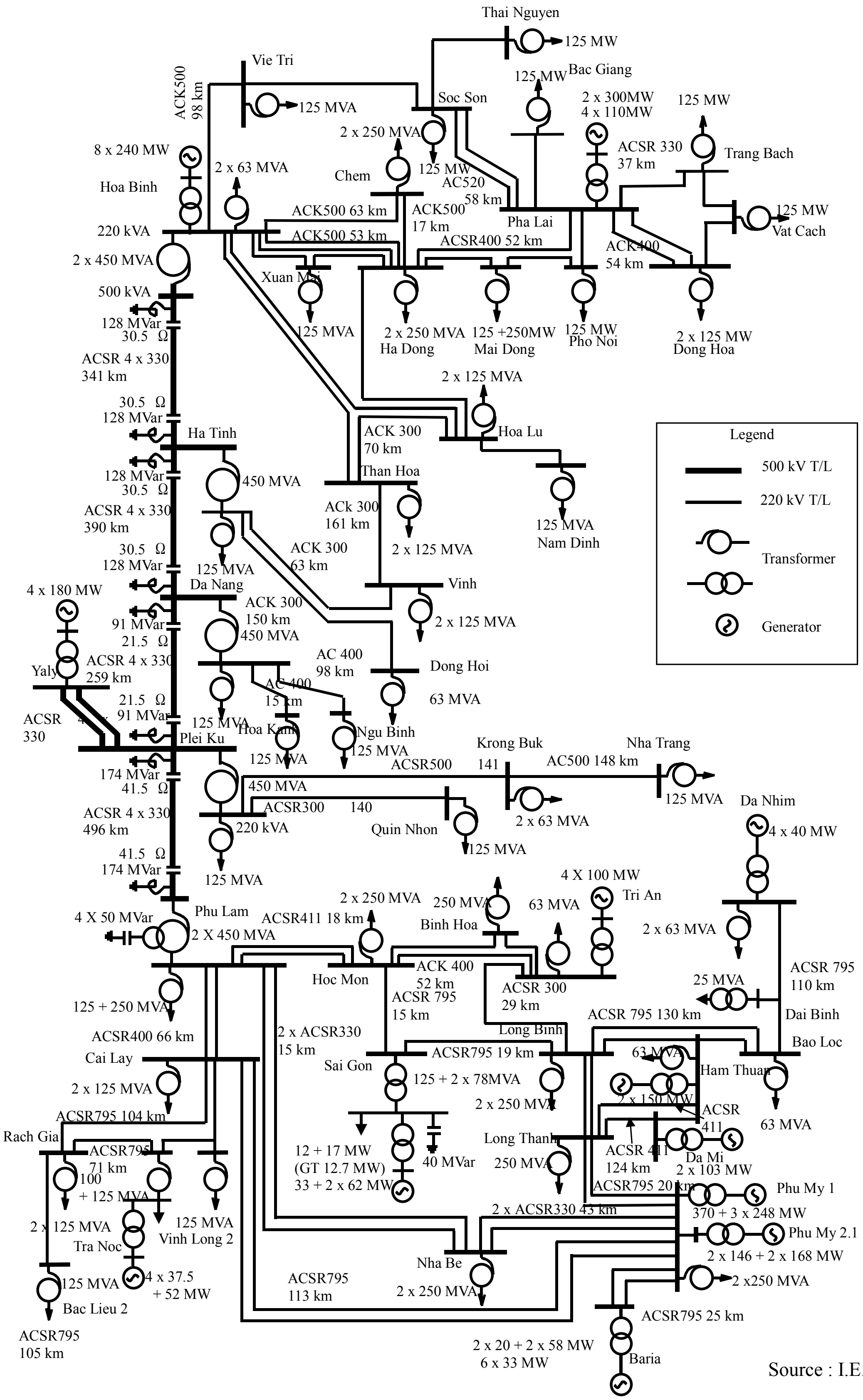
The network system of Vietnam consists of the transmission systems of 500 kV, 220 kV and 110 kV and the distribution systems of 35 kV, 15 kV, 10 kV and 6 kV. The 500 kV transmission lines mainly take the role of interconnections between the north, center and south regions of Vietnam. In order to evaluate the effects of the PSPP with several hundreds MW on the networks, it is important to understand the existing and future development program of 500 kV and 220 kV transmission facilities.

The 500 kV transmission line of Vietnam was constructed from Hoa Binh hydro power station in the north region to Phu Lam substation in the southern region as a one-circuit transmission line. The construction began in 1992 and was completed in 1994. 500 kV/ 220 kV transformers were installed at Hoa Binh hydropower station. Ha Tinh substation, Da Nang substation and Plei Ku substation were installed on the route. The 20 km double circuit lines are branched from Plei Ku substation to Yaly hydropower station of which output is 720 MW.



Source: IE, JICA Expert estimates

Figure 2-2-15 Existing 500kV and 220kV Transmission Lines (as of Dec. 2002)



Source : I.E.

Figure 2-2-16 500 kV and 220 kV Transmission System in 2002

Table 2-2-6 shows the outline of the 500kV transmission lines. The north-center 500 kV transmission lines have the total length of 1,500 km with ACSR330 mm^2 and 4 conductors. Table 2-2-7 shows the outline of the facilities of the 500kV substations. The unit capacity of the transformers is 450 MVA. The 500 kV series capacitors and the shunt reactors are installed at each substation and they compensate the line reactance and capacitance. System analysis data shows that the line reactance from Hoa Binh to Phu Lam is about 420 Ω the line capacitance is about 1,500 MVar. The reactance and the capacitance are compensated by the series capacitors of 248 Ω and the shunt reactance of 1,042 MVar. Therefore, the electrical characteristics of the lines under 50 HZ are the almost same as the lines with 40 % length of the north-center transmission line. A 544 km transmission line from Plei Ku to Phu Lam is under construction as the second circuit of the 500 kV transmission line.

220 kV transmission lines of Vietnam basically have double circuits with a few exceptions. Around Hanoi or Ho Chi Minh city, 220 kV transmission lines have loop shaped configurations.

Table 2-2-6 500 kV Transmission Lines

Interval	Distance	Number of Circuits	Conductor
Hoa Binh - Ha Tinh	341 km	1	ACSR 330 mm *4
Ha Tinh -Da Nang	390 km	1	ACSR 330 mm *4
Da Nang – Plei Ku	259 km	1	ACSR 330 mm *4
Pleiku - Phu Lam	496 km	1	ACSR 330 mm *4
Total	1486 km	-	-
Yaly - Plei Ku	20.2 km	2	ACSR 330 mm *4

Vietnam Single Line Diagram 2003, EVN

Table 2-2-7 500 kV Substation Facilities

Substation	500kV transformer	Series capacitor Ω	Shunt reactor Mvar	Shunt capacitor
Hoa Binh	450 MVA×2	30.5	128	-
Ha Tinh	450 MVA	30.5, 30.5	128, 128	-
Da Nang	450 MVA	30.5, 21.5	128, 91	-
Plei Ku	450 MVA	21.5, 41.5	91, 174	-
Phu Lam	450 MVA×2	41.5	174	50 MVar×4
Total		248	1,042	200 Mvar

* The capacity of each series capacitors is 1,000 A
Vietnam Single Line Diagram 2003, EVN

The present capacity of the north - south 500 kV transmission line is 800 MW. In general, the capacity of a main transmission line is determined by taking into account thermal capacity of transmission facilities, system stability and supply reliability. ACSR 330 mm^2 4 conductors is used for the 500 kV transmission line of Vietnam and its thermal capacity is over 2,000 A. However, the thermal capacity of the series capacitors is 1,000 A, thus the thermal capacity of the transmission route is 1,000 A that is about 800 MW.

System stability can be categorized into static stability against very little disturbances and dynamic stability against the disturbances that occur in case circuit breakers work after a fault. From the view point of the static stability, transmitted power can be estimated by the difference of the voltage-angle between the sending and receiving end of a transmission line. In general, it might be possible to transmit the power in case the difference of the voltage-angle on a transmission line is below the range from 35 to 45 degrees. The difference of the voltage-angle between Hoa Binh and Phu Lam is estimated as about 30 to 35 degrees by the line reactance and the capacities of the series capacitors. The 800 MW power transfer seems possible from the aspect of the static stability. However, there might be some effects on the system in case of the large disturbances.

The N-1 criteria usually set as reliability of the main power system. The N-1 criteria are that power transmission is still possible without any special measures in case of a lack of one of the facilities. However, the criteria cannot be applied for the existing 500 kV transmission line in Vietnam because it is a circuit line. The reliability of the line is lower than the N-1. This is because the whole system may be separated into the north and the south when the 500 kV transmission line is suffered from accidents. When such a case occur, measures for independent frequency regulations are sometimes conducted with load shedding and generator shedding both by the Northern Load Dispatching Center and the Southern Load Dispatching Center instead of the National Load Dispatching Center.

The protection systems of the 500 kV transmission line of Vietnam are composed of two independent systems, containing the differential relay devices and the distance relay devices. Power supply can still be continued even if a one-phase fault occurs, on the condition that the single-phase auto reclosers successfully work.

The 500 kV series capacitors have parallel-connected non-linear reactance devices, gap devices and bypass devices against the impacts such as over voltages. The bypass - devices work under the conditions determined by the quantity such as currents through series capacitors, phase imbalance ratios and over load ratios of the series capacitors. Table 2-2-8 shows statistical data of the faults on the 500 kV transmission line from the commissioning (Jun. 1994) to Dec. 2001. The amount of the interruptions of power-transmission reaches about 366 hours and the averaged interruption is about 48 hours per year. Incidentally, there is little supply interruption due to the faults at 500 kV transmission lines in system of TEPCO. That is because the instantaneous supply recovering is usually successful by the functions such as multi-circuit re-closers if the faults occur, the remaining circuits still have supply-abilities owing to the net-shaped 500 kV grids even if a circuit fault occurs, and to begin with, the criterion applied for planning of 500 kV transmission system is the N-1 that does not permit any supply interruption in case of a circuit fault.

The reason for the large number of the total faults at intervals is that there are some cases of multi-interval interruptions at a fault occurring. One of the causes is considered that miss-detection of the fault intervals occurs because of minus impedances of the series capacitors.

Table 2-2-8 Statistical Data of Faults at 500 kV Transmission Lines

Year		1994 6-12	1995	1996	1997	1998	1999	2000	2001	Total
Number of faults		27	76	34	20	51	17	30	10	265
Interruption		96h32	12h14	16h40	21h48	49h27	5h23	43h33	4h19	365h56
Short circuit		3	59	23	10	36	7	15	6	159
Successful auto reclosing		0	36	9	2	12	4	12	3	78
Intervals	Hoa Binh -Ha Tinh	5	1	6	3	10	3	2	2	160
	Ha Tinh - Da Nang	8	11	4	9	20	3	4	2	61
	Da Nang - Plei Ku	24	26	9	13	30	12	4	2	161
	Plei Ku - Phu Lam	10	52	15	9	21	3	10	4	124
	Plei Ku – Yaly 1							1		1
	Plei Ku – Yaly 2									
Phase	A	0	10	6	5	12	4	5	4	46
	B	0	14	3	1	10	3	12	2	45
	C	3	35	14	4	14	0	2	0	72
Cause	Eternity	2	7	0	1	1	0	1	0	12
	Temporary	1	53	22	8	35	6	15	5	145
	Humanbeings	3	4	0	0	0	3	1	0	11
	Facilities	3	3	4	1	3	0	0	3	17
	Secondary	15	6	4	2	10	5	8	1	51
	Unknown	3	3	4	8	2	3	5	1	29

Statistical data of faults on 500 kV North- South Transmission Lines after 7 years operation, 2003, IE

Table 2-2-9 shows past records of sending and receiving energy at the 500 kV substations from Jun. 1994 to Aug. 1998. Large amount of sending energy was recorded at Hoa Binh substation, that is at the starting point of the 500 kV transmission line, and almost all the energy of Da Nang and Plei Ku substations in the central region, was receiving. At Phu Lam substation, the receiving energy was recorded larger than sending energy. There is more power flow from the north to the center and the south, however, temporal power flow from the south to the center and the north exists as well.

Table 2-2-10 shows past records of maximum loads of the 500 kV substations from 1994 to 2002. The maximum load of Hoa Binh substation and Phu Lam substation was about 800 MW.

Table 2-2-9 Sending and Receiving Energy of 500 kV Substations (from Jun.1994 to Aug. 1999)

Substation	Sending energy (GWh)	Receiving energy (GWh)
Hoa Binh	12,045.79	508.60
Da Nang	0	2,371.93
Plei Ku	0.39	1,430.62
Phu Lam	1,038.10	7,514.44

Seminar on Vietnam 500 kV Transmission System, 1999, EVN/VEEA

Table 2-2-10 Maximum Load of 500 kV Substation

	Hoa Binh (MW)	Da Nang (MW)	Plei Ku (MW)	Phu Lam (MW)
1994	574	121	49	418
1995	630	116	87	478
1996	564	112	81	414
1997	664	123	104	476
1998	756	126	112	516
1999	800	194	216	540
2000	798	200	208	610
2001	800	250	221	776
2002	802	292	238	816

Seminar on Vietnam 500 kV Transmission System, 1999, EVN/VEEA
Situation of capacity and energy transmission on 500 kV lines from 1995 to 2001, 2003, IE

2.2.5 Present Conditions of Transmission System and SCADA System Operation

Figure 2-2-17 shows the load dispatching structure of EVN. Located in Hanoi, NLDC operates large-scale generators and 500kV transmission lines, and the controls frequency of the whole system. NLDC also manually changes the position of transformer taps and orders to operate shunt reactors. Under NLDC, regional load dispatching centers in the north, central and south region operate 200kV and lower voltage transmission systems as well as regional shunt reactors. Furthermore, regional supply centers operate 110-66kV transmission systems under the regional load dispatching centers.

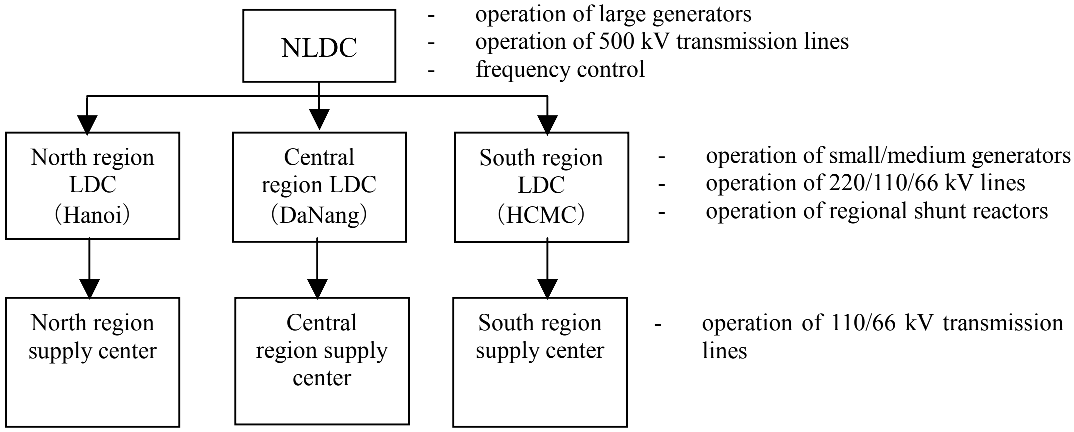


Figure 2-2-17 Load Dispatching Structure of EVN

SCADA systems are installed at 4 locations: NLDC and 3 regional dispatching centers. The software of the SCADA systems is made by Beiley, and the hardware is made by ABB and Alstom. These SCADA systems are connected through an integrated communication system, and NLDC plays a leading role in emergency operations. Regional dispatching centers utilize a monitoring function of the SCADA systems, but some of the functions remain unused.

The SCADA system at NLDC is equipped with a function to automatically control generators in emergency. The function is applicable to two generators, but is not currently used because of poor communication conditions and delays in transmission. As a result, all the load-dispatching orders are placed manually. Frequency of the system is controlled to maintain 50Hz±0.5Hz and the voltage of 500kV lines is managed not to exceed ±10%. However, NLDC sometimes struggles to keep voltage within the range due to insufficient transformer taps as small as ±5%.

2.2.6 Electricity Tariff System

(1) Vietnam Electricity Tariff System

The electricity tariff system in Vietnam is separated into two areas, EVN controlled and EVN non-controlled.

Firstly, in EVN non-controlled areas, local governments such as Communes and Districts operate and maintain their own distribution facilities, purchase electricity from PCs and sell it to the final consumers at their own prices.

In EVN controlled areas, electricity tariff system is separated into 1) retail price and wholesale price for Communes, and 2) wholesale price for PCs.

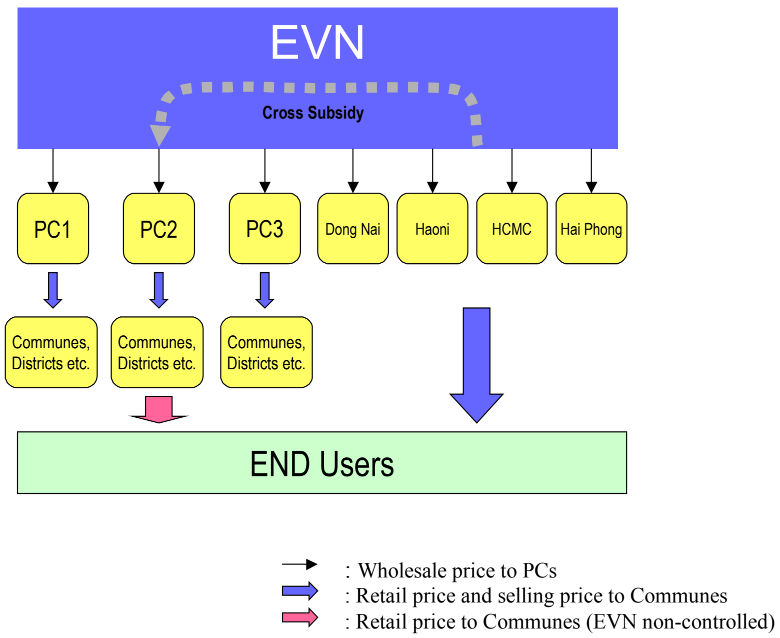


Figure 2-2-18 Vietnam Electricity Tariff System

a. Retail Price and Wholesale Price for Communes

The electricity tariff revision process is as follows. EVN prepares the draft tariff schedule and submits the schedule to MOI and MOF. MOI and MOF review and pass on the new tariff schedule to the Prime Minister's Office after hearing the opinions of the regulatory agencies and concerned parties. The tariff schedule is formally approved when agreement from the Political Bureau is obtained.

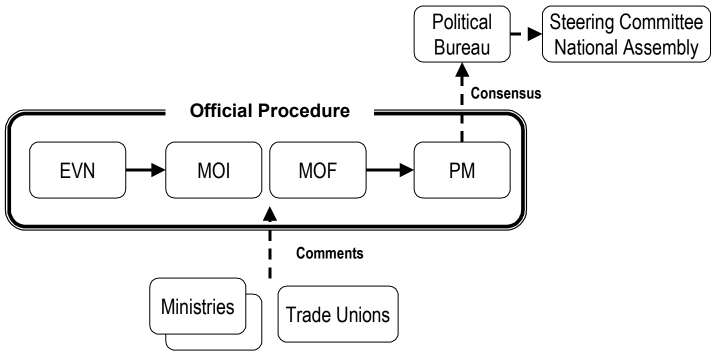


Figure 2-2-19 Tariff Revision Process

EVN adopts a nationwide uniform electricity tariff system based on power use.

The tariff system is comprised of two prices, for Vietnamese and for foreigners. Foreigner price is set higher than twice the level of Vietnamese price.

In terms of household use, electricity expense is charged according to the amount of electricity consumed. For other users, three tariff rates are applied: peak, normal, and off-peak hours.

The current electricity tariff was revised in October 2002 and average tariff was raised to 5.6 cents/kWh. Tariff for household use and for off-peak hours were the most raised. The current tariff schedule is shown in Table 2-2-11.

b. Wholesale Price to PCs

Wholesale price to PCs is determined after considering electricity revenue and profit of the PCs. Therefore, wholesale price to PC1~PC3, that supply electricity to rural communities, are set lower than other regions, while wholesale prices to PCs situated in urban areas are set higher to cover losses related to PC1~PC3 (internal subsidization).

c. Electricity Tariff to Communes

Some Communes and Districts operate and maintain their own distribution facilities, purchase electricity from PCs, and sell electricity to final consumers by their own prices

The actual average tariff is 720VND/kWh (in some regions even higher than 1,000VND/kWh), which is much higher than the tariff in EVN controlled areas. Such high electricity price in poor regions is an issue of the power sector.

Figure 2-2-20 Distribution Company (Power Company) Electricity Supply Area Map

Table 2-2-11 EVN Electricity Tariff System

Unit: VND/kWh

	Decision 87/1999/QD-BVGC Norvember 23,1999	Decision 124/2002/QD-TTG September 20,2002	Percentage of tariff increase
A. Electricity Tariff for production			
Ⅰ. Electricity Tariff applied for normal production sector			
1. voltage of over 110 kV			
Normal time	770	785	1.9%
Off-peak time	374	425	**13.6%**
Peak time	1364	1325	-2.9%
2. voltage of over 22 and up to 110kV			
Normal time	803	815	1.5%
Off-peak time	396	445	**12.4%**
Peak time	1419	1370	-3.5%
3. voltage of over 6kV and up to 22kV			
Normal time	847	895	5.7%
Off-peak time	429	480	**11.9%**
Peak time	1474	1480	0.4%
4. voltage of up to 6kV			
Normal time	880	895	1.7%
Off-peak time	451	505	**12.0%**
Peak time	1529	1480	-3.2%
Ⅱ. Electricity Tariff applied for particular production sector			
1. applied for irrigation, water for rice, vegetable, crops and short-term			
1. voltage of over 6kV			
Normal time	630	600	-4.8%
Off-peak time	250	240	-4.0%
Peak time	990	950	-4.0%
2. voltage of up to 6kV			
Normal time	660	630	-4.5%
Off-peak time	260	250	-3.8%
Peak time	1045	1000	-4.3%
2. applied for production of clean water, urban drainage, steel mill, ferro, clindon, soap, fetilizer			
1. voltage of over 110kV			
Normal time	na	740	
Off-peak time	na	390	
Peak time	na	1265	
2. voltage of over 22 and up to 110kV			
Normal time	na	770	
Off-peak time	na	410	
Peak time	na	1310	
3. voltage of over 6kV and up to 22kV (Former: over 6kV only)			
Normal time	781	795	1.8%
Off-peak time	385	425	**10.4%**
Peak time	1375	1350	-1.8%
4. voltage of up to 6kV			
Normal time	825	835	1.2%
Off-peak time	396	445	**12.4%**
Peak time	1463	1420	-2.9%
B. Electricity Tariff applied for the State Administration Agencies			
Ⅰ. Electricity Tariff applied for hospitals, kindergarten and secondary school			
1. voltage of over 6kV	770	780	1.3%
2. voltage of up to 6kV	810	820	1.2%
Ⅱ. Electricity Tariff applied for public lighting			
1. voltage of over 6kV	847	860	1.5%
2. voltage of up to 6kV	880	895	1.7%
Ⅲ. Electricity Tariff applied for State Administration Agencies			
1. voltage of over 6kV	869	885	1.8%
2. voltage of up to 6kV	902	920	2.0%

C. Electricity Tariff applied for daily use			
I. Retail price applied for end-user			
-per kWh for first 100 kWh	500	550	**10.0%**
-per kWh for next 50 kWh	704	900	**27.8%**
-per kWh for next 50 kWh	957	1210	**26.4%**
-per kWh for next 100 kWh	1166	1340	**14.9%**
-per kWh for any additional kWh exceeding 301 kWh	1397	1400	0.2%
II. Wholesale price			
1. Applied for rural area			
a. for daily use	360	390	8.3%
b. for other purposes	715	730	2.1%
2. Applied for quarters, residential areas			
a. for daily use			
- through customer's transformer	495	570	**15.2%**
- through power company's transformer	506	580	**14.6%**
b. for other purposes	759	770	1.4%
D. Electricity Tariff applied for business, tourism, trading services			
1. voltage of over 6kV			
Normal time	1342	1350	0.6%
Off-peak time	726	790	8.8%
Peak time	2266	2190	-3.4%
2. voltage of up to 6kV			
Normal time	1397	1410	0.9%
Off-peak time	748	815	9.0%
Peak time	2387	2300	-3.6%
E. Applied for foreign enterprises & foreigners in Vietnam			
I. Electricity Tariff applied for production			
1. voltage of over 110kV			
Normal time	na	830	-
Off-peak time	na	440	-
Peak time	na	1410	-
2. voltage of over 22kV and up to 110kV			
Normal time	na	890	-
Off-peak time	na	480	-
Peak time	na	1510	-
3. voltage of over 6kV and up to 22kV			
Normal time	na	950	-
Off-peak time	na	520	-
Peak time	na	1600	-
4. voltage of up to 6kV			
Normal time	na	1020	-
Off-peak time	na	560	-
Peak time	na	1710	-
II. Electricity Tariff applied for business, tourism, trading services			
1. voltage of over 22kV			
Normal time	na	1260	-
Off-peak time	na	690	-
Peak time	na	2110	-
2. voltage of over 6kV and up to 22kV			
Normal time	na	1400	-
Off-peak time	na	760	-
Peak time		2360	-
3. voltage of up to 6kV			
Normal time	na	1530	-
Off-peak time	na	850	-
Peak time	na	2550	-
III. Electricity Tariff applied for daily use			
1. voltage of over 22kV	1320	1200	-9.1%
2. voltage of over 6kV and up to 22kV	1463	1330	-9.1%
3. voltage of up to 6kV	1617	1470	-9.1%

(2) Electricity Tariff Revision Schedule

Plans to revise the tariff have been discussed and changed many times in the past.

The major tariff revision schedules and background are described below.

When the Power Sector Policy was established in 1997, it was agreed between WB to raise the electricity tariff to average 7.0 cents/kWh in 1999. However, the tariff could not be raised according to the original schedule due to the economy crisis in Asia.

In May 2001, WB and ADB agreed to postpone the tariff raise to average 7.0 cents/kWh until 2005. The first tariff raise to 5.6 cents/kWh was scheduled for July 2001, but was postponed until October of the following year, as consent from concerning parties could not be obtained.

In 2002, Price Hike 2002 was adopted, which target was to achieve 7.0 cents/kWh in 2005. However, the next tariff raise to 6.1 cents/kWh scheduled for 2003, was again postponed.

Therefore, considering the opposition from various areas, it seems very difficult to achieve the target tariff level according to schedule.

The tariff schedule used in EVN financial projections, which the mission obtained from the Finance and Accounting Division, plans to achieve 7.0 cents/kWh in April 2006. Based on this schedule, EVN has already requested to the government to raise the tariff to 5.9 cents/kWh in April 2004.

However, considering the tariff revision process described above and the limited time, the schedule may be delayed, again.

Table 2-2-12 Electricity Tariff Revision Schedule

(Unit: cents/kWh)

	1998	1999	2000	2001	2002	2003	2004	2005	2006
Original Agreement with WB (1997)	6.6	7.0							
Negotiations with WB & ADB (2001/5)				5.6 July	6.0 July	6.4 July	6.8 July	7.0 July	
Price Hike 2002 (approved 2002/10)					5.6 Oct.	6.1 Apr.	6.6 Apr.	7.0 May	
Study Mission (2003/12)							5.9 Apr.	6.5 Apr.	7.0 Apr.
Actual Average Electricity Tariff		4.9-5.0	5.1-5.2	5.1-5.2	5.6 Oct				

2.2.7 EVN Financial Situation

EVN's past financial situation is analyzed below based on EVN's consolidated financial statements until the year ended December 31, 2002 prepared in accordance to the international accounting standards, and annual reports until the year ended December 31, 2001.

(1) Profitability

EVN's consolidated income statement is shown below.

Table 2-2-13 EVN Consolidated Income Statement

(Unit: Billion VND)

	1997	1998	1999	2000	2001	2002
Revenue	11,221	13,472	14,121	16,510	19,209	23,565
Cost of Goods Sold	-8,719	-10,913	-10,929	-13,574	-15,958	-19,067
Gross Income	2,502	2,559	3,191	2,936	3,250	4,497
Selling Expense	-177	-204	-253	-335	-405	-476
Administration Expense	-1,131	-577	-644	-673	-904	-1,092
Operating Income	1,193	1,776	2,293	1,926	1,941	2,928
Non-Operating Income	-11	-217	-559	-529	-400	-580
Net Income before Tax	1,181	1,558	1,733	1,397	1,540	2,347
Tax Expense	-670	-535	-644	-514	-541	-676
Net Income	510	1,023	1,088	882	999	1,671
Gross Profit Rate	22.3%	19.0%	22.6%	17.8%	16.9%	19.1%
Operating Profit Rate	10.6%	13.2%	16.2%	11.7%	10.1%	12.4%
Net Profit Rate	4.5%	7.6%	7.7%	5.3%	5.2%	7.1%

Revenue has increased steadily every year.

Profit rate graduately continued to decrease until 2001 but improved in 2002.

According to EVN, this growth of profit was due to strong electricity demand and good weather conditions, which contributed to lowering generation cost. Electricity tariff was also raised in October 2002. However, EVN's view is that its positive effect is just for three months and limited.

Overall, profit is steadily growing with the strong electricity demand.

(2) Financial Stability

EVN's consolidated balance sheet is shown below.

Table 2-2-14 EVN Consolidated Balance Sheet

(Unit: Billion VND)

Year	1997	1998	1999	2000	2001	2002
Non Current Assets						
Fixed Assets	20,066	18,213	18,747	23,716	30,914	45,082
Construction in Progress	7,475	10,738	17,807	20,971	15,926	9,069
Others		42	122	4,157	4,364	4,534
Sub Total	27,541	28,995	36,676	48,844	51,204	58,687
Current Assets						
Cash and Cash Equivalents	4,424	4,085	5,306	6,693	7,653	10,791
Receivables	10,583	5,467	3,919	2,619	2,665	4,075
Inventories	3,076	3,952	5,123	1,374	1,731	2,298
Others	540	709	513	503	670	463
Sub Total	18,625	14,214	14,863	11,191	12,720	17,629
Total Assets	46,167	43,209	51,539	60,035	63,924	76,316
Equity						
Capital	24,143	25,182	26,902	27,834	28,681	33,896
Retained Earnings	319	17	187	62	65	279
Sub Total	24,462	25,199	27,090	27,897	28,747	34,175
Long-term Liabilities (LTL)	5,339	12,824	19,064	25,565	26,601	32,644
Current Liabilities						
Payables	15,572	4,544	4290	5,217	6,843	7,717
Short-term Liabilities	143	44	43	68	112	136
Current Portion of LTL		10	494	1,287	1,620	1,641
Others	648	585	556			
Sub Total	16,365	5,185	5,385	6,572	8,576	9,495
Total Equity and Liabilities	46,167	43,209	51,539	60,035	63,924	76,316
Current Ratio	113.8%	274.1%	276.0%	170.3%	148.3%	185.7%
Equity Ratio	53.0%	58.3%	52.6%	46.5%	45.0%	44.8%

Regarding fund source and use, EVN funds are comprised of government capital and long-term borrowings. The raised funds are used for fixed assets, which account for the most part of assets.

Equity ratio (equity/total liability and equity×100), which indicates long-term stability, has continued to decline, but the rate of decline slowed somewhat in 2002.

Current ratio (current assets/current liabilities×100), which indicates short-term stability, has also continued to decline but also improved in 2002. This is due to the profit growth in 2002 as previously stated.

Overall, EVN is financially stable in respect to the recent financial trends.

However, like most governmental corporations in developing countries, EVN largely depends on foreign loans for capital investment, and therefore is susceptible to currency fluctuations, which in turn will affect financial stability. Such foreign exchange risk needs to be understood.

(3) Cash Flow

Table 2-2-15 EVN Consolidated Cash Flow

(Unit: Billion VND)

	1997	1998	1999	2000	2001	2002
Cash Flow from Operating Activities	4,040	-2,808	5,882	7,311	6,739	8,413
Cash Flow from Investing Activities	-4,218	-4,539	-11,666	-13,696	-9,206	-9,915
Cash Flow from Financing Activities	1,242	7,008	7,004	7,772	3,426	4,640
Net Cash Flow	1,064	-339	1,221	1,387	959	3,138

EVN's cash flow statement shows that funds for capital investment consist of cash flow from operating activities, mainly electricity sales, and cash flow from financing activities, mainly borrowings. Basically, the overall cash flow structure has not changed over the last five years. However, it should be noted that cash flow from financing activities decreased significantly from 2001, as the amount of repayments for past borrowings increased and even some borrowings were repaid in advance.

In 2002, cash flow from operating activities increased from the previous year. This was due to good business performance, and free net cash flow increased as a result.

(4) Summary of Financial Situation

The financial analysis results based on past financial statements (for past six years) are summarized below.

- Profitability and financial stability are in relatively good condition. Financial indicators for the year 2002 show improvement due to a good business environment.
- Cash flow structure changed from year 2001. One cycle of capital investment may have ended, or it could be said that capital investment was intentionally constrained to prevent borrowings from increasing. Overall, cash flow has improved in the past two years by reductions in net increase in borrowings and increases in cash flow from operating activities.

2.3 Relevant Measures and Policy

2.3.1 Relevant Power Sector

With respect to regulations of the electric power industry, electricity tariff system, and DSM, the latest information is collected from MOI, MPI and International organizations.

(1) Results of Interviews

a. MOI/MPI

- Regarding the necessity for a regulatory body of power market after the completion of the power sector reform, MOI has intention to establish a so-called Energy Division, which is temporarily under the supervision of Planning and Investment department within MOI.
- Raising electricity tariff must be done taking into account its effect on the whole socio-economic development. However, there is no organization to analyze the impact.
- The electricity law is under preparation of 18^{th} to 20^{th} draft in parallel, and will be submitted to the national assembly in 2004.

b. WB

- Among the 5 projects that have been loaned, the two ongoing projects cover the expansion of transmission and the expansion of the national grids in the rural area.
- In the future, WB main attention is the rural area's access to the national grids, There is one project planned, called rural electrification 2.
- WB assists Vietnam power sector to strengthen the power network and improving the whole system's efficiency considering whether PSPP is needed.
- WB, ADB and the Vietnamese government agreed on a process to raise the electricity tariff to 7.0 cent/kWh by 2005. In the first stage, the tariff had been raised to 5.6 cent/kWh in Oct. 2002 and hopes to be 6.2 cent/kWh by April 2003, then 6.6 cent/kWh in 2004 and 7.0 cent/kWh in 2005.

- Vietnam National Assembly is too busy to ratify the draft law. But State decree No.45 which cover main points in the draft of electricity law was constituted in 2001.

c. ADB

- The electricity law is on the 17th draft step, the main point is establishment of a independent regulatory body.
- Regarding the power reform, ADB is now developing a load map. (ADB is planning to hold a workshop on this matter.)
- ADB now provides a financial assistance for an improvement of distribution lines in the center and south regions, and is planning to provide assistances for international transmission lines and improvement of the load dispatching systems including its master plan study and preparation of manuals for operation.

d. Japan Bank For International Cooperation (JBIC)

- No change in the policy of providing assistance to the power sector as a major sector.
- Order of assistance priority is stable electricity supply and then electricity supply at reasonable cost.
- Assistance for infrastructure is still necessary from the view of stable electricity supply but JBIC also intends to provide assistance for institutional development (tariff system, environmental measures, contract management etc.).

(2) Assistance from International Cooperation Organizations

a. WB

Table 2-3-1 summarizes the WB projects related to the power sector in Vietnam.

Table 2-3-1 The WB Project in the Power Sector in Vietnam

Project Name	Project No.	Amount	Approval Date	Closing Date
Power Sector Rehabilitation and Expansion Project	P004836	165 million$	1995/05/16	2000/06/30
Power Development Project I	P042236	180 million$	1996/02/20	1999/12/31
Transmission, Distribution, and Disaster Reconstruction Project	P045628	199 million$	1998/01/20	Active
Rural Energy Project	P054252	150 million$	2000/05/30	Active
System Efficiency Improvement, Equalization, and Renewable Project	P066396	225 million$	2002/06/25	Active
Phu My 2 Phase 2 Power Project	P067973	75 million$ (Grant)	2002/10/15	Active
"A Generation – Transmission Transfer Pricing System"				Final report 2001/04

1) Power Sector Rehabilitation and Expansion Project

This TA is conducted by the ESMAP (Energy Sector Management and Assistance Program). The TA held workshop on sector reform in May 1995, in which the draft of Electricity Law was discussed.

2) Power Development Project

This is a part of the ESMAP TA and assisted to prepare Electricity Law and Grid Code. In addition, for promoting private sector participation in the power generation sector, consulting was conducted to formulate BOT-JV for PHMY2-1 and PHMY2-2 project.

3) Transmission, Distribution, and Disaster Reconstruction Project

EVN's internal PPA between the generation and transmission section was prepared, together with the incentive formation for cost reduction in the generation section. EVN introduced internal PPA in Jan. 2002.

4) Rural Energy Project I

Consultant provided technical assistance for project management on engineering and financial aspects. In order to propose measures for applying IT in EVN, financial and management capabilities of EVN are examined. In addition, the TA assisted the process, standard and methodologies for establishing transparent and reasonable bulk supply tariff for the establishment of independent distribution companies.

5) System Efficiency Improvement, Equalization, and Renewable Project

As the phase II of the DSM project, the following TOR is to be conducted: (a) introduction of time-of-use metering for bulk customers, (b) introduction of direct load control program at HCMC PC, (c) distribution of 1 million florescent bulbs, and (d) promotion of the use of energy efficient florescent bulbs. In addition, Financial Management Information system (FMIS) is to be introduced aiming at establishing information system for standardizing financial and accounting systems of different sections of EVN.

b. ADB

Table 2-3-2 summarizes the ADB projects related to the power sector in Vietnam.

Table 2-3-2 The ADB Project in the Power Sector in Vietnam

Project Name	Project No.	Amount	Approval Date	Closing Date
Rehabilitation of Transmission and Distribution Infrastructure in 3 Northern Cities	VIE1358	70 million$	1995/01	1999/12
Rehabilitation of Transmission and Distribution Infrastructure in 18 Central and Southern cities	VIE1585	100 million$	1997/11	2002/12
Central and Southern Viet Nam Power Distribution Project	VIE25187		1995/12	
Improvement of the Power Sector Regulatory Framework	TA2888-VIE VIE31040	800 thousand$	1997/10	2000/08
Commercialization of Power Companies	TA2897-VIE VIE2897		1997/10	1999/09
Se San 3 Hydropower Project	TA3222-VIE VIE31362	998 thousand$	1999/07	2001/12
Implementation of the Power Sector Road Map and Grid Code	VIE34343	400 thousand$	2001/11	2002/02
Northern Power Transmission Project	VIE32273	750 thousand$	2002/12	

1) Improvement of the Power Sector Regulatory Framework

The 10^{th} draft of Electricity Law as well as the following draft legislations were prepared.

- Electricity Regulatory Commission
- Tariff Setting
- Demand Side Management

2) Commercialization of Power Companies

The TA assisted institutional design of distribution companies as independent accounting units and capacity building of employees in the accounting section of EVN.

3) Implementation of the Power Sector Road Map and Grid Code

Based on the review of past TAs, issues on rescue reform are to be identified. Accordingly, workshop is to be held for discussing countermeasures and alternatives for the issues.

c. Japan Bank For International Cooperation (JBIC)

JBIC assistance to Vietnam restarted in November 1992 from the product loan conducted through the former OECF. The projects implemented in the power sector after restarting the yen-loans are shown below.

Table 2-3-3 JBIC Projects in Related to the Power Sector

Project Name	Amount	1st L/A Date
Phu My Thermal Power Plant Project	61,932 million¥	1994/01
Pha Lai Thermal Power Plant Project	72,826 million¥	1994/01
Ham Thuan-Da Mi Hydropower Project	53,074 million¥	1994/01
Da Nhim Power System Rehabilitation Project	7,000 million¥	1997/03
O Mon Thermal Power Plant and Mekong Delta Transmission Network Project	43,819 million¥	1998/03
Dai Ninh Hydropower Project	14,030 million¥	1999/03
Phu My-Ho Chi Minh City 500kV Transmission Line Project	13,127 million¥	2001/03

1) Phu My Thermal Power Plant Project

Construction of gas combine cycle power plant with total output of 1,090MW and related network facilities in Phu My, to respond to the strong growth in electricity demand in the southern regions.

2) Pha Lai Thermal Power Plant Project

Construction of coal thermal power plant with total output of 600MW and related network facilities next to the Pha Lai thermal power plant, to respond to the electricity demand increase in the northern regions.

3) Ham Thuan-Da Mi Hydropower Project

Construction of two hydropower power plants, Ham Thuan (total output 300MW) and Da Mi (total output 175MW), and related network facilities at the tributaries of Don Nai river located 150km northeast of Ho Chi Minh City.

4) Da Nhim Power System Rehabilitation Project

Provided yen-loan for maintenance of the aged Da Nhim hydropower plant and network facilities, which had been supplying electricity to Ho Chi Minh City for thirty years and were originally constructed by Japanese funds in 1964.

5) O Mon Thermal Power Plant and Mekong Delta Transmission Network Project

Construction of thermal power plant (total output of 300MW) and network facitilties in O Mon located northeast of Can Tho City in order to respond to the drastic growth in electricity demand in the Mecon Delta regions.

6) Dai Ninh Hydropower Project

Construction of hydropower plant with total output of 300MW, related network facilities 260km northeast of Ho Chi Minh City, based on the prediction that electricity demand will increase in the southern regions.

7) Phu My-Ho Chi Minh City 500kV Transmission Line Project Northern Power Transmission Project

Construction of 500kV transmission line and related network facilities to supply electricity to Ho Chi Minh City from Phu My power plant to Phu Lam substation located in the suburbs of Ho Chi Minh City via Nha Be substation.

2.3.2 Environmental Considerations in Vietnam and for Other Related Projects

The current conditions and contents of the following items will be reviewed, and based on the results, appropriate and adequate evaluation of the Project will be enacted.

- Environmental considerations conducted in the previous water resources developments of which purposes are power development and flood control
- System of the Environmental Impact Assessment (EIA) in Vietnam
- Protected area system in Vietnam
- Policies and measures for conserving important fauna / flora and ecosystems

Interviews have been conducted with Yaly HPP and the relevant governmental organizations / institutes on the environmental issues. The followings summarize points of interviews and discussions.

(1) Results of Interviews

a. Yaly Hydro Power Project

- The Resettlement Bureau belongs to Project Management Unit (Hydropower Project No.4). The Bureau conducted the resettlement program with the Departments of Resettlement of the two provinces, Gia Lai and Kon Tum, where the impacts by the Yaly Hydro Power Project occurred.
- The number of the resettled people are 8,475 (1,658 households).
- There were 15 staff for the resettlement program, and there are 19 staff working for a new

program for Pleikrong Dam Project.

・The Bureau represents EVN, and the provincial departments represent the local people. The departments convey requests from the people to the Bureau and solve raised issues.

・The budget of the Bureau is 4~6 billion VD and is supplied by EVN. The budgets of the provincial departments are also supplied by EVN.

b. Ministry of Natural Resources and Environment (MONRE)

・MOSTE was divided into MOST (Ministry of Science and Technology) and MONRE (Ministry of Natural Resources and Environment) in December 2002.

・Regarding to nature conservation in Vietnam, MONRE closely works together with MRAD (Ministry of Agriculture and Rural Development) which is in charge of the protected area system.

・Regarding to an EIA for the Study, a preliminary EIA should be conducted for a whole study and a report should be submitted to MONRE. After approval from MONRE, a detailed EIA should be conducted at each PSPP site at a feasibility study stage.

・The following references were collected.

  - ✓ Documents of setting up a report on EIA
  - ✓ Circular letter of guidance on setting up & reviewing

c. Ministry of Agriculture and Rural Development (MARD)

・There are 14 national parks in Vietnam.

・There are 94 protected areas and there is a plan to increase them to 120 in the future.

・There is an approved plan by the government that, by 2010, the area under protection will be increased to 2,000,000 ha (target figure). This figure has already been mentioned by the current plan of expansion of the protected area system. This plan is expected to be reviewed and to be approved by the end of this year.

・There are three categories of protected areas, namely National Parks, Nature Reserves and Cultural, Historical and Environmental Sites. Currently, there is an idea to categorize nature reserve into Nature Reserve and Species and Habitat Protected Area.

・Regarding a map with a boundary of each protected area, maps of national parks should be held by FPD or FIPI (Forest Inventory and Planning Institute). Maps of the other protected areas are not well prepared yet. About half of the protected areas have this kind of map. FIPI or institutions of provincial governments should also have these maps.

・Each protected area has an Investment Plan, and detailed information on each protected area should be described in the Investment Plan.

・Although a provincial government may establish a buffer zone for a protected area, there is no legal base for establishing a buffer zone.

The following NGOs were also visited and information on the protected area system and nature conservation in Vietnam were collected.

- BirdLife International
- WWF Indochina
- Vietnam National Parks and Protected Areas Association (VNPPA)

Local consultant was subcontracted and they conducted data collection. It is difficult to collect detailed information on protected areas (existing and proposed protected areas) at MARD, which is in charge of the system management, because of language barrier. The subcontracted local consultant, therefore, is in charge of collecting the information especially on the location of each protected area.

Regarding the social environment, little information on protection of ethnic minority and compensation system was collected due to time constraints in the second field survey. The information on these points needs to be collected in the next study.
Regarding the natural environments, the local consultant reviewed a list of literatures on aquatic ecosystem in Vietnam. It is, however, not sufficient for more detailed survey in the next stage (e.g. feasibility study), and based on the list, a more comprehensive literature survey including on terrestrial ecosystem needs to be conducted before the next study.