

VIETNAM

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1. GENERAL INFORMATION

1.1. General Overview

Vietnam, a nation located along the eastern coast of the mainland of Southeast Asia, is shaped like a giant letter S, extending some 1,600 km from the Chinese border to Point Ca Mau (Baibung) on the Gulf of Thailand, see Figure 1. The total area of Vietnam is 333,688 km². At its widest it reaches a width of about 560 km. In the narrow centre it is less than 50 km wide.



FIG. 1. Map of mainland Vietnam

The altitude of the land is generally high in the north and low in the south. In the north, the coastal plain extends over a fertile delta plain called the Red River Delta, which covers an area of about 12,500 km². Hanoi, the capital of the country, is located in the delta and the Red River pours into the Gulf of Bac Bo. In the south, the coastal plain widens into the Mekong River Delta, which has an area of about 39,600 km².

Vietnam belongs to the Asian Monsoon Zone and gives tropical conditions in the south and sub-tropical conditions in the north. The country enjoys a variety of climatic conditions, including the cool weather in the northern mountain area, the wet tropical climate from northern to central low land, and the tropical monsoon climate in the southern low lands. The wet season lasts from May to October and the dry season from November to April.

In 2000, the population of the country was about 78 million of which about 76.5% lived in rural areas and 23.5% in urban areas (Table 1). Major urban centres are Hanoi accounting 3.5 million people, Da nang 1.8 million and Ho Chi Minh City around 5 million. The average population density is about 228 per km². It varies from one area to another. The population density in the northern Red

River Delta is approximately 900 per km², which is twice as high as that in the southern Mekong Delta. The population density in the central high land area is only 100 per km². The past 5 years trend of population is given in the Table 2.

TABLE 1. POPULATION INFORMATION

	1960	1970	1980	1990	1995	1996	1997	1998	1999	2000	Growth rate (%) 1980 to 2000
Population (millions)	34.7	42.7	53.7	66.7	72.11	73.2	74.31	75.45	76.62	76.62	2
Population density (inhabitants/km ²)	104.7	128.8	161.9	201.1				234.8	232.59	235.6	
Urban population as percent of total								20	23	24	
Area (1000 km ²)	331.7										

Source: IAEA Energy and Economic Database; Data & Statistics/The World Bank; Vietnam Statistical Yearbooks.

TABLE 2. PAST 5 YEARS TREND OF POPULATION

	1995	1996	1997	1998	1999	2000
Population, million persons	72.11	73.20	74.31	75.45	76.62	77.68
Growth rate, %	1.51	1.52	1.53	1.55	1.51	1.42

Source: Vietnam Statistical Yearbook, Hanoi 1996,1997,1998,1999, 2000,2001

The population growth rate was 2.3% for the period from 1980 to 1985 and 2.0% from 1985 to 1990. In the recent years, the population growth rate is about 1.55 %.

Based on the projection of the population completed on July 1999 by the General Statistical Office, the total population is expected to increase from 77.9 millions in the year 2000 to 98.4 millions in the year 2020. The projection of the population growth in the period from the year 2000 to the year 2020 is given in the Table 3.

TABLE 3. TOTAL PROJECTED POPULATION FOR THE PERIOD 2000-2020

Year	2000	2005	2010	2015	2020
Population, million persons	77.907	82.931	88.236	93.305	98.39
Growth rate, %	1.50	1.26	1.25	1.12	1.07

In 1995, 80% of the population was distributed in rural areas. However, the urban population is expected to increase from 20% in 1995 to 46% in the year 2020. This is illustrated in Table 4.

TABLE 4. THE DISTRIBUTION OF THE POPULATION

Year	1995	2000	2005	2010	2015	2020
Urban, %	20	23.5	30	35	40	46
Rural, %	80	76.5	70	65	60	54

1.2. Economic Indicators

Since 1986, Vietnam has initiated a reform from a centrally planned economy to a market economy. As a result, Vietnam's economy began to develop steadily in the recent years and most likely it will have high growth rates in the near future. The economic development alone will force an increase in energy development in general and electricity in particular. In the period 1991-1995, the

Gross Domestic Production (GDP) has grown at an average rate of 8.2% per year and the growth rate of the electricity consumption was 12.5%. From 1995 to 1997, Vietnam's economy developed stable, but in the years 1998 and 1999, it went down due the financial crisis. From 2000, as in most Asian countries, the Vietnam economy began to pick up again. The trend of the economic development over the past 5 years is given in the Table 5 and that of the export and import of goods is given in the Table 6. Exports include crude oil, rice, marine products, coal, coffee and rubber and imports petroleum products, steel products, tractors, cotton and textiles.

Currently, the Vietnamese Government has reviewed and adjusted targets for the economic development for the period 2000-2020. The concrete targets for 2010 are:

- A doubling of GDP by 2010 to be attained through an economic growth of over 7% per annum;
- Investment to be increased to 30% of GDP;
- Export to grow more than twice the rate of GDP;
- The share of agriculture in GDP to decline from 25% to 16-17%; industry to increase from 35% to 40-41%; and services to increase from 40% to 42-43%;
- The share of rural employment to decline from about two-thirds to half; and
- The share of urban population to increase from a quarter to a third.

TABLE 5. ECONOMIC DEVELOPMENT AND STRUCTURE

Parameters	1995	1996	1997	1998	1999	2000
GDP growth rate, %	9.54	9.90	8.15	5.77	4.77	6.75
GDP ¹ Billion VND	228,892	272,036	313,623	361,016	399,942	444,139
Million USD	20,808	24,552	26,794	26,989	29,538	
GDP per Sector:						
Agriculture, Forestry & Fishing, %	27.18	27.76	25.77	25.78	25.43	24.30
Industry & Construction, %	28.76	29.73	32.08	32.49	34.49	36.61
Service, %	44.06	42.51	42.15	41.73	40.08	39.09

¹ at current prices

Source: Vietnam Statistical Yearbook, Hanoi 1996,1997,1998,1999, 2000,2001.

TABLE 6. THE EXPORT AND IMPORT OF GOODS

Parameters	1995	1996	1997	1998	1999	2000
Export, million USD	5,448.9	7,255.9	9,185.0	9,361.0	11,523.0	14,308
Import, million USD	8,155.4	11,143.6	11,592.3	11,527.0	11,636.0	15,200
Balance	-2,706.5	-3,887.7	-2,047.3	-2,166.0	-113.0	- 892

Source: Vietnam Statistical Yearbook, Hanoi 1996,1997,1998,1999, 2000,2001.

1.3. Energy Situation

The overall Vietnamese energy reserves are given in Table 7.

TABLE 7. ESTIMATED ENERGY RESERVES

	Estimated energy reserves in 1999 (Exajoule)					
	Solid	Liquid	Gas	Uranium (1)	Hydro (2)	Total
Total amount in place	4.40	3.44	6.95	0.71	28.92	44.42

(1) This total represents essentially recoverable reserves.

(2) For comparison purposes a rough attempt is made to convert hydro capacity to energy by multiplying the gross theoretical annual capability (World Energy Council - 2002) by a factor of 10.

Source: IAEA Energy and Economic Data Base.

1.3.1. Coal

Coal reserves in Vietnam are concentrated in the northern part, especially in the Quang Ninh province. Total reserves of anthracite and semi-anthracite to a depth of 1,000 meters are said to be 6.6 billion tons, in which the total of surveyed reserves to a depth of 300 meters are 3.1 billion tons. There are other coal reserves besides anthracite: 11.8 million tons of bituminous and 244.1 million tons of lignite and semi-bituminous are surveyed reserves. The production comes from 3 coal companies: Uong Bi Coal Company (Vang Danh, Mao Khe, Trang Bach), Hon Gai Coal Company and Cam Pha Coal Company (Khe Tam, Dong Bac). Data of the past 5 years of coal production and coal use is given in Table 8 and the projected coal- production in Table9.

TABLE 8. COAL PRODUCTION AND COAL USE

Parameters	1995	1996	1997	1998	1999	2000
Coal prod., million tons	8.35	9.80	11.40	11.40	9.40	10.86
Coal Export., million tons	2.80	3.70	3.60	3.20	3.30	3.04
Domestic use, million tons	4.84	6.10	7.30	7.88	6.72	7.82

Source: Vietnam Statistical Yearbook, Hanoi 1996,1997,1998,1999, 2000,2001.

TABLE 9. PROJECTED COAL PRODUCTION AND CONSUMPTION

Parameters	2000	2010	2020
Projected-coal production, million tons	11.00	15 -17	18 -20
Demand for elect. prod., million tons	3	8-10	15-17
Demand for Exp. & other, million tons	7	5-6	11-12

1.3.2. Oil, Gas & Petroleum products

Exploration of oil and gas in Vietnam has been carried out since 1959. The potential reserves of oil & gas are estimated to be 4.8 billion m³ oil equivalent, which are mainly offshore located. By the end of 1999, the discovered reserves of oil & gas were 1.1 billion m³ oil equivalent, of which oil was 430 million tons and gas 620 billion m³. In the past period, the crude oil production has increased remarkably. Up to now, the total amount of crude oil production is more than 100 million tons. At the present time, almost all crude oil is exported, while the domestic demand in petroleum products is met by import. A refinery with a capacity of 6.5 million tons/year is now under construction and will be put into operation in 2004. Currently, the off shore associated gas pipeline supplied 1.5 billions m³ for

electricity generation. The past 5 years of oil & gas production is given in Table 10. The projected oil & gas production is given in Table 11.

TABLE 10. OIL & GAS PRODUCTION

Parameters	1995	1996	1997	1998	1999	2000
Crude oil, million tons	7.70	8.35	10.30	12.20	15.47	16.27
Natural gas, billion m ³	0.23	0.36	0.66	1.00	1.24	n.a
Imported petr. products, million tons	4.82	5.74	6.08	6.67	7.28	8.59

Source: Vietnam Statistical Yearbook, Hanoi 1996,1997,1998,1999, 2000,2001.

TABLE 11. PROJECTED OIL & GAS PRODUCTION

Parameters	2000	2010	2020
Projected-oil production, million tons	16.50	23-25	25-30
Projected-gas production, billion m ³	1.50	12-15	17-20
Import petroleum products, million tons	8.20	3.86	9.70

1.3.3. Hydro power potential

The total technical reserves for hydroelectric power on the ten principle rivers of Vietnam are estimated at 17-18,000 MW with an annual electricity output of 82 TW·h. The total technical potential is based on a study made some ten years ago and currently it is unlikely to be achievable due to environmental problems. More recent estimations suggest that the total exploitable electricity from hydropower will not exceed 50-55 TW·h with a total capacity of around 12,000 MW. 'Usually, the hydropower electricity fraction is in the summer rather high (about 55%), however, during the summer of 1998 there was an insufficient electricity supply caused by lack of water in the hydropower reservoirs. Based on this experience, the Government of Vietnam has implemented several measurements. The share of electricity from hydro power plants will decrease in the future. The projected electricity production for 2010 is about 25-30 TW·h and for 2020 about 50 -55 TW·h.

1.3.4. Uranium

Currently, there is no nuclear power in Vietnam. Uranium ore has been found in the northern and central regions of Vietnam. These uranium deposits have been estimated to hold about 210 thousand tons of U₃O₈, with a low average uranium oxide content of 0.06%.

1.3.5. New and Renewable Energy

Geothermal Energy

There is a potential for geothermal energy in Vietnam since it has more than 300 hot-water areas, with a surface water temperatures ranging from 30°C to 105°C. Recently, an American company, ORMAT, carried out a study at 60 hot-water areas and has chosen 6 sites, mostly in the central and south regions of Vietnam, for installations of geothermal plants with a total capacity of about 200 MW.

Solar Energy

Vietnam is a tropical country with an average sunlight of 2000 to 2500 hours per year and a total average solar radiation of 100 to 175 kcal/cm² per year. Currently, some solar cells have been used to provide power for light residential uses, in isolated rural areas which are not yet connected to the electrical grid. The cost of importing solar cells is high, thus prevents any further plan to expand the programme.

Wind Energy

Vietnam has small scale experiments to explore the option of wind energy. Recently, the government of Vietnam has approved a BOT project for wind energy in the province of Khanh Hoa. The approved capacity is 10 MW, with a plan to increase it to 20 MW.

Biomass

Biomass resources in Vietnam include wood and agriculture wastes and are estimated to be about 43 to 46 million tons of oil equivalent energy. The respective shares for wood and agriculture wastes are about 60% and 40%, respectively. The potential biomass energy is estimated to be about 0.4 million tons of oil equivalent energy. Although the resources are significant, there are environmental concerns with using wood products for electricity generating. At this point, there is not a great potential to explore biomass energy.

1.3.6. Energy

The Vietnamese basic energy situation is given in Table 12.

TABLE 12. ENERGY STATISTICS^(*)

	1960	1970	1980	1990	2000	2001	Average annual growth rate (%)	
							1960 To 1980	1980 To 2001
Energy consumption								
- Total (1)	0.02	0.53	0.40	0.57	1.01	1.04	15.77	4.66
- Solids (2)		0.23	0.33	0.39	0.49	0.46	32.79	1.60
- Liquids	0.02	0.29	0.05	0.13	0.32	0.33	5.07	9.04
- Gases					0.06	0.10		
- Primary electricity (3)		0.01	0.01	0.05	0.14	0.14	29.90	12.20
Energy production								
- Total		0.25	0.36	0.57	1.41	1.39	35.21	6.68
- Solids		0.24	0.35	0.40	0.57	0.53	35.52	2.02
- Liquids				0.11	0.66	0.67		
- Gases					0.05	0.05		
- Primary electricity (3)		0.01	0.01	0.05	0.14	0.14	29.90	12.20
Net import (Import - Export)								
- Total	0.02	0.28	0.04	0.00	-0.48	-0.57	3.24	-13.58
- Solids	0.00	-0.01	-0.01	-0.02	-0.10	-0.11	-20.46	10.05
- Liquids	0.02	0.29	0.05	0.02	-0.38	-0.46	4.95	-10.80
- Gases								

(1) Energy consumption = Primary energy consumption + Net import (Import - Export) of secondary energy.

(2) Solid fuels include coal, lignite and commercial wood.

(3) Primary electricity = Hydro + Geothermal + Nuclear + Wind.

(*) Energy values are in Exajoule except where indicated.

Source: IAEA Energy and Economic Database.

1.4. Energy Policy

The point of view of Vietnam is to consider a macro economic and long-term energy programme. The energy sector has great inertia (slow evolution in conception, long time of construction) and exerts a great influence on several other sectors (science, technology, economics, society, etc.), so the energy planning must be a long-term programme and based on macro economics (with account of external costs).

Vietnam possesses reserves of oil and gas, but oil is not considered for electricity production. Gas can supply approximately 40 billion kW·h and it is important to notice that once thermal plants are operating, gas must be supplied for about 30 to 35 years (life-time of thermal plants). Gas and oil

will be exhausted, besides these natural resources are precious and worth to be conserved for industry and chemistry. The discovery of new oil and gas reserves can delay slightly the introduction of nuclear power but doesn't change the picture.

2. ELECTRICITY SECTOR

2.1. Structure of the Electricity Sector

Electricity of Vietnam (EVN) is the unique state-owned electricity utility in Vietnam operating under management of the government. Electricity supply regime is divided according to the regions: northern, central, and southern. Supply system operation and management responsibilities in each region are Northern Elect. Co., Central Elect. Co., Southern Elect. Co., Hanoi Elect. Co., and Ho Chi Minh Elect. Co. The electric demand/supply conditions differ substantially between them. In Vietnam, there are substantial regional differences in energy endowments and in the patterns of energy consumption. The North has an excess of hydro and coal-fired power resources, and power surplus is now being transported to the Centre and the South over a high-voltage transmission line at 500 kV with a length of about 1,500 km. This transmission line effectively interconnects the electric systems of the three regions of the country

In short, during the last decade (1986-1995), in comparison with other economic sectors, the power sector was given higher priority and it had achieved profound progresses. The power system was nationally integrated with the presence in production of relatively big thermal and hydroelectric power plants. The level of electrification has been step by step expanded not only in urban but also in rural and to some extent in mountainous and highland areas.

2.2. Decision Making Process

Recognizing the extremely important role of energy, particularly electric power in national economic development, to meet the fast growing energy demand of the country, and in order to successfully perform industrialization and modernization policy, the Government of Vietnam has paid special attention to developing the national energy supply system. Every 5 year, VN Government establishes different projects and R&D programme on energy and electricity planning. There are different energy planning organizations take part in these projects and R&D programme. In general, the Ministry of Industry (MOI) is responsible for performing different projects, such as Master plans for developing of Electricity, Coal, Oil & Gas. The Ministry of Science, Technology and Environment (MOSTE) is responsible for performing National R&D programme on energy and electricity planning.

At the present time, the Vietnam Government has launched at MOSTE the National R&D programme on energy and electricity planning KHCN-09: "Strategy and Policy for Energy Sustainable Development", 1996-2000. There are different energy planning organizations take part on this programme, among them:

1. Nuclear Power Centre (NPC), Vietnam Atomic Energy Commission (VAEC) - MOSTE
2. Institute of Energy (IE), Electricity of Vietnam (EVN) - MOI.
3. Hanoi Technical University (HTU), Ministry of Education & Training (MET).
4. Institute of Coal (IC) Vietnam Coal Corporation (VNCOAL) - MOI.
5. Institute of Oil & Gas (I of O&G), Vietnam Petrol & Gas Corporation (PETROVN).
6. Energy Department (ED), National Centre of Natural Science & Technology (NCNST).
7. Development Strategy Institute (DSI), Ministry of Planning & Investment (MPI).

In order to successfully perform energy planning studies, the energy planning organizations have used different energy planning tools, such as ENPEP (mainly MAED, WASP & IMPACTS), MEDEES, EFOM, ETB etc.

2.3. Main Indicators

Presently, the hydro power plants are still predominant in the electricity system of Vietnam, not only in installed capacity, but also in the generation terms. By the end of 1999, the total installed capacity of the electricity generating system was 5,705 MW, of which 50% was hydropower, and the total electric generation was 23,739 GW·h, of which 59% was hydropower. The structure of the generating mix is given in Table 13 and Figure 2.

TABLE 13. THE STRUCTURE OF THE GENERATING MIX

Type of plants	Capacity, MW	Share, %	Electricity, GW·h	Share, %
1. Hydro	2,854	50.02	13,937	58.7
2. Thermal	1,218	21.35	5,386	22.7
3. Gas Turbine	1,174	20.58	4,274	18.0
4. Diesel	459	8.05	142	0.60
Total	5,705	100	23,739	100%

Source: Vietnam Energy Database, Final Report of KHCN-09, Hanoi, May 2000, (in Vietnamese).

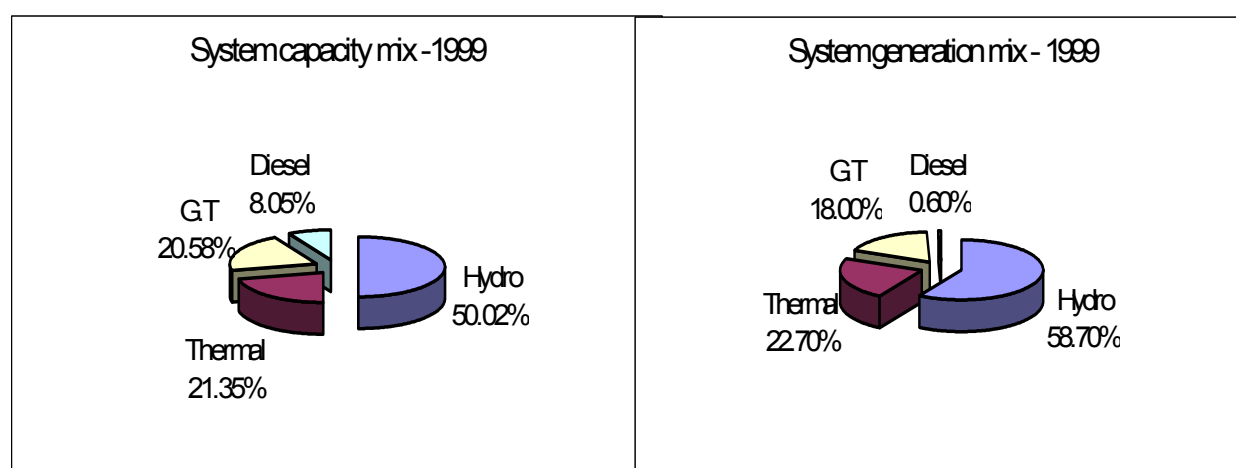


FIG. 2. The structure of the generating mix

The structure of the electricity generation and consumption over the past 5 years is given in Tables 14 and 15 and the EEDB statistics and energy related ratios in Tables 16 and 17.

TABLE 14. THE STRUCTURE OF ELECTRICITY GENERATION

Structure	1995	1996	1997	1998	1999	2000
Total production, GW·h	14636	16960	19151	21654	23739	26600
Hydro, %	72.3	70.5	61.0	51.0	58.7	54.7
Thermal, %	20.0	19.4	22.6	22.0	22.7	22.3
GT & Diesel, %	7.7	10.1	16.4	27.0	18.6	23.0
Total system loss, %	21.7	19.3	18.2	16.1	15.8	15.0

Source: Vietnam Energy Database, Final Report of KHCN-09, Hanoi, May 2000, (in Vietnamese). Institute of Energy Report – 2001

TABLE 15. THE STRUCTURE OF ELECTRICITY CONSUMPTION

Structure	1995	1996	1997	1998	1999	2000
Industry,%	41.2	40.3	39.2	38.5	38.7	40.6
Agriculture,%	5.6	4.8	4.5	4.0	3.0	2.0
Household, service,%	44.1	45.4	47.2	49.9	51.1	49.0
Other,%	9.1	8.2	7.9	7.8	7.2	8.5

Source: Vietnam Energy Database, Final Report of KHCN-09, Hanoi, May 200, (in Vietnamese). Institute of Energy Report - 2001

TABLE 16. ELECTRICITY PRODUCTION AND INSTALLED CAPACITY

	1960	1970	1980	1990	2000	2001	Average annual growth rate (%)	
							1960 To 1980	1980 To 2001
Electricity production (TW.h)								
- Total (1)	0.44	2.12	4.21	8.72	26.68	30.80	8.11	7.23
- Thermal	0.43	1.51	2.90	3.35	12.02	11.80	7.42	5.77
- Hydro	0.01	0.62	1.20	5.37	14.00	18.33	9.83	8.35
- Nuclear								
- Geothermal			0.11		0.66	0.67		6.84
Capacity of electrical plants (GWe)								
- Total	0.13	0.56	1.19	2.13	6.12	8.75	8.03	7.24
- Thermal	0.12	0.40	0.89	1.40	2.77	4.41	7.62	6.33
- Hydro		0.16	0.25	0.68	3.28	4.27		8.47
- Nuclear								
- Geothermal			0.05	0.05	0.07	0.07		1.59
- Wind								

(1) Electricity losses are not deducted.

(*) Energy values are in Exajoule except where indicated.

Source: IAEA Energy and Economic Database, Country Information.

TABLE 17. ENERGY RELATED RATIOS

	1960	1970	1980	1990	2000	2001
Energy consumption per capita (GJ/capita)	1	12	8	9	13	13
Electricity per capita (kW.h/capita)	13	49	74	126	344	392
Electricity production/Energy production (%)		8	11	15	17	17
Nuclear/Total electricity (%)						
Ratio of external dependency (%) (1)	98	53	10	-1	-47	-55
Load factor of electricity plants						
- Total (%)	40	43	41	47	54	54
- Thermal	41	43	37	27	53	53
- Hydro	20	43	55	91	54	54
- Nuclear						

(1) Net import / Total energy consumption.

Source: IAEA Energy and Economic Database, Country Information.

3. NUCLEAR POWER SITUATION

3.1. Historical Development

The introduction of nuclear power in the country needs preliminary studies. The following institutions are responsible for these preliminary studies:

- Institute of Energy (IE), Electricity of Vietnam (EVN), Ministry of Industry (MOI).
- Nuclear Power Centre (NPC), Institute of Nuclear Science & Technology (INST), Vietnam Atomic Energy Commission (VAEC).

The past activities in Nuclear Power Planning Study of these Institutions are as follow:

1. In the years 1980-1985, Institute of Energy (IE) elaborated a preliminary nuclear power planning study in the spirit of command economy and centralized management. The results so obtained by the IE are now out of date and could not serve for an Energy and Nuclear Power Planning.
2. The TC Project VIE/0/004 "Preparatory studies for a nuclear power project" (1/1987-7/1989) was implemented by VAEC in unfavourable situation (i.e. after the Chernobyl accident which aggravated the economic conditions in Vietnam). Although completed, this project has not yet given definitive results.
3. In the years 1992-1995, the preliminary study was carried out in the frame of the National Project KC-09-17: "Study on the viability of the introduction of the Nuclear Power in Vietnam". The main responsible for this project was NPC, INST, VAEC. The major conclusion of this study is as follow: "Around the year 2015, when electricity demand more than 100 billion kW·h, the nuclear power should be introduced for satisfying the continuously growth in the country's electricity demand in that time and beyond". This preliminary study result should be confirmed by energy-planners & decision-makers of all energy-responsible organizations in VN and by an IAEA experts team.

3.2. Status and Trends of Nuclear Power

At the present time, the Vietnam Government has created different projects aimed to broader and more basically consideration of nuclear power option. These projects are as follows:

1. The National Industrial Project: "General survey studies for the introduction of Nuclear power into Vietnam", sponsored by Ministry of Industry. The Institute of Energy, the Electricity of Vietnam and the Vietnam Atomic Energy Commission are the main responsible for this project. This project is being carried out in three years: 1996-1999. The scope of this project includes two main tasks:
 - The non-site studies, covering electricity expansion long-term planning, economics of nuclear power and financing, technical and safety aspects, the fuel cycle and waste management;
 - Site and environmental studies, covering preliminary site selection and environmental impacts.
2. In the framework of National R&D programme on "Strategy and Policy for Energy sustainable development", 1996-1999. There are different energy planning organizations take part on this programme, among them, the VAEC is responsible for R&D Project KHCN-09-04: "Establishment the fundamental basis for the introduction of nuclear power into Vietnam", with following objectives:
 - To analysis of nuclear power role in long-term energy supply system; and
 - To promote the national R&D infrastructure for future nuclear power programme.

3. To assist Vietnamese experts in performing energy and nuclear power planning activities, under the framework of IAEA Technical Cooperation programmes, the TC Project: VIE/0/009 "Pre-feasibility study for the introduction of Nuclear Power Plant into Vietnam" is ongoing. This TC project begins in March 1997 and is planned to finish in the end of 1999. It concentrates on following two aspects:
 - Energy and Nuclear Power Planning, using IAEA planning tool, such as ENPEP, MAED, WASP, IMPACTS;
 - Technology, safety of Nuclear Power plants and infrastructure requirements for Nuclear Power implementation.

In the framework of Bilateral Cooperation, in recent years, Vietnam has received the very useful assistance from different rich-experienced countries, such as Japan, Canada, Korea, India, France and others.

3.3. Current Policy Issues

After the completion of the above-mentioned Projects, the Vietnam Government will have overall arguments related to the possibility of the introduction of Nuclear Power. There are some major arguments for nuclear power consideration:

- The country's balance of energy demand and supply resources;
- The security of energy supply and diversity of energy sources;
- The economical availability;
- The nuclear safety and radioactive wastes management;
- The environmental impacts - sustainable development.

The studies project demand for electric power up to 2020 based on three assumed growth rates of GDP. Based on medium (base) growth rate, the present installed capacity of about 6200 MW (Hydro 53%, Coal 20% and Gas/Oil 27%) is required to reach 33000 MW by the year 2020. On the other hand for high growth rate the requirement in 2020 will be 38000 MW. The study concludes that to meet these requirements, the first Nuclear power plant will have to be introduced between 2017 to 2019 depending on the growth rate achieved. This will call for a nuclear installed capacity of 1200 to 4000 MW in 2020.

Projects on Pre-feasibility studies: 2002-2004

- May 2001, Prime Minister assigned MOI in collaboration with MOSTE to carry out a *Pre-feasibility study* for the first NPP construction in VN;
- June 2001, *Master Plan* on Electric Power Expansion (2000-2010) with vision to 2020 including consideration of NPP's construction around 2020 was approved by Prime Minister;
- March 2002, The Steering Committee for Nuclear Power was established by Prime Minister. The Committee is composed of two main ministries MOI and MOSTE and some other members from various ministries. Main responsibilities of Committee are:
 - Establish National strategy and long term programme for nuclear development , in charge by MOSTE, VAEC
 - Study on Pre-feasibility for first NPP, in charge by MOI
 The Committee have to submit his result by the end of 2003 to the Prime Minister then NA for consideration.

Based on national energy resources and energy demand/supply balance, the priority in electricity expansion development plan in the future is as follows:

- Hydro power plants;
- Gas-fired power plants in the South;
- Coal-fired plants in the North;
- Import electricity from neighbouring countries;

- Import ed- coal -fired plants in the North;
- Active preparation for the introduction of Nuclear power plants after 2015.

3.4. Organizational Chart(s)

Many ministries are involved in nuclear safety related matters, emergency planning, development of programmes and their financing, control of export/import, transportation, etc. mainly from a radiation safety point of view. Most of the tasks have to be performed in co-operation with the MOSTE (Minister of Science, Technology and Environment). The Ministry of Industry, which will in future play a crucial role in establishing nuclear power plants is not covered yet by the existing legislation. At present, MOSTE is the senior governmental body in regulating nuclear safety matters. In accordance with the Law on Environmental Protection and the Decree No.175, the Minister of MOSTE is the country's chief regulator. Under MOSTE, there are several agencies performing mainly advisory function for the Minister. A simplified organizational chart of MOSTE is shown in Figure 3

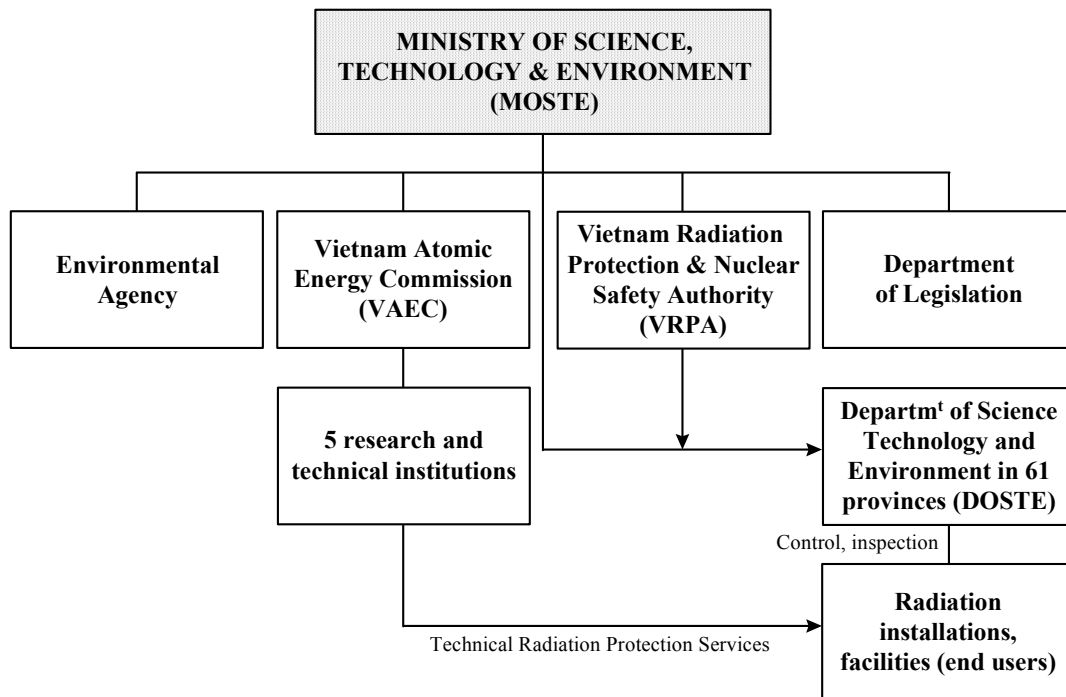


FIG. 3. Simplified Organizational Chart of MOSTE

4. NUCLEAR POWER INDUSTRY

4.1 Supply of NPPs

Not applicable.

4.2. Operation of NPPs

Not applicable.

4.3. Fuel Cycle, Spent Fuel and Waste Management Service Supply

Not applicable.

4.4. Research and Development Activities

One of the agencies under MOSTE is the Vietnam Atomic Energy Commission (VAEC). The VAEC was established in April 1976 and up to April 1994 it was controlled under the Prime Minister's office. In April 1994, VAEC was reorganized and put under MOSTE. As shown in Figure 4, the VAEC comprises five main institutions. These are:

1. Nuclear Research Institute in the Dalat City (NRI, Dalat);
2. Centre for Nuclear Techniques in the Ho Chi Minh City (CNT, HCM);
3. Irradiation Centre in the Ho Chi Minh City;
4. Institute of Nuclear Science and Techniques in Hanoi (INST, Hanoi);
5. Institute for Technology of Radioactive and Rare Elements in Hanoi (ITRE, Hanoi).

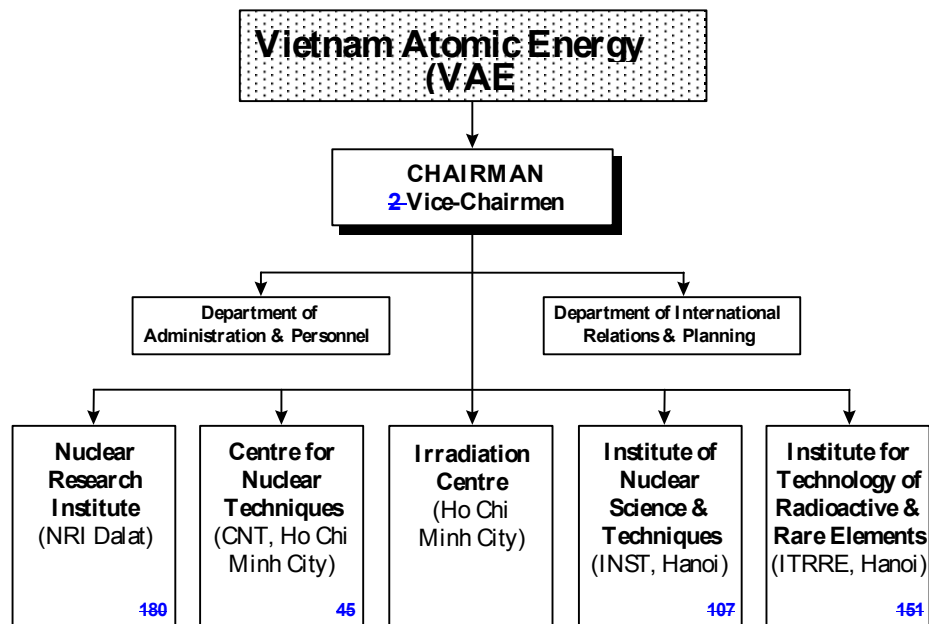


FIG. 4. Organization of the Vietnam Atomic Energy Commission

VAEC represents manpower of nearly 600 people; two thirds of them are scientists. At present, VAEC:

1. serves as an advisory body to the government in developing strategy of the nuclear programme;
 2. performs research, development and transfer of nuclear techniques to end users;
 3. carries out technical services in radiation protection for research and application of nuclear techniques in VAEC and outside;
 4. co-operates with VRPA in preparation of regulations for the nuclear field;
 5. develops human resources for the Vietnam nuclear programme;
- performs implementation of the international co-operation in the nuclear field.

4.5. International Co-operation in the Field of Nuclear Power Development and Implementation

Brief description of research and development activities carried out jointly with other countries and/or within the framework of international projects, technical and industrial co-operation, transfer of know-how and technology.

5. REGULATORY FRAMEWORK

5.1. Safety Authority and the Licensing Process

The Vietnam Radiation Protection and Nuclear Safety Authority (VRPA) was established in 1994 by a Decision of the Prime Minister to assist the MOSTE in the state management of radiation protection and nuclear safety.

The authority of the regulatory body is described in the “Ordinance on Radiation Safety and Control” and includes the normal functions expected of a Regulatory Body but is heavily biased towards the regulation of radiation protection. Although not explicitly stated in the law VRPA must give prior authorization for any activities involving the use of radioactive material or source.

The primary function of VRPA (Decision No. 159/QD-TCCB of March 4, 1995 of the Minister of MOSTE) is to assist the Minister responsible for MOSTE in exercising the state management of radiation protection and nuclear safety. Its responsibilities include the following:

1. establish a National Plan of radiation protection and nuclear safety;
2. draft and submit legal documents, regulations, standards relating to radiation protection and nuclear safety;
3. to organize the system of notification, registration and licensing for radiation sources, practices, installations and workers;
4. to organize the review and approval of the radiation protection and nuclear safety aspects of sites, design and technical justification of radiation installations and works;
5. to organize the control, inspection of radiation protection and nuclear safety for radiation installations;
6. to deal with violations of radiation protection and nuclear safety provisions according to the law;
7. to organize the training and provision of information to the public, concerning radiation protection and nuclear safety;
8. to organize the development of human resources, technical equipment and facilities for ensuring the control of radiation protection and nuclear safety;
9. to organize the implementation of international treaties and conventions which Vietnam signs up to; also to organize other aspects of international co-operation.

5.2. Main National Laws and Regulations

Not applicable.

5.3. International, Multilateral and Bilateral Agreements

INTERNATIONAL AGREEMENTS

- | | | |
|--|-------------------------------------|------------------|
| • NPT related safeguards agreement INFCIRC/376. | Entry into force: | 23 February 1990 |
| • Improved procedures for designation of safeguards inspectors | Prefers to apply the present system | 19 June 1990 |
| • Supplementary agreement on provision of technical assistance by the IAEA | Entry into force: | 01 May 1983 |
| • RCA | Entry into force: | 28 August 1997 |
| • Agreement on privileges and immunities | Entry into force: | 31 July 1969 |

- | | | |
|---|-------------------|-----------------|
| • NPT | Entry into force: | 14 June 1982 |
| • Convention on physical protection of nuclear material | | Non-Party |
| • Convention on early notification of a nuclear accident | Entry into force: | 30 October 1987 |
| • Convention on assistance in the case of a nuclear accident or radiological emergency | Entry into force: | 30 October 1987 |
| • Vienna convention on civil liability for nuclear damage | Non-Party | |
| • Joint protocol | Non-Party | |
| • Protocol to amend the Vienna convention on civil liability for nuclear damage | Not signed | |
| • Convention on supplementary compensation for nuclear damage | Not signed | |
| • Convention on nuclear safety | Non-Party | |
| • Joint convention on the safety of spent fuel management and on the safety of radioactive waste management | Not signed | |
| • ZANGGER Committee | Non-Member | |
| • Nuclear Export Guidelines (INFCIRC/254) | Not adopted | |
| • Acceptance of NUSS Codes | No reply | |
| • Nuclear Suppliers Group | Non-Member | |

BILATERAL AGREEMENTS

- | | |
|--|----------------|
| • Agreement between the government of the Socialist Republic of Vietnam and the government of the Republic of India for the co-operation for utilization of atomic energy for peaceful purposes. | signed in 1986 |
| • Agreement between the government of the Republic of Korea and the government of the Socialist Republic of Vietnam for the co-operation in the peaceful uses of nuclear energy. | signed in 1996 |
| • Agreement for co-operation between Vietnam Atomic Energy Commission (VAEC) and Korea Electric Power Corporation. | signed in 1995 |
| • Co-operation agreement on peaceful uses of advanced nuclear technology between Vietnam Atomic Energy Commission (VAEC) and the French Atomic Energy Commission (CEA). | signed in 1996 |
| • Co-operation agreement between Vietnam Atomic Energy Commission (VAEC) and Atomic Energy of Canada Limited (AECL). | signed in 1997 |

REFERENCES

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- [2] Institute of Energy, EVN, internal reports, Hanoi 1999,2000, 2001(in Vietnamese).
- [3] Nuclear Power Centre, INST, VAEC, internal reports of KHCN-09-4 and VIE/0/009, Hanoi 1998,1999.
- [4] N.T. Nguyen, L.V. Hong, N.M. Hien, Electricity and Nuclear Power Planning Study in Vietnam. INST-VAEC report, 2001.
- [5] Framework of "Strategy and Policy for Energy sustainable development", Final Report of KHCN-09, Hanoi, April 2001, (in Vietnamese).
- [6] Vietnam Energy Database, Final Report of KHCN-09, Hanoi, April 2001, (in Vietnamese).
- [7] IAEA Energy and Economic Data Base.
- [8] Data & Statistics, the World Bank, www.worldbank.org/data.

Appendix

DIRECTORY OF THE MAIN ORGANIZATIONS, INSTITUTIONS AND COMPANIES INVOLVED IN NUCLEAR POWER RELATED ACTIVITIES

NUCLEAR ENERGY AUTHORITY

Vietnam Atomic Energy Commission
59 Ly Thuong Kiet
Hanoi, Vietnam

Tel: 844 9423479
Fax: 844 9424133
<http://www.vaec.gov.vn/>

Ministry of Science, Technology
and Environment
39, Tran Hung Dao Street
Hanoi

OTHER ORGANIZATIONS

Institute for Nuclear Science
and Technique (INST)
No 5T-160, Hoang Quoc Viet
Ha Noi, Viet Nam

Tel: (844)8361432
Fax: (844)8363295
<http://www.vaec.gov.vn/VienKHKTHN/Eng/>

Nuclear Research Institute (NRI)
No.1, Nguyen Tu Luc
Dalati, Viet Nam

Tel: (8463)822191
Fax: (8463)821107
<http://www.vaec.gov.vn/NRI/content.htm>

Centre for Nuclear Techniques (CNT)
Ho Chi Minh City
No.217, Nguyen Trai
Tp. Ho Chi Minh, Viet Nam

Tel: (848)8356568
Fax: (848)8367381

Institute for Technology of Radioactive
and Rare Elements (ITRE)
No.48, Lang Ha
Ha Noi, Viet Nam

Tel: (844)7760340
Fax: (844)8350966

Vietnam Information for Science
and Technology Advance

<http://www.vista.gov.vn/TestEnglish/main.htm>

RCA (Regional Co-operative Agreement)
Vietnam

<http://www.vaec.gov.vn/~rca/>