

Sector Report
Hydropower

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The Power Sector of Vietnam

General overview

Vietnam's power resource potentials are great such as coal, oil, gas and hydro-power. However after 2015, Vietnam will lack these resources and will have to import from other countries by linking the electricity network of 10 ASEAN member countries.

Vietnam's power sector has a regional character because of the geographical distribution of resources and the country's long and narrow shape. Hydropower and coal-fired power dominate in the north, while in the south there is hydropower but it also relies on diesel-fired generation and increasingly it will rely on gas from the offshore gas fields of Bach Ho and Nam Con Son. In the centre there is hydropower and diesel-fired capacity.

Electricity of Vietnam, EVN, is responsible for all generation, transmission, supply and distribution of electricity and, until recently, had a monopoly in the power sector, but with the increasing importance of gas in the south and substantial reserves of coal available in the north, the Vietnam Oil and Gas Corporation (PetroVietnam) and the Vietnam National Coal Corporation (Vinacoal) will start playing important roles in the energy sector. The Ministry of Industry has State management control of all three Corporations, EVN, PetroVietnam and Vinacoal

EVN has set up relations with more than 100 companies and corporations around the world including major energy suppliers from Britain, Finland, Germany, Russia and China. The Corporation has joined the Cigree organisation.

Demand and Supply

Demand: In 2003, 40TWh were produced (up 5 TWh from 2002), of which 35TWh was sold at a total turnover of over US\$ 1400 million. According to the current Revised Master Plan V, demand is expected to continue to grow with 15-17% annually, to 50 TWh and 90 TWh in 2005 and 2010 respectively. Per capita energy consumption in 2003 was 390 kWh. Compared with neighbouring countries like Malaysia, Taiwan, Thailand, Vietnam lags 20 years behind.

Supply: Total installed capacity in 2002 was 8.860 MW. Generation in 2003 was 35,8 TWh in which hydro electricity is approximately 50 %, coal-fired 13 %, gas-turbines 30 % and diesels and IPP 7%. By the end of 2002, EVN had 14 large and medium-sized power plants, 9 of which are hydropower plants, in addition to dozens of small diesel and mini-hydro stations. From 2004 till 2010, 12000 MW new capacity in 25 new power stations must be added, i.e. 1700 MW/year. Annual growth rate for hydro power will be approx. 13% or 6-700 MW/year. Vietnams total hydropower potential of about 17- 18000 MW is close to fully exploited in

Name of Power station		MW	Gwh/yr
1	Tuyen Quang	342	1329
2	Son La 215	2045	7397
3	Ban La (Nghe An 1)	300	1077
4	A Vuong 1	210	808
5	Ba Ha River	250	915
6	Plei Krong	110	766
7	Se San 3	273	1110
8	Se San 3A	100	401
9	Ry Ninh II	8	
10	Buon kuop - CPK	280	1353
11	Draylinh II	16	85
12	Dai Ninh	300	1178
13	Srok Phu Mieng	51	238
14	Can Don	72	280
15	Upper Ea Sup	70	
16	Rao Quan	70	260
17	Quang Tri	70	
18	Azun Ha		
19	Bac Binh	35	
20	Coc San - Chu Linh	70	
TOTAL UNDER CONSTRUCTION		4672	17197

of

12

years from now. According to the Revised Master Plan V, hydropower is expected to constitute 47% of total production in 2005 and 45% in 2010. A new Master Plan VI will be ready in about 2 years. To reach the forecasted demand levels, power generation capacity should be increased up to 11,000 MW within 5 years and to 28,000-35,000 MW by 2020. Several new transmission lines will be built in the next decade including 15,000 km of 110kV-500kV lines.

The development of the energy sector in Vietnam is critical to the future growth of the country. The demand for power is rising rapidly and is expected to continue an annual high growth rate of 15 percent for the next ten years. Hydropower's share of total is expected to drop from 59% in 2001, around 50% today till about 40% in 2010. Hydropower systems will then have a total capacity of 8 GW, natural gas-fired plants will be 6.5 GW and coal-fired thermal plants will be around 3 GW

EVN's Power Development Plan 2001-2010 (Master Plan V, and its revision of March 2003) prioritizes the development of large hydro, natural gas and coal resources. In terms of installed generation capacity, the country's generating capacity reached 8748 MW in 2001. EVN owned and operated 7878 MW of this capacity while the remaining 600 MW were owned by independent power producers (IPPs). The installed capacity in 2010 is projected to be between 12-14 GW. The additional installed capacity from 2001 to 2020 is planned to be 28980MW. The total installed capacity in 2020 will be 34455 MW against the estimated peak load demand of 26854MW with a reserve margin of about 28%.

As per April 2004, 20 hydropower projects totalling some 4600 MW are under construction. Vietnam plans to build 60 power plants from now till 2020, including 40 plants with a combined capacity of 12,000 MW in the 2001-2010 period, In 2001 and 2002 EVN put five more power projects into operation -- the Phu My 1, the Pha Lai 2, the 720 MW Yaly hydro-power plant, the Ham Thuan-Da My hydropower plant, and the Ba Ria 306 Add-on project -- with a combined capacity of 2,188 MW. Among the existing power plants, hydropower accounts for 60 percent, coal-fired 17 percent, gas and fuel fired 23 percent.

Tariffs

Electricity price subsidies are now being removed and cost reflective electricity pricing is introduced. The reform framework was initially planned to increase retail tariffs to an average of US\$0,07 per kWh in 1999. Because of the Asian financial crisis, the government postponed its implementation. In 2001, the government raised the tariffs to an average of US\$0,056 per kWh and would progressively rise to US\$0,07 per kWh in 2005. The government is also considering adopting an automatic energy price adjustment mechanism in retail tariffs, to automatically pass-through to consumers the actual cost of fuel, foreign exchange gains or losses, and local inflation. At present there is an increasing pressure from the government to implement the tariff reform plan to avoid

Unit: VND/kWh, 1 USD = 15500 VND

No	Types of charges	Domestic businesses (Production)	FIEs and foreigners (Production)	FIEs and foreigners (Business)
1.	At voltage of over 110KV • off peak • low peak • high peak	785 425 1325	830 440 1410	
2.	At voltage of between 22-110KV • off-peak • low peak • high peak	815 445 1370	890 480 1510	1260 690 2110
3.	At voltage of between 6-22KV • off-peak • low peak • high peak	860 480 1430	950 520 1600	1400 760 2360
4.	At voltage of under 6KV • off-peak • low peak • high peak	895 505 1480	1020 560 1710	1530 850 2550

financial risks to EVN. For example, the average price of some of the recent BOT projects in the country is US\$0,04 per kWh while the average retail tariff is US\$0,051 per kWh. This indicates that there may be insufficient margin to cover transmission and distribution costs.

Financing

Investment needs in the power sector is approximately 2 billion USD/year, of which 1,2 bn USD to generation alone. The hydropower sector may require 6-700 m\$/year. Projected capital needs from now till 2015 is \$ 22 bn. EVN cannot raise the capital required for the electricity sector, and other domestic and foreign investors are therefore encouraged to invest

Financing sources: The primary financial driving factor for the power industry is Official Development Aid (ODA), which has contributed to the sector \$2.9 billion between 1996 and 2000, i.e. close to 600 m\$/year. Especially JBIC has been very active and has financed up to two third of EVN's recent power plant projects. Funding from JBIC means that there must be a Japanese company as the main contractor. In bilateral assistance Sweden, France, Belgium, Switzerland and Finland have been quite active. *Export finance* has not been used much.

New policy: Due to large investment requirements, there is currently a shifting in policy away from donors. There is no guarantee that ODA funding will be made available and EVN is interested in project proposals and alternative funding sources. EVN will consider those proposals on their merits.

To attract additional capital, the power generation sector is opening up to foreign and domestic investors from other sectors under various forms, including Independent Power Producers (IPP), Build-Operate-Transfer (BOT), Build-Transfer (BT), Build-Transfer-Operate (BTO), Joint Ventures (JVs) and Joint Stock firms. IPPs currently generate about 8,7% of total power supply.

Transmission

Main voltage levels are 500kV, 220 KV and 110 KV. In 2000, the high voltage network consisted of 1,514 km of 500 kV, 3,732 km of 220 kV and 7,851 km of 66-110 kV. A 500 kV North-South 1487 km transmission line, commissioned in 1994, transmits electricity from Vietnam's largest generator, the Hoa Binh hydropower plant in the north, to large population centers in the south, linking the country into one electricity grid. The cable has helped to alleviate an electricity shortage in Ho Chi Minh City. Construction is also started on the country's 2nd 500kV transmission line linking Pleiku in the Central Highlands and Thuong Tin (northern Ha Tay province) to settle the problem of electricity shortage in northern provinces by 2005. The medium voltage network consisted of over 50,000 km. Five companies reporting to EVN distribute electricity in Vietnam: Power Company N°1-PC 1 (North Vietnam), PC 2 (South Vietnam), PC3 (Central Vietnam) , Hanoi Power Company (Hanoi) and HoChiMinh City Power Company (HCMC).

The government currently is considering building more transmission lines. 15,000 km of transmission lines and transformers with a total capacity of 50,000 MVA are planned to be built up to 2010¹. In the period 2001-2010 EVN plans to construct 2416 km (500 kV), 4414 km (220 kV), 7757 km (110 kV), 92600 km of medium voltage, and 19000 km of low voltage. EVN in 2003 put into use 956 km of 220 kV transmission line, a number of 220 kV transformers with a total capacity of 3,271 MVA, nearly 700 km of 110 kV transmission line

¹ BBC Monitoring Asia Pacific , volume 8, issue #2 - Friday, January 24, 2003

and 110 kW transformers with a total capacity of 2,706 MVA. Especially, the Vinh Long-Bac Lieu 220kV transmission line, two 220 kV transformers in Bac Lieu and Vinh Long provinces started operating, and the construction of the 500 kV transformer in central Ha Tinh Province completed improving electricity service in the Mekong delta and northern central provinces.

For the *medium voltage* power there will be a plan step by step transferring the existing multi-voltage system (6, 10, 15, 22, 35 KV) to single voltage of 22 KV system in urban, delta, and midland areas and to 35 kV voltage at mountainous area. Development of Power network must conform to the plan to ensure the consistency of voltage level and the safety operation, to reduce total line losses from 18-20% at the moment to 10% in 2010 and 8% 2020.

In general, the electricity transmission and distribution systems in the country are in need of *rehabilitation*. The transmission systems are unreliable and undeveloped. Poor quality equipment and the absence of modern dispatching facilities are prevalent.

Distribution

Vietnam's power distribution system is in relatively good condition; however, the distribution transformer capacity, the conductors, and the connections are generally too small and result in high losses.

Technical and non-technical losses and end-use inefficiencies in both urban and rural areas exacerbate the poor financial position of the power companies and reduce potential investment funds. Inefficiencies on the distribution side include low system power factor, transformer inefficiencies and poor quality of cables.

One of the biggest contributors to end-use inefficiencies are electric motors, which are manufactured locally and designed to comply with a power factor requirement of 0.7 at nominal output. In rural areas, pumps for irrigation/drainage form a major part of the connected load. A combination of poor design standards and mismatching to duty requirements mean that pump efficiencies and motor power factors tend to be low.

In some places, fraud and theft have created losses of over 40 %. A major contributing factor is that most of the installed meters are inaccurate and unreliable, causing significant revenue losses to power companies. It is estimated that 300,000 meters per year would be needed to equip newly connected customers and gradually replace the old meters.

Equipment

Most of Vietnam's power generation equipment is imported. Most foreign power companies and suppliers of power equipment are currently focusing on projects that are financed through overseas development assistance. Sales efforts for power generation projects/equipment in Vietnam should target the Ministry of Industry, the three large government power companies, and the government power design and investigation companies (PECCs). Government buyers prefer to buy new power generation equipment, which represent state-of-the-art technology. The most important decision criteria is quality, followed by price. Other considerations are the ability of the equipment to fit into the plant's network of existing equipment and availability of after sales service and spare parts. As Vietnam favours a diversity of foreign supplier relationship in its approach to working with vendors, access to contract is somewhat easier.

Assuming that the value of hydro-mechanical and electro-mechanical equipment in a hydropower plant account for min. 30% of total costs, the value of equipment to be purchased up 2010 is roughly 3 bUSD.

Approximately 300 mUSD worth of equipment is likely purchased from Western countries

Forecast demand for equipment in hydropower generation

	2004-2005	2006-2010
Total installed hydropower capacity (MW)	2.195	4.847
Total investment capital (\$ mill.)	3.073	6.786
Estimated demand for equipment & technology (\$ mill.)	922	2.036

Source: Vision & Associates' estimates

every year. Around 30% of hydro-mechanical equipment and 100% of electro-mechanical equipment will be imported. Major exporting countries are the G8 countries, of which Russia and Ukraine traditionally holds about 50%.

The *competition* is strong from countries like Japan, France, Germany, Sweden and other European firms. The largest supplier of power generation equipment to Vietnam at the present time is France. An expanding involvement of Korean and Taiwanese firms in the industrial sector of Vietnam is expected to encourage purchases of power generation equipment from their home countries

The *market* in Vietnam for imported power equipment surpassed \$1 billion in 2002 and is expected to grow at an annual rate of 10 to 13 percent. Some of the best prospects for foreign companies include: technical and engineering services; equipment for power generation projects like turbines, capacitors, circuit switches, switchgear, and insulators; electrical protection equipment such as surge arresters, fuse cut-outs, circuit breakers, and reclosers; electrical testing and calibration equipment and instruments; and pole line hardware for high-tension transmission lines.

The Ministry of Energy oversees the electric power sector. It also *prequalifies firms* that seek to bid on projects. The main suppliers of energy are the government entities known as Power Company 1, Power Company 2, and Power Company 3. These companies are also responsible for the operation of the energy transmission and distribution networks under their jurisdiction. The government Power Investigation and Design Companies are engineering consulting organisations, which specialise in investigating and designing power plants and transmission and distribution networks. Also, there is an Electrical Installation Company responsible for the installation of transformer stations. The above organisations work closely on plans for implementing projects and buying equipment. The Government may expect interested companies that bid on projects to finance their own feasibility studies and provide a complete financial package as part of their proposals. However, formal feasibility studies are difficult to conduct and reliable data is hard to obtain or non-existent.

Equipment standards. European and international technical standards for power generation and transmission equipment are now prevalent. Many projects which have been developed with international technical assistance specify European or Japanese standards or equivalent.

Power pooling

Vietnam is preparing for this in connection with preparations for restructuring of the whole power sector. In 2003 EVN submitted to Ministry of Industry a preparatory mechanism to expose EVN's power plants to a competitive power trading market. This is regarded as the first step towards a competitive power pool. Norwegian experience in this area may be welcomed in Vietnam. This was also the view of the World Bank.

Hydropower

Runoff²

The average rainfall of the whole territory of Vietnam varies from 1500 to 2000 mm. It is distributed unevenly both in space and time. The annual rainfall can reach 4500 mm in some places, while in others it

can be as low as

600mm. Annual runoff

discharge per capita in

Mekong Delta

provinces is about 4

times of country's

average, while that of

Dong Nai river is only

34%, of Ca and Ma river, only 50% to 60%.

Table 2. Seasonal change of monthly discharge

River	Annual discharge (m.c.m)	Max.monthly discharge(b.c.m)	Min.monthly discharge (bcm)	Ratio max./min.
Red River	137 000	24 600	2,420	10.47
Ma	20 100	4 190	448	9.35
Ca	24 200	5 360	526	10.19
Dong Nai	30 600	3 890	145	26.82
Mekong	526 000	91 800	6 175	14.87

Source: Vietnam Water Resources Sector Review, Hanoi, 1994

The rainy season usually starts in May or June and finishes in October, while it normally provides 75% to 80% of the entire annual rainfall. The ratio between maximal and minimal monthly discharge varies from 10 for Ca river or Ma river in northern part of Central Vietnam to 27 for Dong Nai river in the southern part. Water resources in Vietnam are also very unevenly distributed geographically. Vietnam has an annual river flow estimated about 830 billion cubic meter, providing a runoff per capita of 10,986 c.m. The average run-off per sq. km is 2,66 million cm, about 10 -90 liter/s.km². The actual water resources withdrawal under existing diversion and storage infrastructures is still very low, estimated about 7.8% of total runoff. Thus only a small part of the total natural runoff is artificially managed and the remaining + 90% still has the opportunity of freely flowing in river and spring beds

Along with annual variation long term hydrological data series in Red River and Mekong River show yearly *cyclical variations* of flows runoff. Several consecutive years of water abundance are alternated with consecutive years of water poverty. For the Red River a 20 years cycle of water abundance from 1932-1951 has been followed by a 16 years cycle of water poverty. For Mekong River a 17 years cycle of water abundance from 1937 to 1953 has been followed by a 24 years cycle of water poverty

River systems and Hydropower Potential³

² Source: Presentation of management and development of hydropower sources In Vietnam, By Nguyen Ngoc Minh, Institute of water resources planning.

³Source: "Hydropower in Vietnam: updates on current and future developments", by Nguyen Anh Tuan, Electricity of Vietnam

Vietnam is well endowed with over 2200 rivers and streams with rich water resources, the Red river system in the north, including the Da and Lo - Gam - Chay rivers, and the Mekong river delta in the south being among the largest rivers in the world. In the center, there are the Ma river and the Ca river of the northern part, the Vu Gia - Thu Bon river of the central part, the Se San river and the Srepok river of the Central Highlands, the Ba river of the Coastal Area, and the Dong Nai river of the southern part. The locations of the river basins of

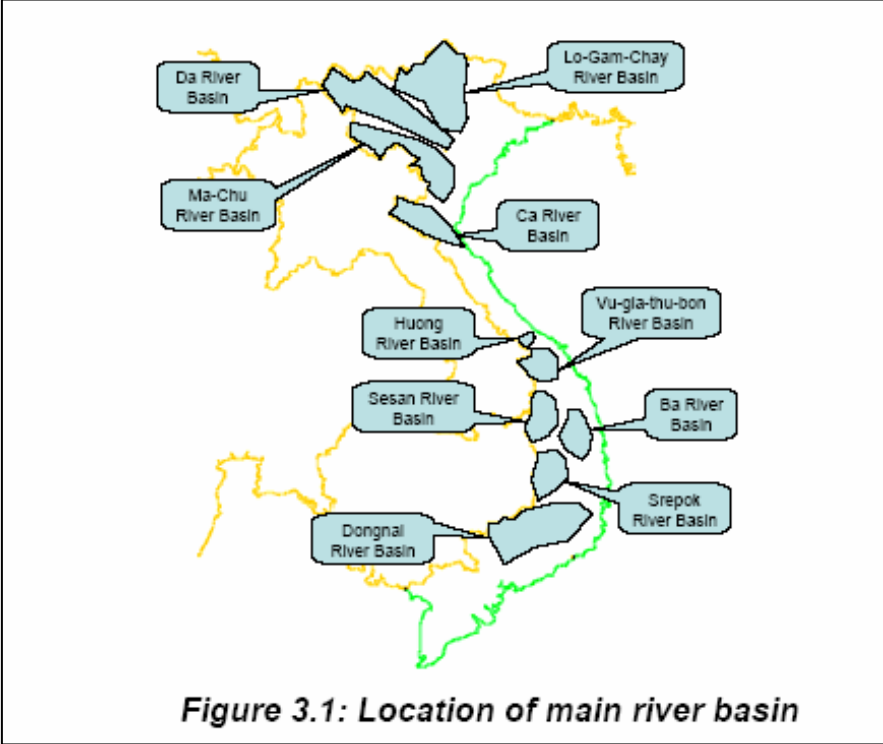


Figure 3.1: Location of main river basin

Vietnam are shown on the Figure 3.1.

Vietnam’s gross *theoretical* potential of hydropower is 34674 MW or 300 TWh/a, and its economically feasible potential is 18,6-20 GW or 82-100 TWh/a. Vietnam’s *technical/economical* hydro power potential is estimated to 80 to 100 TWh/year, representing about 17700 MW. About 20% of this or 4200 MW / 18 TWh (average load factor 50%) is exploited as per April 2004, and another 2900 MW (+ Son La 2400 MW) in 20 new power stations is under construction. Of the total potential 51 TWh/year are in the north, 19 TWh/year in the central regions and 10 TWh/year in the south. The hydropower potential is mainly concentrated on three rivers: 6250 MW on the Da river in the north. 1500 MW on the Sesan river in central Vietnam, and 2500 MW on the Dong Nai river in the south. In addition to the above the potential for small- and medium-size hydropower stations is estimated at 1600 to 2000 MW of which only 56 MW has been developed.

According to the current revised Master Plan V, there are 80 projects of more than 30 MW to be built in Vietnam. Between 5-30 MW there are some 134 projects totalling some 1500 MW. For projects less than 5 MW, they do not have valid statistics, but an estimate in the order of 2-300 projects.

Multipurpose projects

Floods: Hydropower stations will often also serve the purpose of *flood control* in Vietnam, and many hydropower in Vietnam are therefore often associated with multipurpose dams.

Flood disasters are considered as the most serious natural disasters in the country in terms of economic damages, as well as loss of people life and environmental conditions. For example in 1998 and 1999 floods killed more than a 1000 people, devastated millions ha of crop fields, destroying important infrastructures constructions, deteriorating the living environment, deferring the local socio-economic development for several years. The total loss were estimated to about 4 000 billion Vietnamese dong. Flood patterns are very diversified according to local climatic and landscape conditions: extensive floods in densely populated agricultural lands of delta regions of Red River and Ca, Ma rivers in northern central Vietnam; widespread, prolonged flooding in Mekong River delta; intensive flash flooding in highlands and midlands of northern and central part of the country. About 55 million of Vietnamese live in the lowlands flood-prone areas. The annual economic losses by flood has been estimated in hundreds millions of US dollars every year. Losses of people life and environmental losses happen every year and could not be calculated in financial terms.

Drought: On a total annual basis, in evaluating water balance of various rivers, nearly all watersheds show significant surplus of runoff comparing to current water demands. However on seasonal balance basis serious water shortages occur frequently during the dry season in almost all river basins throughout the country. In Mekong River Delta during the dry season, especially from early March to May, river discharge is always lower than rice fields irrigation demands. In coastal areas of the delta some fresh water discharge is also necessary for prevention of salinity intrusion, which could affect about 1.5 million ha of crop fields. Preliminary calculation shows that with the current population and economic growth there will be on Red River Delta a lack of water for agriculture, industry, and domestic use of 6 b.c.m in the year 2010 Drought pressure is more serious in river basins of Central Viet Nam. leading to a loss of about 30% of local agricultural production value.

Peak power

The *peak load* duration in Vietnam is 4 hours from 6:00 pm to 10:00 pm. However, the daytime load has been steadily rising with increased daytime power demand due to industrialization. The load factor has accordingly increased year by year, and is expected to be around 67% in 2010.

A minimum requirement for hydro power generation at multipurpose reservoir projects is that they must be operational with the installed capacity for these 4 hours. Thus, water volume necessary for 4 hours operation with the installed capacity is assumed to be the minimum water requirement for power generation of multipurpose reservoir projects.

The reservoir water level may have to be lowered during the rainy season for flood control purposes. Power output with the installed capacity may not be possible due to such flood control, but the required 4 hours peaking is possible.

National Hydropower Plan

Currently, Vietnam is developing a study on National Hydropower Plan with a time horizon to year 2020. This study is being undertaken by Sweco and Norplan, and forms input to the official power development Master Plan. It covers a full investigation of the five main river basins which are estimated to possess about 75 percents of the country's exploitable hydropower potential. These are the Da, Lo Gam, Ca, Se San and Dong Nai river basins. A brief overview of the location and size of the most important plants are given below.

North Vietnam

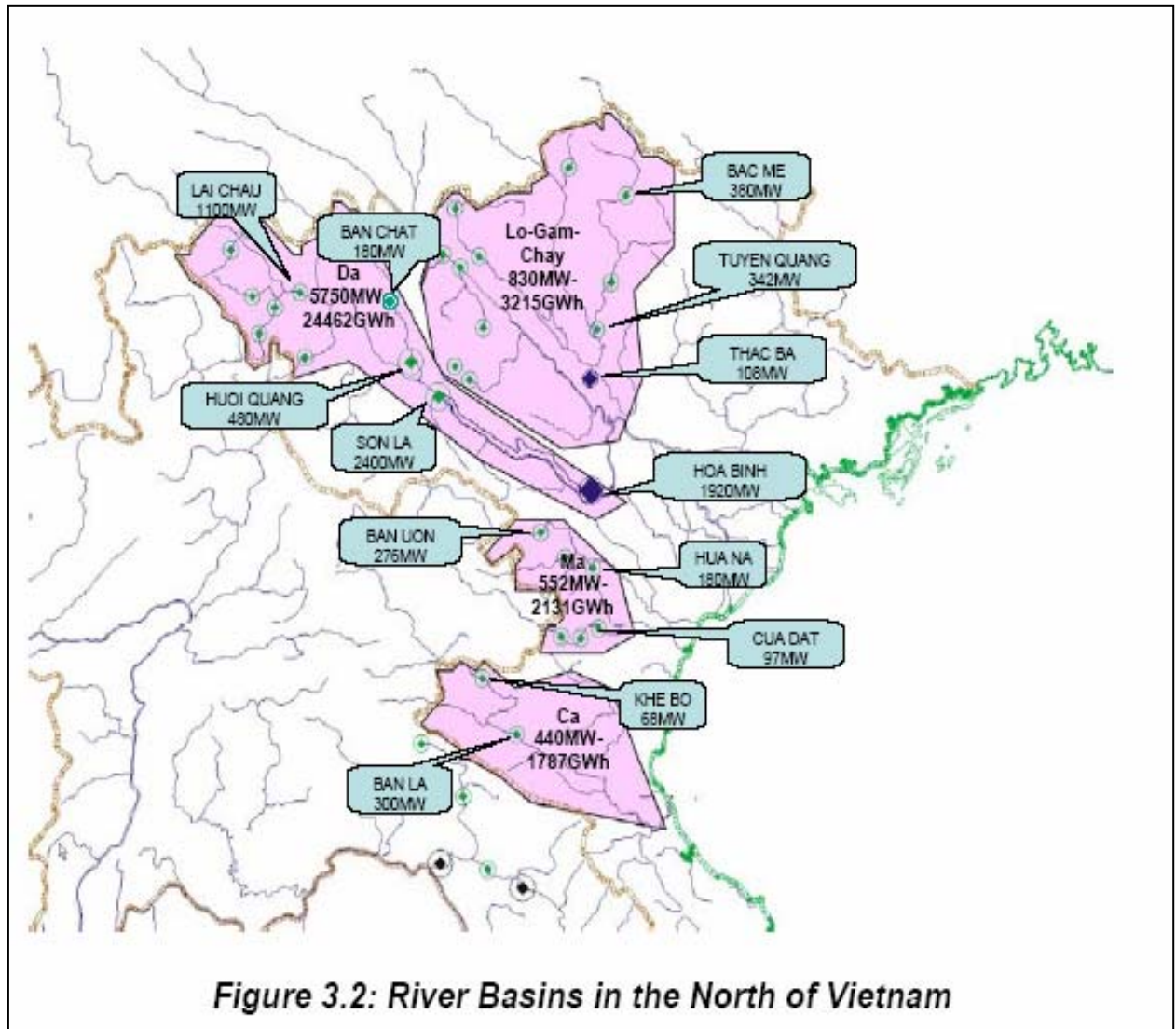
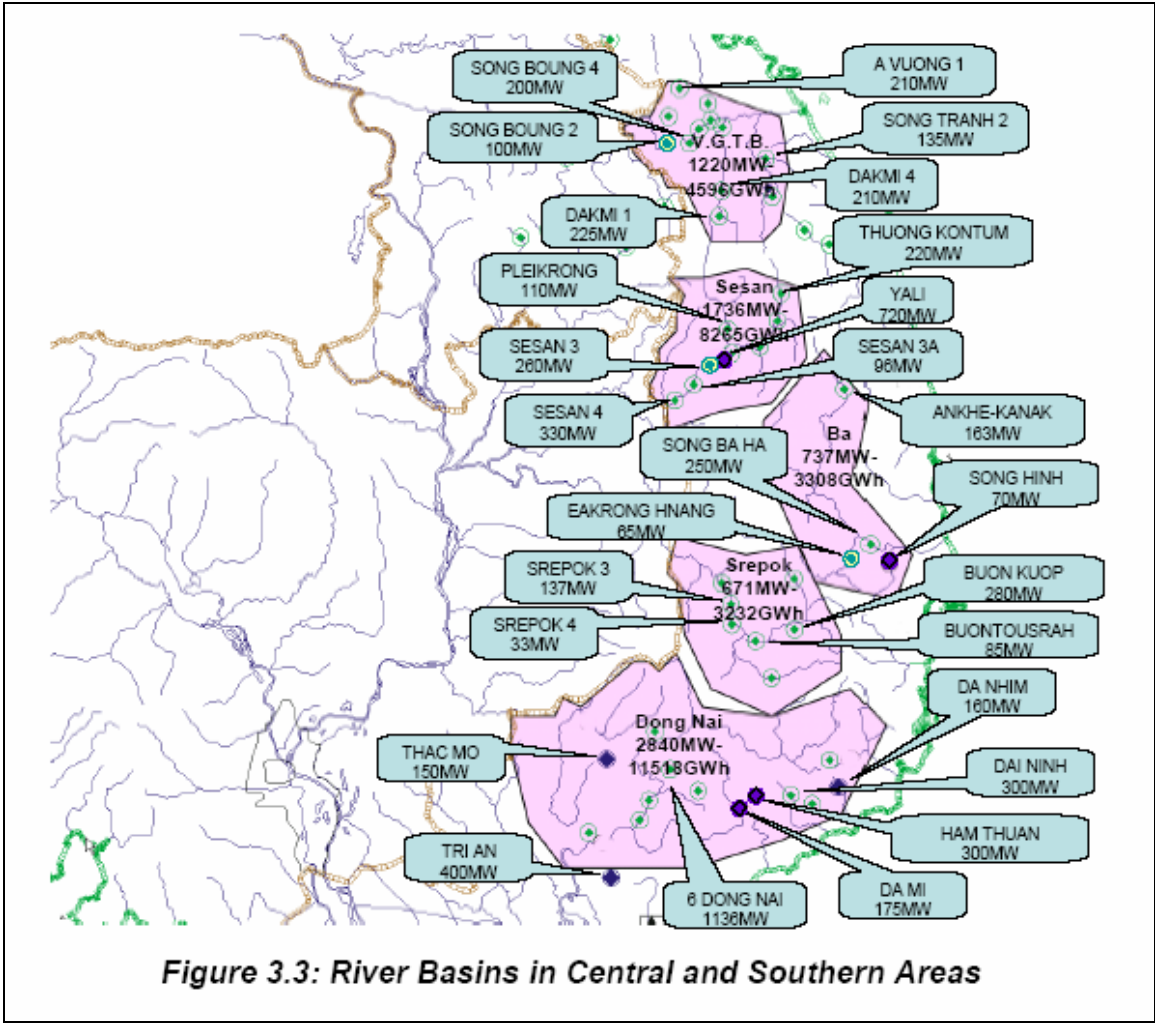


Figure 3.2: River Basins in the North of Vietnam

Central and South Vietnam



Other Rivers

Apart from the above mentioned major rivers with significant hydropower resources, there are a number of rivers in which the potential power is smaller such as Huong River Basin, Tra Khuc River Basin

Hydropower construction plans to 2010

The power supply scheme for 2003-2010 period requires construction of at least 20 hydropower plants, meaning a huge amount of construction and building work for contractors, equivalent to digging and moving about 180 million cubic metres of soil, seven million cubic meters of concrete and drilling and filling more than 90 kilometres of tunnels and installing about 200,000 tonnes of steel structures and equipment. The plan also includes the construction of 80 small and medium sized hydropower plants owned and built by other businesses apart from EVN.

Approved power projects have been handed out to contractors or groups of contractors, with A Vuong hydropower project given to Licogi and their subcontractors, Ban La hydropower project to Vinaconex and their subcontractors and Play Krong hydropower project to Song Da and their subcontractors. As many as 13 corporations and companies under various ministries

have signed contracts with EVN to handle power projects. Many corporations have taken the work of main contractor for the first time and have to negotiate with the investors, their subcontractors and direct the construction works on major hydropower projects

Small and mini hydro

Small hydro power stations (0,5 -10 MW) play an important role in the electrification of the midland and mountainous areas. The potential for small mini hydroelectric power is estimated to 7 - 10% of the total economic hydropower potential in Vietnam, between 1500 and 2000 MW.

Small hydro resources are mostly situated in the north and central Vietnam, near the border of Laos and Cambodia. The small hydropower potential (<10 MW per site) in the country is estimated to be around 800-1400 MW. This consists of the following: i) 400 – 600 MW for grid connected mini-hydro; ii) 300 – 600 MW for isolated mini-grids and; iii) 90 – 150 MW picohydro systems. About 60 MW capacity of grid-connected mini-hydropower is being exploited in 48 sites in Vietnam. The mini-hydropower systems have capacity sizes ranging from 100 to 7500 kW. It was reported that 13% of these sites are not in operation due to equipment failure. There is a significant scope to increase the capacity of each system through rehabilitation. The installation of these systems were either directly financed by the government or through international aid.

Isolated mini-hydro grids are commune-based small hydro systems. These mini-grids have capacity sizes ranging from 5 – 200 kW. Currently, there are 300 communes in North and Central Vietnam that have small hydro systems installed with an aggregate capacity of around 20 MW. The mini-hydro grids are either commune-operated or commercially operated. It was reported that commercially operated mini-hydro grids are better managed and have lower failure rate than commune-operated grids.

In order to accelerate the development of small hydropower, new policies and incentives will be introduced to attract additional investments and know-how to this sector. Provincial or district level autonomy for authorising small project development will be essential. It is envisaged that the private sector shall be allowed and encouraged to play a lead role in small hydro power development.

A Master Plan for Small Hydro (defined there as less than 30 MW) is just completed in April 2004. After MOI approval, interested parties can apply for development licence. Likely investors are contractors, and the different distribution companies (DC1 DC 2, DC 3, DC 4 etc.) Other investors than EVN have now invested in more than 100 projects. 20 small hydro power projects are currently under construction.

The Hydro Power Centre (HPC) is the most active organisation in providing consultancy for grid connecting mini hydro plants. The centre has a manufacturing capacity for around 30 mini hydro plants of 20 to 400 kW annually. A project for privatisation of the centre has been presented to the World Bank without success so far; the present status of this organisation is certainly a barrier to possible partnership with a private company Two major reasons limit the market and the development of this kind of local enterprises

- The failure rate of the local fabrication is still rather high. There is a need for new techniques and a whole review of the quality of manufacture to improve the reliability.
- The local fabrication has difficulties to compete in terms of quality with imported (Chinese) equipment.

O&M management and services, and sourcing of spare parts for small hydropower equipment requires improvement

The majority of pico and micro hydropower schemes have been developed in the Da Basin in the North and in the Central Highlands. In the North there are plenty of streams and rivers near to population centres.

Import of equipment: Local institutions and companies have already shown their capability to manufacture a large number of systems of various types, Francis, Kaplan, Pelton and Crossflow in the capacity range from 5 to 1500 kW. However, due to a large number of installations which have stopped working, the authorities have shown some reluctance to purchase Vietnamese equipment, favouring more expensive Chinese machines (e.g. Chinese equipment for a 200 kW rehabilitation scheme may cost US\$ 125,000 compared with US\$ 70,000 for Vietnamese). However, these are still cheaper than European sourced equipment, though inferior products in terms of efficiency and reliability. European-sourced family hydropower sized units are also likely to be too expensive for the current market.

Private and foreign participation

The government in 2001 decreed to open up 20 percent share of the total installed capacity to foreign investors in the form of IPP, BOT or joint ventures. Investment licenses were already issued to 2 power generation projects (715 MW each) to be developed by foreign investors. For the period 2001-2005, EVN planned to uptake 1512 MW capacity through BOT projects and 1220 MW through IPPs.⁴ The limit of 20% share for foreign capital in the power sector is now to be abandoned. We were told in the Ministry of Industry that no specific limit would apply in the future.

Until recently, private participation (both domestic and foreign) in the power sector has been limited to small foreign invested plants usually built primarily to supply power to industrial zones and then selling excess capacity to EVN (eg Nomura (50 MW), Amata (18 MW) and Hiep Phuoc (375 MW)).

However, the Phu My 2.2 and Phu My 3 power projects have now shown that foreign invested projects can be successfully negotiated (even though the negotiations have been very long...) and financed.

The *Phu My 2.2* project is a 715 MW combined cycle gas power plant negotiated in the form of a 20-year BOT concession with a power purchase agreement (PPA) between EVN and the BOT Company and a gas supply agreement (GSA) between the BOT Company and PetroVietnam. The sponsors are Electricite de France, Tokyo Electric Power Co and Sumitomo Corporation. A loan of US\$150 million was obtained from JBIC and other commercial loans have been obtained backed by guarantees of various sorts by the World Bank, ADB and Proparco.

The *Phu My 3* project is a 717 MW combined cycle gas power plant negotiated in the form of a 20-year BOT concession with a PPA and GSA. The sponsors are BP, Nissho Iwai, Kyushu Electric Power Co and Sembcorp Utilities. A loan of US\$99 million has been obtained from JBIC and loans

Project	Capacity	Main contractor
Plei Krong	100 MW	Song Da Construction
Quang Tri	64 MW	Construction Corporation No.4
Ban La	300 MW	Song Da Construction
A Vuong	2 x 105 MW	Licogi

⁴ "New and Renewable Energy Opportunities for Electricity Generation in Vietnam", Report produced in conjunction with the Technology Partnership for New and Renewable Energy, HCMC 4-5/3 2004

have also been obtained from ADB and commercial banks with political risk guarantees from ADB, MIGA and NEXI.

Participation by local (domestic) companies and State-owned enterprises is being encouraged, with the investor for the Can Don hydropower plant (72 MW) being Song Da Construction Corporation. Five hydropower plants to be commenced in 2003–04 are to be constructed by applying EPC contracts, with a domestic construction company already selected as the main contractor in each case as shown in table. Both of these projects are being built as Build-Operate-Transfer (BOT) projects, where the foreign investors operate the plants for a set period of time. These projects were held up for quite a long time due to disagreements over pricing. The foreign investors considered the prices offered by EVN to be below the levels which would give them a sufficient rate of return on capital. The Vietnamese government eventually stepped in to resolve the issue, and the price was set at 4.09 cents per kilowatt hour (kWh).

Methods of investment suggested by EVN

In the RMP-V of March 2003, EVN has listed 32 power projects for the 2001–10 period where EVN will be the investor, but since then EVN has added to the list and divided the list between:

- power plants to be owned by EVN and for which EVN will raise finance domestically and overseas (26 projects: five in 2003–05 and 21 in 2006–10)
- power plants *calling for outside investment* (nine power plants of which only three are listed in the RMP-V and six have been added but are for putting into operation after 2010)
- power plants to be financed by *joint ventures between EVN and domestic corporations* (five power plants)
- power plants for which EVN has called for finance from ODA funding (either from the World Bank, ADB or JBIC) – in most cases if ODA funding is not available, EVN will seek commercial loans, mostly in the form of lines of credit for the purchase of materials and equipment (ECAs).

In some cases the power plants appear in two different lists. Prospective investors would need to check with EVN whether investment in, or financing of, a particular plant is required and what method of investment or financing is sought.

Apart from three projects in the 2001–10 period where outside investors are sought, EVN has arranged for eight projects to be financed wholly or partly for equipment procurement, it has commitments of finance for six other projects and is seeking finance for the remaining 15 projects. More capital also needs to be raised for investment in power plants to be put into operation after 2010.

Other projects where EVN will not be the investor

The RMP-V also lists projects where EVN will not be the investor. It is not clear in many cases who will be the investor although Vinacoal is identified as the investor for the Na Duong, Cao Ngan and Cam Pha plants, PetroVietnam is the investor for the Ca Mau plant, and Song Da Construction is reported to be the investor in respect of several smaller power plants. The RMP-V indicates that enterprises of various economic sectors are encouraged to participate in investing in coal-fired projects in the Quang Ninh area or in hydropower

projects having a capacity of up to 100 MW in the form of a joint stock company where a State corporation holds a controlling share. At the moment therefore it is unlikely that direct investment in these plants would be open to foreign investors although this is not entirely clear.

In addition to power generation plants, the RMP-V sets out a plan for projects involving 500 kV transmission lines, 500 kV transformer sub-stations and 220 kV transmission lines and transformer sub-stations. EVN is seeking ODA funding for a large number of these projects, but also has a substantial number of 220 kV power network projects and 110 kV sub-station and transmission line projects for which other financing is required. For 110 kV projects, most materials and equipment can be domestically supplied but EVN would need foreign loans for equipment that cannot be manufactured domestically such as circuit breakers, insulators, control panels and systems and optic fibres.

EVN has not listed the very controversial Son La hydropower project proposed for the Da River 320 km west of Hanoi. This massive 3600 MW project will be the largest of its type in Vietnam and requires substantial resettlement of people. It is due to start in 2005 and is scheduled for completion in about 2015–16.

Foreign investment in Vietnamese hydropower enterprises

Experience so far in Vietnam with foreign investments in thermal power projects is that PPA and particularly the power price has been very difficult and lengthy to negotiate. Too much attention has been paid to tariffs and too little attention has been paid to investors being allowed a reasonable rate of return on investment when negotiating BOT projects. However, with tariffs slightly above 4 UScents /kWh, it is assumed that ROE would be roughly 20% on BOT projects. Nevertheless it is probably better to buy into an existing power company, or a project that has been negotiated (but not necessarily yet implemented), because it takes so long to get to the finally agreed position. Below are some considerations regarding buying into existing projects or companies.

Regulation: Foreign investment in Vietnamese enterprises are regulated through Decision No. 36-2003-QD-TTg from the Prime Minister, and Circular No. 73/2003/TT-BTC (Circular 73) dated 31 July 2003 from the Ministry of Finance (MOF). It applies to all activities involving foreign investors contributing capital to, or buying shares in, Vietnamese companies under the Law on Encouraging Domestic Investment.

The *maximum amount* (in shares or capital contribution) that foreign investors can hold in a Vietnamese company is 30 per cent and investment is still limited to certain sectors of the economy. If several foreign investors subscribe to contribute capital to, or buy shares in, a Vietnamese company with a value of more than 30 per cent of the company's authorised capital, the company must select a foreign partner by tender or by auction. It was indicated during meetings in Ministry of Industry and EVN, that this 30% limit now might become negotiable. 51% Vietnamese ownership would though be preferred, but even foreign majority could be possible.

Hydropower is still not officially on the lists of national projects calling for foreign investment. However, as long as a project involves the right method of investment for the relevant sector and fits into Vietnam's socio-economic development plan, the project will always be considered by the Ministry of Planning and Investment (MPI), even if it is not in the List or in a list of a relevant ministry.

Equitisation: Several hydropower projects are now in the process of being equitised. Where an SOE is being equitised, it is up to the relevant minister (or chairman of a people's committee if the project is under local control) to decide whether foreign investors will be allowed to participate in an initial sale of shares. The structure of the initial sale of shares must be included in the equitisation plan, and only after determining the number of shares to be held by the State and the number of shares to be sold to employees and suppliers will a decision be made whether the balance of the shares will be sold to domestic outsiders or foreign and domestic outsiders.

In the case of a joint stock company, an investment plan or plan for issuing additional shares must be approved by the board of management or shareholders' general meeting (depending on the terms of its charter) and where the company's shares are not listed, the sale of shares must be carried out by itself or through an intermediary financial institution. The company must publish in the mass media its proposal to sell shares to foreign investors together with other information about its activities, capital and funds for the relevant year and the two previous years.

Circular 73 also contains guidelines relating to the price for the sale of shares or contribution of capital and relating to the information to be provided before and after shares are sold to, or capital is received from, foreign investors.

The sale price for shares in an SOE being equitised is determined in accordance with GOVN decree. The sale price of shares in an unlisted company will be agreed between the company and the foreign investor but cannot be less than the price offered to domestic investors; and the sale price of shares owned by an existing shareholder can be agreed between the shareholder and the foreign investor but cannot be lower than the initial sale price offered to domestic investors (for an unlisted company) or the sale price quoted on the securities market (for a listed company).

Domestic involvement in power projects

The Government encourages domestic involvement in hydropower projects in many ways. For the power projects listed below, - all under construction as per April 2004, the Government on 17 June 2003 issued Official Letter 797/CP-CN indicating that, as much as possible of the building of these power stations must be carried out using domestic contractors and domestic funds so that, by constructing these projects, "domestic enterprises will be able to improve their consultancy, engineering and manufacturing capabilities". The projects are:

- *A Vuong* power station (170MW) in Quang Nam Province, with Licogi as main contractor
- *Quang Tri* power station (70MW) to be built by Construction Corporation No.4
- *Buon Kuop* power station (280MW) in Dak Lak Province to be built by Vinaconex
- *Plei Krong* power station (110MW) in Gia Lai Province and
- *Ban La* power station (300MW) in Nghe An Province, both to be built by Song Da Construction.

Permission has been given for each of the five projects to be undertaken through EPC contracts entered into by groups headed by a main Vietnamese contractor with the Vietnam Electricity Corporation (EVN) and the contracts do not have to go out to tender. Other aspects of the projects are:

- EVN and the main EPC contractor can rely on current tendering regulations to appoint consultants for the main design and for managing each project and the design construction drawings; the consultant must, in each case, be an experienced domestic consultant; *if any*

foreign consultant is to be involved, approval must be obtained and the foreign consultant will only act as a sub-consultant

- the Ministry of Finance will issue a guarantee, at the request of EVN, to enable foreign loans to be borrowed for the import of equipment and technology for each project
- each of the four domestic commercial banks will be allowed to provide loans to EVN exceeding the limit of 15 per cent of its equity
- an international tender is to be conducted for the import of foreign equipment and technology which cannot be produced domestically.

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