

Ministry of Industry and Trade
Socialist Republic of Viet Nam

**The Study on National Energy Master Plan
in Viet Nam**

**Final Report
(Main Report)**

September 2008

JAPAN INTERNATIONAL COOPERATION AGENCY

**THE INSTITUTE OF ENERGY ECONOMICS, JAPAN
TOKYO ELECTRIC POWER COMPANY**

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PREFACE

In response to a request from the Government of Socialist Republic of Vietnam, the Government of Japan accepted to carry out the Study on National Energy Master Plan of Vietnam. The study was implemented by the Japan International Cooperation Agency (JICA).

From December 2006 to September 2008, JICA dispatched to Vietnam six times a study team led by Mr. Kensuke Kanekiyo of the Institute of Energy Economics, Japan (IEEJ). During staying in Vietnam, the team consisting of member from IEEJ and the Tokyo Electric Power Company, conducted related field surveys and held discussions with the officials concerned of the Government of Socialist Republic of Vietnam. While in Japan, the team conducted further studies, the result of which they compiled in this final report.

It is our wish that this report will contribute to devise the optimum strategy for the Development of Energy Industry in Socialist Republic of Vietnam and at the same time to enhance the relationship between both countries.

I express my sincere appreciation to the officials concerned of the Government of Socialist Republic of Vietnam for their close cooperation in conducting the study.

September 2008

Seiichi NAGATSUKA
Vice President
Japan International Cooperation Agency

September 2008

Mr. Seichi Nagatsuka
Vice President
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Letter of Transmittal

We are pleased to submit to you the Final Report of the Study on National Energy Master Plan of Vietnam. Under the contract with your esteemed organization, the subject study was carried out during 22-month period from December 2006.

With due consideration of the current situation of energy supply and demand, and also of related law, rules and regulations in Vietnam, the present study has been conducted to determine a comprehensive and long-term energy master plan that enables the Ministry of Trade and Industry (MOIT) to promote utilization of energy continuously after the completion of the study.

In the process of conducting the study, technical transfer to MOIT's officers by means of on-the-job training has been conducted constantly. The result of this technical transfer has been strengthened by occasional workshops attended by people from related government institutions and industry participants as well as MOIT.

This report is compiled an action plan showing a twenty-year program for construction of energy supply facilities, investment and financing, development of human resources and policy measures to promote energy utilization. Those comments by officials from MOIT have been taken into consideration occasionally in making the master plan, and are reflected in the contents of the report.

We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs, and Ministry of Economy, Trade and Industry. We also wish to express our deepest gratitude to the Ministry of Trade and Industry (MOIT), the Embassy of Japan in Socialist Republic of Vietnam and the JICA Vietnam office for the close cooperation and assistance extended to us during the period.

Very truly yours,

Kensuke Kanekiyo
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Abbreviation

ACE	ASEAN Centre for Energy
APEC	Asia-Pacific Economic Cooperation
APP	Asia-Pacific Partnership
ASEAN	Association of South-East Asian Nations
AUSAID	Australian Agency for International Development
BAU	Business as Usual
BCC	Business Cooperation Contract
BOT	Build-Operate-Transfer
BPD (BD)	Barrel per Day
BTX	Benzene Toluene Xylene
CAN	CDM National Authority
CCR	Continuous Catalytic Reforming
CCT	Clean Coal Technology
CDM	Clean Development Mechanism
CERs	Certified Emission Reductions
CFBC	Circulating Fluidized Bed Combustion
CNECB	CDM National Executive and Consultative Board
CNG	Compressed Natural Gas
COP	Conference of Parties
CSV	Comma Separated Value
CTBT	Comprehensive nuclear test ban treaty
DME	Di-Methyl-Ether
DNA	Designated National Authority
DSM	Demand Side Management
DWT	Dead Weight Tonnage
EEC	Energy Efficiency and Conservation
EPC	Engineering Procurement Construction
ERAV	Electricity Regulatory Authority of Vietnam
ESC	Environmental and Social Considerations
ESCO	Energy Service Company
ESI	Environmental and Social Impacts
EVN	Electricity of Vietnam
F/S	Feasibility Study
FDI	Foreign Direct Investment
GAMS	General Algebraic Modelling System
GHG	Green House Gas
GMS	Greater Mekong Sub-region

GSO	General Statistics Office
GTL	Gas-to-Liquid
ICD	International Cooperation Department
IE	Institute of Energy
IEA	International Energy Agency
IEEJ	The Institute of Energy Economics, Japan
IGCC	Integrated Gasification Combined Cycle
IPE	International Petroleum Exchange
IPO	Initial Public Offering
IPP	Independent Power Producer
JICA	Japan International Cooperation Agency
JOC	Joint Operating Contract
JODI	Joint Oil Data Initiative
JV	Joint Ventures
LCO	Light Cycle Oil
LP	Linear Programming
MARD	Ministry of Agriculture and Rural Development
MEPS	Minimum Energy Performance Standard
MOC	Ministry of Construction
MOI	Ministry of Industry
MOIT	Ministry of Industry and Trade
MONRE	Ministry of Natural Resources and Environment
MOST	Ministry of Science and Technology
MOT	Ministry of Transportation
MPI	Ministry of Planning and Investment
NBP	National Balancing Point
NEDO	The New Energy and Industrial Technology Development Organization
NGO	Non-Governmental Organization
NPT	Nuclear Non-Proliferation Treaty
NYMEX	New York Mercantile Exchange
ODA	Official Development Assistance
OLADE	Organizacion Latinoamericana de Energia
OPEC	Organization of Petroleum Exporting Countries
PCI	Pulverized Coal Injection
PDD	Project Design Document
PDP	Power Development Plan
PDPAT	Power Development Planning Assist Tool
PIN	Project Idea Note
PPA	Power Purchase Agreement
PPP	Public Private Partnership

PSC	Product Sharing Contract
PSPP	Pumped Storage Power Plant
R/P	Reserve-production ratio
RFCC	Residue Fluid Catalytic Cracking
RPS	Renewables Portfolio Standard
SEA	Strategic Environmental Assessment
TCM	Trillion Cubic Meter
TOE	Ton Oil Equivalent
TPA	Ton per Annum
UNFCCC	United Nations Framework Convention on Climate Change
USC	Ultra Super Critical Pressure
VAT	Value Added Tax
VEM	Vietnam Environmental Monitor
VLCC	Very Large Crude Carrier
VND	Vietnam Dong
Wp	Watt peak
WTI	West Texas Intermediate
WTO	World Trade Organization

National Energy Master Plan – Its Issues and Objectives

Introduction: National Energy Master Plan – Its Issues and Objectives

1. General Overview

Among ten ASEAN countries, the Socialist Republic of Viet Nam (hereinafter called as “Vietnam”), spreading over 300,000 square kilometers and having over 84 million people, is the second largest country after Indonesia in terms of population. However, its per capita GDP was US\$724 in 2006, being positioned among the late developing group of ASEAN. Its per capita energy consumption is also low at 0.3 tons in oil equivalent (toe). On the supply side, Vietnam yields various kinds of domestic energy such as coal, oil, natural gas, hydro and renewable energies, and has maintained a self-sufficient energy structure to date.

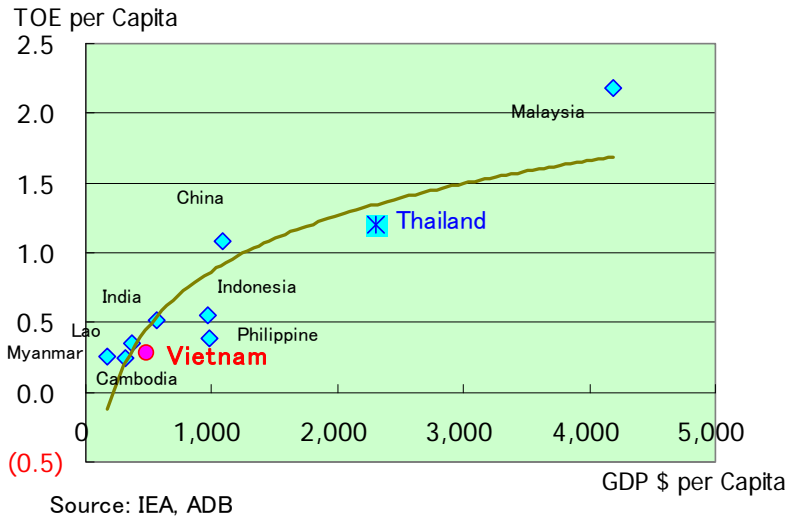


Figure 1.1 Per capita GDP and Energy Consumption of Asian Countries (2003)

Looking to 2025, the target year of the National Energy Master Plan, however, while its energy demand continues to grow to sustain the country’s socio-economic development, the signal on increase of indigenous energy supply will be turning from green to yellow. In ten years from now, Vietnam may become a net oil importing country and will also begin import of electricity and coal. The energy structure of Vietnam is going to change substantially.

While energy consumption increases along with economic growth, a long lead-time, high technology and a huge amount of funds are necessary to construct the energy supply system. For Vietnam, aiming at poverty reduction and sustainable socio-economic development, realizing secured supply, optimum distribution and rational utilization of energy are the important policy objectives. To this end, it is essential for the country to establish a comprehensive and coherent energy plan, which incorporates internal and international changes and envisages for a sufficiently long period.

In Vietnam, the Five Year Socio-economic Development Plans were set forth and used to date as the indicator for economic development. In the energy sector, organizations responsible for electric power, coal and oil & gas have set forth development plans individually and implemented energy

supply. However, these plans have had tendencies to reflect strong development aspirations of individual sectors with insufficient collaboration among them and, by no means, provided a central pillar to assure an optimized energy demand/supply plan from the viewpoint of national economy. In order to materialize sustainable economic development in the era of violent energy circumstance, the country needs a firm and powerful energy plan. It is an urgent issue to establish a comprehensive energy plan, which is positioned above the sectoral development plans aiming at optimal energy distribution and integrated and efficient use. Based on such background, possibility of formulating the National Energy Master Plan has been discussed in Vietnam, which shall envisage a certain long period such as 20 years. Thus, this Study is planned to assist its formulation.

2. Composition of the Report

In this study, we at first conducted review of the current energy status in Vietnam, preparatory work such as data collection/arrangement and supplemental energy demand survey. Then, we proceeded to construction of the demand forecasting model and the demand/supply optimization model, which will be the fundamental tools projecting the energy demand/supply outlook. Following the preparatory work, we examined energy outlook up to 2025 and compiled a draft of *the Master Plan and the Road Map* for energy policy actions. Through the foregoing study, we also conducted technology transfer and career development programs for the Vietnamese experts. These are compiled in this report in four parts as follows.

Part I Current Status of Energy Demand/Supply and Energy Policy reviews the current status of society, economy, energy and relevant policies and institutions in Vietnam.

Part II Energy Outlook to 2025 analyzes the international energy circumstance and issues on the Vietnamese energy sector, and explains the basic concept of approach and forecasted results of the long-term outlook, which will provide fundamental materials for formulating the Master Plan.

For *the Reference Case*, which stipulates the standard energy demand/supply scenario, basic assumptions are made that, through to 2025, the economic growth rate will be at annual 8.4% and the global crude oil price in real term will remain at the same level as it is now. Then, the primary energy demand is forecast to increase at annual 9.1%, growing from 28 million toe in 2005 to over 161 million toe in 2025. This is a sort of BAU (Business as usual) estimate before policy responses although it assumes moderate energy conservation. According to the outcome, per capita energy consumption in 2025 will be 1.6 toe, which is 5-fold jump from now. It is substantially higher than the trend among ASEAN countries, and the import dependence of energy supply would come close to 50% by 2025. In view of the serious progress in the BAU outlook, we decided to adopt *Reference Case* with enhanced energy conservation, where the energy consumption of Vietnam would be 10% lower in 2015 and 25% plus lower in 2025 compared with the BAU case. In the Reference case, the energy import dependence would be lowered to 31%.

We also analyzed effects of alternative scenarios and various policy options looking into variances of factors that give substantial impacts on energy and environment such as economic growth rate, energy price, energy conservation policies and domestic energy development trends, and examined

ways to strengthen responding measures against demand and supply fluctuation. At this stage, we also conducted a strategic environment assessment to provide social and environment considerations.

Part III The National Energy Master Plan is the core part of this report. Explanation is made there on the drafts of the National Energy Master Plan and the Energy Road Map, which are compiled based on the analysis made in Part II. To cope with the aforementioned demand increase trend, we propose that Vietnam should implement the fundamental energy policy, as a part of the nation's long-term strategy, with the following five principles.

- 1) To enhance efficient energy use and conservation (EE&C)
- 2) To construct reliable and efficient energy supply system
- 3) To secure necessary energy import and reinforce energy security
- 4) To reform energy sector for improved efficiency based on market principles
- 5) To establish measures to raise fund for implementation of the above policies

Part IV Energy Database, Energy Demand Model, Energy Demand/Supply Optimization Model and Technical Transfer provides explanation on these database and models, which are constructed as the tool for constructing the National Energy Master Plan.

3. Analytical Tools

In designing the analytical tools such as the database, demand forecasting model and the supply/demand optimization model, we considered the following points as the important principles.

- 1) Collection of necessary data and smooth functioning of data processing
- 2) Expression of the energy system to be incorporated into the models as accurate and simple as possible
- 3) Consistent balances among sectors and compilation of comprehensive energy table
- 4) Construction of a model to enable quantitative analysis on various scenarios and policy options

Availability of meaningful data is the first problem we encounter when we start a study on energy in developing countries. In this study, we first conducted collection and compilation of the existing data, and then conducted an energy demand survey to supplement necessary data to a least extent. Then, we constructed a database to effectively utilize them. However, data collected to date is far from sufficient and a sustainable data collection system is yet to be established.

Then, based on these data and using econometric methods, we constructed the demand forecasting model and the energy demand/supply optimization model. The energy demand forecasting model is made using the analytical software *Simple-E*, which is developed and provided by The Institute of Energy Economics, Japan (IEEJ) free of charge. This model is for conduct of regression analysis and logical aggregation of energy demand. The energy supply/demand optimization model is divided into the electric power block and the general block. For the analysis of the electric power block, the PD-PAT model developed by Tokyo Electric Company is used. For the general block, a new Supply/Demand Optimization Model was constructed as a LP model using the Linear Programming software GAMS, which is available on the market. The general block model implement optimization analysis incorporating the outcome of the PD-PAT analysis, and also produces summary report sheets

and annual energy balance tables. The combination of such sub-models is the standard configuration used by IEA for its World Energy Outlook and by IEEJ for its World/Asia Energy Outlook.

These models are by no means perfect. It is impossible to incorporate completely the development of society and economy, changes in circumstances relating to energy and so on, while it is desirable that models are as simple as possible for easy operation and maintenance. Therefore, we hope that the characteristics of the demand forecasting model and the supply/demand optimization models constructed this time should be fully understood and they will be maintained from time to time updating and reflecting socio-economic changes.

Technologies and skills on the above have been transferred to the counterparts through training courses and on-the-job training during the course of the study. These tools and their manuals are separately provided to the counterpart. We expect that, from now on, Vietnamese experts will conduct maintenance and improvement of the database and the models by themselves.

4. Objectives of the National Energy Master Plan

In compiling the National Energy Master Plan, we aim at clear and comprehensive long-term plan. To this end, it is important to keep in mind the following principles.

1) Formulation of an energy plan consistent and coherent with the objective of the Socio-economic Development Plan

2) Clear explanation of the relation between the assumptions and/or hypothesis and the outcome

3) Clear indication of priority in policy selection and project implementation

4) Draw up roadmaps clearly showing the decision-making milestone

5) Compile efficient implementation programs

In this study, the 20 years up to 2025 are divided into two phases, and the roles of the Master Plan are defined as follows.

Phase-1 (2006-2015): To provide basis for preparing plans and policies for action

Phase-2 (2016-2025): To provide basis for considering the standard path and policy options

The main objective for the first ten years will be updating and inter-sectoral coordination of the ongoing projects such as oil field construction based on the proved reserve, synchronized development of gas fields and gas fired power station, adjustment of refinery construction plan and etc. In the second ten years, however, circumstance surrounding energy may change substantially. Oil and gas reserves may change subject to result of extensive exploration. International circumstance shall change. Technology will advance. We may have wider scope for selecting policy options, economic reform, life style change and so on. It would be possible to select policies for economic reform, energy conservation and etc. from among various options. It is desirable to formulate flexible energy policies considering the differences in the background relating to the time span to be covered.

In formulating the National Energy Master Plan, the most important element we should keep in mind is the fact that our future would not be a copy of the past. The size of the Vietnamese economy will expand five fold in the coming twenty years. That is, four fifth of the Vietnamese economy in twenty years from now shall be built from now on, and it should be defined in a *Grand Design* how we should built the future society. We should note that a better Master Plan would be constructed through extensive discussion by all the stakeholders on the *grand design* of our future from the energy viewpoint.

We have compiled this report in accordance with principles stipulated above, while we still recognize that there is a big space for improvement. We sincerely hope that, with frank comments from every concerned people, the draft National Energy Master Plan and Energy Road Map proposed in this report shall be continuously reviewed and upgraded as a useful measure to contribute to the development of Vietnam.

Part 1 Current Energy Trend and Energy Policy

Chapter1 Economic Trend and Socio-Economic Development Plan

1.1 Vietnamese Economic Developments and Energy Demand

Remarkable economic development has been achieved in Vietnam through adoption of "Doi Moi (the Reform)" policy since 1986, implementing several "Socio-Economic Development Plans." In the energy field, Vietnam was also successful in domestic energy resource development by effectively introducing foreign capitals. Thus, the country changed from an energy importing to an exporting country after 1990.

According to the "Statistical Yearbook 2006" by GSO, the real term economic growth rate for the period of 1990~2005 was 7.55%/year; RGDP increased from VND 132 Trillion to VND 393 Trillion. Vietnam experienced very high economic growth rate of 8.34%/year until the "Asian Currency Crisis" in 1997. Economic growth rate temporally slowed down to 5.76% in 1998 and 4.77% in 1999. After then, its economic growth gradually recovered to high level and recorded 8.43% in 2005.

During the period of 1990-2005, Manufacturing and Mining sector recorded the highest growth rate at 11.72% among demand sectors followed by Transportation and Communication sector at 9.24%, Commerce and Trade sector at 8.42%, Service and others sector at 6.80% and "Agriculture and forestry industry" recorded the lowest growth rate at 2.76%. Judging from the sectoral economic development pattern, economic development of Vietnam has centered on the industrial sector followed by the commercial sector, while the agricultural sector was relatively stagnant and behind other sectors.

Share of the agriculture and forestry industry in the Vietnamese economy decreased from 39% in 1990 to 20% in 2005, while the manufacturing and mining industry increased its share from 23 to 40%. During the same period, transportation and communication sector increased its share from 3 to 4%, the commerce and trading sector from 13 to 16%, while the service sector decreased from 22% to 20%. As the share of transportation and communication sector is increasing gradually, it is still very small.

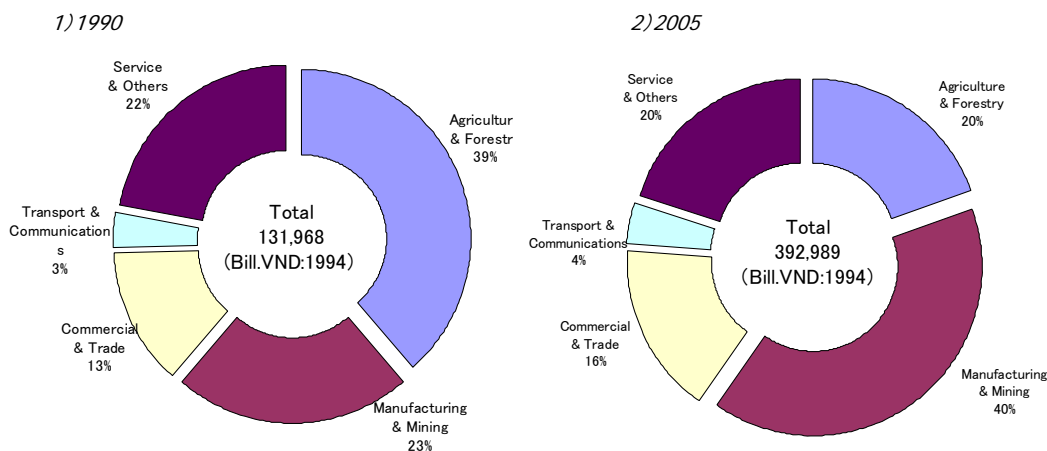


Figure 1.1-1 Economic Structural Changes(1990-2005)

Reflecting economic development and structural change, the energy demand increased from 5.275 million toe (ton oil equivalent) to 12.745 million toe during 1990-1998, with an annual growth rate of 11.6% and the GDP elasticity of energy of 1.5 (11.6/8.0). Though energy demand was affected downward during the Asian Currency Crisis in 1989, it regained afterwards and recorded even greater growth rate of annual 11.3% through 2005. The energy to GDP elasticity rose to 1.61 (1.3/7.0). Although GDP elasticity below 1.0 was seen in single year records, the growth rate of energy was largely higher than the economic growth rate for the medium term of five to ten years.

During the same period, energy consumption increased from 5.275 million toe to 28.17 million toe by five times. The energy consumption structure among industry, transportation and other sectors changed from 36:36:28 to 46:30:24. The share of industry sector expanded greatly, while the shares of transportation and other sectors declined. The rapid increase of the energy consumption reflected the vigorous development of the industry sector, while consumption increase in other sectors were relatively small. Anyway, reflecting the vigorous economic growth, every sector recorded two-digit growth of energy consumption.

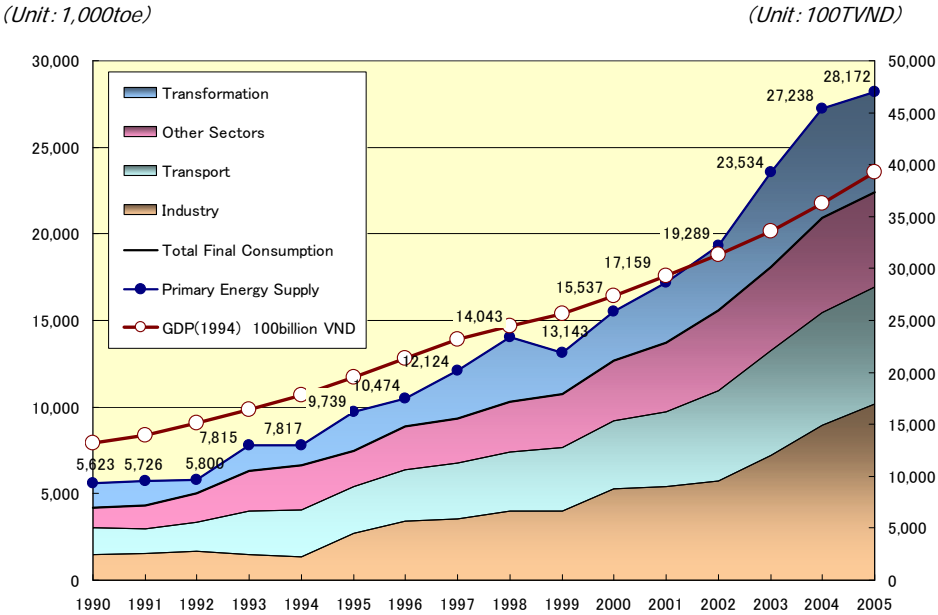


Figure 1.1-2 Economic Development and Energy Demand Trend in Vietnam

1.2 Role of Socio-Economic Development Plan and Energy

The scope of socio-economic development of Vietnam is set out in the “Socio-Economic Development Strategy” formulated every ten years and “Five-Year Socio-Economic Development Plan” formulated every five years. While the "Development Strategy" covers ten years of 2001-2010, more detailed plan was set out for the first five years and implemented as the “Five-Year Socio-Economic Development Plan: 2001-2006.” Succeeding the first five-year plan, the “Five-Year Socio-Economic Development Plan: 2006-2010” is being carried out at present as the second half plan to achieve the objectives of the “Development Strategy”.

1.2.1 Target of Socio-economic Development Strategy (2001-2010)

The Socio-Economic Development Strategy 2001-2010 set forth as its target that the national economy of Vietnam in 2010 should grow up to double of 2000. The detail targets are as follows.

- Agriculture Sector Growth rate: 4-5%, Composition: 16-17% (20% at present)
- Industry Sector Growth rate:10-15%, Composition: 40-41% (40%)
- Service Sector Growth rate:7-8%, Composition:42-43% (40%)

Comparing to the present position, the agricultural sector will reduce its share while the service sector will expand instead.

1.2.2 Five-Year Socio-Economic Development Plan (2006-2010)

The Socio-Economic Development Plan 2006-2010 finally approved by the government in 2006 was formulated considering the first half plan and results of the Socio-Economic Development Strategy. In this plan, the following numerical targets are set out.

- The economic development: The economic size in 2010 shall expand up to 2.1 times or more of 2000 and the per capita GDP shall increase to 1,050-1,100 dollars.
- Economic growth rate: 7.5-8.0% (2006-2010 years)
(Agriculture 3.0-3.2%, Industry 9.5-10.2% and Service 7.7-8.2%)
- Share of GDP: Agriculture about 16%, Industry 43-44%, and Service 40-41%
(Judging from the record for 2005, the industrial sector has overshoot the target while the service sector is in short of the target.)
- Foreign Direct Investment (FDI): 24 billion dollars

1.2.3 Socio-Economic Development Plan and Energy Policy

The Socio-Economic Development Plan consists of nine chapters. Although energy is a big issue, only some lines are spent on description of them in “Section 2 Directions of Industrial Development” in “Chapter 4 Development Orientation” of the Plan. It stipulates as follows.

Power sector:

Stable power supply: Securing supply of high quality power to 90~95% of Household and 100% of rural Community

Power Generation; 1.12TWh in 2010

Generation Capacity; 23~24GW in 2010

Creation of competitive power market

Power exchange with China, Laos, Cambodia and Thailand

Installation of Micro Hydro, Wind and Solar energy and so on in rural areas

Coal:

Securing long term coal supply

Coal production to be at 42~45 million tons in 2010 with 8~9million tons exported

Oil/Gas:

Expanding investments in exploration activities

Oil production to be 19.16 million ton and gas production 1.11 TCM in 2010

- Starting operation of the Dung Quat refinery in 2009
- Construction of the Nghi Son chemical industry and refinery
- Investment in the energy resource development overseas

Under the recognition that, beyond indication of simple guidelines as above, more comprehensive energy strategy covering longer term is necessary in order to realize the objectives of the Socio-economic Development Plan, the National Energy Policy was approved in July 2007 and formulation of the National Energy Master Plan is urged.

1.3 Energy Resource Development and Role of Foreign Investment

1.3.1 Trend of FDI Inflow

Foreign direct investment (FDI) inflow to Vietnam has recovered gradually since 1999 from the temporary set back in 1997 affected by the Asian currency crisis. We can safely say that inflow of FDI has driven the economic development of Vietnam. There are two kinds of figure on FDI; one is the registered amount of investment representing the investor’s willingness and another is the actual amount of investment. As the registered FDI amount decreased sharply after the Asian currency crisis, it has been increasing gradually since 2004 with policy support such as issuance of the Investment Law in 2004.

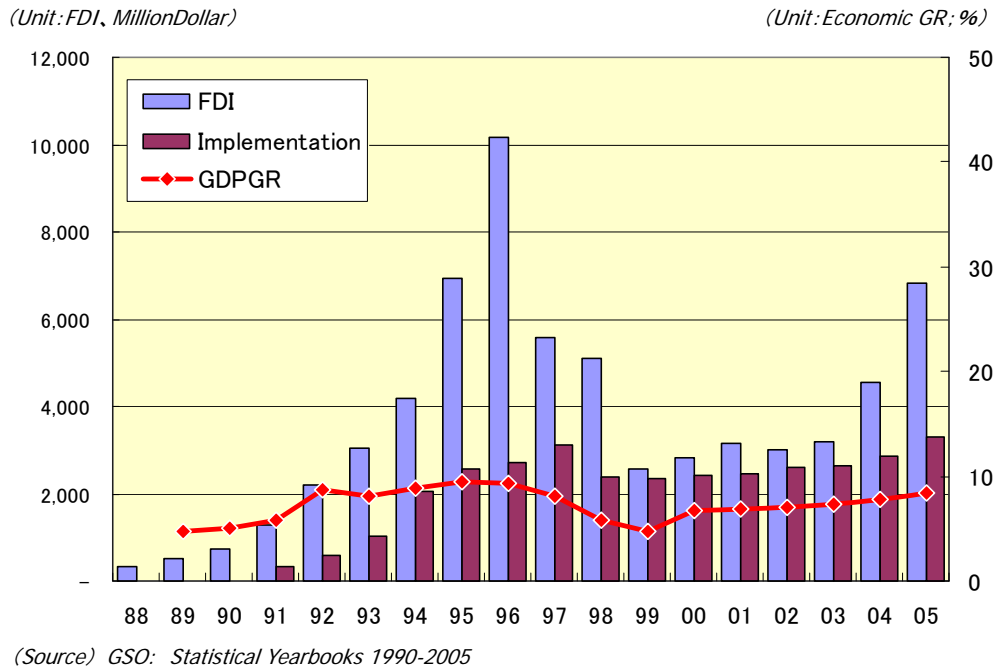


Figure 1.3-1 FDI and Economic Growth Rate

1.3.2 Important Sectors of Investment

Capital investment may be classified into those made by state company, non-state company and FDI. In 2005, the total estimated capital investment was VND 212 trillion, of which state companies

contributed VND 111 trillion or 52 %, non-state companies VND 68 trillion or 32%, and FDI VND 33 trillion or 16%. The investment in the energy sector was VND 33 trillion or 15%, mostly implemented by state companies. The FDI was mainly directed to the manufacturing industry and the sector's share on the cumulative FDI exceeds 50 %. Shares of other investment sectors were 9.4% for real estate, 7.9% for energy, 7.8% for construction, 7.8% for hotel and restaurant and 7.0 % for warehouse and transportation. The energy sector investment was in the third position next to the real estate investment; this may increase should favorable policy priority were given to energy investment.

Chapter2 Energy Trend and Issues of Energy Sector

2.1 Recent energy trend in Vietnam

In this Chapter, we will overview the recent energy demand and supply situation in Vietnam and anticipated issues referring to recent data and information, in particular those attached to the “National Energy Policy” approved in 2007.

2.1.1 Primary energy supply and final energy consumption

2.1.1.1 Primary energy supply

The domestic energy production in 2005 was 45.97 Mtoe (million ton oil equivalent), in which coal production was 18.90 Mtoe, crude oil production 18.86 Mtoe, the natural gas production 1.84 Mtoe and hydro power production 1.39 Mtoe. The average growth rate of energy for the period of 1990-2005 was 14.8%, in which oil and gas production growth rate was the highest or 16.0% followed by coal at 14.3%. In the energy production mix of 2005, coal shared 41.1%, oil 41.0%, natural gas 14.7% and hydropower 3.0%. The GDP elasticity of the energy production recorded extremely high level of 2.1 over the economic growth rate of annual 7.05%.

A total domestic primary energy supply after subtracting net import/export balance increased to 28.13 Mtoe in 2005 from 5.62 Mtoe in 1990; the average annual growth rate was 11.3%. The GDP elasticity of the domestic energy supply, as an index of domestic energy consumption, was 1.6, which was lower than the GDP elasticity of production. This demonstrates that production and export of energy increased substantially during the period.

2.1.1.2 Energy export

Crude oil export increased greatly in 2005. Vietnam exported 18 million tons of crude oil and 14.7 million tons of coal in 2005. The energy export revenue was about \$8 billion, increased 33% from 2004 and accounted for 25% of the national export earnings.

Most of the petroleum products were imported for domestic supply, as no oil refinery exists in the country at present. The 12.12 Mtoe of petroleum products were imported in 2005. The net energy export of Vietnam recorded 18.2 Mtoe in 2005, mainly composed of coal and crude oil.

2.1.1.3 Energy consumption of the energy conversion sector

The total domestic energy supply is converted into products for final consumption in the energy conversion sector; power generation, oil refinery, gas processing and etc. However, data other than the power generation sector are currently not available in Vietnam. The annual average growth rate of the national electricity generation (including privately owned plants) was 12.6% for the period of 1990-2005. During the same period, the demand growth rate of EVN was lower at 10.9% since private owned plants increased rapidly in recent years. Power generation of EVN was 41.2 billion kWh, in which hydropower shared 39.2%, natural gas thermal power 25.9%, coal-fired thermal power 21.4% and other steam turbine thermal power 13.5%.

2.1.1.4 The final energy consumption situation

In 2005, the total final energy consumption was about 21.8 Mtoe, and the annual average growth

rate for the period 1990-2005 reached 11.6%. During the same period, electricity consumption recorded annual 14.2% growth, while oil and gas consumption 11.4% and coal consumption 11.6%. Compared to the GDP annual growth rate (7.55%), the GDP elasticity was 1.9 for electricity, 1.5 for oil and gas and 1.5 for coal, which may be deemed to be very high.

In the energy consumption mix by sectors, industry sector shared 44.0%, transport sector 29.7%, residential sector 16.2%, service sector 7.7% and agricultural sector 2.4%. In the energy consumption mix by energy sources, petroleum products shared 51.5%, coal 27.4%, electricity 17.5% and natural gas 3.6%. The rate of electrification (the share of power consumption over the total final energy consumption) as one of the important indexes of people's living standards was 17.5%. It is a little bit low, but almost at the same level compared with other Asian countries. It decreases to 7.6%, if “non-commercial energy” consumed in large quantities in Vietnam (Energy Balances of Non-OECD Countries of IEA) were added to the denominator.

The intensity of commercial energy consumption in Vietnam was 616kgOE/\$1,000 GDP (in 1994 dollars), which was 1.5 times that of Thailand and twice the world average. The average primary energy consumption per person was 360kgOE/person in 2005, and the final energy consumption was 264kgOE/person. The per capita energy consumption was about 1/5 of the world average.

2.1.2 Current situation and issues of energy sector

The current situation of the energy sector of Vietnam, developing remarkably, may be appraised as follows in terms of energy security and other challenges.

2.1.2.1 Energy security

The energy security in Vietnam has been strengthened greatly since the country changed from a net energy importing country in 1990 to the present net energy exporting country. Great progress is seen in its energy supply security as follows.

Power supply security:

The total installed capacity of power plants is 11.3 GW, basically meeting the electricity demand (the peak demand was 10.5GW). However, in some areas such as rural and mountainous provinces, electricity supply is still unstable with low voltage. The potential shortage of electricity facing increasing power demand (increasing at about 14 % per year) still exists, especially in years of rainfall shortage as hydropower plants share high ratio, about 40 % of the total installed capacity, with high dependency on the long distance transmission among regions.

Supply security of gasoline and fuel oil:

The present oil-stockpiling program of Vietnam aims at one million kiloliter, which compares to 30 days consumption of gasoline and other petroleum fuel. The currently planned storage capacity would not be sufficient to stabilize domestic market, once the world faces oil crunch.

2.1.2.2 Challenges of Vietnamese energy sector

Vietnamese energy sector has been developing vigorously in all aspects of exploration, development, production, transmission, distribution, and export/import activities according to the evaluation of MOIT. The oil demand for the socio-economic development plan is basically met. The volume of sales in electric power, coal, and oil/gas sector is increasing steadily contributing to the

promotion of industrialization and the modernization of the Vietnamese economy. However, development level is still low with many problems such as:

1. General efficiency of the energy sector is still low.
2. Efficiency of production and marketing is not high.
3. Energy prices still contain loss compensation and cross subsidies.
4. Investment in energy development is still lower than required, progress of many projects is delayed, etc.

In addition, looking to the next 20 years, it is anticipated that, while energy consumption is expected to increase further along with high economic growth, the domestic energy production, having increased dramatically in the past, may face reserves restriction indicating yellow light on its production increase. Thus, there is a possibility that the country's energy balance would fall back to the "import excess balance" again. We will over view the current status and challenges in the energy sector facing Vietnam in the following sections.

2.2 Power Sector

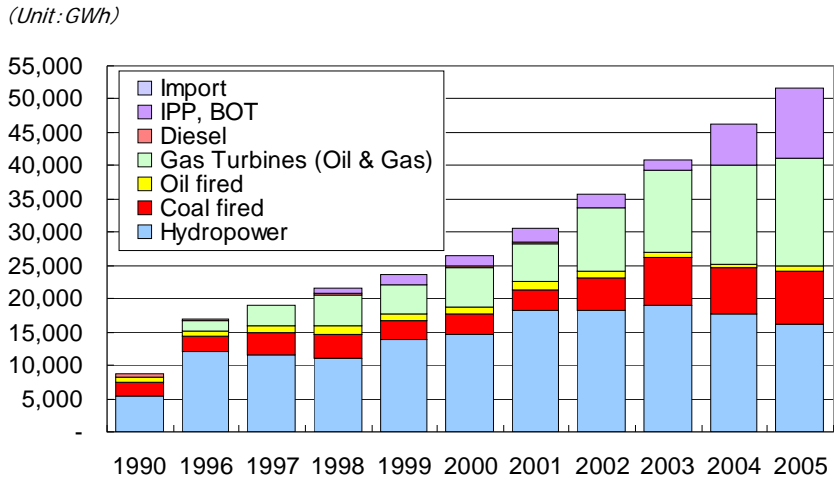
2.2.1 Current Status of Power Supply and Demand Balance

With rapid growth and expansion of the Vietnamese economy for the last decade, power demand has been increasing dramatically. With an average annual growth of power demand for 10 years from 1996 to 2005 accounting for 15%, power demand in 2005 recorded 45,600GWh that is 3.4 times larger than that of 1996 at 13,400GWh. Peak demand has also more than tripled during this period, coming up to 10,500 MW from 3,200MW. Potential peak demand was much higher than reported since electricity supply was cut off by load shedding during peak hours due to power shortage.

As for the daily load curve, the increase rate of electricity consumption in daytime (8-17) is larger than that in nighttime (18-22) and peak hours are changing from evening at 18-19 to morning at 10-11. These trends are much clear during summer season and the consumption in the evening and the morning has been almost same since 2003. It is forecasted that an increase trend of peak hours in daytime continues in the future.

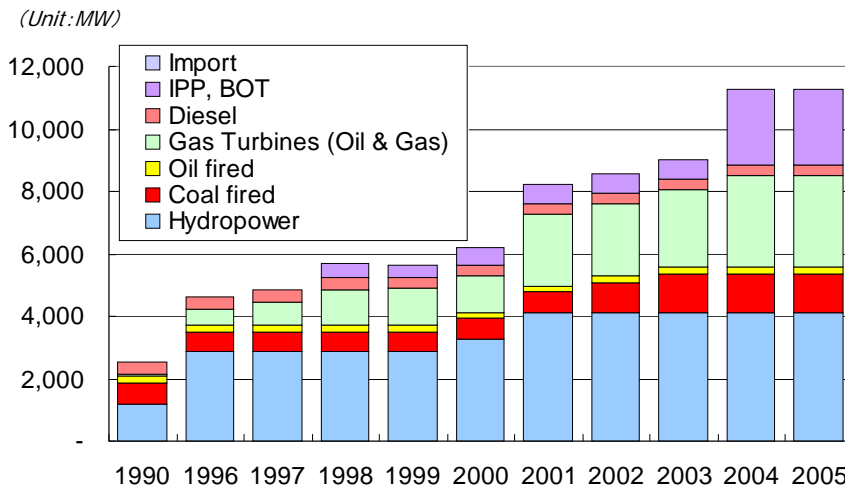
In order to meet the rapidly growing demand, Vietnam's power industry has struggled to expand and improve the power system through power resource development, enhancement of high voltage transmission lines connecting the country's three regions (north, center and south) and reduction of transmission and distribution losses (T&D losses). Power resource development was facilitated not only by EVN's (Vietnam Electricity, vertically integrated power utility in charge of development, management and operation of the state's electric power industry assets) own investment but also under BOT (Build-Operate-Transfer) and IPP (Independent Power Producer) schemes through private capital participations. As a result, IPP/BOT share in the total installed capacity of 11,300 MW in 2005 has come to 22%. EVN has also completed the a parallel, second north-south 500 kV lines of total 3,232 km as of 2005, and strengthened power transfer capabilities among the regions. Power import from Yunnan Province and Guanxi Autonomous Region in China has started through 110/220 kV lines. T&D losses fell sharply from 21.4% in 1995 to 11.78% in 2005.

Despite these considerable efforts, serious power shortages did appear during the summer of 2005 and even the office of Prime Minister experienced the power cut off. During that period from May to July, power shortage was estimated at 800-1,300 MW and the whole northern region including Hanoi faced load shedding for several weeks. A part of the reasons of this power shortage was the decrease of hydropower output due to drought conditions, but a main and fundamental reason was a lack of reserve margin against peak demand.



(Source) EVN, Annual Reports

Figure 2.2-1 Electricity Generation by Power sources



(Source) EVN, Annual Reports

Figure 2.2-2 Installed Capacity by Power Sources

2.2.2 Mid and Long Term Strategies at Government Level

2.2.2.1 Demand Forecast

At the initial stage of drafting the PDP6, demand growth rate of the base case was set at 16% until 2010. However, since Prime Minister Ngyuen Tan Dzung commented that demand growing scenario should be examined considering recent rapid improvement of rural electrification, growing electricity

consumption per capita, acceleration of foreign investment and high economic growth of recent years, a growth rate of each case was reset at more high rate.

2.2.2.2 Power Resources Development Plan

According to the base case of PDP6, total capacity in 2025 reaches 180,000MW, which is almost equal to 2000,000MW, the total capacity of current Japan. This power resource development plan is decided, with political consideration, by setting intentionally high demand growth rate and forwarding the commencement year of each power plant by 1 or 2 years taking into account the recent power shortage and delays of the power plant development. In implementation of these plans, however, re-examination will be required from the more realistic point of view. Power resource development strategies by energy sources are summarized as follows.

- 1) Hydro: Hydropower development is the top priority as a domestic energy resource. Exploitable hydro potential is estimated at about 18,000MW that will be fully exploited by 2015.
- 2) Nuclear: First unit operation is expected in 2020. Currently two candidate sites located in Phuoc Dinh and Vinh Hai District in Ninh Thuan Province has been identified.
- 3) Diesel & Oil (FO+DO): Existing old power plants with low efficiency plants shall be abolished step by step. Only one new oil combined cycle power project in the central region remains.
- 4) Gas: Exploiting the gas field in the seacoast of southern Vietnam, gas thermal power plants are developed. All the potentials with a total capacity of 17,000MW are to be developed by 2020.
- 5) Renewable Energy (RE): Small-scale hydropower less than 30MW and wind power are counted in the plan. Private investors are expected to develop small hydro projects.
- 6) Power Import (Import): Currently electricity has been imported from China. Import from Lao PDR and Cambodia is also planned.
- 7) Pumped Storage Power (PSPP): First unit operation is expected in 2019 in the north and south region. Three potential sites have been identified.
- 8) Coal (Importing Coal, Domestic coal): The entire shortfall against the demand after developing above energy resources shall be covered by coal thermal. Domestic coal is used in the north region and importing coal is planned in the central and south region after 2012.

Hydropower, domestic coal and power import from China are the main energy resources in the north region. Since there is no large consuming area, a total capacity is small in the central region. An oil thermal power plant is planned where a neighboring oil refinery will supply fuel. In the south region, gas thermal is the main resource until 2010, but other resources such as thermal power plants of imported coal after 2012 and nuclear after 2020 increase their capacity.

2.2.2.3 Power System Development Plan

The second circuit of North-South 500 kV line, the section of Thuong Tin – Nho Quan – Ha Tinh was put into operation in September 2005. Hence double circuit power lines connecting between north and south regions of Vietnam have been completed. Until 2008 it is estimated that power will be transmitted from south to north due to the serious power shortage in the north region. On the other hand, since 2009, power flows from north to south due to the completion of large-scale hydropower, coal thermal power development and increase of power import from China. (Refer to the

power transmission system chart in the appendix 1.2-5)

2.2.2.4 Energy Efficiency Improvement and DSM

Improvement of energy efficiency and DSM (Demand Side Management) are the effective measures approaching from demand side to control the rising power demand.

As previously mentioned, transmission and distribution losses of the national grid (excluding the low voltage distribution lines owned by local communes) have fallen steadily over the last decade to 11.8% in 2005 from 21.4% in 1995. Management of consumer account receivable of EVN has been exceptionally effective compared to other developing countries, with accounts receivable in 2003 equivalent to only about 17 days of annual electricity sales. Non-technical losses, including theft, are low compared to many other countries. To further decrease technical losses and improve the power supply reliability, expansion of 500/220/110 kV transmission lines and rehabilitation of aging distribution lines are planned. Target of transmission and distribution losses is set at 9% in 2010.

Thermal efficiencies in thermal power plants are highly plant specific. New, large-scale combined-cycle natural gas based power plants such as Phu My Complex incorporate world-class technology and provide high thermal efficiency of almost 50% by achieving plant operation rate of more than 95% with rated operation. With the exception of the Pha Lai 2 power plant, however, thermal efficiencies of existing coal-fired and oil-fired power plants are poor less than the level of 30% since facilities and technologies are relatively old and unit capacities are small. Therefore, these old power plants are to be shutdown in turn on condition that supply capacities are sufficiently secured by promoting high efficiency thermal power projects.

In order to disseminate DSM aiming at load curve levelling, time-of-day electricity tariff system has been adopted. Time slot is classified into three categories, i.e. peak hours (18-22), off-peak hours (22-4) and normal hours (4-18). In the case of power tariff for industrial use (more than 110 kV), tariff of peak hours is set at 1,590 VND/kWh that is three times larger than off peak hours of 425 VND/kWh (excluding VAT).

2.2.2.5 Strategy for Financial Resources Mobilization for Power Development

Advancing the power resource development projects is the immediate top priority to meet the power demand. However, how to secure the financial sources for these projects is a major issue. Under such conditions, basic strategies for financial sources mobilization are as follows:

- 1) Diversify financial sources such as ODA loans with low interest rates and long term for payback, commercial banks and bond issues.
- 2) Mobilize funds from stock market through equitization of power plants and distribution companies under EVN.
- 3) Invite domestic and foreign developers under IPP scheme.
- 4) Carry out electricity tariff reform reflecting long run marginal cost of power infrastructures.

a) Equitization

With the passage of the Electricity Law, Vietnam has embarked on a long-term program to restructure its power sector by discarding current vertically-integrated utility system in favor of a competitive power market. In line with the sector reform, major power infrastructures owned by EVN will be equitized except for hydropower plants with multi-purpose dam, important thermal

power plants and transmission lines that continue to be affiliated companies 100% owned by EVN. “Equitization” in the Vietnamese context means to transform a wholly state-owned enterprise into a shareholding company. The basic plan on equitization has been shown in the Prime Minister Decision regarding the Approval of a Member Company – Vietnam Electricity Holding Company issued in June 2006, but list of power plants / generation companies to be equitized is currently under discussion. EVN continues to possess more than 51% of the stocks even after equitization, but other stocks are to be sold to foreign and domestic investors. EVN’s earnings made by the sales of these stocks are to be spent for new projects of EVN.

b) IPPs (Independent Power Producers)

Generation capacity of IPP/BOT based power plants has reached to 22% of the total capacity and they have played important roles in power supply. Development and management of power plants owned by foreign and domestic investors can be classified into following categories:

1) Projects under BOT scheme wholly owned by foreign parties

Ex. Phu My 2.2, Phu My 3 gas thermal power plants. Generally, “BOT” in Vietnam means this type of project arrangement.

2) Projects under BOT or BOO scheme owned mainly by local companies

Main project developers so far are VINACOMIN, PetroVietnam and large construction companies. Projects that EVN is participating as a minor shareholder are included. Generally, “IPP” in Vietnam means this type of project arrangement.

3) Projects implemented by equitized new generation companies

Projects in the above first category are the large-scale projects with long term PPA (Power Purchase Agreement) guaranteed by the Government of Vietnam. However, due to the experiences of expensive electricity purchase prices and excess guarantees for existing “BOT” projects, the Government of Vietnam has indicated a policy of not allowing this type of project arrangement any more.

On the other hand, projects in the above-mentioned second and third categories are welcomed by the sector. Almost of these projects are invested by local companies but foreign companies can also participate.

2.2.2.6 Strategy for Electricity Tariff Revision

Vietnam has a uniform retail electricity tariff, which applies across the country (in the case of rural area where its power grid is managed by local communes, electricity tariff sold to the local commune is same as a uniform tariff, but electricity tariff provided by local communes for end-users is high since local communes add their costs on the uniform tariff). This uniform tariff is basically adopting pay-as-you-go system, with rates varying by voltage level and consumer type, and offering time-of-day rates for major customers. Among various customer categories, residential use of first 100 kWh (550 VND/kWh, (=3.4 cents/kWh), VAT excluded) is cross-subsidized by higher tariff for industry and commerce.

Average unit rate of electricity sales was 789 VND/kWh (=4.9 cents/kWh) in 2005. In the coming years, in view of the necessity of enormous capital for power infrastructure development, it is inevitable to raise the tariff in order to secure financing of EVN and attract private capital of domestic

and foreign developers. Power Sector Development Strategy has stated, “Continue carrying out electricity tariff reform according to the roadmap which was approved by increasing tariff towards long run marginal cost of electricity generation and transmission and reforming tariff schedules.” In addition, cross-subsidy from industrial and commercial use to residential use is to decrease in the future.

2.2.2.7 Strategy for the Institutional Reform of Power Sector

As a part of power sector reform, establishment of power market is planned. Aims of the power market are to i) attract the investment capital from different economy sectors nationally and internationally to participate in the power activities to reduce the investment burden on the State for the power sector, ii) improve the business effectiveness of the power sector, reduce the pressure of raising the electricity tariff, iii) ensure the power to be supplied stably, reliably with the increasing quality and iv) ensure the power sector to be developed stably.

Details of the power market design are under discussion supported by international consultants. Its basic concept and development schedule is stipulated in the Electricity Law and the Prime Minister Decision 26: Approval of the Roadmap, the Conditions to Establish and Develop the levels the Power Market in Vietnam issued in January 2006. According to these legal documents and interviews with officials of EVN etc., the power market is to be established through sequential development of three phases.

Phase-I realizes competition among power plants and companies, while purchase of electricity is undertaken by a power purchase company (single buyer model). Development of wholesale competition is envisaged in Phase II where multiple bulk buyers such as large customers, wholesalers, and distribution companies can buy electricity through PPA or from spot power market. Phase III will involve competition for retail customers, who will have access to different supply companies. Categories of retail customers who can freely select suppliers will be gradually expanded from large and high voltage customers to small and low voltage customers.

At present, preparation phase for Phase I in 2009 has already been started, where experimental generation market is created under the supervision of EVN and power transactions have been simulated by the participation of equitized generation companies and major power plants under EVN. Though a road map until Phase III has been announced, its institutional design and schedule will be reviewed as needed based on the performance of the power market in Phase I.

2.2.2.8 Rural Electrification

Vietnam has adopted a unique approach to improve the access to electricity in rural and remote areas, where seven regional Power Companies that are in charge of power transmission and distribution from 110kV downwards have provided a medium voltage connection to commune centers, and local communes have taken responsibilities for installing and operating the low voltage networks. This approach has enabled Vietnam to increase the household electrification rate from 51% in 1995 to over 90% in 2005.

To further proceed with rural electrification, the Government of Vietnam has set concrete targets in Decision No.176 on approving Vietnam Power Sector Development Strategy as follows:

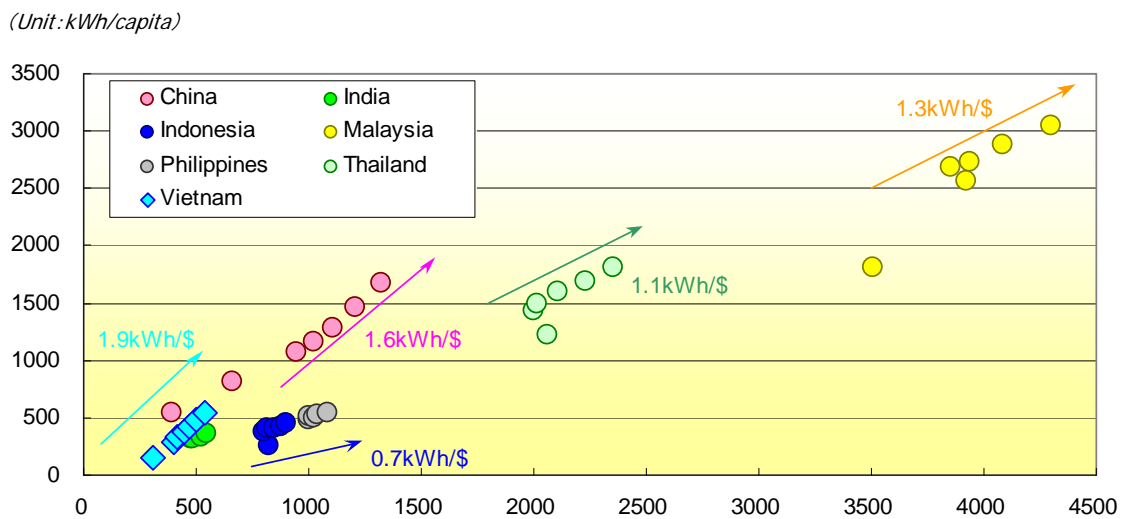
- 1) Rapidly promote program of bringing electricity to rural, mountainous areas so that all commune

- centers will have electricity and 90% of rural households will access to electricity by 2010
- 2) 100% of rural households will access to electricity by 2020

2.2.3 Issues of Power Sector

2.2.3.1 Energy Efficiency

Relationships between electricity consumption (= total national electricity sales) per capita and the GDP per capita in Asian countries are shown in Figure. 2.1-3 (1990, 1995, 2000-05 data has been used where available). It shall be noted that though GDP per capita in Vietnam just passed \$500, electricity consumption per capita is almost as same as Philippines and Indonesia where GDP capita is in the level of \$1,000. It is also worth noting that recent increasing trend of Vietnam in the period of 2000-05 is very high compared to other countries.



(Note: Data of China includes T&D losses and station service, while other countries exclude.)

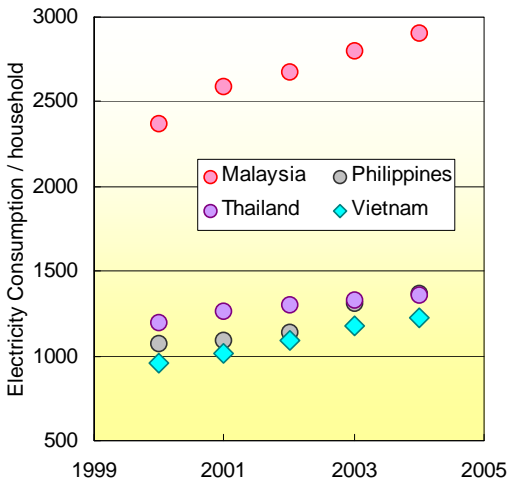
Figure 2.2-3 Relations between Electricity Consumption per Capita and GDP per Capita

To further clarify the consumption pattern in Vietnam, electricity consumption for residential use that accounts for almost 50% of the total consumption and the consumption for commercial & industrial use are separately analyzed. Figure. 2.2-4 shows the residential electricity consumption per electrified household (left graph, since definition of the raw data used in the graph is slightly different by countries, analysis of calculated results need careful considerations) and recent trends of electricity intensity against commercial & industrial electricity consumption (right graph, electricity intensity mentioned in the graph is calculated by commercial & industrial electricity consumption / GDP). As shown in the figure, electricity consumption per household of Vietnam increases by 5-7% annually and has almost reached the consumption level of the Philippines or Thailand though GDP per capita of Vietnam is only 1/2 or 1/4 of respective countries. It is also prominent in the right graph that electricity intensity of Vietnam is dramatically increasing in recent 5 years, which may indicate electricity intensive industry is rapidly developing in Vietnam.

These data shows that Vietnamese society is likely to go to the energy intensive society in a short

period of time. Further detail analysis on the drivers of these phenomenon and studies on effective counter measures to control the increase of electricity consumption such as strong promotion of energy saving policy and energy efficient equipment are strongly recommended.

(Unit: kWh/household year)



(Unit: kWh/\$)

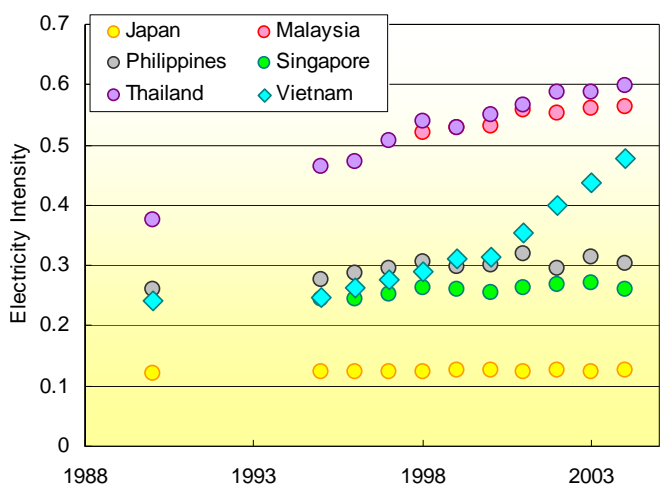


Figure 2.2-4 Residential Electricity Consumption per Electrified Household and Electricity Intensity against Commercial & Industrial Electricity Consumption

2.2.3.2 Power Supply Capability

A fundamental issue in the power resource development plan is the excessive dependence on coal thermal powers. Considering exploitation of all the hydropower potentials are to be completed by 2015, a power resource development plan shall achieve the best mix of various energy resources (gas, liquid natural gas, nuclear, pumped storage power and renewable energy) while keeping the energy security. Issues of each power resource by fuel type are explained in this section.

a) Nuclear

The Government of Vietnam has issued “Long term strategy on peaceful utilization of nuclear energy until 2020”¹ as a Prime Minister Decision in January 2006. Its strategies are;

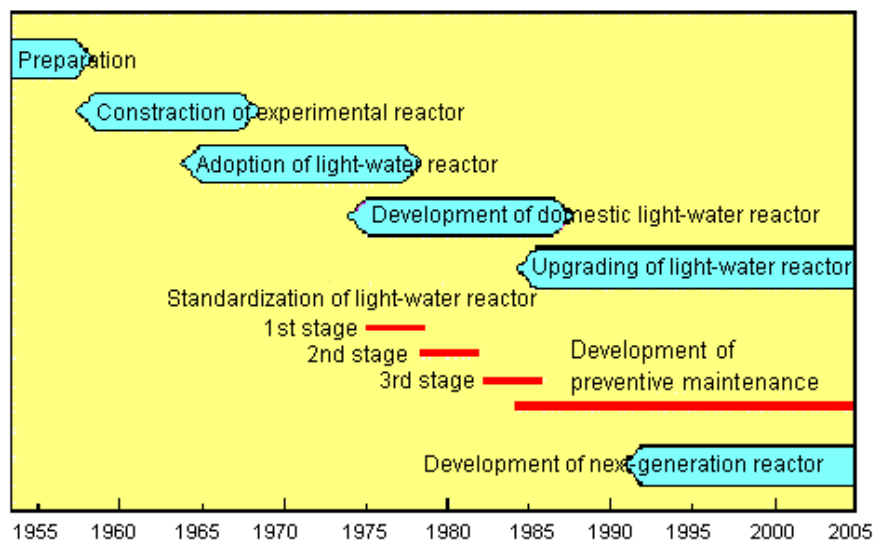
- To start construction of the first nuclear power plant no later than 2015, and start operation in 2020 or before.
- To select the best partners from the foreign countries who could cover both technical and operational portions. The Government of Vietnam should lead every activities related to nuclear energy utilization though three stages i.e. i) Technical investigation, ii) Technology transfer from the partners, iii) Technology development for the next decade after commissioning of the first plant operation.
- To project the domestically produced nuclear equipment in the future that includes not only

¹ Prime minister decision No.01/2006/QĐ-TTg; Chapter-1: Current status and future possibility of nuclear energy development, Chapter-2: Policy, objective and significance of nuclear energy utilization in Vietnam, Chapter-3: Measures for achieving the long term strategy

nuclear reactor and auxiliary equipment but also nuclear fuel.

- MOST (Ministry of Science and Technology) should lead the strategic development of nuclear energy in cooperation with related Ministries and authorities.

Developing nuclear energy is very important to meet the future power demand, and retain the energy security as well as environmental conservation for the country. In the PDP6, the nuclear power project has been newly listed to start operation in 2020. On the other hand, reviewing Japan's development chronicle of the nuclear energy as shown in Figure 2.1-5, Japan Nuclear Power Generation Co. was established in 1957 after 3-4 year preparation period, and the first 166MW-nuclear reactor, so-called "Calder Hall reactor" made in UK, started trial operation in 1965. And subsequently it came into commercial operation in 1966. Hence, Vietnam's nuclear development plan would be feasible in schedule based on Japan's experience.



(Source) Thermal and Nuclear Power Engineering Society, "50 year chronicle of thermal and nuclear power generation development", 2000

Figure 2.1-5 Chronicle of Nuclear Power Development in Japan

The Government of Vietnam makes a plan promoting the peaceful utilization of nuclear. MOST is a focal authority for the implementation of nuclear energy development. On the other hand, EVN and the Institute of Energy are responsible organizations to implement the nuclear power generation projects under the instruction of MOIT.

As for the nuclear power generation development plan, the Pre-F/S had been carried out, and the report was submitted to Prime Minister in September 2005 and approved in August 2007. The pre-F/S report consists of 12 chapters such as 1) Safety and regulation, 2) International cooperation and treaties, 3) Human resource development, 4) Public acceptance, 5) Nuclear power generation technology, 6) Fuel management and waste disposal, 7) Necessity of Nuclear power, 8) Site selection, 9) Environmental impact assessment, 10) Construction management, 11) O&M and 12) Economic and financial analysis

The Government of Vietnam has maintained the development policy of aiming at import of nuclear

power generation technologies from foreign partners rather than developing domestic technologies like the case in Japan at the first stage. Thus there is no concern on technical issues. On the other hand, there are many other sorts of issues as follows:

- Safety: Establishment and arrangement of safety management technology and regulation are needed. As for safety management, human resources should be developed, and the law system such as “Atomic Energy Fundamental Law”, “Nuclear Reactor Regulation Law” and so on needs to be established at once.
- Cooperation with international community: The Government of Vietnam has already ratified “Nuclear Non-Proliferation Treaty (NPT)”, “Safeguard agreement”, “Comprehensive nuclear test ban treaty (CTBT)”, and “Convention on Early Notification of a Nuclear Accident”. Ratification of other treaties such as “Protocol of safeguard”, “Treaty of nuclear safety”, “Treaty of nuclear material safeguard”, “Treaty on Compensation for Nuclear Damage” shall be also considered.
- Human resource development: HRD is essential for promotion of the new technology development such as nuclear energy.
- Public acceptance: MOST organized the workshops on peaceful utilization of nuclear energy in Ninh Thuan Province, Phu Yen Province and HCM city in 2003- 2004. However, the full-dress activities for public acceptance shall be considered after Prime Minister’s approval on Pre F/S report.

b) Coal thermal power

Coal thermal is the main energy resource of power sector in Vietnam. Expected electricity generation in 2015 is 10 times larger than that of 2005. Power plant development projects have been planned not only in the north region where domestic coal can be produced but also central and south regions importing coal from abroad. As of 2006, only domestic coal consumption for power plants accounts for only about 10% of the total consumption of 40 million t. However, following points shall be studied and examined to ensure the stable coal procurement.

- Establishment of Coal exploitation and transportation plan reflecting the future increase of coal consumption for power plants.
- Securing stable coal suppliers abroad: Preparation for the possible future risks such as price hike (spot price of Australian fuel coal rose to USD70/t in August 2007), decrease of production due to cyclone etc. and rapid increase of coal demand in Asian countries.
- Infrastructure development for domestic coal transportation: Increase of carrying capacity of railways and river traffic.
- Infrastructure development for import coal: Seaports development in the central and south region to receive imported coal.
- Environment and social considerations: Particularly considerations for the increase of CO₂ emissions (It is said that coal thermal power plants produces two times larger CO₂ emissions / kWh than LNG combined cycle power plants from exploitation to consumption).

c) Gas thermal power

Since there is a capacity limit of domestic coal production, it is not recommendable to too much rely on coal fuel in terms of energy security. Gas fuel is the promising domestic natural resources for

electricity generation next to coal. However, it requires huge development costs and long periods since integrated development of gas field exploitation, pipeline placement and power plant construction is indispensable. Furthermore, while more than 80% of domestically produced gas has been used for power generation at present, it is forecasted that gas demand for industrial and consumer use will increase so that mid and long-term procurement plan putting import in perspective shall be established. Important points to be examined in the development of gas thermal are:

- Appropriate gas purchase price and electricity tariff setting in order to accelerate the gas field exploitation by private sectors.
- Establishment of development plan taking into account the long lead time from gas field potential surveys to the commercial operation of power plants.
- Examination of the necessity of gas import through LNG or pipeline.

2.2.3.3 Formation of Networks for High Quality Power Supply

EVN has completed a parallel, second north-south 500kV transmission lines between Nho Quan – Ha Tinh in 2005. While capacities of main transmission lines have been increased, it is an urgent issue to increase numbers and their capacities of substations and to develop and expand middle and low voltage transmission lines. A lack of adjacent connecting points from new power plants to be constructed will cause inefficient formation of power networks, increase of transmission costs and lower the feasibilities of power projects that lead to the delays of power plants' commercial operation. In rural and remote areas, rehabilitation and renovation of aged and greater loss distribution networks is required.

Expanded and complex power network will make stable and reliable network operation more difficult particularly when rapid demand fluctuation happens, a large power plant is disconnected from the network by an accident, and in the voltage and frequency control overnight with small demand in the network. It becomes important to have power supply resources for peak hours due to the increase of base power supply such as coal thermal and nuclear (even gas thermal in Vietnam may be difficult to save electricity generation as a middle power resource due to constraints of the PPA or constant gas supply). Therefore, development of pumped storage power plant (PSPP) as a peaking power is required. A PSPP, in addition to providing peaking power, has many advantageous functions such as excellent adjustment capability against demand fluctuation and frequency and voltage control of whole power network. In the future when IT industry and automated factories will require much higher quality of electricity, PSPP can be the best system to meet such a requirement.

In the comprehensive operation of power network, formation of optimal power resource composition considering yearly, seasonally and daily fluctuations of power demand and accumulation of operation know-how of such network will be indispensable in order to achieve stable, reliable and high quality electricity supply.

2.2.3.4 Power Sector Reform

Creation of power market and foreign and domestic private sector participation in the power resource development expect to facilitate the effective and efficient management of power sector. About 50% of the total new generation capacity is to be developed by private capital through IPP or BOT scheme.

In inviting private investors to the power sector, there are some risks as follows:

- A lack of technical and financial capabilities of domestic investors

Main domestic investors currently participating in the power resource development are VINACOMIN, PetroVietnam, Power Companies and large construction companies. However, their capabilities with regard to capital resource mobilization and know-how of power plants construction and its long-term O&M are uncertain.

- PPA and power market

Detail design of power market and trade is underway. While establishment of transparent and fair rules is necessary, rapid introduction of complete competition shall be carefully examined because power market may cause i) price hike of wholesale tariff when electricity supply capacity is short and ii) heighten the entry barrier of private sectors. Particularly in developing countries where country risk is ranked not low, no long-term PPA or PPA with unfavorable conditions could be the fatal barrier to entries to the power sector in Vietnam.

Another important issue is to satisfy both free competition and stable electricity supply. Electricity supply is a universal service requiring huge capital resources and periods in the infrastructure development. If infrastructure development is fully made by market-driven, development tends to be delayed. This tendency is often observed in the countries where free competition has been introduced. Therefore, while improving the investment environment and entrusting the market-driven development by private sector, MOIT and EVN shall make overall middle and long-term development strategy and commit its implementation with the nationwide energy balance, energy security and global environment in mind.

2.2.3.5 Proper Electricity Tariff Setting

There is no question as to the importance of infrastructure development in the Vietnamese power sector, but how to mobilize necessary capitals is always the major issue. According to the PDP6 approved in July 2007, necessary funds for power plants development become 7 billion USD / year in 2010, 10 billion in 2015 and 12 billion in 2020. Looking the annual electricity sales of EVN in 2005 is only 2.4 billion USD, it is absolutely impossible for EVN on its own to cover such costs. As previously mentioned, four strategies to mobilize funds have been set. Among them, “electricity tariff reform” is a key strategy since tariff reform directly relates to sales and collection of funds, moreover, it relates to power purchase price of BOT/IPP generation companies that leads to the attraction of private investors. According to the Decision No. 276 on Selling Prices of Electricity, average retail price target is set at 842 VND/kWh in 2007, 890 VND in 2008 and achieving tariff level that is consistent with costs of infrastructure development and O&M in 2010. With fulfilling the accountability to the public, tariff reform shall be properly implemented in accordance with the set schedule and, at the same time, social consideration to the poor is required under the increase their economic burden.

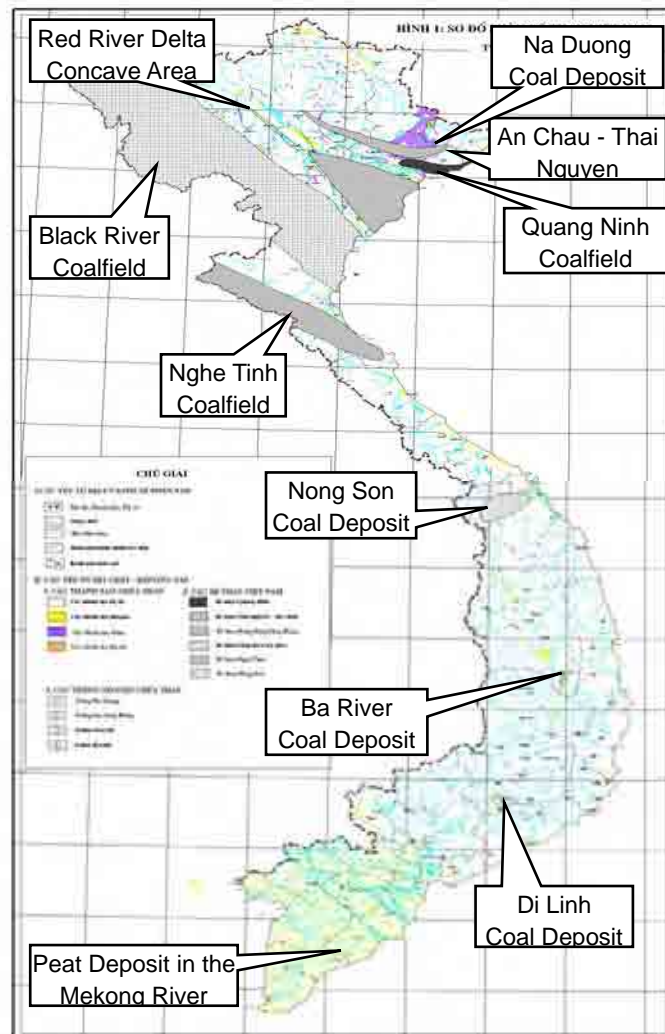
2.3 Coal Sector

2.3.1 Current Status of Coal Sector

2.3.1.1 Reserves of Coal

Coal in Vietnam was being sedimentation from Palaeozoic Era to Cainozoic Era in geological, and reserves mostly in the northern east of Vietnam. There are anthracite, semi anthracite, bituminous and lignite as a coal type.

As of the end of 2006, coal reserves excluding peat in Vietnam is 5,833 million tons as the geological reserves. By coal type, 71.2% of the geological reserves are anthracite, and are depositing in Quang Ninh Province located at the northeast of Vietnam where is a major coal producing site. As for the rest, sub-bituminous coal deposit 1,580 million tons (27.1%) at Khoai Chau region of Red River Delta, and lignite deposit 96 million tons (1.7%).



(Source) VINACOMIN, "Sustainable Development Strategy for Vietnam Coal Sector," February 2007 より作成。

Figure 2.3-1 Vietnam Coal Resource Map

On the other hand, the mineable reserves are 3,390 million tons, and being about 58% quantities of

the geological reserves, of which anthracite is 2,830 million tons (83.5%), sub-bituminous is 525 million tons (15.5%), and lignite is 36 million tons (1.1%) by coal type. This means that a share of anthracite increases. The R/P ratio of mineable reserves becomes approximately 85 years.

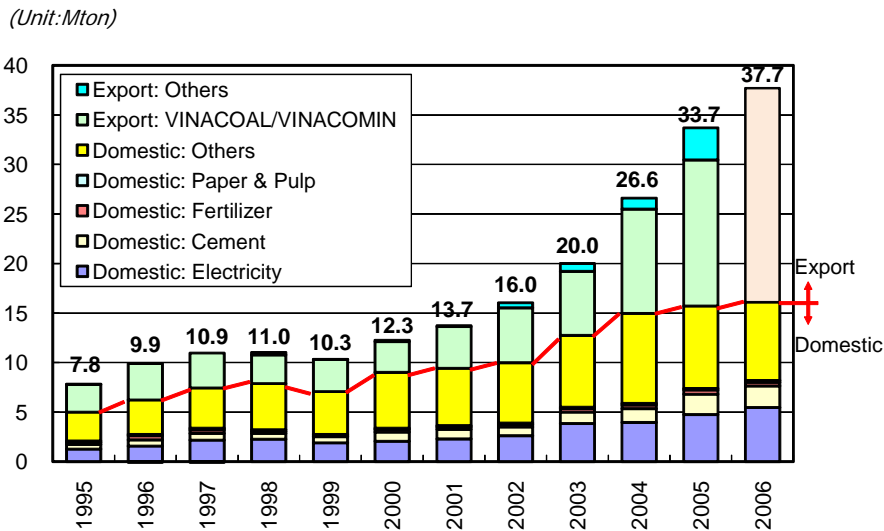
2.3.1.2 Supply/Demand Trend of Coal

1) Coal Demand

Coal consumption in Vietnam is increasing 29.9 million tons from 7.82 million tons in 1995 to 37.70 million tons in 2006, and average annual growth rate of 15.4% in this period. An increase in domestic coal consumption in the same period was 11.06 million tons (average annual growth rate 11.2%), whereas coal export increased hugely compare with domestic demand as 18.78 million tons (20.3%). As the result, the percentage distribution of domestic to export was reversed from 64:36 to 43:57.

Electricity, construction material and cement industries is account for majority of domestic coal demand. In future, coal demand for electricity forecast dramatically increase, then coal demand for cement and construction material will increase.

Coal export increased substantially after 2002, because export for china was increased rapidly. Present major destinations for coal export are China and Japan, but Vietnam exports low grade coal for coal-fired power in China and high grade one for iron & steel and general industry in Japan.



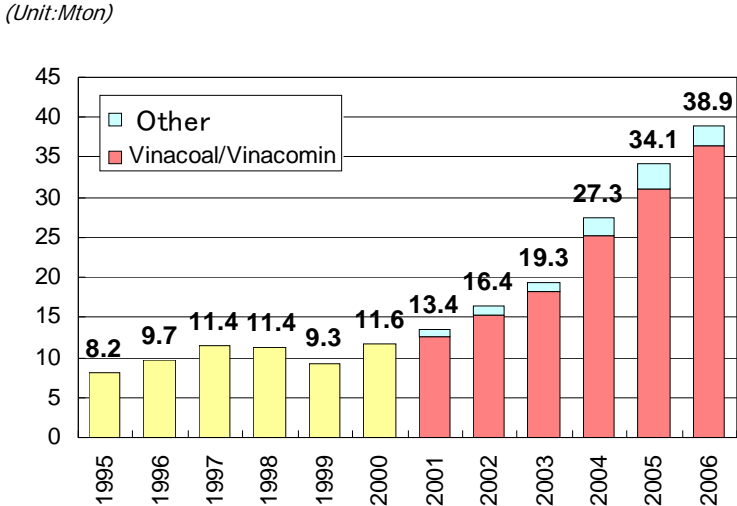
(Source) VINACOMIN, "Master Plan on Coal Development for Vietnam in Period 2006-2015 with Expectation to 2025," December 2006

Figure 2.3-2 Coal Demand Trend

2) Coal Supply

The clean coal supply is also increased by 30.75 million tons from 8.16 million tons in 1995 to 38.91 million tons in 2006, and annual average growth rate at this period was 15.3%. At the same period, an increasing of national corporations is 28.60 million tons (average increase rate 14.9% a year), whereas that of other suppliers is 2.15million tons (22.1%). As the result, the supply ratio by national corporations including the Vietnam National Coal Corporation (hereinafter referenced to as

VINACOAL) and the Vietnam National Coal and Mineral Industries Group (hereinafter referred to as VINACOMIN) is still high in 2006 with 94.0%. On the other hand, coal import is estimated 400 thousand tons a year which are mainly coking coal for the iron industry and steam coal for other industry (IPP).



(Source) From data supported by VINACOMIN

Figure 2.3-3 Trend of Coal supply

2.3.1.3 Players (or Stakeholders) of Coal

The coal business of Vietnam was not unified until VINACOAL was established on October 10, 1994. VINACOAL had reformed as Vietnam National Coal Group (VINACOAL) on August 2005. Based on Prime Minister Decision No.345/2005 QD-TTg, VINACOAL Group and Vietnam Minerals Corporation (VIMICO) had merged to form VINACOMIN Group on December 26, 2005. VINACOMIN becomes to cover a broad range of activities from the mining to processes and sales of coal and mineral resources (bauxite, iron ore, copper, lead, zinc, and other mineral). VINACOMIN is mainly organizing geological exploration, production, processing, domestic sale, and export on coal related business, and has presently been changed into the diversified management that has business conditions like mineral and metallurgy, electricity, construction materials, real estate investment, construction machinery, and service industry, etc.

As a coal player excluding VINACOMIN, the Thai Nguyen Iron and Steel Corporation (TISCO) that is a subsidiary of the Vietnam Steel Corporation (VINASTEEL) organizes two collieries (Phan Me and Lang Cam) in Thai Nguyen province, and they produce coal and consume at own facilities. PT. Vietmindo Energitama of 100% capital investment from Indonesian owns Dong Vong – Uong Thuong colliery in the Quang Ninh province, and is producing and exporting coal. In addition to these, there are eight collieries in whole country where are located in Ninh Binh province, Hoa Binh province, Son La province, Yen Bai province, Thai Nguyen province, and Da Nang city. These collieries are doing coal business.

2.3.1.4 Introduction of Private/Foreign Capitals of Coal

An active investment has not been performed for the entry into the coal business by private and foreign capitals up to now. In October 1991, PT. Vietmindo Energitama contracted a business collaboration agreement for anthracite's exports and sales with Uong Bi Coal Company. PT. Vietmindo Energitama had been developed the Dong Vong - Uong Thuong colliery in the Uong Bi district of the Quang Ninh province, and coal production was begun in September 1997, and continues until now. This became a first investment to Vietnam's coal business by private and foreign capitals. After that, several private capitals invested, total production by those collieries in 2006 was approximately 1.2 million tons.

After October 2006, VINACOMIN offered 20% of each stock issued of the four subsidiary coal companies, Cao Son, Deo Nai, Ha Tu and Nui Beo to the public on the Hanoi Securities Trading Center, and financed from the open market, in time for Vietnam's formal entry into World Trade Organization (WTO) in January 2007. In this tender of initial public offering (IPO), Sumitomo Corporation makes a successful bid for 5% of each saleable stock (1% of stock issued) for Cao Son Coal Company and Deo Nai Coal Company that are exporting anthracite coal for Japan. This investment to the Vietnamese coal business is the first time as Japanese capital. Moreover, the employee share holding commission in each coal company also makes a successful bid, and it invests as a private organization. VINACOMIN's subsidiaries will be anticipated to offer IPO one after another in the future. Therefore it is expected that a private and a foreign capital will be promoted to introduce into coal business further more in the future.

2.3.1.5 Coal Price

The central government has been basically decided the coal price until 2006. The total coal production cost comprises costs for exploration, transport, processing and selection, marketing and administration cost and average coal price had kept low until 2003. A domestic coal price set to a production cost that was lower than it, and the balance between production cost and domestic coal price was covered by earnings from coal export. Average coal price is remaining at a high level compared with production cost because the price of the global metallurgical coal market including the coal for PCI (pulverized coal injection for blast furnace) rose from tight metallurgical coal supply and demand in worldwide after 2004. The average coal price are VND399,500(US\$25.17)/ton for domestic use and VND555,400(US\$35.00)/ton for export and total average price is VND488,900(US\$30.81)/ton.

2.3.1.6 Coal Transportation

Produced coal (raw coal) from the colliery is transported to a coal classified plant (rock removal and sizing only) and coal preparation plants by belt conveyers, trucks, and railways, etc. Coal products after processing is directly carried to domestic customers by trucks and railways, or transfer it to shipping ports once, then it is transported for domestic or overseas customers.

The railway used for the coal transportation is used coexistence of three kinds of gauges as 900 mm, 1,000 mm (narrow gauge) and 1,435 mm (standard gauge), and 1,000 mm gauge width is constructed as a standard in the single track. Both locomotives and wagons have been introduced according to each gauge width, but all of locomotives are diesel powered and not electrified, and maximum load of

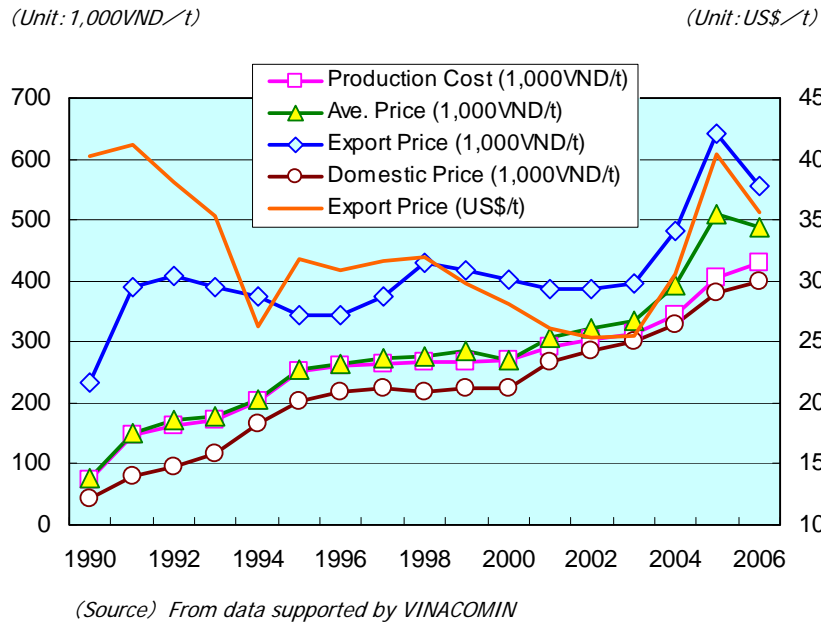


Figure 2.3-4 Trends of Coal Prices in Vietnam

wagons is 50 tons, and those equipments are becoming too old.

Transportation by trucks is used for a carriage between colliery and main transportation system such as railway and belt conveyer, and between colliery and coal classified plants and/or coal preparation plants. Transportation by trucks is controlled to the minimum requirement from consideration to the environment and the residents in the surrounding, and the shift to transportation by railway and belt conveyer is planned.

On the other hand, shipping ports used for coal transportation are developed to link with each coal classified plants and coal preparation plants. Loading capacity of shipping ports that faces the Halong Bay are relatively large, but the depth of the water is shallow. Therefore, even Cua Ong port which is the largest coal shipping port, a maximum vessel deadweight ton that direct loading is possible in the berth is limited to 40,000 DWT. In other coal shipping ports, coal is loaded into a small vessel of 200-400 DWT or less, and then it has been transhipped to another vessel in offshore. Coal loading facilities is not efficient.

2.3.1.7 Tend of Coal Mine Safety

As for coal mine safety, after 1995, with the increase of the production volume and a rise of the underground mining ratio, a number of accident, fatality and injury largely increase. Although it was in a tendency to decrease from 2000 to 2004, it turn for increase again after 2005. The number of accident and injury for each one million tons coal production decreased greatly after peaking in 2000, and both numbers are in some increasing tendencies after 2005. Decreasing of both numbers after 2000 are guessed to be large contribution of the coal mine safety technology to the local colliery employee by technical co-operation project of Japan International Cooperation Agency (JICA) “Vietnam Coal Mine Gas Proof Management Center” conducted from 2001 to 2006 and New Energy and Industrial Technology Development Organization (NEDO) “Training Project on Coal Mining Technology.”

2.3.1.8 Current Status of Clean Coal Technology

The clean coal technology (CCT) of Vietnam is applied partially, but an application is not yet enough. There are applied technologies such as conventional type coal preparation, briquette, biomass-briquette, circulating fluidized bed combustion (CFBC), desulfurization, and denitrification, etc.

2.3.1.9 Alliance with Foreign Countries

At first, Vietnamese coal industry introduced the technology from France, and also introduced from the countries of Communist bloc such as the Former Soviet Union, China, and Poland after World War II. Since VINACOAL was organized in the 1990's, it cooperated with a lot of overseas various organizations such as Japan, Australia, South Korea, Czech Republic, and Canada in addition to the above-mentioned country in a wide field like production, mine safety and utility, etc, and has been trying the modernization of the coal industry.

Japan has been promoted technical cooperation up to now in the CCT field including the resource exploration, the mining technology, the coal mine safety technology, the coal preparation, and the environmental protection through the Japanese organizations such as NEDO, Coal Energy Center (JCOAL), and JICA since the latter half of the 1980's. Currently Japan has been have favorable relations with VINACOMIN.

2.3.2 Issues and Subjects for Coal Sector

2.3.2.1 Issues and Subjects for Coal Supply

1) Mineable Reserves

The mineable coal reserves with 3.39 billion tons excluding peat are including sub-bituminous coal 530 million tons of the Red River Delta region that is seemed difficult to mine economically. Therefore, the mineable coal reserves will be reduced realistically to about 2.87 billion tons, and the R/P ratio is shortened in about 70. There is a possibility of decreasing the R/P ratio when coal production increase in the future. Therefore, as the mining depth will be deeper, it is necessary to increase mineable reserves by the detailed geological exploration of the deep layer.

2) Development of Red River Delta

Vietnamese government and NEDO have jointly conducted a survey on the geological exploration of Red River Delta coalfield in 1998 to 2003. Considering factors such as weaken rock strata, necessary countermeasures against rock pressure and mine water, and necessary countermeasures against environmental pollution caused by mining, through existing Red River's levee, residential district and agricultural land on the surface of mining area, it will be mined coal seams of 600m under sea level. Therefore mining cost is seemed to high considerably, and there is little possibility of coal supply from Red River Delta coalfield from the economical aspect. On the other hand, VINACOMIN is now under planning a joint mining of Red River with foreign companies using underground gasification technology. Its possibility will be evaluated by afterward examination.

3) Mining Cost

The mining cost of coal is rising in the past several years, and will be seemed to rise further when underground mining method will become a main force in the future. The rise of the mining cost is not

avoided from the cost rises of a personnel expense and equipment and material expense, etc.

When the price liberalization of domestic coal achieves in the future, coal price will go up according to the rise of the mining cost. Vietnamese coal industry will face the price competition with overseas steaming coal.

4) Mine Safety Technology

It is certain that the amount of the coal resource that is mineable by opencast method decreases greatly, and underground mining will become a main method in Quang Ninh coalfield that is main coal production region. As for the underground, the mining condition and the working environment are worse than the opencast, and the accident incidence is also seemed to increase.

It is thought when not only the personal suffering but also the production recovery requires significant cost, and it becomes abundant coal mine if any accident such as the dust explosion, the mine combustion and fires occur. Thorough these accident preventive measures are necessary.

The improvement of the coal mine safety is indispensable, and technology introduction and spread activity for that are requested further for stable coal supply.

2.3.2.2 Issues and Subjects for Coal Demand

1) Coal Preparation

In Vietnam, a main purpose of coal preparation is to select a high grade of coal for export. As for domestic low grade coal, deashing and calorific value adjustment are insufficient because it is mainly sizing. Except some of coal preparation facilities, uncollected coal is mixing in waste, and there are much landfill quantity increase of the waste and yielding is no so high.

Dust coal gets mixed in wastewater used for preparation, and the issue of pollution occurs by abandoning to rivers and the ocean. Regarding existing equipments and the coal preparation facilities to build newly in future, it is required to reduce environment load by improving coal yield, waste water purification, and decreasing coal ash by introducing high technologies of coal preparation.

2) Coal Type Consumed in Thermal Power Plant

The coal class mainly consuming in coal-fired stations are the fine coal No.4B and No.5 of the domestic anthracite coal for now. Supply expansion of the correspondence coal class will be necessary because of the increase of the coal consumption in the coal-fired stations is expected in future. The coal-fired boiler that is designed the domestic anthracite coal is able to use the steaming coal, but the coal-fired boiler designed in steaming coal is not able to use domestic anthracite coal. It will be necessary for consumers using coal to select the coal-fired boiler after discussing the coal procurement in a medium- and long-term perspective enough in future.

2.3.3 Supply Plans for Coal Sector

2.3.3.1 Coal Development Plan

Whole development plan of coal sector in Vietnam is made by VINACOMIN. There are “Draft of the Master Plan on Coal Development for Vietnam in Period 2006-2015 with Expectation to 2025” and “Sustainable Development Strategy for Vietnam Coal Industry” as the latest development plan. Hereafter, the outline of these coal development plans is described.

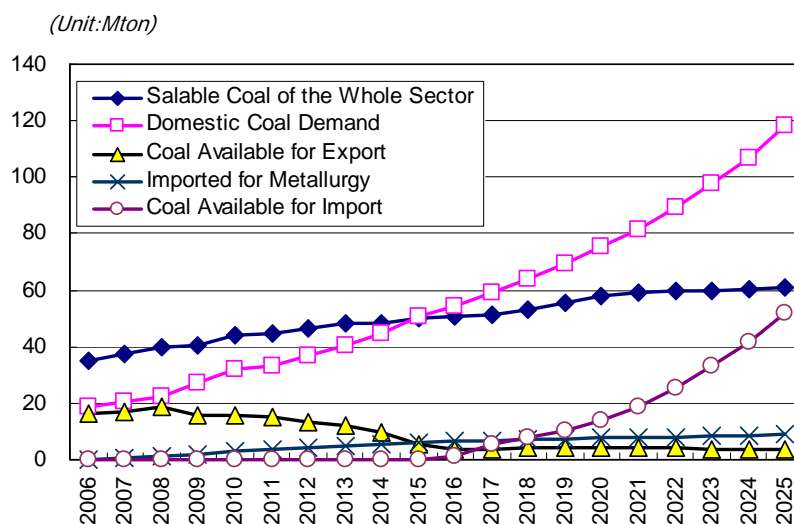
1) Master Plan on Coal Development in Period 2006-2015

The government according to the decision notification on January 29, 2003 approved “the Master Plan on Coal Development for Vietnam in Period 2003-2010.” However, the master plan became meaningless in fact, because coal demand in 2003 already well over that of the master plan at that time. Afterwards, the former Prime Minister Phan Van Khai ordered making the revised edition of the coal development master plan. In December 2006, VINACOMIN submitted “Draft of the Master Plan on Coal Development for Vietnam in Period 2006-2015 with Expectation to 2025” to the Prime Minister Nguyen Tan Dung through Ministry of Industrial, and is under the approval waiting for it.

In “Draft of the Master Plan on Coal Development for Vietnam in Period 2006-2015 with Expectation to 2025”, the development strategy of the coal sector includes the following,

- From now to 2010, the coal production growth rate will be maintained in order to maximally meet the domestic coal demand, take advantages of export to make finance for overcoming negative environmental impacts which outstand in past years, investment in rehabilitation, expansion of coal mines, improvement of infrastructure and investment in development of new mines in order to meet high coal demand in future.
- Sustainable development of coal sector in harmony with development of natural resources, environment and society.
- Encouraging research and development of technologies, conservation measures for saving coal. Application of policy that the users near coal mines will use low quality coal and the users in far distance will use higher quality coal.
- Exploitation of coal with lowest loss in order to increase value of coal resources.

Encouraging research and development of technologies for coal processing in order to increase value of coal in terms of price and use value Creating and operating of coal demand – supply market



(Source) VINACOMIN, “Master Plan on Coal Development for Vietnam in Period 2006-2015 with Expectation to 2025,” December 2006

Figure 2.3-5 Coal Demand Forecast (Case B) of Coal Development Master Plan

in context of international integration.- Flexible operation of coal import and export activities in the directions that coal export from north region and import to the southern region based on the common efficiency of the whole coal sector and national economy.

- Diversification of investment and ownership forms, giving priority to cooperation in investment with foreigners in order to attract advanced technologies and investment capital from domestic and overseas markets.

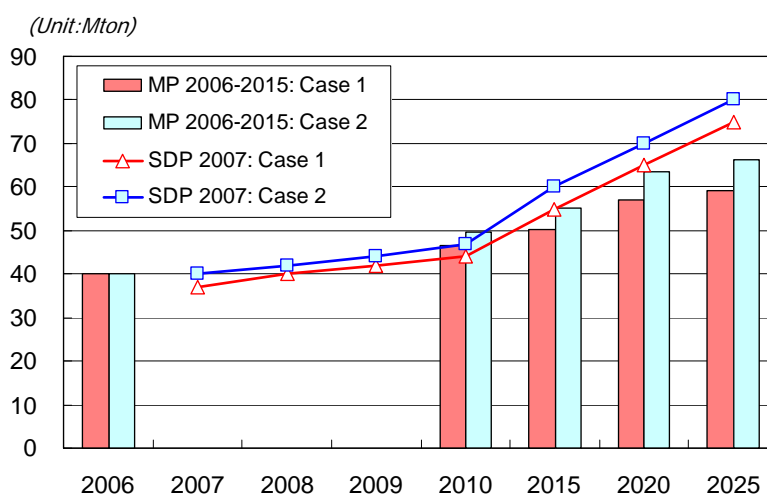
VINACOMIN in this coal development master plan forecasted an average growth rate annually of coal demand for 10.6-10.8% higher, and an average growth rate annually of domestic coal production for 2.2-2.8% lower, and as the result, the coal demand will be exceed the domestic coal production in around 2015. The coal export will decrease until about 2015, and keep a minimum of coal export after that. In other side, shortage in coal supply will be supplemented with the import from Indonesia and Australia.

2) Coal Development Plan of VINACOMIN

The Coal development plan of “Sustainable Development Strategy for Vietnam Coal Industry” that is issued by VINACOMIN in 2007 is basically same as “Draft of Master Plan on Coal Development for Vietnam in Period 2006-2015 with Expectation to 2025.” In this strategy, the growth rate of demand outlook is similar to the master plan until 2025, but the production is made a plan corresponding to domestic coal demand, such as outlook revised down somewhat until 2010 and revised up significantly after 2015. However, coal import from overseas countries will be inevitable because domestic production is not able to meet domestic demand.

The following four items are enumerated as the main issue of the Vietnamese coal sector in the future, and it will become a key how these problems will overcome.

- a) The coal production doesn't catch up with a rapid increase in the domestic coal demand, and after 2015, Vietnam becomes a coal importing country facing serious domestic coal shortage.



(Source) VINACOMIN, “Master Plan on Coal Development for Vietnam in Period 2006-2015 with Expectation to 2025,” December 2006 および “Sustainable Development Strategy for Vietnam Coal Industry,” February 2007

Figure 2.3-6 Comparison of Coal Production Forecasts

- b) It should mine the coal resource that are in deep layer and Red River Delta coal field to achieve the coal production target, but this is necessary the huge finance and production cost becomes considerably high.
- c) The difficulty is caused in coexisting of the environmental protection that adjusts to mining of the above coal resource.
- d) The introduction of advanced coal preparation technology from overseas is required such as improving neither the additional value nor yield at the same time as decreasing the environmental impact, and not developing and applied in Vietnam yet.

3) Import/Export Plan of Coal

Coal export is planned to decrease by 8 million tons from 11 million tons in 2006 and 3 million tons in 2010 in the Commodity export plan between 2006~2010 which was submitted by the MPI and approve by the Prime Minister. But the actual export volume of coal was more than 20 million tons in 2006 showing big difference from the coal export policy.

On the other hand, coal import will increase according to generation from the new coal power plant exclusively burning imported coal in the central and southern part of Vietnam. If the installation of such a big coal power plant as 4GW is completed, it means to increase by 10million tons of coal import annually in future.

4) Infrastructure Plan for Coal Transportation

Coal is transported using the infrastructures such as road, railway and port. Although big development plans of coal-related road and railway are very little except the port infrastructure improvement due to increase of coal import. The candidates of port development in future are as follows; North Vung Anh, Central Son My, Song Can, Van Phong, Nha Trang, Tan Thanh, Cam Ranh, Southern Vinh Tan, La Gi, Tra Vinh, Soc Trang, Ba Trai. There may be the deep ports in the central area, although there may be the shallow ports in the north and south area with shelving bottom on the continental shelf.

2.3.3.2 Review of Coal Price

Recent coal production cost is on the rising trend because of price increase oil products and equipment/materials and cost increase due to changing mining technique from open cut to underground mining. It is forecasted that a management of coal sector is very hard without coal price hike, because a coal export profit is expected to decrease by imposition of 10% as coal export tax after 2007 and more coal preparation cost will be added on in case of preparing all produced coal in future.

On the other hand, VINACOMIN could negotiate coal prices directly with Cement, Chemical Fertilizer and Paper/Pulp industries to increase them by 20% from the previous year, after the deregulation of price decision mechanism, which had been submitted by VINACOMIN, was approved by the Prime Minister in December, 2006. Coal price negotiation with Power sector, the biggest coal consumer, will start after 2008, due to large impact on the electricity tariff of coal price hike. Coal price hike through deregulation of coal price decision process is inevitable to keep the least investment capital in considering increasing production cost, preparing cost and export cost by tax.

2.3.3.3 Affecting Factors to Coal Development Scenarios

The affecting factors to coal development scenarios are as follows;

Securing the proved coal reserves

Whether or not to secure the sufficient proved reserves of coal through detailed investigation, analysis and evaluation?

Results of F/S on the coal development plan of the Red River delta

Whether or not to implement coal mining after 2025 due to the results of F/S on the coal development plan of the Red River delta? Or whether or not to produce a coal by selecting a mining technique of underground gasification?

Coal consumption trend by domestic coal consumer and progress of energy conservation

Whether or not to change the coal consumption by the progress of energy conservation like boiler replacement, of which coal consumptions are composed of domestic coal consumers, especially intensive coal consuming industries such as Power sector and Cement, Construction materials and Paper/Pulp sectors? Especially, whether or not to make progress in installation of coal power plant by IPP consuming domestic coal?

Regulation of coal export and subsidy of coal import

Whether or not to adopt rising up of coal export tax and other policies to enhance the effectiveness of coal export regulation by the Government? Or what kind of policies will be adopted to improve coal import?

Market pricing mechanism of domestic coal price (complete deregulation)

When will market pricing mechanism (complete deregulation) be implemented or can be implemented?

2.4 Oil Sector

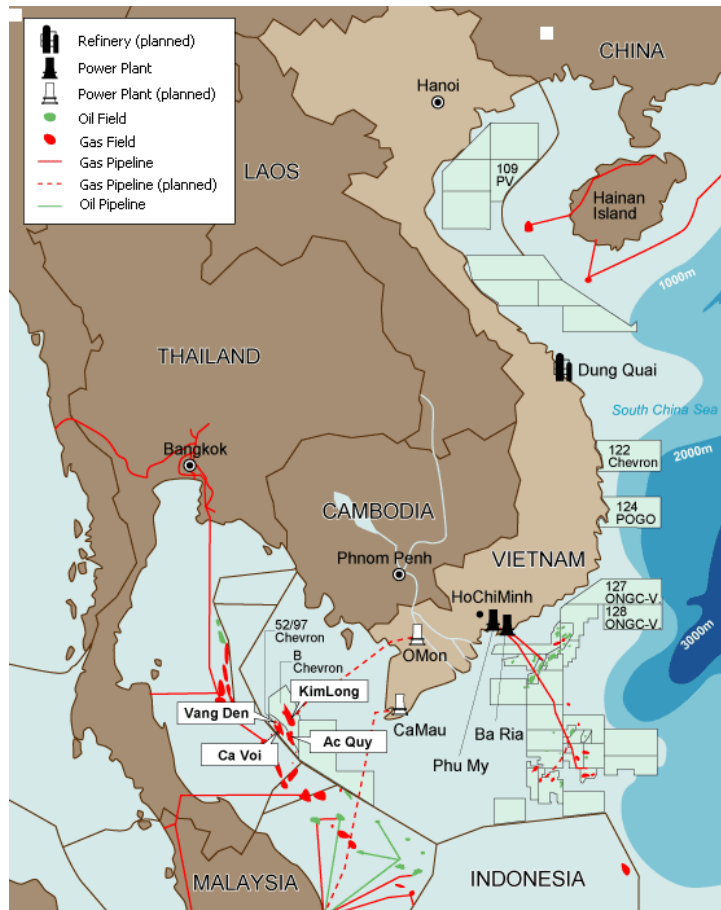
2.4.1 Current Status of Oil Sector

2.4.1.1 Reserves of Oil

Major oil and gas fields under production or development in Vietnam situate mostly in off-shore regions to South-East from Ho Chi Minh City, and to South-West in the Gulf of Thailand and near border of Malaysia. While the current development is centered in off-shore blocks in the South, favorable exploration results are also expected in other regions such as the Gulf of Tonkin in the North and off-shore Central provinces of Vietnam in the East Sea, while outstanding border issues exist with China.

While oil portion is the majority rather than natural gas for the Cuu Long basin, gas portion is larger in other basins such as Nam Con Son, Malay Tho Chu, Song Hong (Red River). Looking at the trend of the reserve since the 1980's, the increase after the 1990's is significant, especially gas, as offshore blocks were opened inviting active exploration of foreign companies. However the growth trend seems declining in the 2000's.

In overall, the ratio of the accumulated production and the potential reserve is about 15-20, while the ratio of the exploited reserves and the potential reserve remains only at 1/5 to 1/7. These figures indicate that further activities are required in the upstream exploration and development.



(Source) Shigeki Sakamoto "Vietnam: New current of the oil & gas Industry"
 JOGMEC Homepage, November 2006

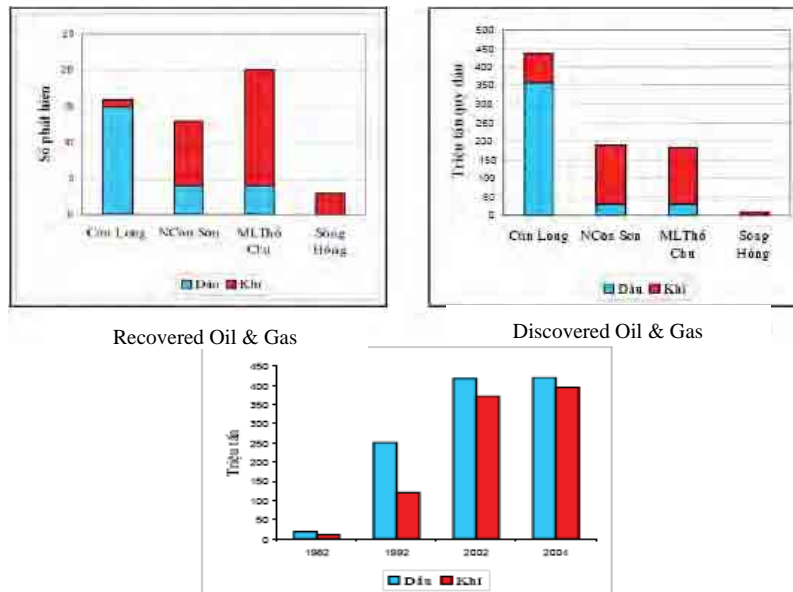
Figure 2.4-1 Main Oil and Gas Exploration Blocks in Vietnam

2.4.1.2 Supply/Demand Trend of Oil

Looking at the oil production trend in Vietnam, the main oil field "Bach Ho" seems to be passing the peak and starting decline in its production. As new oil production is starting at newly developed fields such as Rong, Dai Hung, Rang Dong, Ruby, Su Tu Den, both total production and export hit a peak in 2004, and began to decrease in 2005-6

While Vietnam produces crude oil, no refinery exists in the country. Thus, the country's oil products supply fully relies on import. Transport fuel shares a substantial portion of it, as gasoline and diesel oil shares 30% and 50%, respectively.

Among the petroleum products, jet fuel in transport sector and kerosene in commercial /residential remain levelling off, while demand on diesel oil in the transport and industrial sectors as well as gasoline is increasing steadily. In particular, LPG consumption in industrial, commercial and residential sectors is growing fast, causing rapid increase of production and import.



Reserve of Oil & Gas: 1982-2004

(Source) Seminar of "Vietnam Geology and Oil and gas Resource", Nguyen Van Dac- PVN, Presenter. Địa chất và tài nguyên dầu khí Vietnam, 2007, Tạp đoàn dầu khí Vietnam

Figure 2.4-2 Oil and gas Reserves in the Oil and Gas Exploration Blocks in Vietnam

2.4.1.3 Introduction of Foreign Capitals in Upstream Activities

The domestic upstream activities for oil and gas exploration and development are conducted by the Vietnam Oil & Gas Company (Petrovietnam). Under the Doi Moi policy, the state company aggressively promoted nation's oil and gas activities in the 1990s opening offshore petroleum blocks and inviting foreign oil companies. As a result, Vietnam achieved substantial oil production increase and become a net oil exporting country. At present, there are various forms of oil and gas development contracts in Vietnam such as Product Sharing Contract (PSC), Joint Operating Contract (JOC), Business Cooperation Contract (BCC) and Joint Ventures (JV). As shown in Table 2.4-1, there are more than 30 blocks in Vietnam which are jointly operated with foreign capitals.

2.4.1.4 Players in the Downstream

Import license of petroleum product is controlled by the government, and eleven (11) companies are at present authorized to import petroleum products as shown in Table 2.4-1. Petrolimex is the biggest downstream player among them sharing more than 50% of the total oil product import. The sales amount of the company is evenly distributed among three sectors, which are direct sales to large industrial customers, wholesale to agents and retail marketing. Product-wise, gasoline, kerosene and diesel oil are mainly sold through wholesale to agents and retail outlets, while fuel oil is handled for direct sale to large industrial customers.

Table 2.4-1 Upstream Activities in Vietnam

No	Name of operator companies	Location	Major fields in operation	Cooperation Form
1	PetroVietnam	Block 05-0, Hanoi trough	Dai Hung (O) , Tien Hai C (G) , D14 (G)	participating interest of PV = 100%
2	Vietsovpetro	Block 09-1 & 04-3	Bach Ho (O&G) , Rong	JV, participating interest of PV > 50%
3	Petronas Carigali	Block 01 & 02	Ruby (O)	PSC, participating interest of PV =15%
4	Petronas Carigali	Block 102 & 106		PSC, participating interest of PV =20%
5	Hoan Vu	Block 09-2		JOC, participating interest of PV =50%
6	VRJ	Block 09-3		JOC, participating interest of PV =35%
7	Cuu Long	Block 15-1	Su Tu Den (O)	JOC, participating interest of PV =50%
8	JVPC	Block 15-2		PSC, participating interest of PV =17.5%
9	Hoang Long	Block 16-1		JOC, participating interest of PV =41%
10	BP	Block 05-2		PSC, participating interest of PV =17.5%
11	BP	Block 05-3		PSC, participating interest of PV =15%
12	BP	Block 06-1	Lan Tay - Lan Do (G)	PSC, participating interest of PV =20%
13	Vamex	Block 07 & 08/03		PSC, participating interest of PV =15%
14	KNOC	Block 11-2		PSC, participating interest of PV =25%
15	Premier Oil	Block 12 W & E		PSC, participating interest of PV =15%
16	Conoco Philips	Block 133 & 134-1		BCC, participating interest of PV =30%
17	VietGasprom	Block 112 & 113		JOC, participating interest of PV =50%
18	Talisman Malaysia Ltd.	Block PM3-CAA		PSC + CAA, participating interest of PV =12.5%
19	Chevron Vietnam	Block B & 48/95		PSC, participating interest of PV =23.5%
20	Chevron Vietnam	Block 52/97		PSC, participating interest of PV =30%
21	Chevron Vietnam	Block 122		PSC, participating interest of PV =20%
22	Talisman Vietnam	Block 46- cai nuoc	Cai Nuoc (O&G)	PSC, participating interest of PV =30%,
23	Con Son	Block 10 & 11-1		JOC, participating interest of PV =55%
24	Lam Son	Block 01/97 & 02/97		JOC, participating interest of PV =50%
25	Truong Son	Block 46/02		JOC, participating interest of PV =30%
26	Idemitsu	Block 05-1b & 05-1c		PSC, participating interest of PV =15%
27	Thang Long	Block 15-2/01	Rang Dong (O&G)	JOC, participating interest of PV =40%
28	Pogo Producing Company	Block 124		PSC, participating interest of PV =20%
29	ONGC Videsh	Block 127		PSC, participating interest of PV =20%
30	ONGC Videsh	Block 128		PSC, participating interest of PV =20%
31	Santos	Block 101-100/4		PSC, participating interest of PV =20%

Note: O= Oil, G= Gas.

Source: Petrovietnam brochure 2007

Table 2.4-2 Petroleum Importing Companies in Vietnam

No.	Name	Under (Belong to)	Share (2005)	Name in Vietnamese
1	Petrolimex	Ministry of Trade	57.0%	Tổng công ty xăng dầu VN
2	Petec	Ministry of Trade	10.8%	Công ty Thương mại kỹ thuật và đầu tư
3	SaigonPetro	HCM people committee	7.5%	Công ty cổ phần một thành viên Dầu khí TP. Hồ Chí Minh
4	PDC	Petroleum Group of VN	5.0%	Công ty Chế biến và kinh doanh các sản phẩm dầu mỏ
5	Petechim	Petroleum Group of VN	3.2%	Công ty Thương mại Dầu khí
6	Mipeco	Ministry of Defence	3.6%	Công ty Xăng dầu quân đội
7	Vinapco	Vietnam Air Corp.	3.5%	Công ty xăng dầu hàng không
9	Petromekong	Private Company/ Can Tho people committee	2.2%	Công ty liên doanh dầu khí Mèkông
8	Petimex	Private Company/ Dong Thap people committee	7.3%	Công ty Thương mại Dầu khí Đồng Tháp
10	Pygemaco	Private Company/ Phu Yen people committee		Công ty vật tư tổng hợp Phú Yên
11	Vitranschart	Vietnam Maritime Administration		Công ty vận tải và thuê tàu biển
			100.0%	

(Source) Ministry of Trade and Custom General Department

2.4.1.5 Price of Oil

Vietnam exports the domestic crude oil based on the international market price, and imports the

petroleum product similarly. Prices of petroleum products have tripled in the recent three years reflecting the steep price oil hike in the international market.

As for the natural gas pricing system, a double tier pricing is applied to associated gas and non-associate gas. They are supplied to the Phu My power station and other limited users in the adjacent area such as a fertilizer plant. Prices of natural gas are set at low level less than half of the Henry Hub or NBP (National Balancing Point) prices which represent the US and UK gas markets, or the Asian LNG import price².

2.4.1.6 Transportation Infrastructure of Oil

Table 2.4-3 Oil Transport and Storage Systems in Vietnam

Items	Description		Note
Petroleum products import	13,120,000 m3 (2004)		100% imported
Share of each oil company	Petrolimex 58.5%, PETEC 14%, PDC-PV 8.5%, Others		
Oil terminal	Numbers	Nominal	
Total	87	2,016,000 m3	
Primary oil terminal	17	1,448,000 m3	
Secondary oil terminal	70	568,000 m3	
Trans.	Ocean tankers	15 + 9 (LPG)	
	Coastal tankers	39	
	Barges	137	
	Tank trucks	1,368	
	Pipelines	Approx. 300 km	

(Source) MOI ,IEEJ report "Survey on International Oil demand and supply system 2006"

Since there is no oil refining facility at this moment in Vietnam yet, necessary petroleum products are imported for delivery to end-users.

There are 17 primary terminals to receive imported oil products by ocean going vessels and 70 secondary depots located in the downstream side to distribute products to end-users. Coastal tankers and barges are used for domestic surface-transfer and tank-lorries are used on land transport.

2.4.2 Issues in Oil Sector

2.4.2.1 Issues of Oil Supply

a) Recoverable reserves

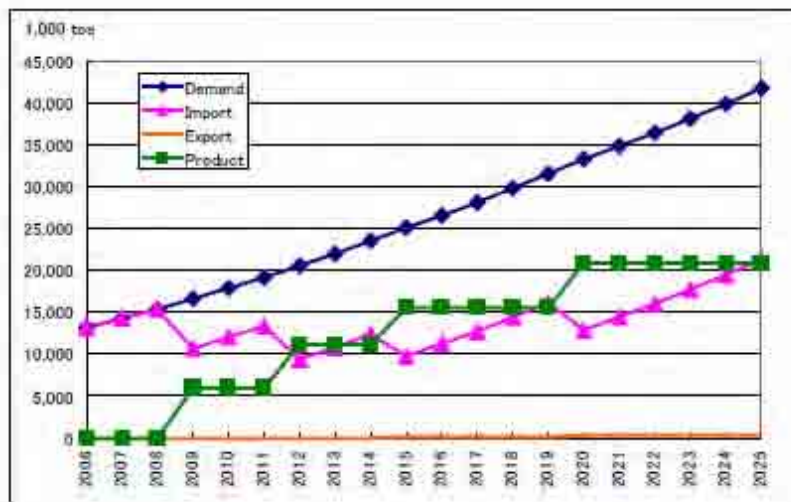
With recent high oil price, some of smaller oil fields which were ranked as non-feasible before are becoming commercially feasible in the present market. Therefore, it is preferable to conduct re-evaluation of the realistic recoverable reserve figures reflecting recent higher prices, maybe applying stepwise approaches corresponding to different price scenarios to utilize nation's hydrocarbon resources to the maximum extent.

² According to BPStatistics (2007), natural gas price (\$/million Btu) in the world region(2006) are as follows: Japanese LNG (cif): 7.14, EU (cif): 8.77, UK (NBP): 7.87, USA (Henry Hub): 6.76

b) Infrastructure of oil import

In a mid/long term future, Vietnam will become a net oil importing country, and the realistic import origin will be the Middle East. Then, it is an important requirement to construct harbors able to accept VLCC class tankers considering an efficient crude oil import. Since oil import from the Middle East depends upon sea transport, it will be required to consider the sea lane security and to maintain the good-relationship with countries located along the sea transport route. In addition, in consideration of increased dependence on import oil, it is also needed to establish the Strategic Petroleum Reserve facilities and operating system.

	2010	2015	2020	2315
Demand	17,905	26,114	33,271	41,744
Import	12,005	9,785	12,825	21,285
Export	0	168	338	326
Product	5,900	15,497	20,784	20,784



(Source) MOI, IEEJ report " Survey on International Oil demand and supply system2006"

Figure 2.4-3 Petroleum Products Demand Forecast in Vietnam

Measures to enhance stable oil import should be considered, in collaboration with other Asian oil importing countries from the Middle East such as Japan, Korea, Taiwan, China, which are located east of the Strait of Malacca, for example, exploring possibility of supply sources which does not need to pass through the Strait of Malacca, or facilitate the oil transportation pipeline plan (Trans-Malay Pipeline Concept) across the northern part of the Malay Peninsula.

2.4.2.2 Issues on Oil Demand

a) Domestic Resources Availability to respond the Increasing Demand

Petroleum product demand in Vietnam in 2025 is forecast to be three times bigger than the current level, which would not be fully supplied with the domestic resources. At the same time, from the viewpoint of national income, the revenue obtained by the crude oil export is diminishing as expense by the energy import increases. Therefore, it is one of the important policy objectives to utilize the indigenous resources as efficient as possible and curb the import at a minimal level.

b) Capacity of refinery facilities

Oil refinery construction is underway in Vietnam with capacity plan at around 150,000 barrels per day. As economics of scale work strongly in this sector, it should be desirable to consider a world-class higher capacity in the future plan. The next refinery project is proposed to incorporate some plastic plants for synthetic resins such as poly-ethylene, vinyl chloride resin, polypropylenes and polystyrenes. Considering the capacity of petrochemical projects, for ethylene plant, which is the base of petrochemical (starting of the various petrochemical derivatives), annual production capacity of 1,000,000 (one million) ton level may be a sort of a standard for new construction as a world class plant. However, it is not realistic for Vietnam to construct such a large scale plants with the limited demand in a single country. The market scope should be enlarged to “Greater Mekong Sub-region” (GMS), which covers Vietnam, Thailand, Laos, Cambodia, Myanmar, and Southern region of China (Yunnan). It is more realistic to explore for regional collaboration linkage in order to materialize efficient plans.

Upon completion of the so-called second Mekong International Bridge crossing the river at the Thailand-Laos border in December 2006, financed with Japanese Yen Credit, the East-West Corridor of GMS was set up. This enables the on-land linkage of the region by truck from Da Nang, Vietnam, located at the East coast of the peninsula, to Moryamain in Myanmar facing to the Indian Ocean at the West coast. Combining other South-North Economic Corridor (Expressway)³ and Southern Economic Corridor (Expressway)⁴, the three Economic Corridors (Expressways) of GMS enable to share the overall GMS regional market. Planning downstream refineries and petrochemicals, it is now possible to consider such a new, greater market for economic effectiveness.

The Petroleum Law of Vietnam issued in 1993 and amended in 2000 emphasizes on the activities of upstream operation, while description on the middle/down-stream activities seems to be relatively lean. Therefore, it would be appropriate to amplify the relevant sections to promote investment of foreign capitals and private sectors into the field of petroleum refining or petrochemicals

c) Development and penetration of alternative fuel based on bio and gas/coal

Vietnamese energy demand in the transportation sector is regarded to grow steadily, where most portion of it is consist of petroleum products such as gasoline and diesel. In response to such motor fuel demand growth, great expectation is put on introduction of non-petroleum origin synthetic fuels such as substitute diesel fuel (bio-ethanol, bio-diesel) from bio-materials. Enthusiasm is growing both in the eastern and western hemispheres on the bio-fuels. As they are still under research and development stage toward commercial technology and commercializing systems, development of bio-fuel will be greatly enhanced in Asia along with the Japanese proposal made at the East Asia Summit meeting. As Vietnam is endowed with necessary resources for developing bio-fuels such as sunshine, water and high temperature, its development is one of the important policy objectives in the energy field.

In terms of the development of non-petroleum origin synthetic fuel, GTL (Gas-to-Liquid) / DME

³ The route connects Bngkok, Thailand and Kunming, Yunnan Province, China, via Laos and Myanmar, and the one connects Kunming, Hanoi, and Nanning. These are the access route to the Southern China Economic Zone.

⁴ The route connecting cities in Southern region such as Ho Chi Minh, Phnom Penh, Bangkok

(Di-Methyl-Ether), based on synthesis gas from gasified coal or natural gas, would be the subject to consider, especially resource diversification viewpoint. However, looking at recent cost escalation of plant construction materials or shortage of required work force for EPC work, it would not be an appropriate timing to rush to GTL / DME. However, subject to future circumstance change, there are possibilities to consider such facilities as self-production/consumption system at isolated locations or as CDM projects under the Kyoto Protocol mechanism.

2.4.3 Supply Plans for Oil Sector

2.4.3.1 Development Plan for Oil Sector

a) Introducing foreign capitals for oil & natural gas development

In the world energy sector, international companies such as oil majors, independents and technical service companies are playing important roles in the energy development. They own high, front-edged technologies as well as sufficient financial capabilities standing for the long-term requirement. Their capability should be sufficiently mobilized for efficient development of energy resources in Vietnam. To this end, terms and conditions of petroleum contracts should be from time to time studied and reviewed to maintain preferential position.

b) Refinery Plan

Since there is no refinery in Vietnam, it exports all the produced crude oil and imports entire quantity of the required oil products. The first refinery in the country is under construction at Dung Quat in Quang Ngai Province, Vietnam for completion in the first quarter of 2009. Major facilities of the refinery include an atmospheric distillation unit (148,000BPD or 6.5 million TPA), RFCC unit, LCO hydrotreating unit, naphtha hydrotreater, CCR, sulfur recovery unit and offsite/utilities facilities. It at first receives domestic crude oil and high-sulfur imported crude oil will be introduced up to 15% as the feedstock after 2020. The second refinery is to be located at Nghi Son, 200km south of Hanoi, having 140,000BPD or 7 million TPA to start up in 2015. Low sulfur domestic crude and high sulfur imported oil will be introduced evenly.

Table 2.4-4 Characteristics of No1, No2 and No3 Refineries

	No. 1	No. 2	No. 3
Location	Dung Quat	Nghi Son	(Southern Region)
District, Province	Binh Son, Quang Ngai	Tinh Gia, Thanh Hoa	
Commissioning year	2009	2015	after 2020
Capacity (1,000 ton/year)	6,500	7,000	- > or bigger
Feed crude	- 2020 : 100%: Vietnam sweet crude	50%: (Vietnam) sweet crude	- >
	2020 - : 15%: Sour crude(imported)	50%: (Imported) sour crude	- >
Notes			Combined with basic chemical plant(s) based on imported crude

(Source) Strategic reports, Master plan on national petroleum stockpile system in the period 2006-2015, with outlook to 2025

The third refinery planned in the southern region will have the same capacity as the second one,

combined with basic chemical plants in the refinery down stream to form a complex.

Ultimately, total 15 million tons of petroleum products excluding LPG, will be supplied to the market. Efficient logistics linking these supply points and major markets in Vietnam (HCM in the south, Hanoi in the north, etc.) will be the issue to be considered in the downstream sector such as system for smooth efficient distribution and storage of products.

Besides the above-mentioned three refineries, foreign investors are directly talking to local governments with the central government authorization, to install refineries in Nhon Hoi and Phu Yen Province, respectively. Former one is planned by Hong Kong investors to construct 5 million TPA with 1.5 billion USD. Latter one is by British-Holland investors of 3 million TPA. Both of them are planning to receive import crude and produce combined 5.4 million tons of products excluding LPG.

The second and third refineries are now under planning. As it needs many years to finalize the design and complete construction before reaching the operating stage, it is required to carefully consider the freedom degree of crude oil selection in future operation.

c) Oil Transportation Infrastructure

Currently, there is no refinery in Vietnam, and all petroleum products are imported. After the first refinery starts up, it will become the new origin of domestic distribution of products, as only import terminals have the function at present. Further, as new refineries in Vietnam such as in Dung Quat, Nghi Son, and others start up, the import portion in the whole petroleum products supply will decrease, and distribution and storage system may need to change. The current delivery system to the destinations of consumer markets in the North, Central, and South made by mainly coastal tankers and tank-lorries, will have to be modified and optimized considering these new bases.

Also, it shall be noted that function/system of national strategic oil stockpiling should be required and installed, when Vietnam becomes an oil importing country. Location of crude oil/product storage facilities should most probably be next to or within the area of these refineries, considering initial investment saving, operation of common loading/un-loading or storage facilities and efficient utilization of the stock in emergency response. It is rational that the government aims at combined design and operation of these facilities classifying them as national infrastructure for distribution and storage. However, these are in principle business of the private sector, and the government should limit its role within guideline setting or construction of infrastructure such as road and port system in accordance with the comprehensive national land development plan.

2.4.3.2 Issues of Concern in Oil Sector

From the Supply/Demand viewpoint, the following are the issues of concern in the oil sector.

a) Progress of oil/gas field development

- 1) Through deregulation and liberalization, to what extent introduction of foreign investments and efficient materialization of natural resources would progress?
- 2) As a result, including the existing players' achievement, how much quantity of domestic resources could be taken into account additionally as assured supply sources?

b) Development of infrastructure relating to petroleum refining, storage, and distribution

1) Vietnam will become an oil importing country in medium-long term. Then, it is required to prepare the function/system for oil stockpiling. How to construct such system in harmony with the international standard, such as the IEA framework?

2) Synchronizing the timing among the following activities is important.

- Installation of stockpiling function/system
- Construction of No.1, 2, 3 refineries
- Infrastructure preparation for oil product distribution, etc.

c) Gasoline and diesel demand growth by motorization

1) What would be the motor fuel tendency which shares a major portion of the petroleum product demand, pending future trend of national living standard and domestic energy prices?

2) Since oil products are chain product, when demand for lighter products and middle distillates increases unevenly, how to dispose the heavy end products like fuel oil?

d) Trend of Energy Price

1) What would be the level of oil price in the international market?

2) How would the oil price affect the oil demand trend?

e) Possibility of the linkage with the neighboring market

1) Is it possible to incorporate neighboring countries as the common market such as Greater Mekong Sub-region, ASEAN, and APEC?

2) From the above consideration, to what extent scale-merit should be pursued in construction of new production facilities/plants?

2.5 Natural Gas Sector

2.5.1 Current Status of Natural Gas Sector

2.5.1.1 Reserves of Natural Gas

Natural gas production in Vietnam became substantial in 1990. At the beginning, associated gas shared majority in the production, while non-associated gas production increased after production started from Lan Tay gas fields in the Nam Con Son basin in 2000. It is a remarkable feature of Vietnam that more than 80% of gas is used for power generation. As for gas consumption in Industrial sub-sectors, almost a half is used in the chemical sub-sector mostly for fertilizer (ammonia/urea) production.

2.5.1.2 Price of Natural Gas

Gas price differs among sectors in the current domestic trade⁵, i.e., 2.5-3.8 USD/MMBtu for power generation, 1.5-2.0 USD/MMBtu for fertilizer production, and 3.0-4.6 USD/MMBtu for food processing, etc. Especially, users of the fertilizer production sector request lower price. The government approves this request paying make-up to Petrovietnam out of the revenue of sale for the power sector. This is may be because the power sector is able to accept higher gas price, since they can dilute it with other power sources and/or pass it on to the end-users.

⁵ Hoang Thi Phuong, "Policies and solutions for gas market development in Vietnam", GASEX Conference in Beijing, China 2006

2.5.1.3 Transportation Infrastructure of Natural Gas

There is a pipeline system in the southern region to send out natural gas from offshore fields to on-shore. However, general gas market is not formed yet in Vietnam as gas infrastructure such as trunk-pipeline and delivery system is yet to be developed.

2.5.2 Issues on Natural Gas Sector

2.5.2.1 Natural Gas Supply

a) Transportation Infrastructure of Natural Gas

Current natural gas utilization is featured by the power generation as the core demand, sending the natural gas from the off-shore gas fields to them. Gas is also fed to ammonia/urea fertilizer plant situated neighboring the core demand. The necessity of domestic transportation and the distribution pipeline construction will become greater in near future, as the gas utilization in the country increases, and the gas market expands. On the other hand, it is conceivable to import natural gas from neighboring countries, i.e., the joint development area with Malaysia and Thailand in the South-West offshore region, or potentially from Cambodia.

As there is a case that development is withheld since the preliminary exploration outcome indicates that high carbon dioxide (CO₂) content in the produced gas, best available technologies to process/treat such gas shall be applied for effective utilization of the stranded resources.

2.5.2.2 Natural Gas Demand

a) Infrastructure Preparation

The immediate task for the natural gas sector is to develop infrastructure such as domestic transportation and distribution pipelines, and promote natural gas demand for diversification of national energy supply. As a huge increase of natural gas demand is expected in Vietnam, it is required to properly guide the potential demand and thus develop new outlets. To this end, it is desirable to implement effective measures such as systematic construction and expansion of trunk and delivery pipelines, gas utilization campaign for new plants and buildings, fuel conversion at existing facilities and new effective utilization technologies such as Natural Gas Vehicles and co-generation.

b) Domestic Resources Availability to respond to the Increasing Demand

In addition to the gas fields to be developed in the southern region, increase of the domestic natural gas resources are expected in the unexplored areas such as Tonkin Gulf and offshore Central region. In addition to such new domestic resources, increasing demand on natural gas may have to rely upon import also in future.

The natural gas supply/demand balance in Vietnam is forecast to get tighter and supply would be in short. In other words, gas demand would increase much faster than the forecast taking the potential demand into account. As it is uncertain at this moment if the natural gas supply could catch up with the fast increasing potential demand, it is necessary to fine tune the gas market development plan through cross checks with progress of upstream exploration.

c) Issues of Gas based Thermal Power Plants

The role of gas-based power-plant is important in the gas field development, since its committed gas

demand should be regarded as the anchor demand when gas fields are developed. Thus, in the natural gas power station development plan, it is necessary to consider it not only for optimization of the power source mix but also for the national energy structure appropriation. Likewise, it is necessary to carefully examine the impact of changes in nuclear power development plan on the power source mix as well as the primary energy supply structure.

d) Penetration of Natural Gas by Policy Guidance

In the energy sector of Vietnam, it is an important issue how to cope with the increasing fuel demand in transportation sector and industrial sector. Should governmental guidance⁶ be mobilized from the viewpoint of improving the national energy structure, natural gas demand would further increase substituting transportation fuel with CNG and aggregating potential demand along the newly extending trunk pipelines.

e) Outlook of Natural Gas Price

The price of natural gas from the Nam Con Son basin, the first natural gas utilization in Vietnam, has been the benchmark of natural gas price in Vietnam, which is set low compared with the current international price and suppressing following gas exploration and development. In order to promote exploration and development, however, it may be fair and preferable to shift to application of international market price with due consideration on project by project cost structure.

2.5.2.3 Factors affecting Natural Gas Developing Scenarios

The following issues are concerned.

a) Progress of oil/gas field development

- 1) Through deregulation and liberalization, to what extent introduction of foreign investments and efficient materialization of natural resources would progress?
- 2) As a result, including the existing players' achievement, how much quantity of domestic resources could be taken into account additionally as assured supply sources?

b) Power source mix in future

- 1) To what extent the start-up timing and size of the nuclear power plants would give impact on the natural gas demand?
- 2) Is there any possibility that specific energy source would be focused on as a result of the international consensus on global warming affecting natural gas demand?

c) New Technologies for effective utilization of natural gas

- 1) Would innovative technologies appear for effective use of natural gas such as technical break-through on substantially lowering Fuel Cell cost, etc?
- 2) Would natural gas promotion policy be enhanced in the field such as cogeneration or natural gas vehicles?

d) Energy Price Outlook

- 1) What would be the level of natural gas price in the international market?
- 2) How and to what extent would the natural gas price affect the demand trend?

⁶ For example, obligation to use or well-treatment in tax etc. of Natural Gas Vehicles in urban area,

e) *Linkage with neighboring market*

Is there any possibility of developing regional natural gas system within the realistic scope of this study in collaboration with neighboring countries such as Greater Mekong Sub-region, ASEAN, and APEC?

2.6 Renewable Energy

2.6.1 Current Status of Renewable Energy Sector

2.6.1.1 Potential and Current Use of Renewable Energy

Renewable energy accounts for the biggest share in the energy supply and demand in Vietnam, and it is expected to still play an important role in the future.

However, the most basic use of renewable energy in Vietnam is biomass for heat. Fuelwood, agricultural residue and animal waste are used as heat source of households. Small hydro and bagasse is used for power generation, though their generation in 2005 was only 265.57GWh, which was approx. 0.5% of the total power generation (51769.68GWh) in Vietnam⁷

Table 2.6-1 Present Status of Solar power by Region

Region	Status
North	40-75Wp: Home; 450 systems, as of Dec. 2004
	165-525Wp: Border defence stations and bases in islands; 94 systems, As of Dec. 2004
	165-300Wp: Clinic and cultural houses; 42 systems, As of Dec. 2004
	35kWp: Quang Ninh, 2systems financed by Government of Vietnam
	6.67kWp: Si Hai Commune, Cao Bang Province
	3kWp: Ai Quoc Commune, Loc Binh District
	195kWp: Telecommunication sector
115.5kWp : Marine Navigation Sector (260 systems for ocean and river navigation lamp)	
Central	125kW: Small Hydro- Solar Hybrid
	9kW: Wind- Solar Hybrid
South	500-1000Wp: Centers of Communes
	250-500Wp: Clinic and cultural houses
	22.5-50Wp: Home; 800 systems

(Source) IE: 6th Power Development Master Plan (Draft), 2007

Looking at the renewable energy potential and current use, the proportion of renewable energy use is low compared to the potential, although accuracy is not high in evaluating each energy resource.

a) *Solar*

Potential

Vietnam is relatively rich in the solar energy potential with 4.5kWh/m²/day of annual average sunshine nationwide. Especially solar potential of central and central-southern provinces, where amount of solar radiation is stable throughout the year, is high. For example, Nha Trang city (Khanh Hoa Province), located in the central coastal area, shows 5.15kWh/m²/day of annual average sunshine hours, which is substantially higher than that of Japan (3.4-4.4kWh/m²/day). According to the ESMAP, Renewable Energy Action Plan, 2002, it is estimated that the solar potential for household in unelectrified areas is 2MW.

7 INDUTEC: Supplemental Data Collection and Questionnaire Survey, 2007

Current Use

Looking at the current status of solar power installation in Vietnam, total installed capacity is 1,152kWp⁸ at December, 2004.

Future Prospect

There are 2 main barriers to install solar power. The first is high initial investment cost. In general, PV (Photovoltaic) panels are imported, and cost of PV panel is about 8.0-8.5US\$/Wp to which transportation cost (5-7%) should be added.

Second one is the capacity of PV panels. The average capacity of a PV panel is small (22.5Wp), and it is often overloaded and damaged in case that the power demand is high.

Therefore, the dissemination of solar power would be possible if the barriers are overcome by the following measures.

- Reduction of initial investment cost by domestic production of PV panel and financial support by the government
- Technology development for increase of PV panel capacity

b) Wind

Potential

Various studies have evaluated the wind power potential in Vietnam. Because there is no comprehensive wind measurement data covering whole country, there is a large difference between the evaluated potentials. According to the 6th Power Development Master Plan (Draft), wind power potential of areas which wind speed is over 3m/s is evaluated as 600MW.

In the World Bank “Wind Energy Resource Atlas of Southeast Asia, 2001”, average wind speed in South-East Asia is estimated by simulation analysis. Based on the flow of upper atmosphere, using ground level altitude, land coverage pattern, degree of vegetation activity, geographic features and roughness of ground, wind speed at 65m above ground is simulated. It doesn't use the wind measurement data near the ground, which has a large margin of error. According to the result, it is estimated that, in central coastal area, average wind speed is over 9m/s according to seasons.

Table 2.6-2 Present Status of Wind Power by Region

Area	Capacity	Commencement of Operation	Note
South coastal area of Da Nang	About 1,000 units (150-200W)	as of 1999	-
Hai Thinh Commune, Hai Hau District, Nam Dinh Province	30kW	1999	Gov. of Japan
Dac Ha District, Con Tum Province	2kW	2000	-
No Data (to be confirmed)	3.2kW	2002	IE
Bach Long Vi Youth Island	800kW	2004	Gov. of Vietnam

(Source) IE: 6th Power Development Master Plan (Draft), 2007

⁸ Wp: Watt Peak; Unit of peak power of PV (photo voltaic) panel under standard conditions of 1,000W/m² of intensity, 25 degree Celsius ambient temperature, 1.5 of Air Mass

In the EC-ASEAN Energy Facility Programme, based on the above simulation, it is estimated that the wind power potential in Vietnam is 22,400MW. It is quite high compared to other estimations. It assumes that 20% of potential area evaluated as “Relatively High”, “High” and “Very High” shall be developed.

Current Use

The total installed capacity is about 1MW, but there is no grid-connected wind power plant in Vietnam. The Bac Long Vi Island wind power project (800kW, Spanish-made, commencement of operation: 2004), which is the largest in Vietnam, has been stopped due to operational problems. The Vietnamese Government funded the project and a Vietnamese local NGO (Youth Association) is responsible for development, operation and maintenance. However, because appropriate technology transfer had not been implemented and the supply contract of maintenance parts was terminated, it can not be operated.

Table 2.6-3 Development Status of Wind Power Generation

Project	Capacity	Progress	Note
Quy Nhon	15 MW (There is an expansion plan up to 100MW in the future)	Bidding procedure of EPC for initial 15MW is finished	BOT by Phuong Mai Joint stock Company
Phy Quy island (Binh Thuan province)	1st stage : 10MW (2007) 2nd stage : 10MW (after 2010)	F/S is completed by PECC3	Invested by EVN
Qui Nhon	54MW and 80MW	F/S is completed by Grabovski company (Germany)	Under tariff negotiation with EVN
Ninh Phuoc district, Ninh Thuan province	625 kW	Pre-F/S is completed, waiting for the approval of Gov. of India	Pilot plant conducted by Gov. of India (55%) and Gov. of Vietnam (45%)
Ly Son island, Quang Ngai province	No Data	F/S is completed	Looking for investors

(Source) IE: 6th Power Development Master Plan (Draft), 2007

Future Prospect

According to the 6th Power Development Master Plan (Draft), the total installed capacity will be about 170MW. In the past, the following were indicated as the issues and subjects for the evaluation of wind power potential.

- There is no comprehensive wind measurement data covering whole country
- The common wind data is measured at about 10m from the ground, so it is affected by the roughness of the ground, and has a large margin of error

However, IE has started a detail wind potential survey, and by April, 2007, has already completed the survey in Ninh Tuan Province and confirmed 100MW potential. IE plans to implement the survey in potential provinces accordingly and an early grasp of the wind power potential in Vietnam is expected.

c) Small Hydro

Potential

According to the 6th Power Development Master Plan (Draft), small hydropower potential (equal or less than 30MW) is estimated to be over 2,300MW and 8,000-9,000GWh. However, since some potential sites are located far from load center and their economic feasibilities are expected to be low, good coordination with local economic development plans is necessary. According to the ESMAP, Renewable Energy Action Plan 2002, small hydropower (under 10MW) potential is estimated to be 800-1,400MW, of which 110-115MW has been developed.

Table 2.6-4 Potential and installation Status of Hydro Power under 10MW

Resource	Potential		Current Use		Location
	Capacity (MW)	Households served	Capacity (MW)	Households served	
Pico-hydro	90-150	200,000-250,000	30-75	100000	North & Center
Isolated mini-grids	300-600	300,000	20	-	North & Center
Grid connected mini hydro	400-600	-	60	-	North & Center
Total	800-1,400	-	110-155	-	North & Center

(Source) UNDP/World Bank: ESMAP, Renewable Energy Action Plan, 2002

Current Use

There are 49 grid-connected small hydropower plants (total capacity: 64MW, unit capacity: 100kW-10MW, 1 plant is stopped). And there are about 300 off-grid small hydropower plants (total capacity: 70MW, unit capacity: 5-200kW) in the northern and central provinces, but their reliability is low and more than half of them have been stopped. Also, about 150,000 of small hydropower system (0.1-1kW) for households have been sold⁹.

Future Prospect

The approach to small hydropower development in Vietnam is as follows.

- Grid-Connected: Small Hydropower Development based on 6th Power Development Master Plan (Draft)
- Off-Grid: Upgrade/Renewal of the exiting hydropower plant and Development of hybrid system (ex. Solar and Small Hydro)

d) Biomass

Potential

According to the VIAEPT (Vietnam Institute of Agricultural Engineering and Postharvest Technology) under MARD (Ministry of Agriculture and Rural Development), it is estimated that the total amount of biomass resources in Vietnam is about 30 million ton/year. Assuming that one third of the biomass resources are used for power generation, its potential is about 500MW.

⁹ JEPIC: Electricity Power Industry of Foreign Countries, 2006

Current Use

- Heat

Biomass is one of the most basic energies in the remote and mountainous area, and fuelwood, agricultural residue and animal waste are used as heat source of households. Vietnam is agricultural country, and there are huge amount of biomass resources such as bagasse, rice husk

Table 2.6-5 Annual Production and Potential of Biomass Resources

Biomass Resource	VIAPET	REAP		IE		COGEN3	
	Annual Production (1,000t)	Annual Production (1,000t)	Capacity (MW)	Annual Production (1,000t)	Capacity (MW)	Annual Production (1,000t)	Capacity (GWh) *
Bagasse	5,000	4,500	150-200	5,500	150-200	3,480	1,160
Rice Husk	10,000	6,400	100-200	6,600	70-150	6,160	4,107
Rice Straw	5,500-7,000						
Coconut Husk	3,600-4,000				30-50		
Coffee Husk	1,200						
Cashew Nut Husk	1,000						
Wood Residue	3,000-4,000		1-5	480	5		
Total	30,000		250-400		250-400		

(Note) Fuel Consumption Rate: Bagasse: 3kg/kWh, Rice Husk: 1.5kg/kWh

VIAEPT, IE, UNDP/World Bank: ESMAP, Renewable Energy Action Plan, 2002, EC-ASEAN Programme, COGEN3

Table 2.6-6 Biomass Energy Consumption by Use (2000)

Type of use		Biomass Energy Consumption (ktoe)					
		Fuelwood	Rice husk	Rice straw	Bagasse	Others	Total
Heat	Cooking stoves	6,997	665	1,950	165	890	10,667
	Kilns (Construction materials/porcelain)	663	140			100	903
	Ovens (Agricultural, food processing and others)	1,145	110		100	698	2,053
Electricity	Cogeneration				377		377
Total		8,805	915	1,950	642	1,688	14,000

(Source) IE: 6th Power Development Master Plan (Draft), 2007



Figure 2.6-1 Bagasse and Co-generation System (Sucrerie de Bourbon Sugar Company)

- *Power Generation (Bagasse)*

Most of sugar mills have installed cogeneration system using bagasse, which generates heat and electricity necessary for sugar production.

3 sugar mills, Son La Sugar Mill (Son La Province), La Nga Sugar Mill (Dong Nai Province), Sucrierie de Bourbon Tay Ninh Sugar Mill (Tay Ninh Province), provide surplus electricity to the power grid.

Sucrierie de Bourbon Tay Ninh Sugar Mill has installed the largest cogeneration system in Vietnam. Its capacity is 24MW (12MW x 2) and 9-10MW is used at the sugar mill and the rest is sold to the power grid (EVN). The current electricity sales price is 4.15 US-cent/kWh, which is valid for 3years, and after it has expired, the sugar mill and EVN shall negotiate on price and validity period.

Sucrierie de Bourbon Tay Ninh Sugar Mill once had the expansion plan of sugar production and cogeneration system, however it was stopped because it was difficult to procure necessary amount of sugarcane.

- *Power Generation (Rice Husk)*

According to EC-ASEAN COGEN Programme, there are about 130 rice mills in Vietnam, and each capacity is 15-600t/shift. Vietnam is one of the largest rice exporting country in the world, but capacity of common rice mill is still small.

In the past, rice husk generated from rice mills were treated as follows; 1) to provide local people as fuel, 2) to sell as feed for cultured fish, 3) to sell rice husk dealer (middleman). However, nowadays, demand for rice husk are decreasing because rice husk users, such as brickyard and households, are switching its fuel from rice husk to coal. Accordingly, some rice mills must pay money to rice husk dealer for collection of rice husk, therefore, treatment of rice husk is going to be problem for rice mills.

Some rice mills have installed small cogeneration system using rice husk, but electricity is used only in rice mills, and not provided to the power grid.

In Long An province, cogeneration system (50kW) was installed in the rice mill with the aid of the Government of Australia (AUSAID), however it is operated only 1 week a year because the



Figure 2.6-2 Rice Husk (left) and Co-generation System (Long An Province, AUSAID)

capacity is too small and it requires 3 workers for operation, then its profitability is too low.

- Biomass-fuel

If large amount of rice husk could be collected from rice mills with low cost, rice husk cogeneration would be feasible. However, because each rice mill's capacity is small and they are scattered, collection of large amount of rice husk is very difficult being the barrier to rice husk cogeneration.

At present, in Vietnam, bio-fuel (bio-ethanol, bio-diesel) is not in commercial production.

Future Prospects

- Power Generation

The potential of biomass power generation is estimated to be 250-400MW, and surplus electricity (about 30%) can be provided to the power grid. However, there are no development plan of biomass power generation (bagasse, rice husk, etc.), and it is thought to be necessary to overcome the following barriers for the promotion.

Regarding bagasse, stable procurement of sugarcane is the highest barrier. Sugar mills purchase sugarcane from farmers based on long-term purchase agreement. However, in case that there are more profitable crops than sugarcane, many farmers tend to reduce sugarcane production and increase profitable crops production, breaching the contract. The purchase price of sugarcane tends to be less than other crops, thus the incentive to sugarcane production is low, and sugarcane production volume is unstable. In addition, the sugar is in competition with the imported one from Thailand and Cambodia, then the price of sugar is unstable and it adversely affects the sugarcane purchase price.

Regarding rice husk, effective collection of rice husk from small and scattered rice mills is the highest barrier. The current situation that disposal of rice husk is becoming costly would be the tail wind for husk power generation. However, the feasibility of rice husk collection through rice husk dealer is unknown, because they are not organized and there is no statistic data. Therefore, a feasibility study is necessary.

- Biomass-fuel

In May 2007, "Development of Bio-Fuels in the Period up to 2015, Outlook to 2020" was submitted to and is under approval process by the prime minister.

There are some bio-fuel development plans, such as bio-ethanol production in sugarcane mill and bio-diesel production using Basa (fish oil) and used cooking oil, while, there are no bio-fuel plant in Vietnam at present. Table 2.6-7 is the summary of studies on bio-fuel in Vietnam.

Table 2.6-7 Research Overview on Biomass Fuels

Biofuel	Sojitz Research Institute: F/S on biomass resources utilization project for alternative energy to petroleum in Vietnam, 2005	Institute of Biotechnology, Vietnamese Academy of Science and Technology, Vietnam: Biomass Potentiality, Utilization and Status Development of Bio-fuel in Vietnam, 2006
Bio-ethanol	<ul style="list-style-type: none"> Naitonal Bio-fuel Development Plan is under consideration Gasohol Installation Target: 500,000t/year by 2010, 2-3million t/year by 2020 Implementation Organizations: Addictives and Petroleum Products (APP) ,Center for Consultancy and Technical Transfer Safe Water and Environment(CTE) and medium-small scale sugar mills (about 20 sugar mills) in central and south region 	<ul style="list-style-type: none"> Target: 500 million liter/year by 2020 (to blend 5 billion liters of gasohol E10) Materials: Sugarcane, Molasses, Cassava, Maize, etc. Potential: 320 million liter/year (Assuming that all molasses and 10% of cassava and maize can be used)
Bio-diesel	<ul style="list-style-type: none"> No numerical target It is thought that coconut is the possible material for bio-diesel, however, there is no surplus production capacity at present 	<ul style="list-style-type: none"> Target: 50 million liter/year by 2020 (to blend 500 million liters of bio-diesel B10) Materials: Basa (fish oil), Used cooking oil, Rubber seed oil —Basa (fish oil) : Pilot plant: 1 plant (An Giang Province, 1.6t bio-diesel/day) has been developed and 1 plant (10,000t bio-diesel/year) is under development by Saigon Petro & Agifish Potential: 48,000t bio-diesel/year (Using 60,000t-Basa) —Used cooking oil : Pilot plant: 1 plant (2t bio-diesel/day, using 4-5t-used cooking oil) is under development by Saigon Petro & Agifish Potential: 33,000t bio-diesel/year (Using 73,800t-used cooking oil) —Rubber seed oil : Under survey

(Source) Sojitz Research Institute: F/S on biomass resources utilization project for alternative energy to petroleum in Vietnam, 2005 & Institute of Biotechnology, Vietnamese Academy of Science and Technology, Vietnam: Biomass Potentiality, Utilization and Status Development of Bio-fuel in Vietnam, 2006

e) Geothermal

Potential

According to the 6th Power Development Master Plan (Draft), 29 potential geothermal sites are identified, and it is thought that 12 sites could be suitable for geothermal power plant (about 180MW). Also, it is evaluated that whole geothermal potential in Vietnam is 340MW.

Current Use

There are no geothermal power plants in Vietnam at present.

Future Prospects

MINERAL & ORMAT company (U.S.A.) carried out feasibility studies of Bang, Nghia Thang, Mo Duc, Hoi Van, Tu Bong and Danh Thanh sites for development of 112.7 MW geothermal power, however, as the profitability was not attractive, these projects have been withheld.

There is no specific geothermal development plan at present.

f) Tidal

Potential

According to the survey by IE, 18 potential tidal sites are identified considering the conditions of gulf, lagoon, pond and tide. It is evaluated that the tidal potential of Vietnam is not high, and there are some sites suitable for small scale tidal power plant.

Also, it is recommended that some potential sites (Cam Ranh Lagoon, Cuu Long River Delta and

Co To Island, etc.) should be surveyed in detail.

Current Use

There are no tidal power plants in Vietnam at present.

Future Prospects

As described above, regarding some potential sites, detailed potential survey is recommended. While barriers of tidal power development are recognized as follows.

- Because potential sites are often located far from large load center, cost of transmission line increases electricity tariff.
- It is difficult to construct standalone tidal power plant because it is unstable power generation depending on the tidal condition.
- Environmental negative impact caused by tidal power plant has not been grasped.

2.6.1.2 Policy Framework

Organizations related to renewable energy are Ministry of Industry and Trade (MOIT), Electricity of Vietnam (EVN) and Institute of Energy (IE). MOIT is responsible for establishment and implementation of energy policies such as National Energy Strategy and Power Development Master

Table 2.6-8 Targets of Renewable Energy Development of the National Energy policy (Draft)

Items	Numerical Target
Share of renewable energy in total commercial primary energy	• 2010 : 2% (0.9 million TOE)
	• 2020 : 3.4% (3 million TOE)
	• 2050 : 7% (22 million TOE)
Renewable energy power development	• 2010 : 3%
	• 2020 : 4% (8-9 billion kWh)
	• 2050 : 10% (60-80 billion kWh)
Use of hot water by solar-energy equipment in Public works and services (hospitals, school and university, governmental offices, restaurants, etc.)	• 10%
Hydro power development	• 2010 : 35,000 million kWh (Addition of 10,000 million kWh)
	• 2020 : 60,000-65,000 million kWh (Addition of 15,000-20,000 million kWh)
	• After 2020 : 70,000-80,000 million kWh
Energy supply in islands and mountainous area	• Use of commercial energy for heating : 50% by 2010、80% by 2020, from existing 30%
	• Rural Electrification Rate : 90% by 2010, almost 100% by 2020

(Source) Ministry of Industry: National Energy Policy (Draft), 2005

Plan, and EVN and IE are responsible for study and implementation of such policies. In particular, IE takes positive actions for renewable energy, such as establishment of Center for Renewable Energy and CDM in 2007 and conducting the Master Plan on Renewable Energy in Vietnam (completed at the end of 2008). Details are shown below.

a) National Energy Policy (Draft)

The numerical target related to renewable energy is given in the National Energy Policy (Draft).

(Meaning of Renewable Energy Development)

- As forecasted, from after 2010, Vietnam will have to import energy. Development of renewable

energy will not only ease the burden on energy supply, but also lessen imported energy, accordingly saving foreign currency.

- In addition, renewable energy will contribute to alleviating impacts on environment caused by its development, as well as minimizing greenhouse gas emissions.

(Barriers and Orientation of Renewable Energy Development)

- The highest barrier is cost
- Priority development areas; 1) Hydropower and wind-power projects and utilizing agricultural by-products and wastes for electricity generation, 2) Utilizing solar energy for heating, drying agricultural products, filtering water, etc. in services, public, households and agricultural production, 3) Biogas for cooking in rural areas

(Renewable energy development policy)

- Investigate and evaluate new and renewable energy potential, make plan on utilizing new energy
- The State encourages developing and using new and renewable energy; provides financial support and tax exemptions for program on investigation, research, trial manufacture and establishment of pilot locations using new and renewable energy;

Table 2.6-9 Generating Cost by Renewable Energies

	Installation Cost	Electricity Generation Cost
Solar	US\$ 2,000-3,000/kW	UScent 35-40/kWh
Wind	US\$ 800-1,250/kW	UScent 4-8/kWh
Hydro	US\$ 1,000-5,000/kW	UScent 5-15/kWh

(Source) Ministry of Industry: National Energy Policy (Draft), 2005

- Select technology in line with Vietnam's conditions; promptly apply for livings, especially in rural and mountainous areas and coordinate with other programs in rural areas such as rural electrification, afforestation, poverty-alleviation and cleaning water programs.
- Encouragement of utilization of Clean Development Mechanism (CDM)

b) Power Sector Development Strategy (Decision: No.176/2004/QD-TTg)

In October 2004, the Vietnam Power Sector Development Strategy (Decision: No.176/2004/QD-TTg) was issued, and it shows the Power Sector Development Strategy for the period 2004-2010, and orientation for the period up to 2020. The followings are renewable energy related issues.

(Viewpoint of Development)

- Renewable energy development in order to meet the electricity demand in island and mountainous areas.
- Effective use of domestic primary energy (multi purpose use of hydro resources: ex. Electricity and Irrigation)
- Suitable policies of electricity tariff should be set for facilitation of power plant development in island and mountainous areas.

(Development Objectives)

- 90 % of rural households will access to electricity by 2010 and 100% by 2020.
- Control and mitigate environmental pollution in electricity activities

(Development Strategies)

- Electricity of Vietnam will only invest in power plants with capacity of 100 MW and above in order to create favorable conditions for other enterprises to invest in power plants with smaller capacity.
- Give priority to hydropower development, especially the multi-purpose projects (water supply, flood control, drought control etc.). Encourage several forms of investment in small hydropower plants in order to develop this clean renewable energy resource. It is expected that about 13,000-15,000MW of hydropower will be developed by 2020.
- Promote rural electrification to contribute for industrialization, modernization of agriculture and rural areas. Develop management mechanism in order to maintain and develop power resources in these areas. Enhance controlling electricity tariffs in order to ensure application of the ceiling tariffs stipulated by the Government.

(Solutions)

- Encourage diversification in investment and management of rural power network on the basis of controlling selling prices in rural areas in order to prevent exceeding ceiling tariffs set by the Government.
- Provide budget for electrification projects in rural, mountainous and island areas, aiming at economic development, hunger eradication and poverty alleviation for these areas.

(Implementation Assignment)

- Ministry of Industry and Trade (MOIT)
- MOIT is responsible for implementation of Power Sector Development Strategies, Vietnam power development master plan, considering and approving independent power projects in accordance with the master plan and shall submit the urgent investment projects to the Prime Minister for approval.
- Electricity of Vietnam (EVN)
- EVN provides budget for investment in renewable electricity projects in the places, which cannot be supplied with electricity from the power grid.
- The Electricity of Vietnam is allowed to separate cost accounting of public portion of the rural and mountainous electricity supply from its production and business accounting.

c) Electricity Law, 2004

Electricity Law, which was put into effect in December 2004, defines “To create conditions for various economic sectors to invest in electricity development with reasonable profits, energy resource saving, the use of various new energy, renewable energy without causing environmental pollution in electricity activities, thus contributing to boosting socioeconomic development, particularly in rural areas, mountainous regions and islands, ” and “To encourage organizations and individuals to invest in construction of electricity grids or electricity-generating stations using local energies, new energies, renewable energies to supply electricity to rural, mountainous or island areas. ”.

d) Approval of National Master Plan on Power Sector Development Period of 2006-2015, perspective to 2025 (Prime Minister Decision No. 110/2007/QĐ-TTg)

According to “Prime Minister Decision No.110/2007/QĐ-TTg”, grid-connected renewable energy power development is planned as follows.

- 2006-2015: 2,451MW
- 2016-2025: 1,600MW

e) Master Plan on Renewable Energy Resources in Vietnam, 2000

In 2000, EVN and IE drew up the master plan on renewable energy resources in Vietnam, which shows the basic policy of renewable energy development for the period 2000 to 2010. The followings are the main contents.

- General status of renewable energy resources exploitation and use in Vietnam
- Assessment of renewable energy resource potential
- Assessment and selection of renewable energy technologies suitable for conditions of Vietnam
- Electricity demand of off-grid areas
- Renewable development plan for the whole country
- Cost estimation
- Economical/Financial analysis

f) Master Plan on Renewable Energy Resources in Vietnam (on-going)

IE has been compiling the new master plan on renewable energy resources in Vietnam (finished at the end of 2008), and the followings are the main contents.

- Current Status of Renewable Energy in Vietnam and Development Trends in the World
- Assessment of potential and exploitability of renewable energy resources in Vietnam
- Assessment of Renewable Energy’s Role in the National Energy Demand - Supply Balance
- Development of integrated strategies for renewable energy development in Vietnam
- Master Plan on Development of Renewable Energy Resources in Vietnam for the Period up to 2015 with Expectation to 2025
- Strategic Environmental Impact Assessment
- Investment -Development Program and Economic Analysis
- Development Policies and Implementation Measures
- Conclusions and Recommendations

g) Development of Bio-Fuels in the Period up to 2015, Outlook to 2025 (Draft)

In May 2007, “Development of Bio-Fuels in the Period up to 2015, Outlook to 2025” was submitted and is under approval process by the prime minister.

(Viewpoint of Development)

- Development of bio-fuel for ensuring energy security and environmental protection
- Dissemination of Gasohol E5 and Bio-Diesel B5 by 2025
- Human resource development, Stable supply of biomass resources, Improvement of energy conversion rate and Establishment of bio-fuel distribution system

(Development Target)

- In the period 2007-2010: Installation of pilot plants (Gasohol E5: 100,000ton/year, Bio-Diesel B5:

50,000ton/year), 8% of gasoline and diesel demand is replaced by gasohol E5 and bio-diesel B5.

- In the period 2007-2010: 20% of gasoline and diesel demand is replaced by gasohol E5 and bio-diesel B5

- By 2025: 100% of gasoline and diesel demand is replaced by gasohol E5 and bio-diesel B5

h) CDM (Clean Development Mechanism)

Vietnam ratified the United Nations Framework Convention on Climate Change on November 16th, 1994 and the Kyoto Protocol on September 25th, 2002. In October 2005, the “Directive on the implementation of Kyoto Protocol to the United Nations Framework Convention on Climate Change” was issued, and it defined the tasks of relevant ministries and people’s committee. Organizations and rules (CDM approval procedure, laws and regulations, guidelines, etc.) related to CDM in Vietnam have almost been established. Due to the CDM promotion by Ministry of Natural Resources and Environment (MONRE), state-owned companies and private companies in Vietnam recognize CDM very well.

MONRE was designated as the CDM focal point by the Government of Vietnam, and the following organizations are established.

1) CDM National Authority (CNA)

In March, 2003, International Cooperation Department of MONRE (ICD) was designated as CNA and Designated National Authority (DNA).

2) CDM National Executive and Consultative Board (CNECB)

CNECB’s functions are guidance and evaluation of CDM projects and discussion of execution and management of CDM in Vietnam. It was established in April, 2003, and has 3 periodic meetings a year. Chairperson is the director general of ICD, and CNECB consists of 12 members from relevant organizations such as MOI.

3) National Expert Team

National Expert Team is a consultative body, which consists of academic experts, and discusses about the evaluation of CDM projects with CNECB.

There are 2 CDM application procedures in Vietnam.

1. 1) Submission of Project Idea Note (PIN) to CNA, 2) Receipt of Endorsement Letter from CNA, 3) Submission of Project Design Document (PDD) to CNA
2. Submission of Project Design Document (PDD) to CNA (Submission of PIN and Receipt of Endorsement Letter can be skipped)

Project proponents can submit PIN/PDD at any time, and it takes about 1 month for evaluation. There are some criteria for approval such as sustainability (ex. contribution to sustainable development of Vietnam, technology transfer, environmental impact and contribution to local community) and feasibility (ex. Support from central/local government).

At present, 2 CDM projects have been registered to CDM executive board (“Song Muc Hydro Power Station Regeneration Project in Vietnam” and “Rang Dong Oil Field Associated Gas Recovery and Utilization Project”).

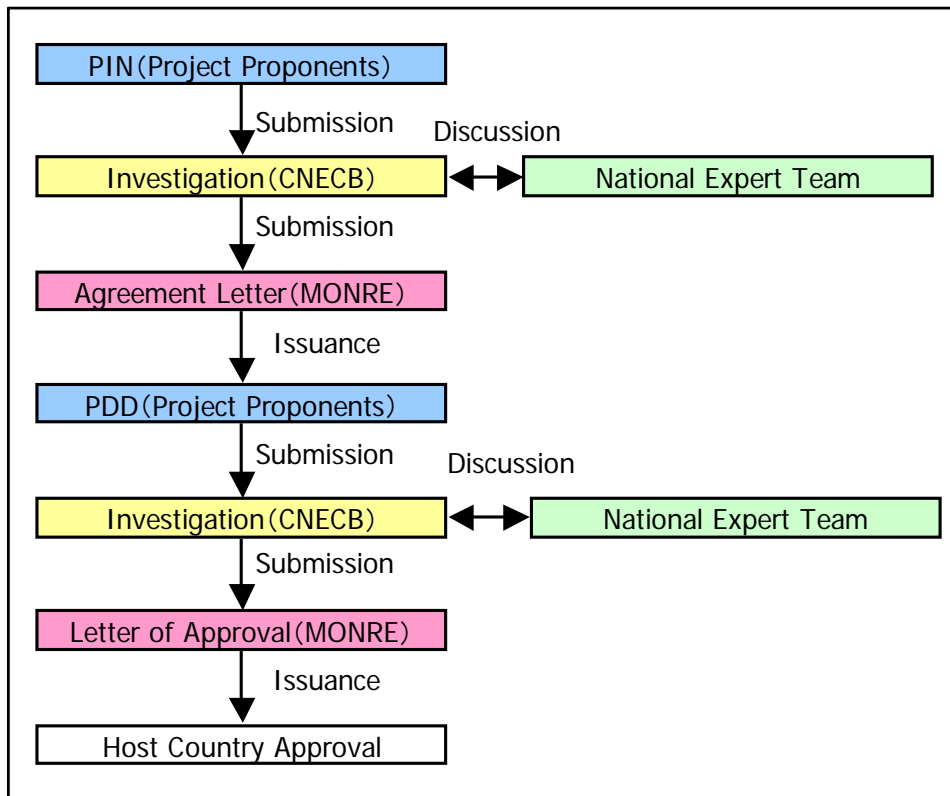


Figure 2.6-3 Flow Chart of CDM Procedure in Vietnam

2.6.2 Issues and Subjects for Renewable Energy Supply

According to Prime Minister Decision No.110/2007/QĐ-TTg, it plans to install the grid connected renewable power sources with capacity of 2,451MW between 2006~2015 and 1,600MW between 2016~2025.

However, there are only 49 grid-connected small hydropower plants (total capacity: 64MW, unit capacity: 100kW-10MW, 1 plant is stopped) and there is no installation of grid-connected wind power plant which is expected to be the main renewable energy source except the mini-hydro power plant.

2.6.3 Issues on Renewable Energy Supply

Anticipated issues on the supply of renewable energies are summarized in Table 2.6-10.

2.6.4 Issues and Subjects for Renewable Energy Promotion

Issues and subjects for renewable energy promotion are classified broadly into the following 3 categories.

1) Establishment of Development Plan of each Renewable Energy

Despite the introduction plan of renewable energy stipulated in Prime Minister Decision No.110/2007/QĐ-TTg, actual introduction is limited until now.

At present, the grasp of energy potential varies widely in each renewable energy sources, and it is

not sufficient in general. IE has been producing the new master plan on renewable energy resources in Vietnam (finished at the end of 2008). However, the contents of the master plan are wide-ranging, and the research period and budget is limited. Therefore, it is necessary to review the master plan and implement a supplemental potential survey and establish development plans on each energy source as appropriate, in order to facilitate the development of “New” renewable energies such as wind and biomass.

Table 2.6-10 Issues and challenges of Renewable Energy supply

	Solar	Wind	Small Hydro	Biomass		Geothermal	Tidal
				Electricity	Biofuel		
Potential	2MW	600MW, 2,200MW, 22,400MW	Over 2,300MW, 8-9billion kWh	250-400MW	—	180-340MW	—
Issues and subjects	<ul style="list-style-type: none"> •High initial cost •Small capacity and failure 	<ul style="list-style-type: none"> •Accurate potential has not been grasped •There is no grid-connected wind power plant 	<ul style="list-style-type: none"> •Depletion of small hydro potential in the future 	<ul style="list-style-type: none"> •【Bagasse】 Stable procurement of sugarcane •【Rice Husk】 Effective collection of rice husk 	<ul style="list-style-type: none"> •Accurate potential has not been grasped • Establishment of the national biofuel development plan 	<ul style="list-style-type: none"> •Low profitability 	<ul style="list-style-type: none"> •Accurate potential has not been grasped •Cost increase by transimission line construction •Unstable power generation •Environmental impact caused by tidal power plant has not been grasped

a) Effective Use of Biomass Resources

Vietnam is an agricultural country, and there are huge amount of biomass resources such as bagasse, rice husk and rice straws. Most of biomass resources are used as heat source, while power generation (about 50MW) use in central and southern areas is exceptionally.

Also, Bio-Fuel is considered as the most possible measure of effective use of biomass resources. In May 2007, “Development of Bio-Fuels in the Period up to 2015, Outlook to 2020” was submitted and is under approval process by the prime minister.

For achievement of effective use of the biomass resources, it is necessary to take the following measures.

- Stable supply of biomass resources, which is balanced with needs for food supply
- Technology Development in energy conversion (Biomass to Fuel, Electricity, etc.)
- Establishment of Bio-Fuel distribution system
- Coordination between related ministries in Vietnam
- Support from Foreign Countries and Introduction of Private Capitals

b) Introduction of Incentives for Renewable Energy Power Development

The fundamental policy on the introduction and dissemination of renewable energy as power resource is now being formulated as a result that a long term renewable energy development targets as power source is set in the National Energy Policy by MOIT and that the promotion of renewable

energy as power source is planned by the Prime Minister's decision as referred before.

At present, there are no specific incentives for renewable energy promotion such as advantageous electricity purchase price for renewable energy and obligation of power producers to purchase/produce certain percent of electricity sold from renewable energy power. In addition, when the electricity market is established, which is planned to start from 2009 as part of the electricity sector reform, each power producing companies will be put in a competitive environment. Because renewable energy power is less competitive in price than conventional power, the installation of renewable energy is expected to slow down unless effective incentives.

2.7 Current Status of Energy Efficiency and Conservation

2.7.1 Trend of energy consumption and necessity of energy conservation

Energy Efficiency and Conservation (EE&C) technologies were introduced in Vietnam since the 1990s as a part of technical and financial assistance programs conducted by international organizations, principally from The Netherlands, Germany, Japan and other countries. This introduction was followed by the implementation of projects addressing the rational use of energy in the cement and ceramics industry sectors and coal fired thermal power plants, together with demand side management (DSM) programs. These projects underpinned the transfer of related technologies and their successful application, and also were the basis for the formulation of government policies to promote energy conservation programs. Since 2003 the efficiency improvement and rational use of energy have been included as a key item in the Policy on Energy Sector Development (2005, at that time MOI, now MOIT), and activities on EE&C have continued to date.

The total energy consumption in Vietnam from 1990 to 2004 increased at a rate of 11.2% per annum, about 1.5 times of the economic growth rate for the same period. According to the MOIT (The current energy status and legal frameworks and institutions on Energy Efficiency and Conservation in Vietnam, 2006), projections of the total energy demand to 2020 indicate that it will increase at an average of 8.1% per year. In order to handle the expected energy demand increase, the government has recognized the necessity to implement measures on energy efficiency and conservation from the energy security point of view.

The Primary Energy Consumption per GDP decreased from 1.351 (toe /US\$1,000) in 1995 to 1.218 in 2004. However, in 2004, this indicator was between 0.5 and 1.0 in other Asian countries and only 0.108 in Japan. Therefore it is considered that the potential for energy saving on primary energy is high in Vietnam.

2.7.2 Main barriers

Energy efficiency and conservation (EE&C) measures have not been of marked interest for the majority of energy consumers. At present, overall energy utilization in Vietnam can be characterized by high losses and low efficiency due to obsolete technologies and equipment used in the industry sector, lack of demand side management practice, public unawareness on the community benefits of energy conservation, and lack of comprehensive national programs on EE&C with clearly defined

strategies and scheduled targets.

Outlined below are the main issues affecting the adequate performance and promotion of energy efficiency measures:

- (1) Lack of policy and administrative framework for the promotion of energy efficiency and conservation.
- (2) Inadequate data and analysis on potential energy efficiency improvements, cost and benefits of EE&C opportunities and low-cost measures, and also limited information on technologies and programs that have been adopted elsewhere.
- (3) High project development costs, due to extensive audits and technical studies required to properly determine investment requirements and to ensure appropriate project formulation. There are also financial risks on projects that are developed with limited planning and using technologies and equipment that had not been thoroughly tested under Vietnamese conditions.
- (4) Affordable financing is limited due to lack of commercial lending practices in Vietnam. Also weakness of the banking sector, relatively small investments assigned for EE & C projects and limited credit available for the residential projects are barriers for the creation of suitable financial instruments.
- (5) Limited interest from end-users partly because their attention is focused on other business priorities. Other issues influencing their interest are the limited financial significance sometimes assigned to the reduction of operating costs derived from energy saving implementation, and that the benefits derived from energy saving projects are owned by municipal agencies.
- (6) Limited availability of local EE&C equipment, due to the low domestic demand for these products and the restricted manufacturing capability in provincial areas in Vietnam. These issues altogether have discouraged any sizeable investment in energy efficiency measures.

2.7.3 Recent legal framework for energy conservation

2.7.3.1 Regulations on energy efficiency and conservation

A Decree on Energy Efficiency and Conservation (Decree No.102/2003/ND-CP) was issued in September 2003 by the Government of Vietnam.

In July 2004 the Ministry of Industry issued a circular providing guidance for the implementation of energy conservation in the industry sector (Circular No. 01/2004/TT/BCN on Energy Efficiency and Conservation). Further in 2005 the MOIT released the National Strategic Program on Energy Savings and Effective Use (hereinafter called The National Program) for the period 2006-2015, which was approved and enforced on 14 April 2006 by the Prime Minister (Decision No.79/2006/QD-TTG). The National Program calls for coordinated efforts for improving energy efficiency, reducing energy losses and implementing extensive measures for conservation of energy.

MOIT issued in November 2006 a Guideline for Energy Efficiency Standard and Labelling, in order to assist on the implementation of energy efficiency standards and labelling in appliances (Circular No.008/2006/TT/BCN).

The National Program is the first comprehensive plan for the establishment of the necessary

institutional mechanism to sustain the formulation and implementation of energy efficiency and conservation strategies in Vietnam. The National Program is set to achieve the specific targets on the reduction of energy use within a defined timeframe, which can be achievable from both technical and economical perspectives to contribute to the environment protection.

The MOIT is authorized to administer the implementation of the National Program, and as part of this enforcement, the Energy Efficiency and Conservation Office within the Ministry of Industry was established on April 07, 2006 (Ministerial Decision No.919/QD-BCN).

This office is responsible for the implementation of the EAEF Project “Establishment of Energy Efficiency Office in Vietnam”. Personnel involved in this project include staff from the EE&C Office and Science and Technology Department with the participation of experts from concerning organizations such as Universities, Institutes and Energy Efficiency and Conservation Centers.

The main works of the Energy Efficiency and Conservation Office are to develop the organizations and systems related to improving energy efficiency and conservation on the level of government from the central to regional governments and the operating system about the establishing energy consumption database (EAEF Project: Establishment of Energy Efficiency Office in Vietnam).

Other related regulations are the Electricity Law approved and enforced in July 2005, comprising sections that specify electricity efficiency in the generation, transmission, distribution and utilization processes. This was followed to the Electricity Saving Program for the period 2006-2010 approved by the Prime Minister in April 2006. Furthermore, the Building Code aiming for the reduction of energy losses and improvement of living conditions in buildings was implemented in November 2005 (Energy Efficient Commercial Building Code No. 40/2005/QD-BXD).

2.7.3.2 Recent institutional framework for energy conservation

The State Steering Committee chaired by MOIT was established for the implementation of the National Program on energy efficiency and conservation. Members of the Steering Committee include representatives from the Ministry of Construction, Ministry of Transport, Ministry of Education and Training, Ministry of Culture and Information (Renamed as Ministry of Culture, Sports and Tourism in 2007 August), Ministry of Science and Technology, Ministry of Planning and Investment, Ministry of Justice, Ministry of Finance, and the Union of Vietnam Associations of Science and Technology.

The State Steering Committee and Office on Energy Efficiency and Conservation have completed preparatory tasks including the formulation of the action plans and detailed programs needed to launch and implement the National Program successfully in cooperation with other governmental organizations.

2.7.3.3 Major activities for energy conservation undertaken by the Government

a). Overall activities

- 1) Promotion of the efficient usage of energy in the residential and commercial sectors.
- 2) Control of the energy use in factories and buildings and also in designated equipment/facilities.
- 3) Optimization of governmental legal bases.
- 4) Establishment of a policy framework and measures for the promotion of EE&C activities such as financial incentive mechanisms, science & technology measures, education and promotion of

awareness on EE&C, public information, support for the community involvement.

b). Measures for the industrial sector

- 1) To report the annual energy consumption to the Ministry of Industry/Provincial Industrial Department and Statistical Authority and to stimulate the application of appropriate measures for the rational and efficient use of energy.
- 2) Definition of designated factories, which are those having a total amount of fuels and heat equal or more than 1000 toe per annum, or have an electric capacity equal to or more than 500kW or an electricity consumption equal to or more than 3,000MWh, must nominate an energy manager, and follow instructions, guidance and orders received of MOIT.
- 3) Penalties will apply in case of violation.

c). Measures for buildings and specified structures

- 1) Definition of designated buildings: The designated buildings consist of one or more buildings located at the same place that meets one or more of the following conditions:
 - Electricity supplied by substations with a total capacity equal to or more than 750 kVA.
 - Consumption of total commercial energy, including heat and electricity, equal to or more than 10 million MJ or equivalent amount of electricity.
- 2) To comply with standards, instructions and guidance on buildings specified by MOC.
- 3) To submit the design and report on EE&C assessment of the building project for approval.
- 4) To implement the advice on appropriate measures by MOC.
- 5) To conduct audits on the energy consumption.
- 6) To establish and observe internal management rules.

d). Measures on selected facility and equipment

- 1) Establishment of a Minimum Energy Performance Standard (MEPS) for each group of selected electric devices, equipment and facilities.
- 2) Annual announcement of the group of devices, equipment and/or facilities that must be removed from the market because of their large consumption of energy.
- 3) Labelling Program (voluntary and compulsory).
- 4) Strict control and penalties in case of violation.

e). Institutional building

- 1) MOIT plays the role of focal coordinator on EE&C.
- 2) Assignment of functions and responsibilities to the authorities concerned:
 - Ministries: policies, standards and guidance; rules and management applicable to factories, buildings and equipment,
 - Provincial Committees: local control,
 - Others: Custom Offices, Statistical Authorities, market control, branch specific inspectorates.
- 3) To establish or nominate Authorized Auditing Agencies/ESCOs to conduct periodical energy audits to factories, buildings, etc.

2.8 Energy Database

2.8.1 Current situation of Statistics in Vietnam

2.8.1.1 Organization

General Statistics Office (GSO) in Vietnam is consisted of Central GSO headquarter, 64 Province Statistical Offices, and 676 District Statistical Offices. Total employee is more than 5,000, of which about 600 employees in Headquarter, 30 to 60 employee in each Province Office, and 3 to 6 persons in each District Office.

2.8.1.2 Items of Statistics

GSO publishes “Statistical Yearbook of Vietnam” every year and this Yearbook is composed of 12 Chapters and 323 Tables as follows.

Chapter 1 Administrative Unit and Climate

Chapter 2 Population and Employment

Chapter 3 National Accounts and State Budget

Chapter 4 Investment

Chapter 5 Enterprise

Chapter 6 Agriculture, Forestry and Fishing

Chapter 7 Industry

Chapter 8 Trade, Price and Tourism

Chapter 9 Transport, Postal Services and Telecommunications

Chapter 10 Education

Chapter 11 Health, Culture, Sport and Living Standard

Chapter 12 International Statistics

Statistics related to energy is included in Chapter 7 Industry. Amounts of main production such as crude oil and coal are shown in this chapter, but amounts of energy supply and demand are not included.

2.8.1.3 Statistics law

Statistics law of Vietnam is composed of 8 Chapters and 42 Articles. The subjects of application of this law include all enterprises, organizations, and individuals including state agency and private companies. Therefore, all enterprises, organizations, and individuals have an obligation to submit necessary data to GSO. However, disclosing statistical information associated with specific names and/or addresses of organizations or individuals without their consent is strictly forbidden by Article 6. Article 14 shows that the funding for conducting statistical surveys shall be covered with the State budget.

2.8.1.4 Survey method

GSO is conducting “Annual Enterprise Survey” by questionnaire sheets every year and publishes Statistical Yearbook based on this survey. At present, GSO is conducting monthly survey of main industries including energy sector (oil, gas, coal, power, etc.) to make up IIP (Indices of Industrial Production) statistics funded by JICA (Japan International Cooperation Agency). Projected

production, actual production, shipment, internal consumption, ending inventory, and shipment value are mentioned in this monthly questionnaire. It is possible to collect energy supply and demand data of main industries by preparing a questionnaire sheet like the above questionnaire sheet.

2.8.2 Current Situation of Energy Economics Data

2.8.2.1 Socioeconomic data

Socioeconomic data stored in the JICA energy database created by the study team are picked up from GSO Statistical Yearbook and these data is necessary for energy demand forecast model. However, GSO Statistics Yearbook doesn't include data on number of vehicles and floor space, which are very important to estimate energy consumption by transport and commercial sectors.

2.8.2.2 Energy data

Energy data for oil, gas, coal, and power sectors are compiled based on energy demand survey conducted by INDUTEC (Chemical And Industrial Safety Technology Institute) last fiscal year. Data items of the JICA energy database are same as that of IEA (International Energy Agency) energy balance table. However, there are some issues as follows.

- There is no stock change data except coal sector.
- Energy supply data of petroleum products and electricity are not classified by sub-sector.
- Unit of original data of petroleum products and natural gas was not unified. For example, Natural gas is in BCM and 1,000ton, Petroleum products in ktoe and kton.
- There is no time series data on renewable energy.
- Energy consumption data of transport sector are not classified by sub-sector such as road, rail, airplane and ship.
- There is no briquette data such as coal consumption and briquette production because VINACOMIN does not supply coal to briquette plants. It is unknown from where briquette factories obtain supply coal.
- Some data don't follow ISIC (International Standard Industrial Classification).

2.8.3 Issues on Energy Database

2.8.3.1 Awareness of energy statistics

Social and economic data are publicly disclosed by GSO. However, data and information in energy sector are very poor because it is not customary to disclose company information in Vietnam. Energy information is necessary to draw up a national energy policy. Should energy data be disclosed, manufacturing companies could get an average unit energy consumption for product from the energy statistics and try to reduce unit energy consumption if their unit energy consumption is higher than the average. With these data, the country will be in particular able to analyze energy supply and demand that is required to set out indicative targets for energy policy, environmental policy, and energy conservation policy. Also it is possible to compare energy situation at international levels. Individuals and households can get information on the average energy consumption, too.

2.8.3.2 Organization

Government organization that administrates energy issues in Vietnam is Energy and Petroleum Department, the Ministry of Industry and Trade. Though this department is reviewing energy plans such as oil, gas, coal, electricity, and renewable energy, there is a lack of staff for handling energy statistics. In order to promote energy statistics, it is necessary to establish a new organization for energy database.

2.8.3.3 Processing method of statistics

Other issue concerned is a lack of experience for processing of energy statistics. There is no standard processing system for energy statistics. In Japan, a common questionnaire is distributed to the designated firms of selected sectors and is collected monthly as Designated Statistics. Based on this questionnaire sheet, total energy consumption is estimated and monthly statistics is published every month. To promote Vietnamese energy statistics, it is necessary to examine and establish statistics processing procedure. To this end, it would be appropriate to ask for technical assistances from international organizations and developed countries.

Chapter3 Energy Policy Framework and Implementation System

3.1 Outline of Energy Policy Framework

3.1.1 National development plans relating to energy

As the preconditions for the energy development plans, there are "Socio-economic Development Strategy" and "Five-year Socio-economic Development Plan". They provide for targets and policy instruments of Socio-economic Development including energy to administer the Vietnamese society. However, there are least descriptions on detail energy policy to materialize objectives of these "Socio-economic Development Strategy" and "Plan".

Energy policies to achieve "Socio-economic Development Strategy" and "Plan" have been set out by individual energy sectors (electric power, coal, and oil and gas sector) in the past. Then, it was decided recently to establish "National Energy Policy" (Vietnam National Energy Policy) and "National Energy Master Plan" (National Energy Master Plan of Vietnam), which shall harmonize and integrate energy policies compiled by individual industries under the title "Comprehensive". Thus, "National Energy Policy" was officially approved in 2007.

Table 3.1-1 Approved National Development Plans Related to Energy

	Term	organization	Situation
Socio-Economic Development Plan			
Strategy for Socio-Economic Development	2001-2010	MPI	Approved
The Five-Year Socio-Economic Development Plan	2001-2005	MPI	Approved
The Five-Year Socio-Economic Development Plan	2006-2010	MPI	Approved
National Energy Strategy (Master Plan)			
Draft of Over View on Vietnam Energy Resources and National Energy Policy (Summary)		MOI	1/2005
Vietnam National Energy Policies	2006-2025	MOI	Approved
The Study on National Energy Master Plan in Vietnam		IE/Jica	
Power Sector			
Strategy for Power Development in the period 2006-2015 and Orientation to 2025	2006-2025	MOI	Approved
Master Plan for Power Sector Development in the period 2006-2015, Perspective to 2025	2006-2025	MOI	Approved
Coal Sector			
Strategy on Vietnam Coal Sector Development in the Period 2006-2015 and Vision to 2025	2006-2025	MOI(Vinacomin)	Approved
Master Plan on Vietnam Coal Sector Development in the Period 2006-2015 and Vision to 2025	2006-2025	MOI(Vinacomin)	Approved
Oil/Gas Sector			
Strategy on Vietnam Oil and Gas Sector Development up to 2015 and Orientation to 2025	2006-2025	MOI(Petrovietnam)	3/2006
Master Plan on Vietnam Oil and Gas Sector Development up to 2015 and orientation up to 2025	2006-2025	MOI(Petrovietnam)	Approved
Renewable energy			
Policy on Rural Electrification		MOI	2000
Renewable Energy Action Plan		MOI, EVN, WB	2001
Energy Conservation			
Gav. Decree No.102 on Energy Saving and Energy Efficiency		Government	3/9/2003

The energy policy in each energy sector consists basically of "Energy Strategy" and "Energy Master Plan" to implement the strategy. "Strategy" and "Plan" are the basis as the national long term energy policy though each energy industry is required to compile five-year plan and single year plan.

“Strategy for Power Development in the Period 2004-2010 and Orientation to 2020” (henceforth Electric Power Strategy) was approved in 2004. “Master Plan for Power Sector Development in the Period 2005-2015 and Perspective to 2025” (henceforth Electric Power Master Plan) was approved in July, 2007.

For the coal sector, there are "Coal Strategy" and "Coal Master Plan" existing similarly with the power sector. The former is " Strategy for Vietnam Coal Sector Development in the Period 2005-2015 and Vision to 2025”(henceforth “Coal Strategy”) and the latter is " Master Plan for Vietnam Coal Sector Development in the Period 2005-2015 and Vision to 2025”(henceforth “Coal Master Plan”). These two policies were submitted to the government and approved by the government now.

In the Oil/Gas sector, "Oil and Gas Strategy" and "Oil and Gas Master Plan" also exist as well as the other two sectors. The former is "Strategy for Vietnam Oil and Gas Sector Development up to 2015 and Orientation to 2025”(henceforth “Oil and Gas Strategy”) and the latter is " Master Plan for Vietnam Oil and Gas Sector Development up to 2015 and Orientation to 2025”(henceforth “Oil and Gas Master Plan”). Oil and Gas Strategy was already approved by the government in February, 2006, and Oil and Gas Master Plan was submitted and approved by the government now.

"Plans" concerning individual energy policy besides sectoral energy policies exists, too; they are renewable energy policy, energy conservation policy and environmental protection policy.

3.1.2 National Energy Policy (Strategy) and their characteristics

Status of approvals on the energy policies of each energy sector is explained in the previous section. They are strategies and master plans of the individual energy sectors, but coordination with regard to energy demand and supply forecast, and price system, etc., has not been attempted adequately among energy sectors. Vietnam needs establishment of overall and efficient energy strategy and master plan, since substantial changes would occur in the energy demand and supply situation in future including a shift from an energy exporting country to an importing country.

"National Energy Policy" (Summary Version) is composed of the following four Chapters

- 1) Vietnam energy overview
- 2) National Energy Policy
- 3) Orientations on energy sector development
- 4) Implementation measures

Among them, major part of the 2) National Energy Policy may be summarized as follows.

3.1.2.1 National Energy Policy (National Energy Strategy)

1) Viewpoints of National Energy Policies

The following eight items are provided as viewpoints of the National Energy Development.

- a) Diversified and effective exploitation of domestic natural resources, in combination with reasonable import-export with gradual reduction of primary energy export, investment in energy

exploitation abroad, meeting energy demand for the socio-economic development, conserving fuels and ensuring energy security for the future.

- b) Development of new projects together with rehabilitation and upgrading of the old projects
- c) Development of energy in line with natural resource protection and environmental protection, ensuring sustainable development of energy sector.
- d) Step by step establishing the competitive energy market, diversification of investment forms and business in energy sector.
- e) Promoting rural energy program. Carry out study on development of renewable energy
- f) Fast development of energy sector in direction of harmonization, effectiveness based on internal efforts in combination with international cooperation.
- g) Ensuring continuous, sufficient and safety supply of energy based on reasonable, effective use and development of energy resources.
- h) Reducing dependence on energy import, etc.

The target of the energy policy based on the above-mentioned viewpoints is summarized as

“Reasonable and effective exploitation and use of domestic energy resources; Supplying sufficient energy with high quality, reasonable prices to the socio-economic development; Ensuring national energy security; Diversification of investment and business forms in energy field, step by step establishment of competitive energy market; Promotion of renewable energy resource development in order to meet energy demand, especially in the remote, mountainous, island areas; Fast, effective and sustainable development of energy sector in combination with environmental protection”.

2) National Energy Development Target

The energy development target is set based on the above viewpoints and policy.

a) Target of Energy Resource Development:

•Oil and gas:

Increasing annual reserve by about 30-50 million m³ of OE (oil equivalent), the proven reserves shall be 1.3 - 1.4 billion m³ of OE by 2010. By 2020, the reserves shall be proven for the whole continental shelf and important economic areas at the depth of 400 m and at promising deep water areas with depth of 400-1000 m.

•Coal:

Completion of exploration of coal reserves in the depth of 300 m to 1000 m, and detailed exploration of coal basin of Red river delta will be carried out. By 2015, exploration of coal reserves in Red river delta will be completed.

•Hydropower:

Add 10 billion kWh of hydropower by 2010 and 15-20 billion kWh by 2020.

•Uranium:

By 2010, about 8000 tons of U₃O₈ of C1+C2 reserves will be identified and by 2020, with reliable data on U₃O₈ reserves, resources will be available for the country

b) Securing of domestic primary energy supply:

By 2010, about 47.5-49.5 million toe and by 2020, about 91-100 million toe, in which

Hydropower:

About 35 billion kWh of hydropower in 2010, 60-65 billion kWh in 2020, and 70-80 billion kWh after 2020.

Coal production:

Coal production will reach 35-40 million tons in 2010, 50-60 million tons in 2010, in which a portion is exploited in Khoai Chau (Hung Yen province), and coal production will be increased to 200 million tons in 2050.

Oil and Gas:

The oil and gas production in the period 2006-2010 is about 25-30 million tons/year; 31-34 million tons/year in 2011-2015 and about 34-35 million tons/year in 2016-2015.

c) Priority on development of renewable energy:

Priority is given to development of renewable energy with increase rate from 2 % of the total commercial primary energy, equivalent to 900 thousand toe at present to about 3.4 % of the total commercial primary energy, equivalent to 3 million toe in 2020 and 7 % of the total commercial primary energy, equivalent to 22 million toe in 2050.

d) Improvement of energy elasticity (ratio of energy demand growth rate / GDP growth rate):

Reduction of average elasticity from 1.46 at present to 1.0 in 2015 to 0.9 in 2010 and 0.8 in years after 2020.

e) Speeding up the rural energy development programs:

The number of households using commercial energy for cooking will be increased from 30 % at present to 50 % in 2010 and 80 % in 2020. By 2010, about 90 % of rural households will have electricity, by 2020 nearly all households will have electricity.

f) Development of power generation, transmission and distribution:

Development of power generation, transmission and distribution in order to supply enough electricity with reserve. By 2020, the reliability of power supply is 99.7 % (LOE is one day per year); the power network meets the criterion n - 1 (the power network shall work normally in case of failure of one element).

g) Speeding up development of refineries:

Speeding up development of refineries in order step by step to meet the domestic demand of petroleum products. In 2009, the Dung Quat refinery will be put into operation. In the period 2011 - 2015, two refineries, one in Nghi Son (Thanh Hoa) and the refinery 3 in the Southwest area will be developed; by 2020, the expansion of the old refineries or construction of new refineries will be considered, increasing the total capacity of refineries to about 25 - 30 million tons of crude oil.

h) Construction of strategic oil stockpiling system:

Construction of strategic oil stockpiling system with capacity equal to 30 days of average oil consumption in 2010, 60 days of oil consumption in 2020 and 90 days in years after 2020.

i) Development of long-term objectives:

In order to control and mitigate the environmental impacts in energy activities, energy projects shall meet the environmental standards by 2010 such as development of long-term objectives, standards on environment in compliance with the regional and international standards, suitable to

the economic conditions of the country.

j) Gradually changing to the competitive market mechanism with state regulation:

Gradually changing operation of sectors of electricity, coal oil & gas to the competitive market mechanism with state regulation. Establishment of the power generation market in the period 2005 - 2014; the competitive electricity wholesale market in the period 2015 - 2011; the competitive retail electricity market in the period after 2022; establishment of coal market, oil -gas market in the period 2006 - 2020.

k) Ensuring sustainable financing balance and diversification of development investment:

The state will have policy for ensuring equality in business operation in order to encourage participation of the economic sectors in energy development.

l) Nuclear power development plan:

Active preparation of the conditions in terms of technical infrastructure, legality, manpower in order to put into operation the first nuclear power plant in about 2020 then gradually increasing the share of nuclear power in the national energy balance; by 2050, share of nuclear power will be 10 - 11 % of the total energy consumption in the country.

m) Enhancing the international cooperation in energy field

Implementation of power system interconnection (by voltage levels up to 500 kV) in the period 2010 - 2015, gas pipeline interconnection in the period 2015 - 2020; Implementing reasonable energy import and export in order to conserve the national energy resources.

n) Training the employees:

Training the employees with high qualification and responsibility to meet requirements of energy sector development.

o) Implementing the multiform operation mechanism:

Implementing the multiform operation mechanism, development of corporations of energy sector in direction of integrated groups of industry - finance - commerce - services.

3.1.2.2 Orientation of National Energy Policy

Energy policies set out in the orientation of National Energy Policy are those regarding national energy security, conservation and efficient use of energy, environmental protection, competitive energy markets, securing of fund, price policy, and international cooperation and so on.

1) National Energy Security

The policy measures to secure the national energy security are as follows.

- a) High priority is given to the energy security.
- b) The preferential policy concerning the development activity is adopted, and the domestic energy production is increased by a sustainable method.
- c) The limitation of the coal import is set though the hydro-power import from Laos, Cambodia, and China is promoted.
- d) Development and use of domestic energy resources are promoted, and dependence on the oil import is decreased.
- e) Financial support is done to Vietnamese enterprise that engages in the investment and development of oil and gas.

- f) An enough power supply is secured through systematic implementation of the national power development strategy and plan, and maintaining an appropriate reserve capacity.
- g) Electricity of Vietnam (EVN) is responsible for development of power generation resources and national power transmission systems. Publish the portfolio of investment projects in order to encourage local and foreign economic entities to participate in development of power generation, transmission and distribution.
- h) Actively find the new gas resources adding to the exhausting gas resources. Promote negotiation with foreign investors in development of gas fields.
- i) The Strategic Petroleum Reserve System and the management procedure are prepared.
- J) The Strategic Petroleum Reserve Increase from 15 days at present to 30 days in 2010
- k) Carry out study for replacing petroleum products by coal, natural gas and LPG, electricity in order to reduce dependence on oil.
- l) Diversification of oil import resources; increasing efficiency of oil use, eliminating the old, obsolete equipment which consume lot of energy.
- m) Study on development of nuclear energy sector and construction of nuclear power plants. Coordinating with the international organizations in development of nuclear energy, gradually manage technology and development of nuclear energy for peace purpose.
- n) Research on renewable energy development, gradually increasing share of renewable energy. The Government will have preferential policy for renewable energy development.
- o) Enhancing relations in the field of energy with multilateral organization such as ASEAN, APEC, ACD, GMS and bilateral relations.
- p) Enhancing cooperation on the power projects development, gas interconnection project; coordinating with ASEAN countries in implementation of ASEAN oil security Treaty.
- r) Coordinating with the international organizations (IEA, APEC, ACE etc.) in evaluation of issues related to oil market, measures for oil stockpiling; development exchange of and updating the information of oil in order to have proper solutions.

2) Energy Conservation and Energy Efficiency (EC & EE)

Energy Conservation & Energy Efficiency means “Reduction of energy consumption through policies of energy conservation and energy efficiency will reduce burden on energy import, saving foreign currencies. Besides, it also contributes in increasing national energy security.” The energy conservation policy and the policy instruments are as follows.

- a) Policy on Energy Conservation and Energy Efficiency
 - Priority is given to the development of low energy intensity sectors
 - Development of finance/taxation policies to encourage energy conservation
 - The income from the energy conservation is exempted or reduced from taxes.
 - Promulgation of national standards on energy consumption rates for equipment, means which use energy
- b) Measures of energy conservation and energy efficiency (EC&EE)
 - Industry and construction sector:
 - Application of technological measures, management improvement, repairing and rehabilitation of

- equipment, renovation, upgrading of equipment, replacement of low efficient equipment.
- Technology renovation, use of modern high energy efficient equipment.
- Application of energy saving and energy efficiency measures in design, investment and construction of buildings.
- Implementation of DSM programs
- Transportation sector:
 - Increasing transport of passengers and goods by railways, water way instead of road transport.
 - Carry out research on subway train systems, trolley-bus over the ground in Hanoi and Ho Chi Minh cities.
 - Development and upgrading the road networks: car road, water way, railway and oil pipeline system.
 - Application of preferential policies on taxation, investment in order to develop distribution and transport means which use LPG or compressed gas.

3) Environmental protection in energy activity

The environmental protection in energy activity instituted the revision of "Environmental standards" and strengthening of "Capacity building" and "Propaganda".

- Strengthening environmental management, increasing qualifications of the staff, investment in testing.
- Amendments of environmental standards and development of long term targets on environment in compliance with the regional and international standards on environment
- Integration of energy development with the environmental protection
- Making investment support, giving privileges on taxation for energy projects such as renewable energy, use of residues from agriculture, forestry, municipal wastes for electricity generation; using cleaner fuels instead of petroleum products in transport etc.
- Enhancing propaganda, education on dissemination of knowledge, inspection, monitoring of environment
- Diversification of financial resources, encouraging attraction of foreign finance for environmental protection
- Active participation in CDM, contribution in global environment protection; and securing state and enterprise benefits in implementation of CDM

4) Reforming energy sector organization, step by step to establish competitive energy market

The purpose of establishment of the competing energy market institutes the following policies as "The energy market will be established in order to encourage competition between units operating in energy field, facilitating favorable conditions for energy enterprises to attract local and foreign financial resources, fast and sustainable development of energy sector".

- Amendments, new development of legal documents for energy sector
- Promotion of administration reform; separating state management functions from the production - business management functions
- The exclusion of State monopoly through implementing pilot equitization and expansion of

equitization of energy enterprises. There will be suitable mechanisms for attracting the investors, especially foreigners to buy the equities of energy projects

- Development of models and step by step to establish energy market suitable to the socio-economic conditions of Vietnam

5) Creating capital resources for energy development

To execute such many projects and policies, the creation of various capital sources like enhancement of own funds, issuing domestic bonds, introduction of ODA, carrying out the equitization and attracting FDI are proposed.

- Ensuring self -finance for investment - development through increasing efficiency, effectiveness of energy sector
- Increasing finance resources by issuing domestic bonds
- Perfecting policies, mechanisms for attracting foreign finances: ODA loans, non-ODA loans, issuing bonds overseas for energy development
- Carrying out the equitization of energy enterprises in which the state doesn't keep 100 % capital.
- Attracting foreign direct investment (FDI) in development of energy projects

Specific fields will be allowed for 100 % of foreign investment and the foreign investors can invest in exploration, exploitation, processing and distribution, selling of oil, gas, distribution of electricity.

6) Energy prices

Energy prices may come to be decided based on the market mechanism as the present pricing regulation by the State is gradually abolished. Control on the energy production and consumption will be implemented through the taxation policy and the monetary policy.

a) Price of coal:

In the period without competitive coal market, coal selling prices to large coal consumers (electricity, cement, paper, fertilizer industries) shall be managed by the State in the principle that all cost will be recovered and reasonable profits will be set for the coal sector. Coal selling price to individual consumers in the country and export coal prices will be set according to the market prices.

b) Crude oil price:

The prices of crude oil to be exported and supplied to refineries shall be regulated in compliance with the international oil prices

c) Price of petroleum products:

- The state will set the ceiling retail prices and orientations for some main petroleum products (gasoline, oils), the enterprises will make decision on retail prices
- In case the international oil prices strongly fluctuate, the State will apply necessary intervention measures such as using national stockpiling, adjustment of prices or orientation of taxation.

d) Price of LPG:

- LPG prices are determined according to the market prices. The State will manage through taxation policies, regulation.
- Application of preferential taxation for production enterprises in order to encourage domestic LPG production, gradually replacing the import

e) Price of natural gas:

- The state will set principles for gas pricing, benefits allocation, costs, receivable for the State etc. when gas field is discovered. These principles will be specified in the oil - gas contracts.
- The gas prices will be determined based on the minimum gas price (calculated according to production costs) and maximal gas price (acceptable price by consumers).
- The natural gas prices will be set based on the market mechanism. The gas consumers will directly negotiate with gas producers. For gas used as raw materials such as for fertilizers (nitrogenous), the State shall not subsidize to the producers or allow cross subsidy between consumers. If necessary, price subsidy is applied only for final products.

f) Policies on electricity tariffs:

- The electricity prices shall be so determined that investors will get reasonable profits, saving energy resources, using renewable energies which don't make environmental pollution, contributing in socio-economic development, especially in rural, mountainous and island areas
- Encouraging saving electricity and electricity efficiency
- Implementing reasonable cross price subsidy between customer classes. Reducing and towards eliminating the cross price subsidy between production costs and electricity prices in residential sector, contributing in promotion of production and increasing competition of the enterprises
- Ensuring self determination rights on electricity buying and selling prices within the tariff schedules specified by the State for sellers and buyers in the electricity market
- Ensuring legal rights and benefits of electricity units and electricity users

7) Development of renewable energy resources

The measures, policies for development of renewable energy resources include the following:

- a) Organizing surveys, evaluation of potential renewable energy resources, preparation of master plan on renewable energy development
- b) The share of renewable electricity in power generation companies:
It shall account for 3 % in 2010, 5 % in 2020 and 10 % in 2040.
- c) Coordination, integration of renewable energy development programs with other rural development programs such as rural electrification, forest plantation, poverty alleviation and hunger elimination, clean water programs etc

8) International cooperation and energy import - export

- a) Priority is given to supply of enough coal for domestic demand and efficient, reasonable coal export with set-out production target for each period. Coal can be exported from the north and imported to central and southern regions; the coal import, export shall be implemented based on general economic effectiveness of the national economy. Coordination with Laos in development of coal mines and coal fired power plants in Laos for importing electricity to Vietnam
- b) Study on hiring for crude oil refining instead of exporting crude oil and importing of petroleum products from the regional market.
- c) Preparation of development plan for refineries in order to reduce dependence on importing of petroleum products and cooperation with other countries in construction and operation of strategic oil stockpiling system.

d) Implementing interconnection of power systems and gas pipelines in ASEAN region.

3.2 Energy Policy Implementation System of the Vietnamese government

3.2.1 Responsible Ministry and decision-making process related to energy

3.2.1.1 Ministry related to energy

Looking at the energy related government organization, there are many ministries related to energy under the cabinet. First of all, Ministry of Industry and Trade (MOIT: changed from MOI since July, 2007) is in charge of activities related to the energy sector and other industries. The former MOT (Ministry of Trade) which administered Petrolimex with authority on importing petroleum products got merged to the new organization. As a result, MOIT became a totally integrated office responsible for energy. Inside MOIT, "Energy and Oil/gas Department" carries responsibility on the energy field, administering Vietnam electric power corporation (EVN), Vietnam coal industrial and mineral group (VINACOMIN) and National Vietnam Oil & Gas Group (Petrovietnam). "Industrial Economic Strategy Institute" under MOIT investigates the industrial policy and advises to MOIT. The Institute of Energy (IE) belongs to EVN.

Another ministry related to the energy is Ministry of Planning and Investment (MPI). MPI has an authority to set out "Socio-economic Development Strategy" and "Plan" and, at the same time, to coordinate distribution of national capital investment among projects submitted by ministries and agencies as well as introduction of foreign capitals (FDI).

In addition, Ministry of Construction (MOC) looking after the cement industry (Vietnamcement) as an energy-intensive industry, Ministry of Transportation (MOT) in charge of the transportation, and Ministry of Finance having jurisdiction over the tariff and taxation, are related to energy activities. Recently, Ministry of National Resources and Environment (MONRE) plays an important role in the energy field reflecting rise of concerns on environmental protection.

3.2.1.2 Decision-making process of energy policy

"Socio-economic Development plan" is formulated every five-year, and the sector policies for the plan have been processed in each sector including energy field before final integration. Although the term of "Socio-economic Development Strategy" and "Plan" assumes periods of 5 years or 10years, ministries or agencies are also responsible for making longer term "Development Strategy" and "Development Master Plan" for the sectors under their administration. They shall be submitted to Cabinet or the Prime Minister and then become formal policy after approval. These "Development Strategy" and "Development Master Plan" are long range plans of 10 or 20 years.

In addition, each ministry and agency makes "Five-year plan" and "Annual plan" for short and middle term projection, submits to the Cabinet or the Prime Minister to be approved as a formal policy through the similar process. It takes a long time for these plans to become a formal policy because strategies and plans submitted to the Cabinet or the Prime Minister are discussed carefully and adjusted for plentiful interests among related organizations.

The energy policy making process goes through the next five steps.

First step:

Each ministry and agency asks for industries under its management to draw and submit strategy, plan and/or conceptual design of the policy. The main organizations are as follows.

- 1) Institute of Strategy Development
- 2) Institute of Energy
- 3) Vietnam Atomic Energy Commission (Nuclear Power Energy Policy)
- 4) Other Organizations (Petrovietnam, Vinacomin, EVN)

Second step:

Policies compiled by industry shall be submitted to MOIT. In case of coal industry, VINACOMIN who is responsible for making energy policy asks its consultant company, one of the subsidiary of VINACOMIN (VINACOAL-Investment Consulting Joint Stock Company: MIICJSC), to draft strategy and plan. Upon completion with due consultation, such plan becomes VINACOMIN's policy plan. VINACOMIN submits it to MOIT as its policy. In some cases, of course, so-called "Management sector" of the company drafts the policy without out-sourcing.

Third step:

MOIT submits the draft of law, ordinance or regulation to the government.

Fourth step:

The government informs this to the Political Bureau.

Fifth step:

The government submits the draft to the National Assembly, as appropriate, and obtains approval. The government shall promulgate and execute them after legislation. The policy formally approved through such process becomes the strategy and plan of MOIT as well as the government.

The detail policy making process at each energy sector is as follows.

1) Coal sector

MOIT examines and drafts the coal strategy and the Prime Minister approves it. In case of the master plan, VINACOMIN and MIICJSC draft and MOIT examines it, and then the Prime Minister approves it. In addition, for the coal prices, VINACOMIN submits the draft, MOIT and MPI examine them, and then the Prime Minister approves, while the coal price except for the power sector is decided according to direct negotiation between VINACOMIN and larger users since 2007. After 2008, EVN (electric power company) and VINACOMIN will negotiate to decide the coal price for the power sector, though examination by MOIT and MOF and approval by the Prime Minister are necessary.

2) Oil and gas sector

The process is similar as above that Petrovietnam makes a strategy of oil and the gas sector, MOIT and MPI examine it, and the Prime Minister approves it. As the oil and gas sector "Master plan" was reported in February 2007 that the Political Bureau had already approved it, the Prime Minister's approval has not been obtained yet. For oil and gas price, the procedure requires that Petrovietnam sets the draft, MOIT and MOF examine it and then the Prime Minister approves it. In the "National Energy Policy" currently waiting for approval, it is stipulated that the prices of crude oil and major petroleum products may be decided in conformity to the international crude oil prices and within the

upper limit of a price band.

3) Power sector

For the power sector, MOIT examines and drafts the strategy and the Prime Minister approves it. As for the master plan, EVN and IE draft, MOIT and MPI examine, and the Prime Minister approves it. Besides this, IE and the consultant compiles "Regional plan" and MOI examines and approves it.

In pricing, Electricity Regulatory Authority of Vietnam (ERAV) proposes the electricity tariffs, and MOIT and MOF examine the draft and the Prime Minister approves it.

Though MOIT basically takes charge of making the Strategy of each energy sector, Petrovietnam is in charge of making strategy of oil and gas sector. As for the master plan, it is a process that each enterprise (VINACOMIN, Petrovietnam and EVN), the related laboratory (IE) or the consultant drafts "Master Plan" of each sector, and the Prime Minister approves it after examination of MOIT and MPI.

4) Energy conservation and renewable energy policies

A policy making process of energy conservation and renewable energy is as follows. MOIT, responsible for these policies, nominates consultant (IE of EVN will be nominated) for policy making at first. The consultant submits the study to MOIT. The submitted draft plan shall be examined at the National Appraisal Commission and adjusted as appropriate. Finally, MOIT submits it as their own plan to the Government and the Prime Minister approves it.

It is not certain in the above observation at which stage coordination among energy sectors is conducted, but such coordination may be inadequate at present. Strategies and Master plans of individual energy sectors may be being set out without thorough consultation with other sectors, making it difficult to re-adjust afterwards. This background may have required formulation of the National Energy Master Plan.

Similarly on pricing, though decision making procedure is set out from drafting, examination through approval, it is uncertain at which stage the relationship among prices of coal, oil and gas, and the electricity tariffs is coordinated. The current situation is not simple as Vietnam is presently in a transitional stage shifting from the "government controlled price" to "marker price". Although government intervention should become very limited at the end of this process, it takes time to reach the stage of complete deregulation. Therefore, it is necessary to formulate the relationship of these prices in a manner as much as fair, reasonable and transparent.

In the above context, it is required to urgently set out the National Energy Master Plan to coordinate sectoral development plans and pricing policies from national viewpoint toward formulation of a comprehensive energy policy.