

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

**MINISTRY OF ENERGY
THE SOCIALIST REPUBLIC OF VIET NAM**

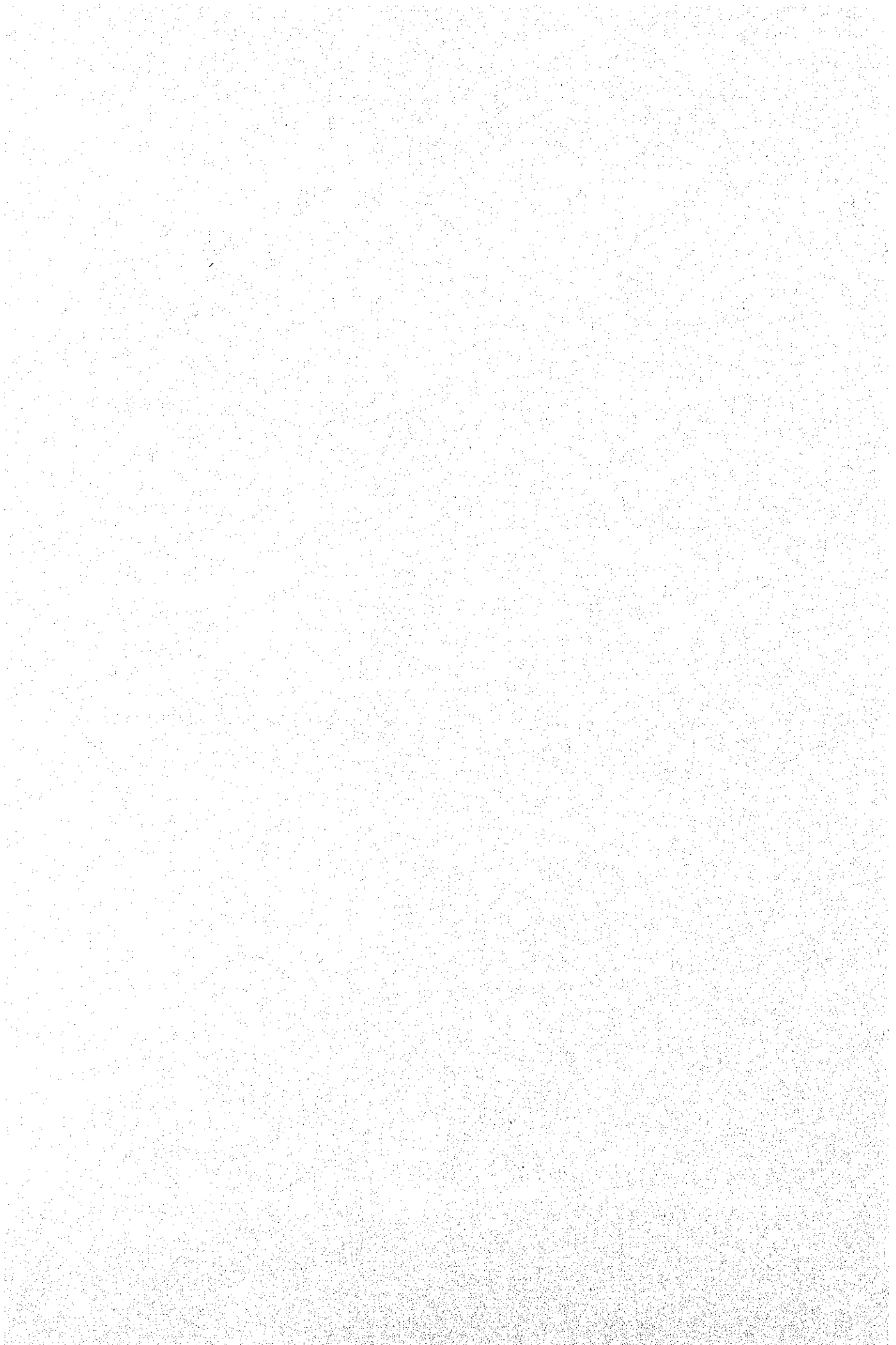
**THE MASTER PLAN STUDY
ON
ELECTRIC POWER DEVELOPMENT
IN
THE SOCIALIST REPUBLIC OF VIET NAM**

**FINAL REPORT
MAIN REPORT**

SEPTEMBER 1995

**ELECTRIC POWER DEVELOPMENT CO., LTD.
THE INSTITUTE OF ENERGY ECONOMICS, JAPAN**

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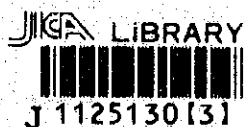


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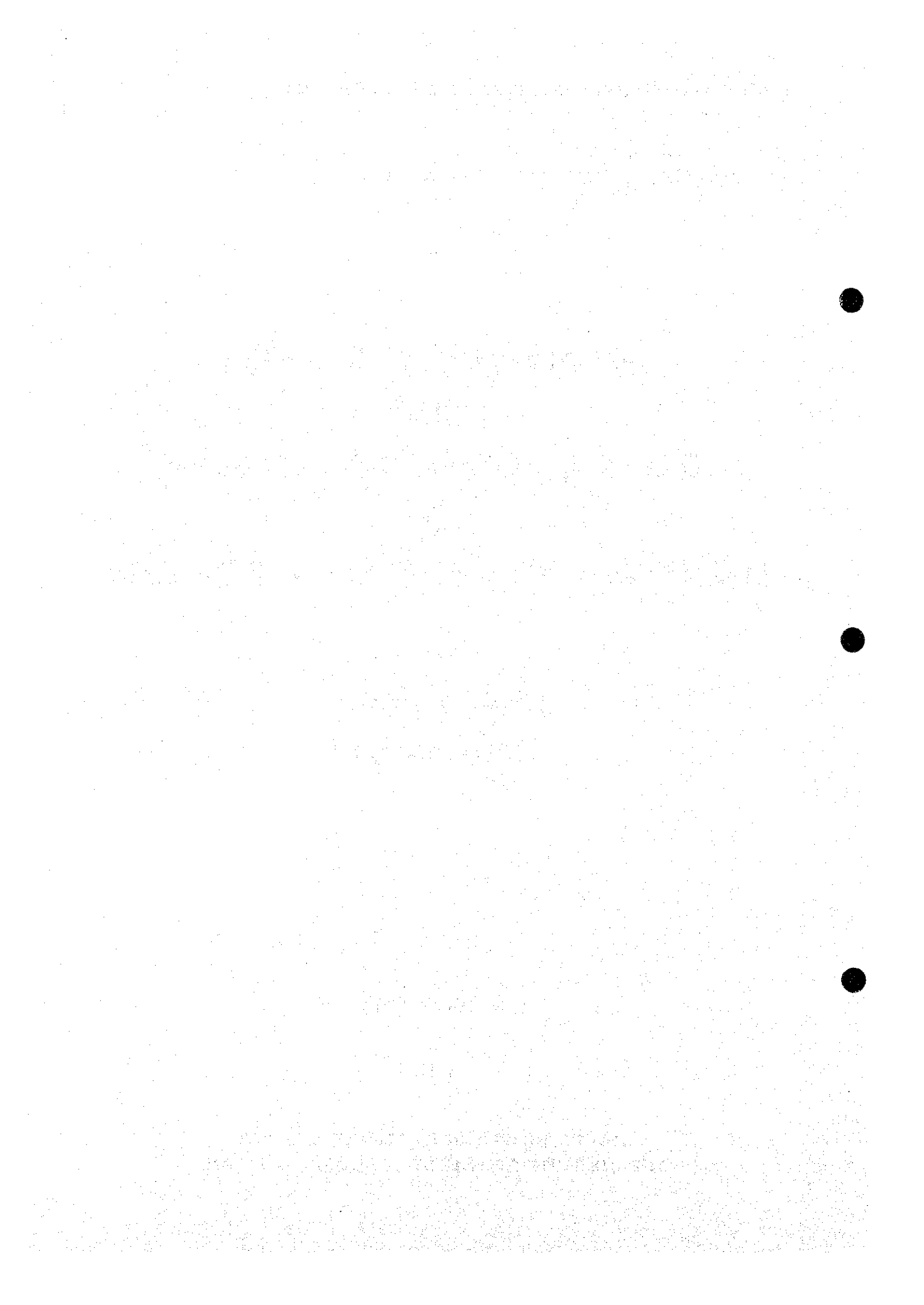
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PREFACE

In response to a request from the Government of the Socialist Republic of Viet Nam, the Government of Japan decided to conduct the Master Plan Study on Electric Power Development In the Socialist Republic of Viet Nam and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent study team led by Mr. Ryuhei Oyama (Electric Power Development CO., Ltd.) and organized by Electric Power Development CO., Ltd and the Institute of Energy Economics, Japan to the Socialist Republic of Viet Nam seven times from December 1993 to August 1995.

The team held discussions with the officials concerned of the Government of the Socialist Republic of Viet Nam and conducted related field surveys. After returning to Japan, the team conducted further studies and compiled the final results in this report.

I hope this report will contribute to the promotion of the plan and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Socialist Republic of Viet Nam for their close cooperation throughout the study.

September 1995



Kimio Fujita

President

Japan International Cooperation Agency

11.25/303

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Tokyo, Japan

September 1995

Dear Mr. Fujita ,

Letter of Transmittal

We are pleased to submit to you the report on "The Master Plan Study on Electric Power Development in the Socialist Republic of Viet Nam".

This Study was conducted by a joint consultant consisting of Electric Power Development CO., Ltd and the Institute of Energy Economics, Japan under a conducting to JICA, during the period December 1993 to September 1995. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Viet Nam and formulated the most appropriate basic design for the project under Japan's grand aid scheme.

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 International Trade and Industry. We would also like to express our gratitude to the officials concerned of Ministry of Energy, Institute of Energy, Viet Nam, the JICA Viet Nam office, and the Embassy of Japan in Viet Nam for cooperation and assistance throughout our study.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,


Ryuhei Oyama

Team Leader,
The study team of
The Master Plan Study on
Electric Power Development in
The Socialist Republic of Viet Nam

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GLOSSARIES AND UNITS

(i) AGENCIES

CCITT	: Consultative Committee of International Telephone and Telegraph
EPDC	: Electric Power Development Company Ltd.
EVN	: Electricity of Viet Nam
IEV	: Institute Energy of Viet Nam
IUCN	: International Union for the Conservation of Nature
JICA	: Japan International Cooperation Agency
MOE	: Ministry of Energy
MOSRE	: Ministry of Science, Technology and Environment
NEA	: National Environmental Agency
PC	: Power Company
PVN	: Petro Viet Nam
SCS	: State Committee for Science
SIDA	: Swedish International Development Authority
UNDP	: United Nations Development Program
UNEP	: United Nations Environmental Program
WB	: World Bank

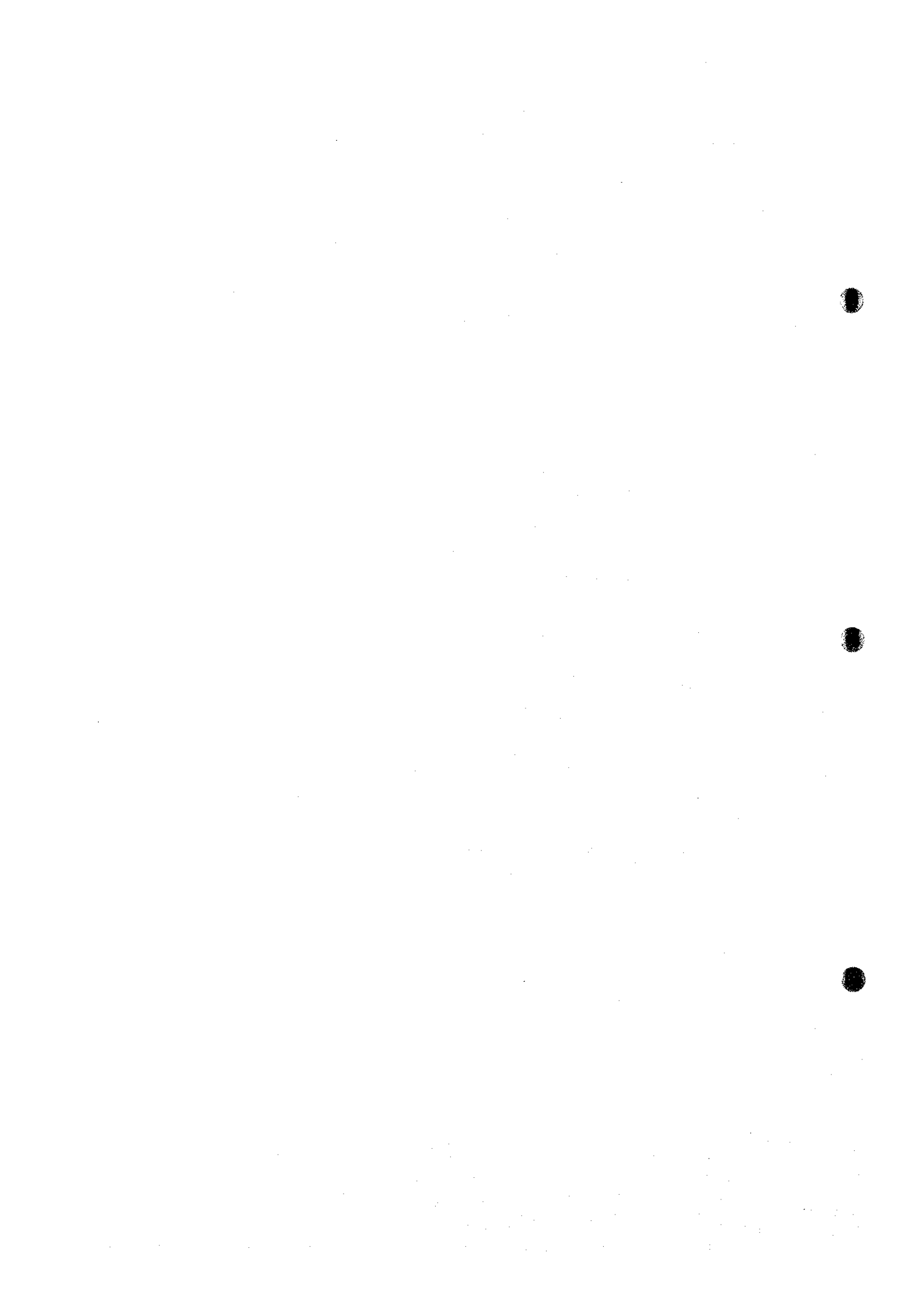
(ii) TERMS

AIC	: Average Incremental Cost
B/C	: Benefit Cost Ratio
BOT	: Built, Operation and Transfer
CA	: Catchment Area
CRF	: Capital Recovery Factor
DSM	: Demand Side Management
EIA	: Environmental Impact Assessment
EIS	: Environmental Impact Study
ESPRIT	: EPDC's System Planning package Reflecting Interconnections and Transactions
EUE	: Expectation Unserved Energy

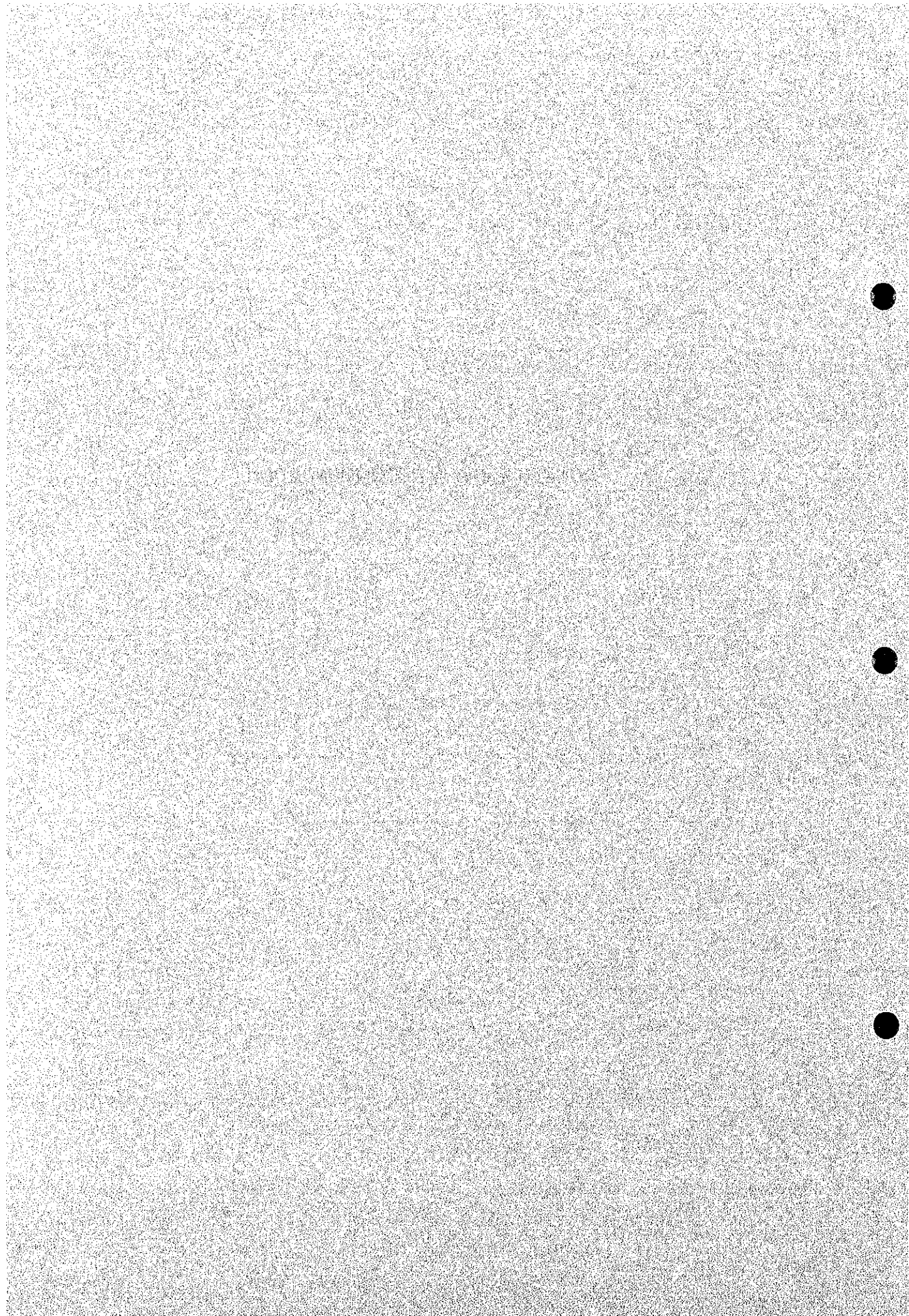
FC	: Foreign Currency
HWL	: High Water Level
IP	: Implementation Program
LA	: Loan Agreement
LC	: Local Currency
LNG	: Liquid Natural Gas
LOLP	: Loss of Load Probability
LPG	: Liquid Petroleum Gas
LRMC	: Long Run Marginal Cost
LWL	: Low Water Level
MC	: Marginal Cost
NMP	: Net Material Product
NOx	: Nitrogen Oxide
NPESD	: Viet Nam National Plan for Environment and Sustainable Development
O&M	: Operation and Maintenance
ODA	: Official Development Assistance
PDP	: Power Development Plan
QC	: Quality Control
RE	: Rural Electrification
ROR	: Rate of Return
S/W	: Scope of Work
SCADA	: Supervisory Control And Data Acquisition System
SNA	: System of National Account
SOx	: Sulfur Oxidation
T&D	: Transmission and Distribution
TOE	: Ton Oil Equivalent
TOU	: Time of Use
WASP	: Wien Automatic System Planning Package

(iii) UNITS

bps	:	bor per second
BTU	:	British Thermal Unit
mm	:	Millimeter
cm	:	Centimeter
m	:	Meter
km	:	Kilometer
mm ²	:	Square millimeter
cm ²	:	Square centimeter
m ²	:	Square meter
km ²	:	Square kilometer
kg	:	Kilogram
t	:	Metric ton
m ³	:	Cubic meter
m ³ /s	:	Cubic meter per second
MCM	:	Thousands of circular mils (for transmission line)
kV	:	Kilovolt
kVA	:	Kilovolt-Ampere
MVA	:	Megavolt-Ampere
kW	:	Kilowatt
kWh	:	Kilowatt hour
MW	:	Megawatt = 10 ³ kW
MWh	:	Megawatt hour = 10 ³ kWh
GW	:	Gigawatt = 10 ³ MW
GWh	:	Gigawatt hour = 10 ³ MWh
rpm	:	Revolutions per minutes
Hz	:	Hertz (cycles per second)
EL	:	Elevation



CONCLUSION AND RECOMMENDATION



CONCLUSIONS AND RECOMMENDATIONS

1. CONCLUSIONS

(1) Electric Power Demand

- (a) Three economic scenarios (low, base and high) required for electric power demand forecasting were prepared for each of the northern, central and southern regions and for each of consumption sectors. Vietnamese GDP in the base case scenario is expected to be the double of 1992 GDP (US\$ 31,600 million) in 2000 and four times (US\$ 71,100 million) in 2010 at 1989 constant price.
- (b) Based on the scenario (base case), total electric power demand nationwide would increase from 8,007 GWh in 1993 to 18,631 GWh in 2000 (2.3 times over the 1993 record), and reach 55,948 GWh in 2010 (almost sevenfold of the 1993). Power generation in the base case, 10,729 GWh recorded in 1993 is likely to rise to 22,289 GWh by 2000 (2.2 times over the 1993) and reach 66,600 GWh by 2010 (6.2 times of the 1993).
- (c) In peak load (in the base case), 2,083 MW in 1993 is expected to reach 4,526 MW by 2000 (2.2 times over the 1993) and further 12,550 MW by 2010 (6.0 times over the 1993).

(2) Power Development Plan and 500 kV Interconnection Transmission Line

- (a) Prior to formulation of power development plans, power development projects identified were evaluated and development potentials of energy resources (coal and natural gas) for power generation were also assessed. The formulation of power development plans is based on two essential factors; one is development scale (3,600 MW and 2,400 MW) of the Son La hydropower project and the other is production potential (Large and Small cases) of natural gas. Two scenarios without the Son La in combination of Gas Large and Gas Small cases were also formulated in order to assess the justification of the Son La project.
- (b) The evaluation criteria employed for identification of optimal power development plan are as follows:
 - 1) Cost effectiveness giving priority to the least cost power development plan,
 - 2) Power system operation,
 - 3) Constraints of fuel resources for power generation, and
 - 4) Socio-environmental consideration.

The conclusions are given below as a result of comprehensive evaluation.

- a) It is desirable to develop the Son La hydropower project.
 - b) The optimal power development plan is identified to be the scenario of the Son La (2,400 MW) under the case of Gas Small where utilization of natural gas for power generation is confined to associated gas.
 - c) The least-cost power development plan is identified to be the scenario of the Son La (2,400 MW) under the case of Gas Large where utilization of natural gas for power generation extends to both associated and non-associated gas. The selection of the least-cost scenario depending on development of non-associated gas enhances economic justification in terms of cost effectiveness.
- (c) 500 kV interconnecting transmission line started its operation in 1994 with the transmission capacity of 700MW.

The construction of another 500 kV line in different route was planned in this Master Plan Study. Transmission capacity from central to south will increase up to 1,500 MW. As a result, the effective power system based on the mix of thermal and hydropower generation will be realized.

(3) Power Investment Plan

- (a) Total power investment requirement (generation, transmission and distribution) during investment plan period from 1994 to 2010 was estimated to be US\$ 23,025 million. Power utilities consist of EVN managing power generation and transmission, and PCs (five companies) responsible for distribution. The investment requirements of EVN and PCs were estimated to be US\$ 16,132 million and US\$ 6,893 million respectively. Total power investment requirement comprises of foreign currency portion (US\$ 14,226 million) and local currency portion (US\$ 8,800 million)
- (b) Capital sources of power investment are contemplated to be official development assistance (ODA) for foreign currency, long-term domestic fund, the government fund and equity capital for local currency. Government fund (US\$ 1,443 million) corresponding to about 21 % of investment requirement (US\$ 6,893 million) of PCs is assumed to be paid in PCs, taking into account their profitability and repayment capability.

2. RECOMMENDATIONS

(1) Urgent Studies for Hydropower Development

(a) In view of implementation schedule of the optimal power development plan, the development studies of five hydropower projects will be urgently required. These hydropower projects are the Son La in the Da river basin and Plei Krong, Thuong Kontum, Sesan 3 and Sesan 4 in the Sesan river basin. Economic viability of the said projects is relatively high compared to other hydropower projects identified in the Master Plan Study.

(b) Son La Small turn out to be cost effective than Son La Large by the analysis of PDP simulation study.

With respect to development scale of Son La project, it is recommended to be decided based on the results of the feasibility study and EIA clarifying socio-environmental considerations (preparation of resettle planning, detailed estimation of compensation cost, preparation of environmental protection measures, etc.).

(c) At present, except for the Yaly project under construction, no technical study was made for other hydropower schemes in the Sesan river. The Plei Krong to be formulated as the multi-purpose project (irrigation) is expected to contribute to incremental energy generation at Yaly hydropower plant located in the down stream of the Plei Krong. Water resource of the Sesan river is planned to be diverted at Thuong Kontum into the other catchment area for the purpose of irrigation. The construction of Thuong Kontum project also contributes to incremental energy generation at planned sites located in the downstream. Reservoir operation of the Yaly hydro power plant will increase power generation of the Sesan 3 and 4 located in the downstream of the Yaly.

A master plan study of the Sesan river should be implemented at first. An optimal power development scale will be formulated for all the planned projects, given the development conditions of Yaly project. Subsequently feasibility studies of the planned projects will be undertaken after a master plan.

(d) Both the feasibility study of the Son La project and a master plan study of the Sesan river will be urgently implemented in 1996.

(2) Establishment of Data Integration System

- (a) Establishment of data collection system and electric power statistics is essentially needed for power demand forecasting analysis, rational management of operation/maintenance and management.
- (b) Power statistics could be prepared more promptly and accurately than now, if data management system be computerized. To this end, a system for data collection and inputting must be introduced, preferably with some legal arrangement. It is recommended to establish a power statistics department under Ministry of Energy.

(3) Expansion of Coal Production

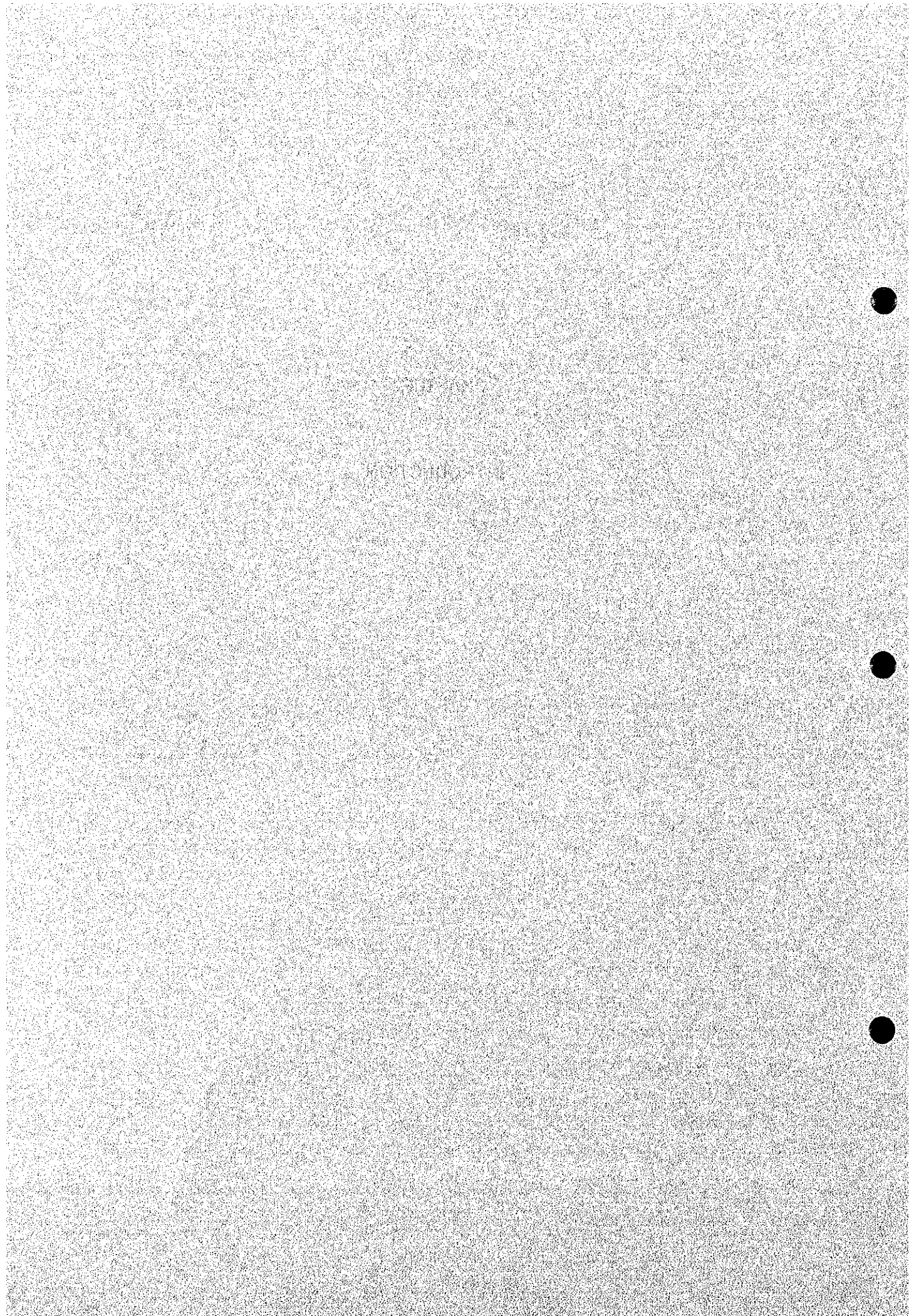
- (a) Natural gas production for power generation is confined to associated gas in the case of Gas Small. Annual coal consumption by the scenario of the Son La (2,400 MW) under the case of Gas Small was estimated to be about 8.8 million tons in 2010.
- (b) It is necessary to expand the coal production taking into account the current production capability of eight million tons of clean coal. A coal development plan is recommended for stable supply to consumption sectors based on detailed survey on domestic demand and export.

(4) Privatization and Fund Mobilization

- (a) There is no guarantee that all power investment will be financed by the proposed capital sources such as ODA, long-term domestic fund and government fund. The mobilization of private fund in the form of project finance would greatly contribute to timely implementation of power development project.
- (b) Lessons from project finance implemented in the past will have to be effectively applied to scheme of project finance in Viet Nam. Transfer of technology will be necessary for the Vietnamese counterparts with respect to knowledge and experiences. Privatization contributes to alleviation of debt burden to be borne by EVN.

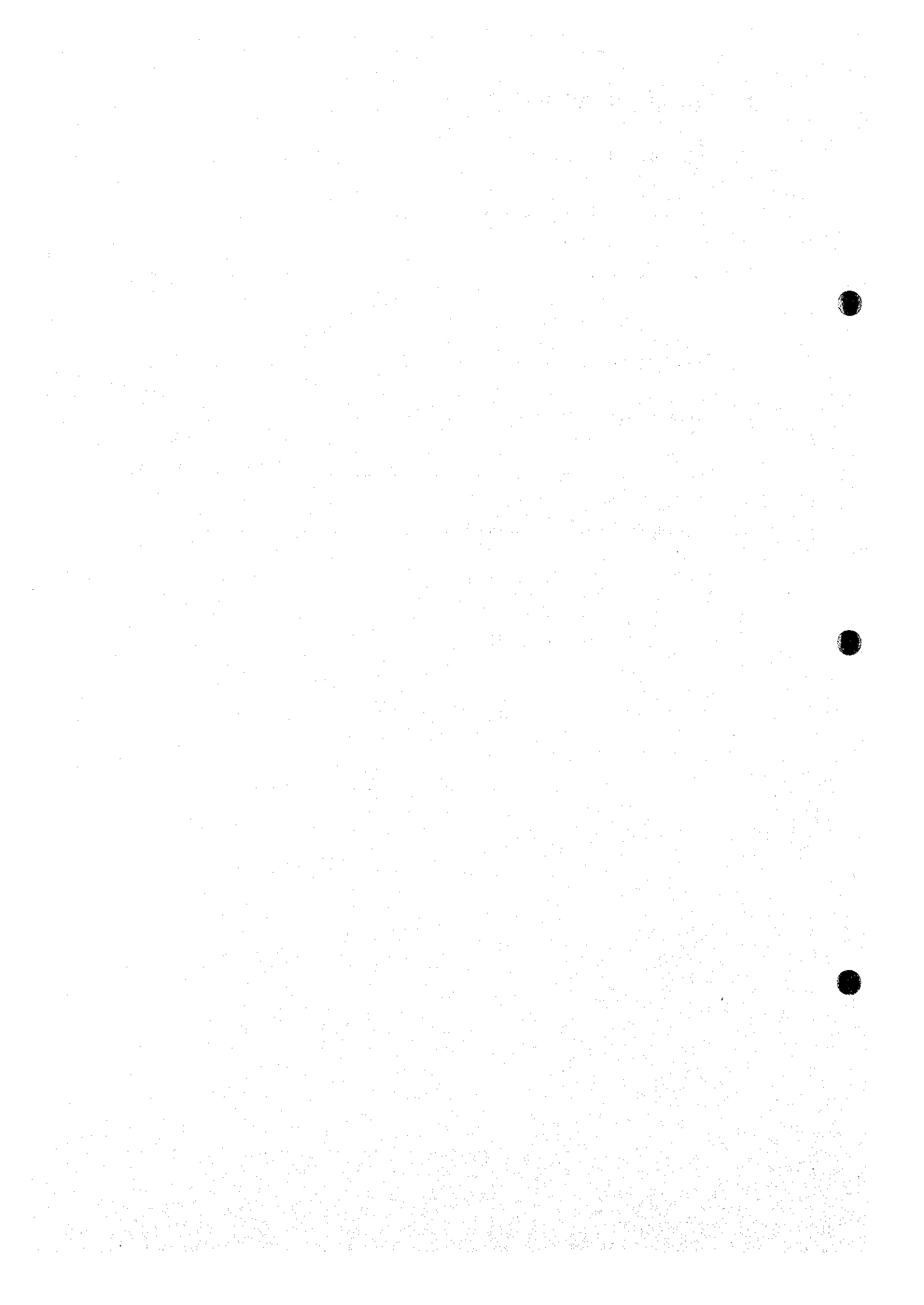
CHAPTER 1

INTRODUCTION



CHAPTER 1 INTRODUCTION

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CHAPTER 1 INTRODUCTION

In response to the request of the Government of the Socialist Republic of Viet Nam (hereinafter referred to as "Viet Nam"), the Government of Japan entered an agreement with the Government of Viet Nam to implement the Master Plan on Electric Power Development in Viet Nam in May, 1993. Based on this agreement, the Japan International Cooperation Agency (hereinafter referred to as "JICA") and the Ministry of Energy signed, in August, 1993, the agreement of the scope of work, that described the works to be performed in the Study.

In December, 1993, JICA contracted to implement the Study with the Electric Power Development Company, Ltd., and the Institute of Energy Economics, Japan, forming a Joint Venture.

1.1 Background of Project

In Viet Nam, a rapid economic growth is in progress since the adoption of the Open Door Policy (Doimoi) in 1986. With this economic growth, the electric power demand in the nation has exhibited a robust growth rate of 7.3% per annum up to 1992, and this trend is expected to continue as the economic growth of the nation is sustained. Under the circumstances, the Government of Viet Nam, recognizing the importance of electric supply, has defined the electric power development in the nation as one of the important items in its national development plan, and now is exercising a substantial effort for expansion of electric power supply capacity.

The electric power supply regime in the nation is divided by the regions of the country to northern region, central region and southern region, and the electric power demand/supply conditions differ substantially from one region to another. The northern region, currently has excess supply capability owing to the large hydroelectric development projects so far implemented, and the generation of coal fired thermal power facilities is now being reduced. On the other hand, the southern region has the largest demand for electric power, the supply capability is not sufficient at this moment (1993), with the supply capability falling short in the dry season due to the reduction of capability of hydroelectric power plants. The central region, where the electrification is not sufficiently realized, is the smallest in terms of electric power demand. The supply capability of the central region is also feeble, and its supply shortfall is being made up by the electric power purchased from the northern and southern regions.

The Government of Viet Nam is now striving to realize more stable power supply, to improve the supply efficiency, to correct the imbalance between power demand and supply at each region, and to promote rural electrification, currently being engaged in many electric power development projects under the Power Development Master Plan, which defines the power development project up to the year 1995 associated with a perspective leading to the year 2000.

However, the Government of Viet Nam has not yet established the basic policy (Master Plan) for its effort of electric power development beyond 1996. In formulating this Electric Power Development Master Plan, the Government desires to formulate a plan which includes such factors as environmental considerations, stable operation of power systems, management of electric utility business, and development of human resources, of which importance is recently recognized. Since the existing electric power development plans have been developed based on the technical disciplines of the former Soviet Union, the Government of Viet Nam does not have expertise related to such factors as referenced above.

1.2 Objective, Area and Scope of Study

1.2.1 Objective of Study

The primal objective of the Study is the formulation of power development plan for the period from 1996-2010 in the whole country of Viet Nam. The Study also aims to enhance technical capability of the Vietnamese side with respect to power development plan through transfer of technology.

1.2.2 Study Area

Scope of the Study is defined within the national territory of Viet Nam.

1.2.3 Contents of Study

Contents of the study to be performed are as follows.

(1) PART I Database System and Demand Forecasting Model

(a) Establishment of database system for the formulation of power development plan, such as

- 1) Demand and supply of electric power
- 2) Energy sources
- 3) Power supply network
- 4) Capital requirement and financing
- 5) Power producers (including private sector)

(b) Demand forecasting model and demand/supply analysis for electric power

- 1) Model building for demand forecast
- 2) Study on power demand analysis
 - Review and assessment of future macro economic framework for power development planning
 - Demand structure analysis
- 3) Improvement of demand forecasting model and supply analysis framework
 - Improvement of the model and the framework
 - Examination and modification of the model and the framework

(2) PART II Study on Power Development Plan and Identification of Prior Plans and Projects

- (a) Review and assessment of thermal power projects (the Third Electric Power Development Plan during the period from 1992 to 2000) prepared by IEV
- (b) Assessment of thermal power development projects after 2000
- (c) Review and assessment of hydropower projects with special reference to construction and compensation costs in reservoir areas
- (d) Assessment of hydropower projects after 2000 with respect to ranking study of individual projects
- (e) Review and assessment of energy resources for power generation
- (f) Formulation of alternative power development scenarios
- (g) Selection of the most recommendable scenario

(3) PART III Formulation of Basic Strategy and Policy for Effective Power Supply and Power Development

- (a) Review and assessment of energy conservation plan
- (b) Examination of environmental protection plan
- (c) Formulation of basic policy framework, such as
 - Electricity tariff rate
 - Accounting system
 - Institutional development
 - Rural electrification
- (d) Review and assessment of future investment plan for power sector
- (e) Preparation of measures and supporting programmes for the achievement of strategies and policies in power sector

1.3 Work Schedule

The study period is scheduled from Dec. 1993 to October 1995.

Within this period, the JICA study team performed following activities in Viet Nam.

(1) 1st Site Survey: December 19th to 27th, 1993

Presentation of the methodology and the schedule of the study based on the Inception Report (Draft), the field survey for the related area, collection of the study data and discussion on the Inception Report (Draft).

(2) 2nd Site Survey: March 8th to 25th, 1994

Explanation of the methodology from study team members to the Ministry of Energy (MOE), Institute of Energy Viet Nam (IEV), Power Company No.1 (PC1), Power Company No.2 (PC2), Power Investigation and Design Company No.1 (PIDC1) and Power Investigation and Design Company No.2 (PIDC2), the field survey for the related areas and collection of the study data.

(3) 3rd Site Survey: July 4th to August 2nd, 1994

Presentation of Progress Report I to MOE, IEV, PC1 and PIDC1, as well as PC2, PIDC2 and PC3 respectively, the field survey for the related Southern and Central areas and collection of the study data, and discussion on the Progress Report I.

(4) 4th Site Survey: September 19th to October 18th, 1994

Explanation of the methodology such as demand forecast, power development plan and creation of database aiming at the Interim Report, the field survey and collection of the study data.

(5) 5th Site Survey: January 8th to 28th, 1995

Presentation of the Interim Report to the Steering members and IEV, the field survey for the related Northern and Southern areas and collection of the study data, and discussion on the Interim Report.

(6) 6th Site Survey: March 5th to 28th, 1995

Presentation of the Progress Report II to MOE including Electricity of Viet Nam (EVN) and IEV, discussion on the Progress Report II.

(7) 7th Site Survey: July 24th to August 13th, 1995

Presentation of the Draft Final Report to IEV and Steering Group including EVN. Signing of Minutes of Meetings on the Study.

1.4 Personnel related to Study

The list of members given below is those for Steering Committee, Working Group and JICA Study Team. All members of Steering Committee are from MOE, while members of Working Group are from IEV.

(1) Steering Committee

Mr. Le Licm	Vice Minister of MOE, Leader of Steering Group
Dr. Tran Quoc Cuong	Director of IEV, Permanent Member
Mr. Pham Van Vy	Director of Economic and Planning Department, MOE Member
Mr. Nguyen Si Phong	Director of International Cooperation Department, MOE Member
Mr. Pham Tien Ba	Director of Technical and Science Department
Director of PC1	Member
Director of PC2	Member

Director of PC3	Member
Director of PIDC1	Member
Director of PIDC2	Member

(2) Working Group

Dr. Tran Quoc Cuong	Director of IEV and Management of Project
Dr. Nguyen Van Hien	Chief of Electric Power System Department
Dr. Pham Dinh Thai	Chief of Energy Demand Forecast Department
Dr. Pham Khanh Toan	Chief of International Cooperation Department
Mr. Nguyen Kinh Luan	Chief of Thermal-Electric Engineering Department
Dr. Nguyen Viet Thanh	Chief of Energy Economic Department
Mr. Ha Tien Luy	Chief of Hydropower Department
Dr. Nguyen Van Hanh	Chief of Technical Department

(3) JICA Study Team

Mr. Ryuhei OYAMA	Team Leader
Dr. Atsushi FUKUSHIMA	Demand Forecast/Sub Team Leader
Mr. Toshimasa FUJIUCHI	Power Supply Planning
Mr. Eijiro MAEDA	Database Creation
Mr. Akira MAMIYA	Thermal Power
Mr. Hiroshi MURASHIGE	Hydropower
Mr. Sumio TSUKAHARA	Power System
Mr. Akio SUZUKI	Power Development Model
Mr. Katsuhiko OTAKI	Overall Issues on Electric Utilities
Mr. Ryoza OHNO	Environmental Issues
Mr. Tatsu KAMBARA	Energy Resources
Mr. Munenori TADA	Economic Analysis
Mr. Hideaki MORISHITA	Secretary

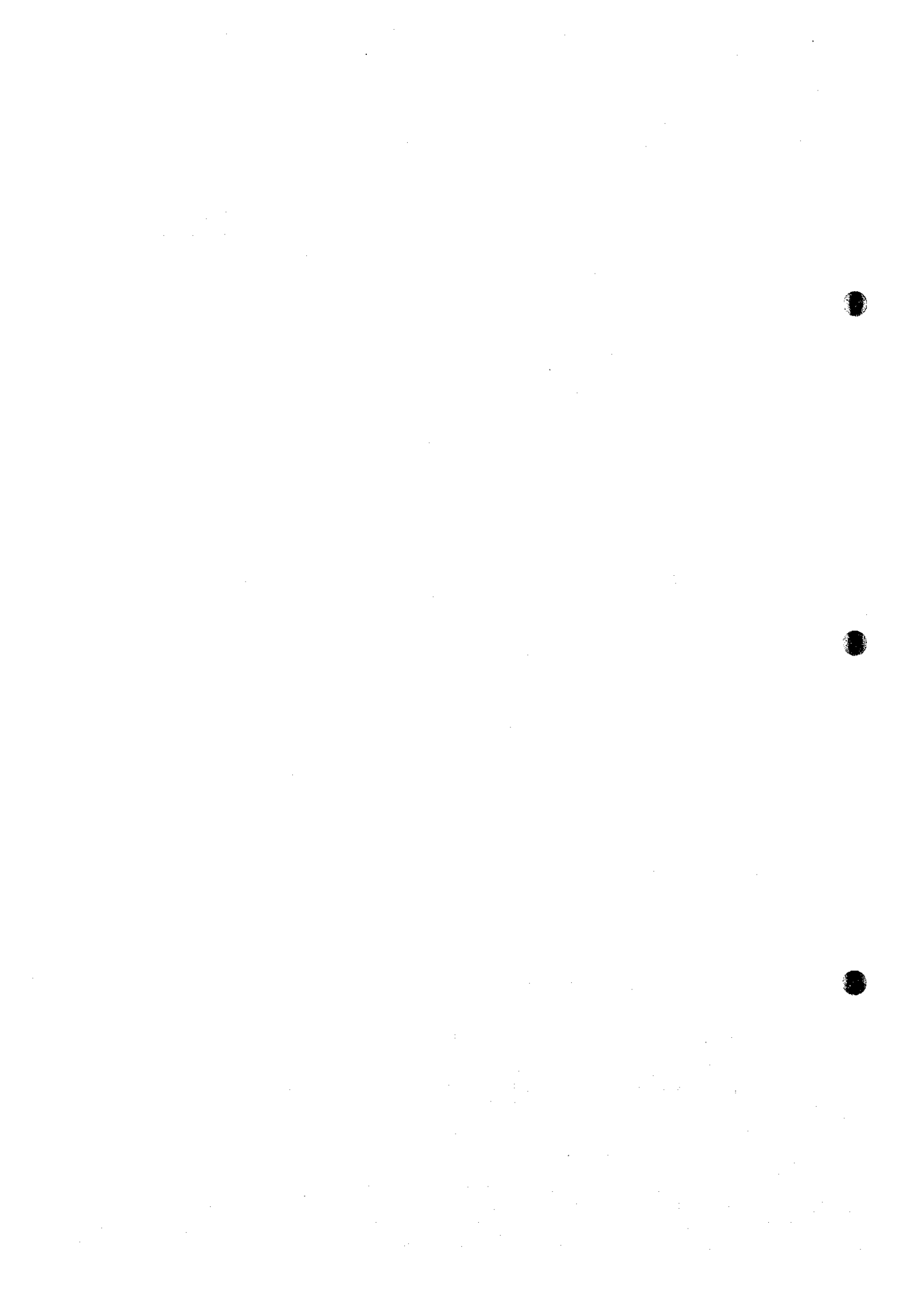
1.5 Provision of Equipment

To promote supply and demand analysis, demand forecast and creation of database in this study, the equipment was provided by JICA to IEV, according to the Agreement. The detailed list of hardware, software and publications are listed in Appendix.

1.6 Technology Transfer to the Counterparts

The technology transfer to the counterparts from IEV was performed in Japan during this study period as follows.

Name of Counterparts	Period
Mr. Nguyen Viet Thanh (Economist)	October 11th to November 9th (30 days)
Mr. Nguyen Van Vy (Electrical Engineer)	October 11th to November 9th (30 days)
Mr. Nguyen Dan Dien (Electrical Engineer)	September 5th to September 27th (23 days)
Mr. Tran Manh Hung (Electrical Engineer)	September 5th to September 27th (23 days)



CHAPTER 2

GENERAL DESCRIPTION OF THE SOCIALIST REPUBLIC OF VIET NAM

CHAPTER 2 GENERAL DESCRIPTION OF THE SOCIALIST REPUBLIC OF VIET NAM

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CHAPTER 2 GENERAL DESCRIPTION OF THE SOCIALIST REPUBLIC OF VIET NAM

2.1 Profiles of the Country

2.1.1 Geography

Viet Nam with an area of 331,111 km² is bounded to the north by the People's Republic of China, to the west by the Republics of Cambodia and Lao People's Democratic Republic and to the south and east by the Eastern Sea. The national land is located between the north latitudes of 8°30' and 23°23', and between the east longitudes of 102°10' and 108°50'.

Viet Nam, lying on the eastern side of the Southeast Asian Peninsula is characterized by the long shape in the north-south direction and short distance in the east-west direction: that is, 1,650 km in the north-south direction with 3,260 km long coastal line, whilst the length of east-west direction is about 600 km at the maximum in the northern part and about 50 km at the minimum in the central part.

Due to the geographic characteristics with long shape in the north-south direction and undulating terrains, Viet Nam is divided into seven ecological zones. Land use by zone is shown in Table 2.1-1.

The land use in the country is different by zone. Ecological zones in Viet Nam and administrative units are shown in Figure 2.1-1. In the north, coastal plain extends over fertile delta plain called the Red River Delta covering an area of about 12,500 km². About 58% of the Delta is used for agriculture. The Delta also featured by high population density has the capital of the country, Hanoi. In the south, coastal plain widens into the Mekong River Delta having an area of about 39,600 km². About 62% of the Mekong Delta is used for agriculture. The zone of Central Highlands is dominated by forestry, about 60% of its zone area. As a whole, half the national land is utilized for agricultural activities such as crop and forest production.

2.1.2 Climate

Viet Nam belongs to the Asian Monsoon Zone and gives tropical conditions in the south and sub-tropical conditions in the north. She enjoys a variety of climatic conditions, including the cool weather in the northern mountain area, the wet tropical climate from northern to central low lands, and the tropical monsoon climate in the southern low lands.

The wet season lasts from May to October and the dry season from November to April. Even during the dry season, the precipitation is relatively abundant in the central areas December through January owing to the seasonal wind bringing moisture from the Eastern Sea. Typhoons do not usually land on the southern Mekong Delta, but they travel westward from the Philippines through the Eastern Sea and go through Viet Nam in the north latitudes over 14°. Average temperature, humidity and rainfall are shown in Figure 2.1-2 through 2.1-4.

2.1.3 Political Structure

The Constitution of Viet Nam has been amended in the People's Convention stipulated in April 1992, and the new constitution was proclaimed on April 18 subsequently. This revision reaffirmed the legal status of the new set of policies ("Doi Moi"; renovation in English) which had been implemented since the Communist Party Convention held in December, 1986.

The new constitution re-confirmed the leadership of the Communist Party, but it postulates the division of the Nation from the Party, and the independence of the legislature, administration and justice. It was also confirmed that the economic structure has been converted from the "centrally planned economy" to the "market economy consisting of various elements" including the business principles of capitalist countries: that is, privately owned business such as individual possession of capital assets, and non-nationalization of foreign capitals. Although the land ownership was retained by the nation, the long-term possession, inheritance and transfer of the land use right by individuals or private organizations were authorized.

Doi Moi has two major objectives to pursue in the economic field: 1) an economic liberalization policy at home and 2) an open door policy internationally.

This renovation programme began in the year 1986 and accelerated in the year 1989 including the following reforms:

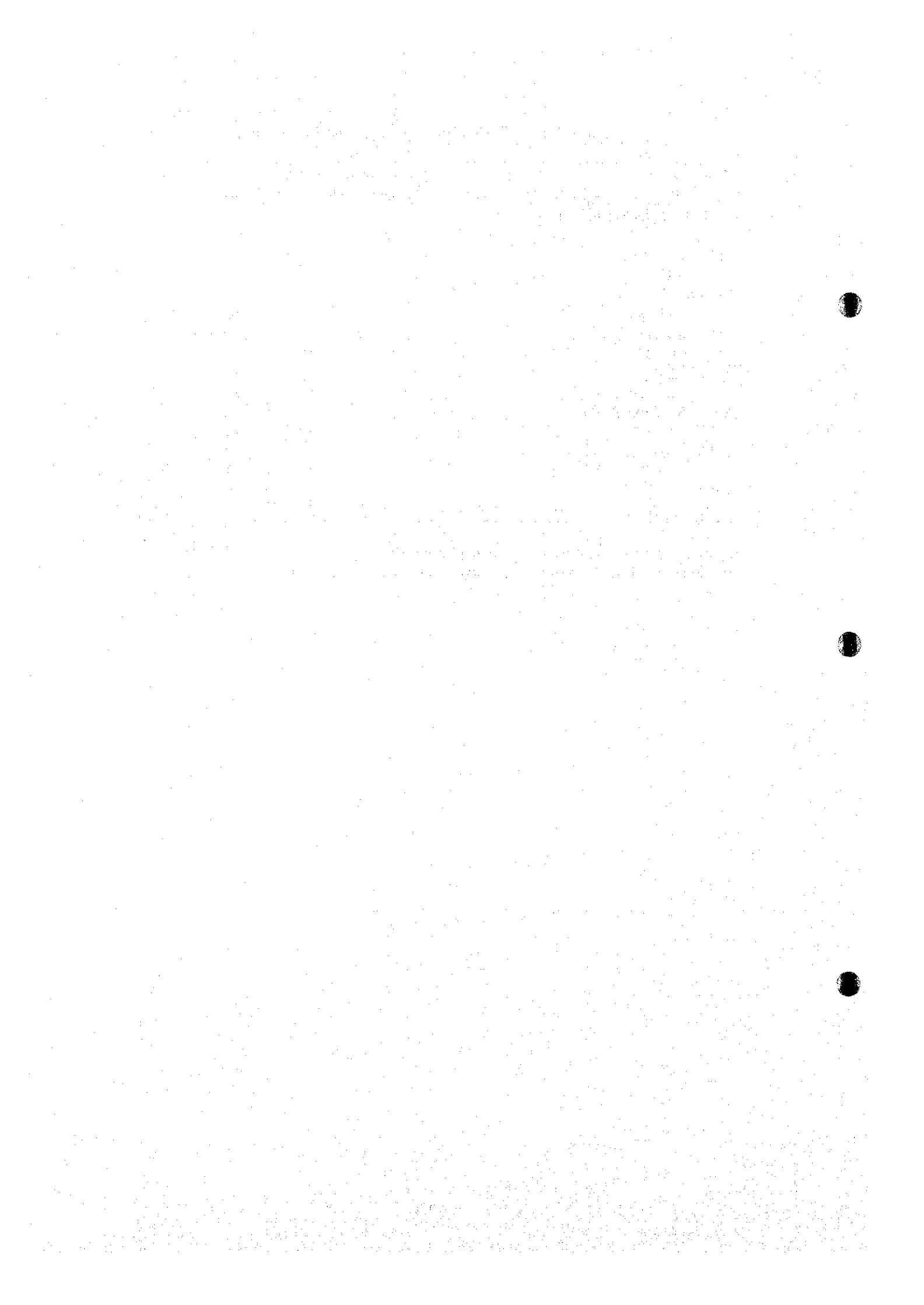
- Provision of long-term land tenure rights, facilitating household farming;
- Opening-up of opportunities for private sector development;
- Increased autonomy for state enterprises and requirements that they operate on a non-subsidized basis and in a competitive environment;
- Decontrol of prices, allowing market supply and demand forces to work;
- Devaluation of the official exchange rate;
- Trade liberalization and reorientation to export-led growth;
- Encouragement of foreign investment;
- Reform of the fiscal and monetary system, to better balance the budget, strengthen tax revenues, stimulate savings and control inflation; and
- Adoption of the new Constitution in the year 1992, introducing changes to democratic freedom and property rights.

Table 2.1-1 Seven Ecological Zones in Viet Nam

Zone	Area (km ²)	% of each land use in area					Total
		Agriculture	Forestry	Habitant	Others	Unused	
1) North Highlands and Midlands	102,965	13	21	2	2	62	100
2) Red River Delta	12,511	58	4	7	14	17	100
3) North Central Coast	51,188	14	33	2	3	48	100
4) South Central Coast	45,876	12	32	1	3	52	100
5) Central Highlands	55,569	8	60	1	1	30	100
6) North East Southland	23,451	34	24	5	5	32	100
7) Mekong River Delta	39,551	62	9	5	4	20	100
Total	331,111	21	29	2	3	45	100

Source : Statistical Data on Labor and Social Affairs 1992

Remarks : "Unused" consists of mountains, water ponds and others.



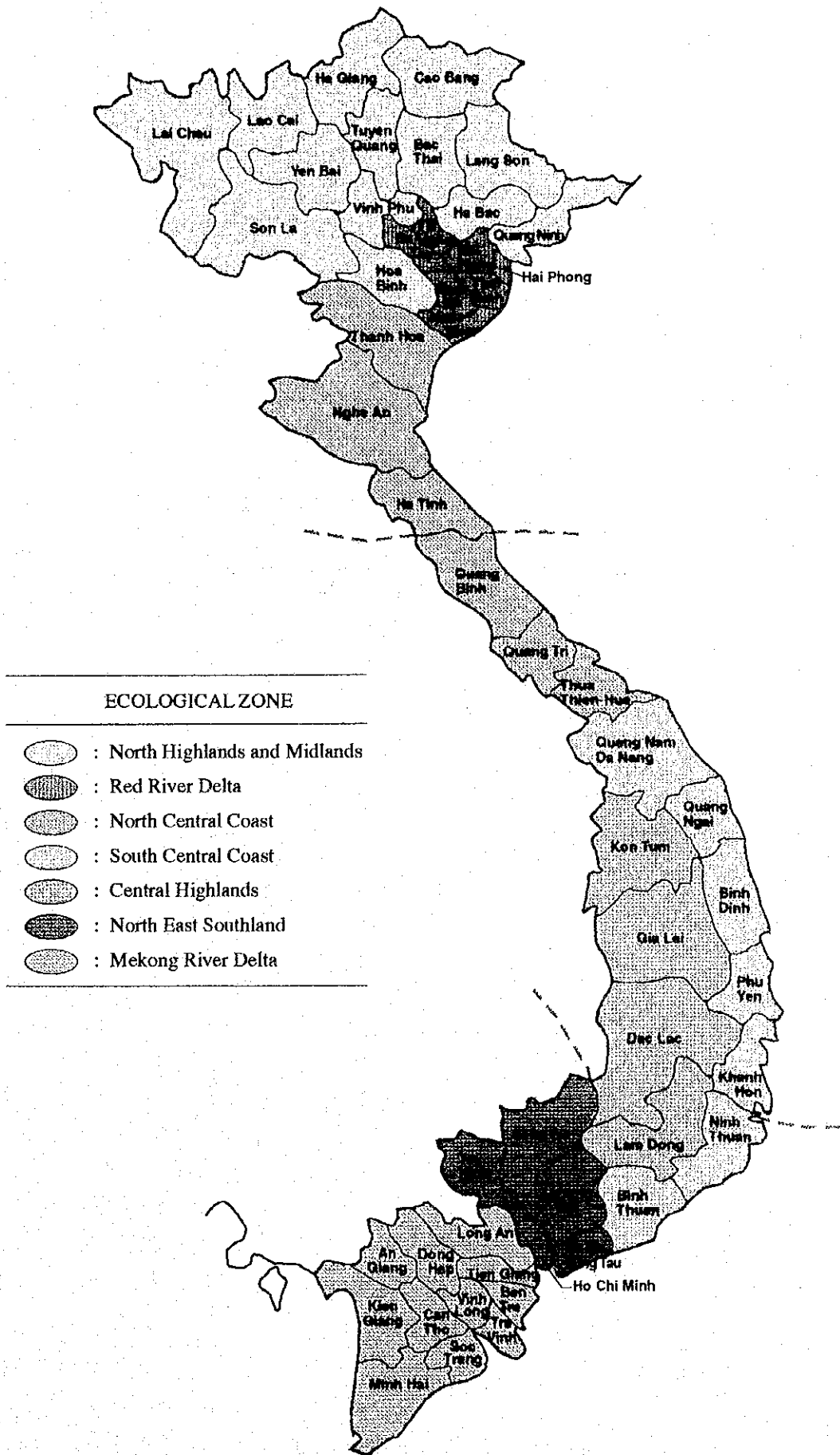


Figure 2.1-1 Ecological Zone and Administrative Unit in Viet Nam

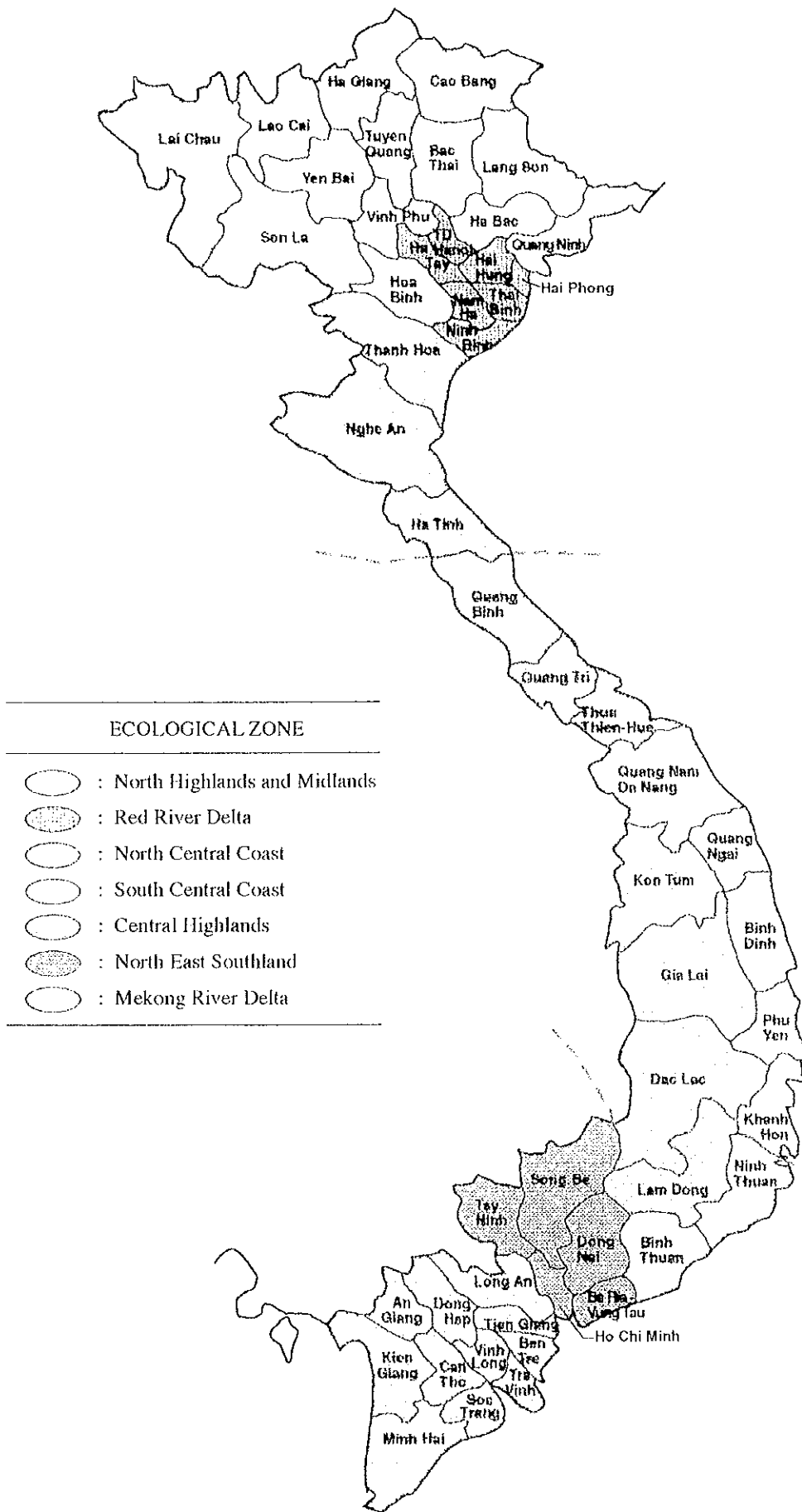


Figure 2.1-1 Ecological Zone and Administrative Unit in Viet Nam

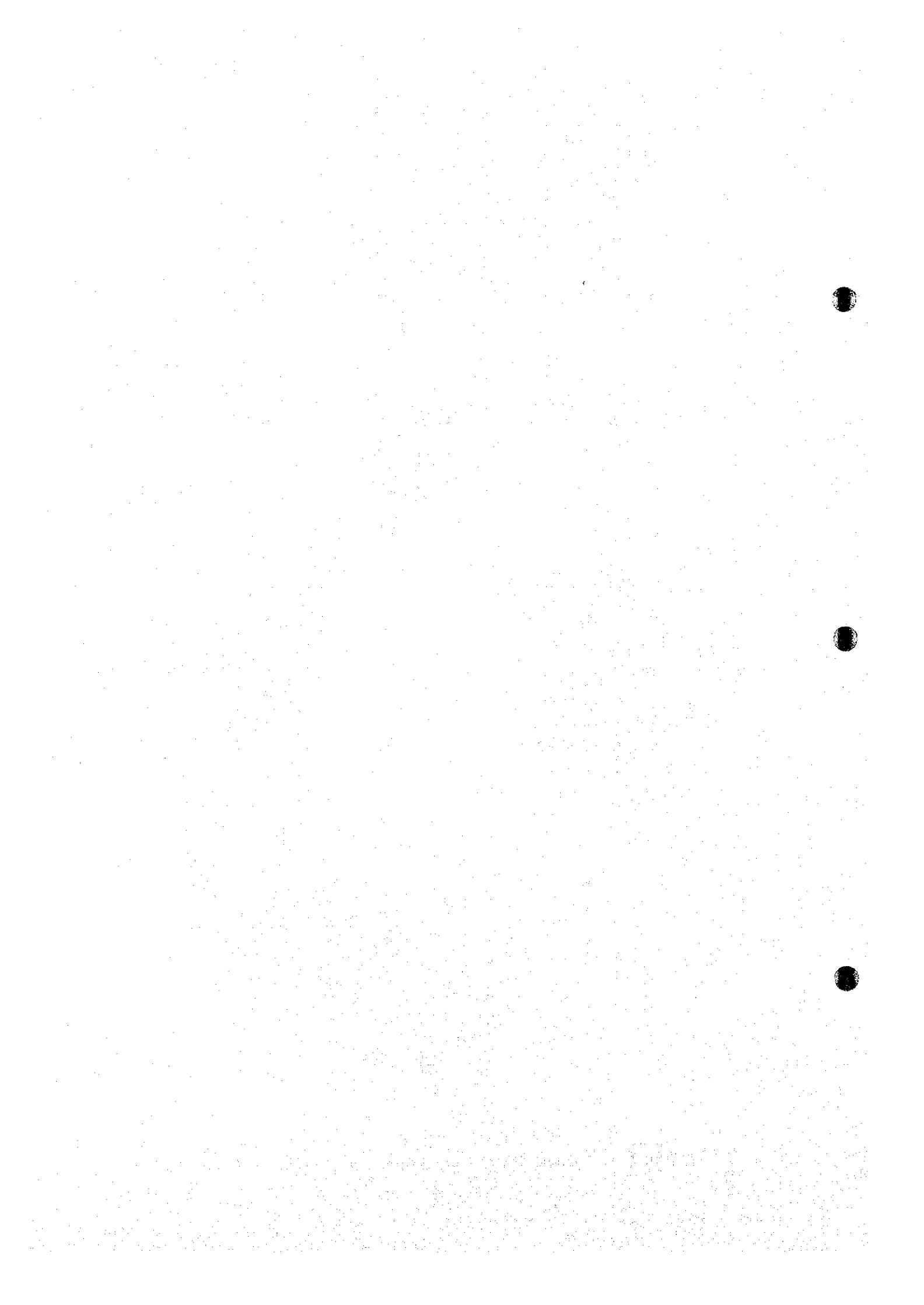


Figure 2.1-2 Average Temperature (Degrees Centigrade)

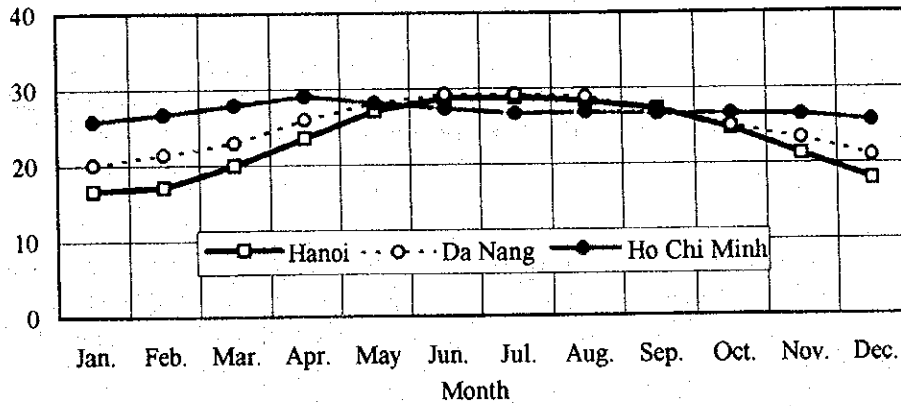


Figure 2.1-3 Humidity (%)

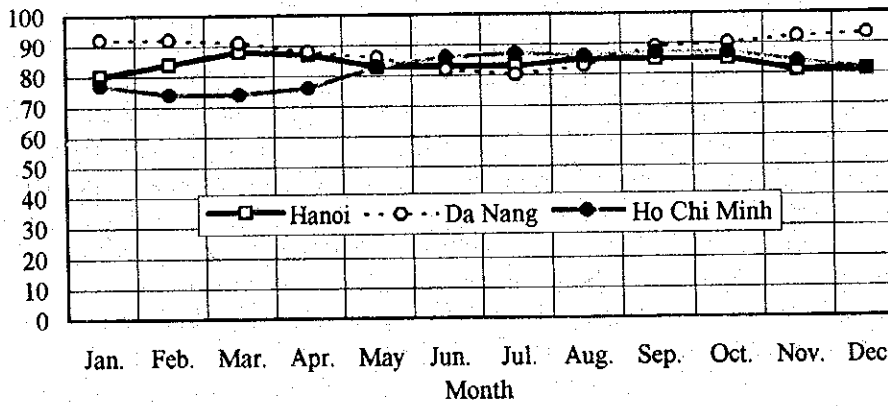
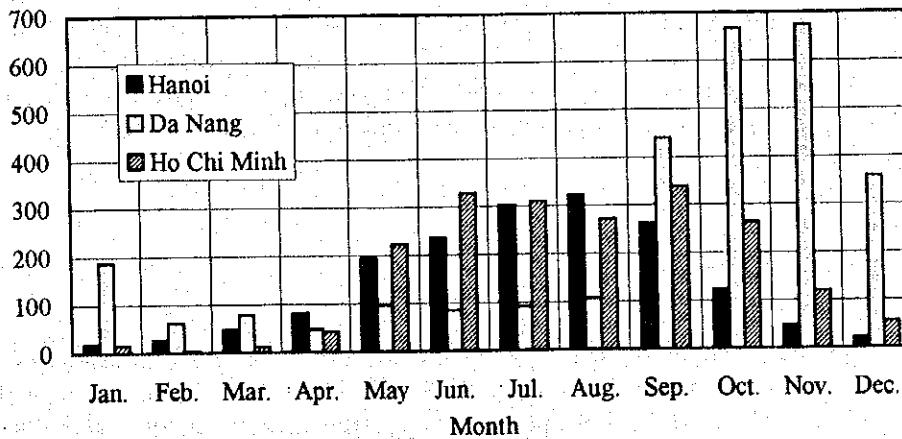


Figure 2.1-4 Rainfall (mm)



2.2 Economy

2.2.1 Administrative System and Population

In December 1991, some provinces previously merged by an administration reform were divided according to the resolution approved by the National Assembly. The country is currently divided into seven ecological zones and 53 administrative units (provinces) as shown in Figure 2.1-1. Table 2.2-1 shows population, population density and a division of population in urban and rural areas in the year 1993.

Total population of the country is estimated to be about 69.9 million in 1993. The national average of population density is about 211 per km². The population density is different by zone. The population density in the Red River Delta is the highest, approximately 1,100 per km², about 5 times as high as the national average.

About 20 % of the country's population is categorized as urban population, while the rest (80 %) inhabits rural areas. The share of urban population in North East Southland is the highest (46 %) because Ho Chi Minh City is located in North East Southland. Rural population is dominant in other zones.

The country is also divided into three regions, northern, central and southern in the Study. A division of the country into three regions is based on the command area of PC1, PC2 and PC3. The dotted line is delineated in Figure 2.1-1 to divide the country into three regions. The list of provinces by region is shown in Table 2.2-2. The number of provinces is 23 in the northern region, 11 in the central region and 19 in the southern region. Table 2.2-3 shows area, population (urban and rural) and population density by region. The area of the northern region (under jurisdiction of PC1) is the largest, about 45% of the country. About 47 % of the country's population concentrates on the north area. Although the area of southern region (PC2) is smaller than that of central region, population is more than twice in the southern region than in the central region. It is obvious that percentage of urban population is the highest (26 %).

The population growth rate was 2.2 % for the period from 1980 to 1985 and 2.0 % from 1985 to 1990. The trend of population growth is illustrated in Figure 2.2-1.

The people of Viet Nam consist of various races. In addition to the Vietnamese (Kin) which account for 80 to 90% of national population, there are several hundred thousands of Chinese (concentrated at Shuron District of Ho Chi Minh City in the south), approximately 750 thousand Kumers (in Mekong River basin), and 55 racial minorities who live in mountain areas. Among those, the racial minorities consisting of the Thais, Mans, Meos, and Roros live in the area called Tongking Mountain Zone, and the Mois live in the southern high land, and the Chums live in the central sea coast area.

2.2.2 GDP and Per Capita GDP

National economy experienced economic recession in the year 1990. GDP in real terms (at 1989 constant price) declined from 8.9% attained in 1989 to 5.1% in 1990. The economy showed a steady growth rate, 6.0% in 1991, 8.6% in 1992 and growth continued in 1993 with a 8.1% rate. The sectoral growth rate was prominent in the sectors of construction (14.6%), industry (13.4%) and financial service (13.6%) during 1991-1993. Because of vulnerability to vagaries of nature, the growth rate of agriculture resulted in merely 5.5%. The GDP shared by agriculture and forestry

sector (at current price) showed a sharp decline from 39.5% in 1991 to 29.3% in 1993. GDP and its growth are shown in Table 2.2-4.

Viet Nam has been in the process of transitional period from centrally planned economy to mixed economy consisting of national state enterprises and private sectors. Macro economic data formally accounted by Material Product System (MPS) is currently accounted by System of National Account (SNA) in accordance with the UN's national accounting system. Due to the different account system past data such as a series of value added lack in reliability and consistency as data. This difficulty is particularly true of regional data on valued added (GDP). GDP in SNA and Net Material Product in MPS is conceptually the same in terms of the difference between gross output and intermediate inputs, but different in accounting. GDP by region (northern, central and southern) is difficult to calculate, but can be roughly estimated by use of past provincial data on Net Material Product (NMP). Provincial data on NMP is arranged for each region based on Table 2.2-2. Regional share of NMP in 1990 is as follows:

	Northern	Central	Southern	Unit: %
	35.6	11.0	53.4	

Per Capita GDP in 1993 is estimated to be 1,953,000 Dong (US\$180). In contrast to Per Capita GDP of the neighboring countries such as US\$1,800 in Thailand, US\$680 in Indonesia, US\$820 in Philippines and US\$2,960 in Malaysia.

2.2.3 State Budget, Trade, Exchange Rate and Inflation

Viet Nam experienced deficit finance ranging from 7% to 21% during four years from 1989 to 1992. Revenue collection was low, at 15.2% of GDP in 1992 and the deficit finance increased from 1,648 billion Dong in 1991 to 3,845 billion Dong in 1992. State revenue and expenditure is presented in Table 2.2-5.

Merchandise exports increased from US\$ 1,946 million in 1989 to US\$ 2,581 million in 1992, while imports fluctuated from US\$ 2,566 million in 1989 to US\$ 2,541 million in 1992 and marginally attained trade net surplus in 1992. Trade balance is again estimated to be deficit (US\$ 444 million) in 1993. The main growth in exports was accounted for two commodities, rice and crude petroleum. Export and import statistics are presented in Table 2.2-6.

In 1989, the official exchange rate was unified and devalued. Since then the rate has been floated and continuously devalued. During the last two years the rate fluctuated within the range of 10,000-14,000 Dong per US\$. Historical exchange rates are summarized in Table 2.2-7.

High rates of inflation, more than 100% per annum, continued during 1980s. After the 1989 reform, the inflation rate slowed down to double digit, for instance, 76% in 1989 and further dropped to 14.4% in 1992 (Refer to Table 2.2-8).

2.2.4 External Debt

Historical records of total external debt to COMECON and west countries are shown in Table 2.2-9. Total external debt has gradually increased and amounted to about US\$17.9 billion as of 1992.

Viet Nam's GDP (136,571 billion Dong as of 1993) is converted to US\$12.6 billion assuming that US\$1 is equivalent to 10,810 Dong. Viet Nam is a heavily indebted country, with total external debt in the range of 142% of GDP as of 1992. Out of total external debt, hard currency debt was reported to be about US\$4 billion at the end of 1991.

Progress has been made at the Paris Club held in November 1993, which handles government-to-government debt. It has agreed in principle to write off or reschedule about 50% of Viet Nam's debt.

Table 2.2-1 Area, Population (Urban and Rural) and Population Density by Zone

	Area (km ²)	Population (thousands)	Population Density (pers/km ²)	Urban Population		Rural Population	
				(thousands)	(%)	(thousands)	(%)
1. North Mountain and Mid lands	102,965	12,109	118	1,576	(13.0)	10,533	(87.0)
2. Red River Delta	12,511	13,809	1,104	2,386	(17.3)	11,423	(82.7)
3. North Central Coast	51,188	9,517	186	936	(9.8)	8,581	(90.2)
4. South Central Coast	45,876	7,375	161	1,705	(23.1)	5,670	(76.9)
5. Central Highlands	55,569	2,903	52	672	(23.1)	2,231	(76.9)
6. North East Southland	23,451	8,693	371	4,008	(46.1)	4,685	(53.9)
7. Mekong River Delta	39,551	15,532	393	2,364	(15.2)	13,168	(84.8)
Total	331,111	69,938	211	13,647	(19.5)	56,291	(80.5)

Table 2.2-2 Administrative Units by Region

Northern		Central	Southern
1. Tuyen Quang	18. Thai Binh	24. Quang Binh	35. Ninh Thuan
2. Ha Giang	19. Nam Ha	25. Quang Tri	36. Binh Thuan
3. Cao Bang	20. Ninh Binh	26. Thua Thien Hue	37. Lam Dong
4. Lang Son	21. Thanh Hoa	27. Quang Nam	38. Ho Chi Minh
5. Lai Chau	22. Nghe An	Da Nang	39. Song Be
6. Yen Bai	23. Ha Tinh	28. Quang Ngai	40. Tay Ninh
7. Lao Cai		29. Binh Dinh	41. Dong Nai
8. Bac Thai		30. Phu Yen	42. Ba Ria-Vung Tau
9. Son La		31. Khanh Hoa	43. Long An
10. Ha Tay		32. Kon Tum	44. Dong Thap
11. Hoa Binh		33. Gia Lai	45. Tien Giang
12. Quang Ninh		34. Dac Lac	46. Ben Tre
13. Vinh Phu			47. Vinh Long
14. Ha Bac			48. Tra Vinh
15. Hanoi			49. An Giang
16. Hai Phong			50. Can Tho
17. Hai Hung			51. Soc Trang
			52. Kien Giang
			53. Minh Hai

Remarks: Northern (23 provinces), Central (11 provinces), Southern (19 provinces)

Table 2.2-3 Area, Population (Urban and Rural) and Population Density by Region

	Area (km ²)	Population (thousands)	Population Density (pers/km ²)	Urban Population		Rural Population	
				(thousands)	(%)	(thousands)	(%)
Northern	149,078	33,204	223	4,496	(13.5)	28,708	(86.5)
Central	97,435	10,458	107	2,245	(21.5)	8,213	(78.5)
Southern	84,598	26,275	311	6,906	(26.3)	19,369	(73.7)
Total	331,111	69,938	211	13,647	(19.5)	56,291	(80.5)

Table 2.2-4 Gross Domestic Product (GDP) by Kind of Economic Activity, 1991-1993

	1991	(%)	1992	(%)	1993	(%)	Annual Ave. Growth Rate 1991-93 (%)
<i>(At Current Prices)</i>							
GDP (In billion of Dong)	76,707	(100.0)	110,535	(100.0)	136,571	(100.0)	33.4
1. Goods							
Agriculture and forestry	30,314	(39.5)	36,468	(33.0)	39,998	(29.3)	14.9
Industry	15,193	(19.8)	23,956	(21.7)	29,371	(21.5)	39.0
Construction	3,059	(4.0)	6,179	(5.6)	9,423	(6.9)	75.5
Others	744	(1.0)	1,045	(0.9)	1,476	(1.1)	40.8
2. Services							
Transport, postal service & telecommunication	2,860	(3.7)	4,662	(4.2)	6,036	(4.4)	45.3
Trade and material supply	9,742	(12.7)	15,281	(13.8)	17,549	(12.8)	34.2
Finance, banking and insurance	1,108	(1.4)	1,567	(1.4)	2,318	(1.7)	44.6
State management, science, education, health and sport	6,807	(8.9)	9,718	(8.8)	14,402	(10.5)	45.5
Housing, tourism, hotel and repairs of personal computer goods	6,880	(9.0)	11,659	(10.5)	15,998	(11.7)	52.5
<i>(At Constant 1989 Prices)</i>							
GDP (In billion of Dong)	31,286	(100.0)	33,991	(100.0)	36,735	(100.0)	8.4
1. Goods							
Agriculture and forestry	11,894	(38.0)	12,751	(37.5)	13,235	(36.0)	5.5
Industry	6,042	(19.3)	6,925	(20.4)	7,766	(21.1)	13.4
Construction	1,186	(3.8)	1,317	(3.9)	1,558	(4.2)	14.6
Others	370	(1.2)	381	(1.1)	399	(1.1)	3.8
2. Services							
Transport, postal service & telecommunication	792	(2.5)	842	(2.5)	897	(2.4)	6.4
Trade and material supply	3,654	(11.7)	3,877	(11.4)	4,109	(11.2)	6.0
Finance, banking and insurance	448	(1.4)	496	(1.5)	578	(1.6)	13.6
State management, science, education, health and sport	2,841	(9.1)	3,040	(8.9)	3,322	(9.0)	8.1
Housing, tourism, hotel and repairs of personal computer goods	4,059	(13.0)	4,362	(12.8)	4,871	(13.3)	9.5
Growth Rate (%)	6.0	-	8.6	-	8.1	-	-

Source : Statistical Yearbook 1993, General Statistical Office

Table 2.2-5 Revenue and Expenditure of State Budget

		(Unit: Billion Dong)			
Items		1989	1990	1991	1992
(1)	Revenue				
	Domestic Revenue	3,899	6,249	10,083	18,970
	Revenue from state enterprise	2,392	4,337	7,339	18,400
	Revenue from non-state sectors	845	1,088	1,825	3,080
	Others	662	824	919	2,360
	Revenue from Foreign	1,072	1,860	530	570
	Total	4,971	7,109	10,613	16,848
(2)	Expenditure				
	Capital Expenditure	2,208	2,123	2,315	5,710
	Current Expenditure	3,756	6,257	8,728	15,005
	Interest Payment	707	905	1,218	2,100
	Total	6,671	9,285	12,261	22,815
(3)	Balance (Deficit)	-1,700	-1,176	-1,648	-3,845
(4)	GDP	24,308	38,166	76,707	110,535
(5)	Ratio of (3)/(4)	7.0	3.1	2.1	3.5

Source: Statistical Yearbook 1993

Table 2.2-6 Trade Balance

		(Unit: Million US\$)							
Items	1986	1987	1988	1989	1990	1991	1992	1993	
Export	789	854	1,038	1,946	2,404	2,087	2,581	2,970	
Import	2,155	2,455	2,757	2,566	2,752	2,338	2,541	3,414	
Balance	-1,366	-1,601	-1,719	-620	-348	-251	49	-444	

Source: Statistical Yearbook 1993

Table 2.2-7 Historical Exchange Rate

	1987	1988	1989	1990	1991	1992	1993
Rate (Dong per US\$)	368	3,000	4,000	6,500	13,870	10,680	10,810

Source: Statistical Yearbook 1993

Table 2.2-8 Retail Price Index
(Rate of Change from Previous Year in %)

	1980	1981	1982	1983	1984	1985	1986	1987
Index	25.2	69.5	95.4	49.5	64.9	91.6	487.2	301.3

	1988	1989	1990	1991	1992	1993	1994
Index	308.2	76.0	67.8	67.7	17.7	5.2	14.4

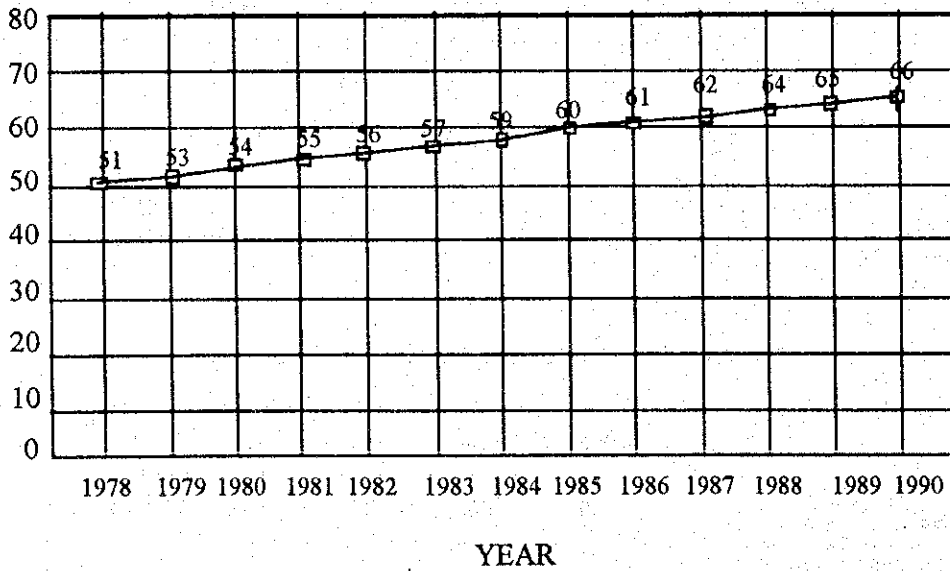
Source: National Statistic Office

Table 2.2-9 External Debt

(Unit: Billion US\$)

	1986	1987	1988	1989	1990	1991	1992
Debt	11.4	14.5	15.2	15.7	17.5	17.7	17.9

Figure 2.2-1 Trend of Population (Million persons)



2.3 Power Development Policy in Energy Sector

2.3.1 Power Sources

Viet Nam is endowed with natural resources such as coal, oil, gas and water resource. Electricity is the secondary energy generated from different primary energy sources. The National Energy Policy prepared by IEV in 1991 addressed effective use of natural resources for power development. Table 2.3-1 shows a historical change of composition of power generation sources.

The share of hydropower sharply increased during the last several years as a result of Hoa Binh (the northern region) and Tri An (the southern region) hydropower plants, whilst thermal power generated from coal and fuel oil shows a sharp decrease of share. The Energy Policy explicitly states the following strategy for development of power source.

- The country should develop renewable energy (i.e. hydropower) while maintaining a reasonable share of fossil fuel (coal, fuel oil).

As seen energy policy of other countries, the above strategy is closely linked to the country's development policies. The development of renewable energy clearly contributes to environmental objective such as alleviation of air pollution. Viet Nam is an import country of oil refinery products. To control the use of fuel and diesel oil to be imported contributes to foreign exchange saving.

Regional distribution of power source in Viet Nam is unique and summarized as follows:

- (1) The northern region is endowed with the rich hydropower potential represented by the Da river. (The existing Hoa Binh power station is located in the downstream of the Da river.) Coal reserves concentrate in the northern part, particularly in Quang Ninh province. There are currently four state coal companies operating coal production.
- (2) The prominent power source in the central region is hydropower potential represented by the Sesan river. The Yaly hydro project under construction is located in the Sesan river. Huge gas reserves were discovered in Da Nang basin in off-shore mid-Viet Nam, however the gas in Da Nang basin contains a large amount of carbon dioxide (CO₂). The development of gas production in off-shore Da Nang is difficult economically to be justified.
- (3) The southern region is endowed with both hydropower potential in the Dong Nai river, and natural gas from oil fields (associated gas) as well as gas fields (non-associated gas). Associated gas from Bach Ho oil field in off-shore south Viet Nam is being flared and planned to deliver to thermal power plants.

The north-south 500 kV transmission system was constructed to interconnect three regions. Taking into account regional distribution of power source and the existing 500 kV transmission line, the following points are to be considered in order to formulate power development plan:

- (a) A plan of a mixed hydro-thermal system to meet regional daily load duration curve,
- (b) A reasonable allocation of power supply; regional and interregional power sources,
- (c) A balanced development of power generation and power network, and
- (d) Least-cost expansion plan.

2.3.2 Power Sector Depending on Energy Sector Development

Power sector itself depends on development of primary energy sources. The energy sector consisting of coal, oil and gas is basically regarded as capital intensive industry requiring huge amount of foreign capital together with advanced technology. The market issues relating to development of those energy sources indirectly affect power sector's development.

Coal is a valuable non-renewable energy source. Coal production is mostly operated by the four state coal companies. The coal sector supplies the bulk of coal to external and domestic markets. Power and cement industries have been the major coal consumption sectors in domestic market. Table 2.3-2 shows historical performance of coal sale by end-use.

Coal sale has been stagnant, but shows a steady recovery due to coal export. Coal consumption in power sector has recently declined due to the commissioning of Hoa Binh hydropower plant. The present production facilities of each mine and coal ports as well as transportation system are obsolete and inefficient, which cause decline of coal production and rising production cost.

The introduction of foreign capital into the rehabilitation of those facilities depends on the market prospect for coal export and coal pricing. There is dual pricing in coal sector. Export prices determined by international market are in favor of coal companies. Expansion of coal export leads to the increase of foreign exchange reserves, which will become capital source of cash repayment. Prices in domestic market are generally market determined, but subject to the minimum price levels. The determination of the wholesale coal price to the power industry is based on the cost to the power company of alternative power source, low cost hydropower. Thus the wholesale price was unreasonably regulated at low price, sometimes below production cost.

A raise of coal price to the power sector will depend on the government policy because power sector is contemplated to be the basic infrastructure for the country's development. As an incremental part of coal price is transferred to electricity price, the uniform rise of electricity price would perhaps cause reduction of power consumption. If the coal sector accumulates profits by coal export to balance the loss occurred by domestic coal sales, the prospect for the coal sector's development with adequate foreign capital would not be so pessimistic. In this situation, the power sector would continue to enjoy the subsidized coal price for the time being. MOE having the responsibility of both the coal sector and the power sector will have to consider not a single sector's development, but interrelation between energy sub-sectors.

Natural gas currently exploited in Viet Nam is called associated gas from oil fields. Gas flared in the Bach Ho field is the by-product of oil production. The domestic market for gas is limited to power generation, fuel for industry, not heavy chemical industry and residential heating purpose. Economies of scale does not justify use of gas for commercial activities unless the domestic economy catches up with the middle-income status. In this situation, even if the demand for associated gas in power sector fluctuates due to the government policy, the development cost and pipeline costs would be cushioned by crude oil export. The case of non-associated gas development from gas fields is rather different because the market prospect for the gas is uncertain.

The use of new non-associated gas for power development should be carefully reviewed repeatedly with respect to a demand-supply situation of new gas.

2.3.3 Institutional Development

Viet Nam is in the transitional process from the former centrally planned economy to a mixed economy. The role of the government (i.e. MOE) in the energy sector used to be operator and regulator in both the coal and power sectors. The three power utilities (PC1, PC2, PC3), though still called companies, were operated as government departments under the MOE. Since 1991, however, the government strategy is to corporatize the three companies by reorganizing them in line with a mixed economy. The role of government, would perhaps be confined to regulatory functions, while the existing three companies are to be involved in management in their day-to-day operations and in the management of their finance.

Institutional development in power sector will be largely discussed from the following two aspects: One is the policy and regulatory functions of the concerned government agencies relating to power development. The other is reorganization of power industry. The major issues of policy and regulation in power sector are probably as follows:

- | | |
|-------------------------------|--|
| (1) Energy pricing: | Output (coal, gas) prices, input (electricity) price |
| (2) Natural resource rights: | A multi-purpose water resource management |
| (3) Environmental regulation: | Air pollution |
| (4) Finance: | Foreign exchange risk, government subsidy |
| (5) Training | |

The reorganization of power utilities is a complex issue and should be carefully proposed in due consideration of the nature of power sector. The power sector is featured by capital intensive industry requiring huge capitals and by special development from generation to distribution supplied to widely scattered consumers. The criteria for review of power industry is

- Centralization versus decentralization, and
- Division of power function into generation, transmission and distribution.

Alternative institutional development plans for power sector will be formulated on the basis of the criteria mentioned above.

Table 2.3-1 Historical Change of Structure of Power Generation Sources

	(Unit: %)				
Power Source	1976	1985	1990	1993	1994
Thermal	62.6	59.6	32.7	16.6	18.4
Hydro	28.0	29.1	61.9	74.2	72.7
Diesel	9.3	8.1	4.7	3.4	2.2
Gas turbine	0.1	3.2	0.7	5.8	6.6
Total	100.0	100.0	100.0	100.0	100.0

Table 2.3-2 Historical Performance of Coal Sale

	(Unit: Million tons)					
	1989	1990	1991	1992	1993	1994
Domestic						
Electricity	1.968	1.560	0.920	0.592	0.538	0.900
Cement	0.402	0.521	0.225	0.238	0.280	0.276
Others	1.431	2.033	2.058	2.698	2.709	1.771
Sub-total	3.801	4.114	3.203	3.528	3.527	2.947
Export	0.579	0.789	0.920	1.324	1.824	2.058
Total	4.380	4.903	4.123	4.852	5.351	5.005

Source: IEV