No. 2

Japan International Cooperation Agency (JICA)

Department of Energy
The Republic of The Philippines

A Master Plan Study
on
The Development of the Natural Gas Industry
in
The Republic of The Philippines

Final Report
Main Report

January 2002

The Institute of Energy Economics, Japan

Osaka Gas Co., Ltd.

Japan International Cooperation Agency (JICA)

Department of Energy
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PREFACE

In response to a request from the Government of Republic of the Philippines, the Government of Japan accepted to carry out the Study on the Development of the Natural Gas Industry in Republic of the Philippines. The study was implemented by the Japan International Cooperation Agency (JICA).

From August 2000 to December 2001, JICA dispatched to The Philippines five times a study team led by Mr. Toru Kimura of the Institute of Energy Economics, Japan (IEEJ). During staying in the Philippines, the team consisting of member from IEEJ and the Osaka Gas & Co., Ltd., conducted related field surveys and held discussions with the officials concerned of the Government of Republic of the Philippines. 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 Natural Gas Industry in Republic of the Philippines 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 Republic of the Philippines for their close cooperation in conducting the study.

川上隆朗

Takao Kawakami
President
Japan International Cooperation Agency

December 2001

Mr. Takao Kawakami
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Mr. Kawakami

Letter of Transmittal

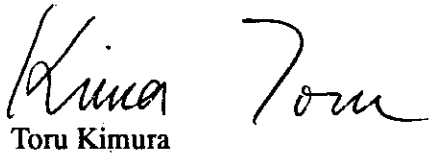
We are pleased to submit to you the Final Report of the Study on the Development of the Natural Gas Industry in Republic of the Philippines. Under the contract with your esteemed organization, the subject study was carried out during 17-month period from August 2000.

With due consideration of the current situation of energy supply/demand and Natural Gas production, and also of related law, rules and regulations in the Philippines, the present study has been conducted to determine a comprehensive and long-range master plan that enables the Department of Energy (DOE) to promote utilization of Natural Gas continuously after the completion of the study.
In the process of conducting the study, technical transfer to DOE's officers by means of on-the-job training has been conducted constantly. The result of this technical transfer has been strengthened by occasional seminars attended by people from related government institutions and industry participants as well as DOE.

In this report compiled is a master plan showing a ten-year program for construction of pipelines and LNG terminals, investment and financing, development of manpower and policy measures to promote natural gas utilization. Among others proposed priority projects feature the master plan and are recommendable for implementation in the near future.
Those comments by officials from DOE 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 Affaires, and Ministry of Economy, Trade and Industry. We also wish to express our deepest gratitude to the Department of Energy (DOE), the Embassy of Japan in Republic of the Philippines and the JICA The Philippines office for the close cooperation and assistance extended to us during the period.

Very truly yours,



Toru Kimura
Team Leader
Development of the Natural Gas Industry in the Republic of the Philippines

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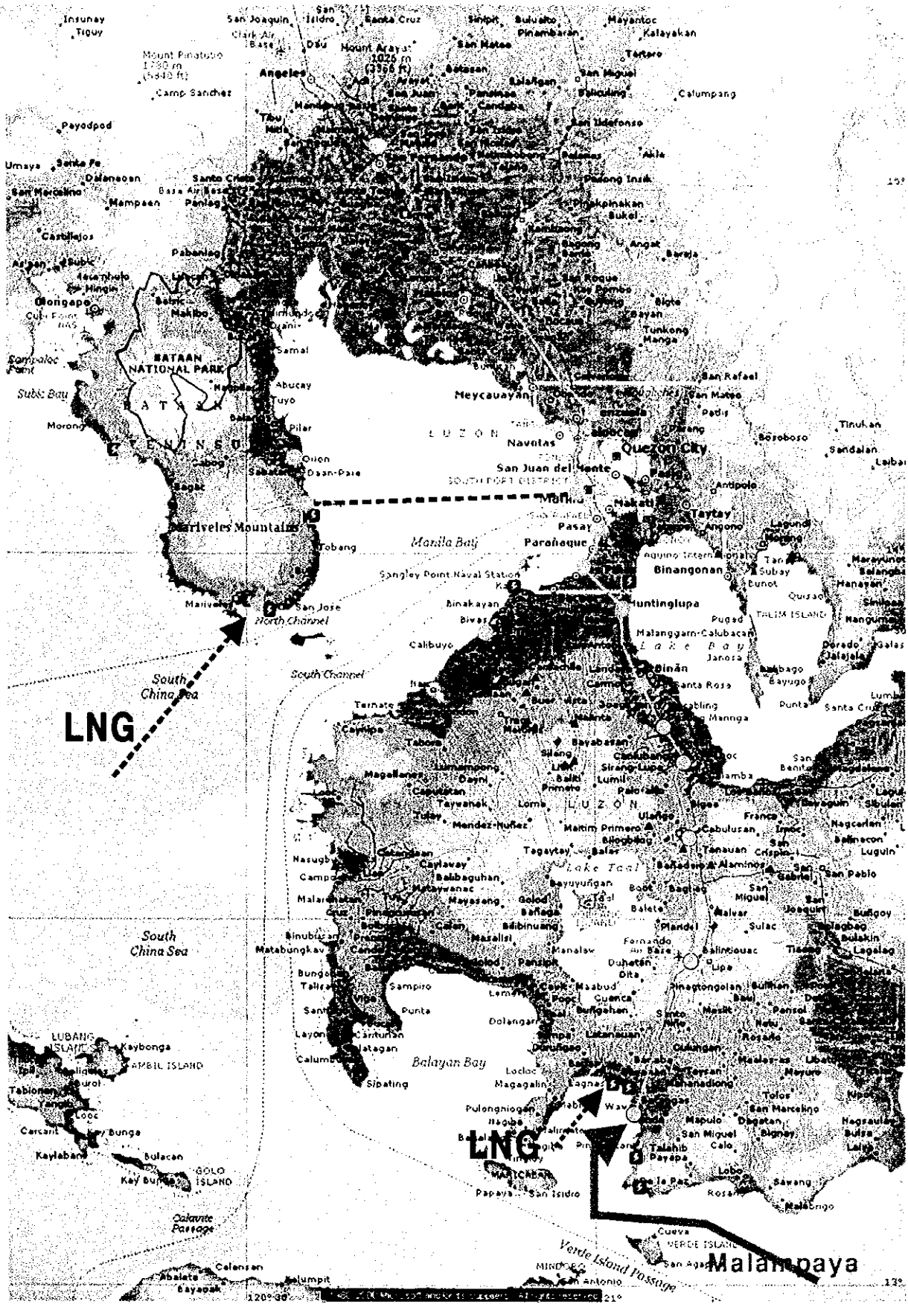
Abbreviations

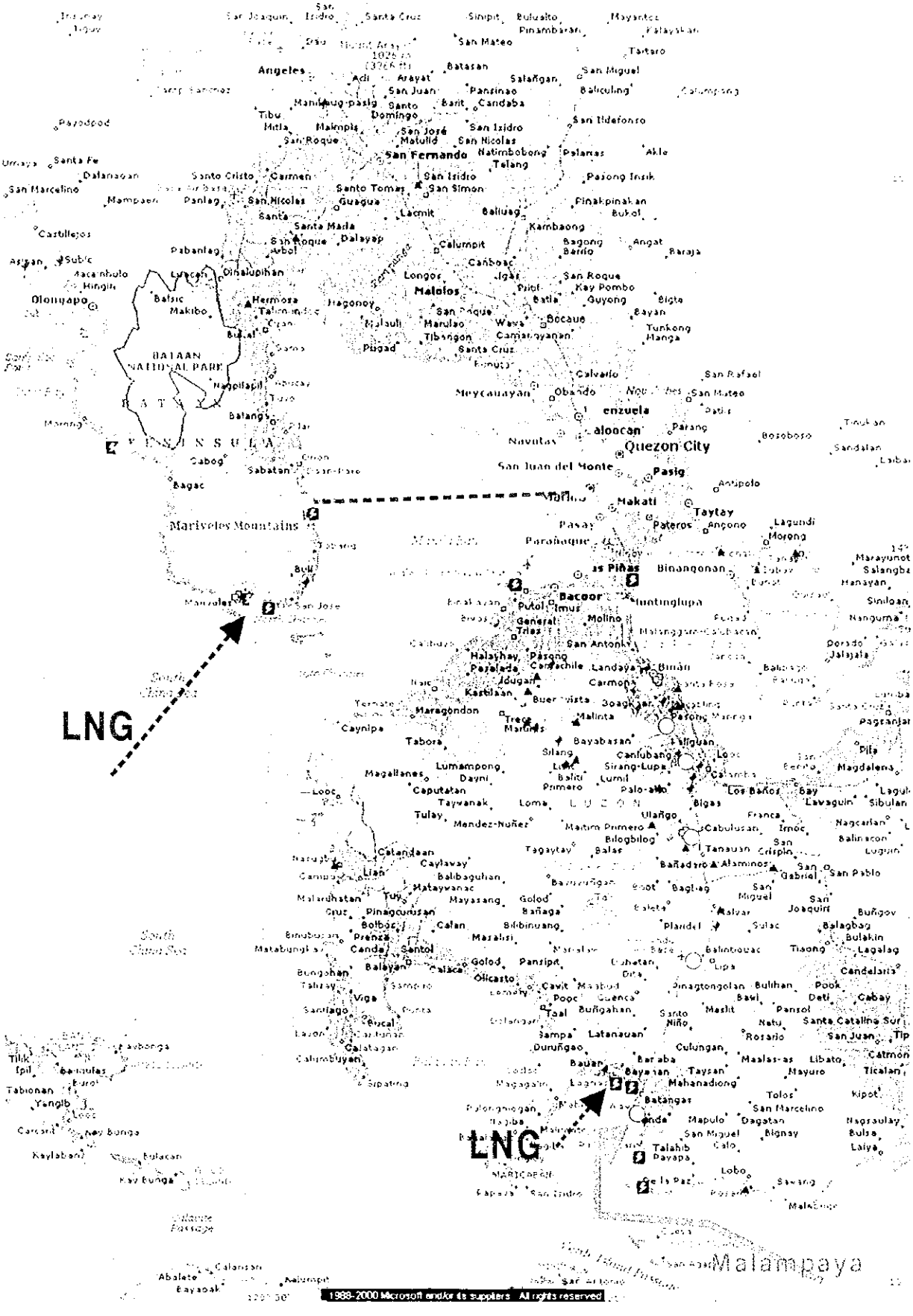
ADB	Asian Development Bank
AGA	American Gas Association
APERC	Asia Pacific Energy Research Center
ARMM	Autonomous Region in Muslim Mindanao
ASEAN	Association of South East Asian Nations
bbl	barrel
BCF	Billion cubic feet
BG	British Gas
BIMP	Brunei, Indonesia, Malaysia and Philippines
BNPP	Bataan nuclear power plant
BOG	Boil off gas
BOI	Board of Investment
CAPEX	Capital fund concept word including investment and working capital
CAR	Cordillera administrative
CCGT	Combined cycle gas turbine
CDM	Clean development mechanism
CF	Conversion factor
CIF	Cost, Insurance and Freight
C-M	Cebu-Mactan
CNG	Compressed natural gas
COP	Coefficient of performance
CPI	Consumer price index
CV cable	Crosslinked polyethylene polyvinyl chloride cable
D	Davao
DCR	Debt coverage ratio
DCS	Distributed control system
DENR	Department of Environment and Natural Resources
DIDP	Davao integrated development plan
DME	Dimethyl ether
DMS	Dimethyl sulfide
DOE	Department of Energy
DOH	Department of Health
DOF	Department of Finance
DOJ	Department of Justice
DOT	Department of Tourism
DTI	Department of Trade and Industry
DW	Durbin Watson ratio
EAGA	East Asia growth region
EDA	Export development act
EIAB	Energy Industry Administration Bureau
EIRR	Economic internal rate of return

EMB	Environmental Management Bureau
ERB	Energy Regulatory Board
ERC	Energy Regulatory Commission
ESD	Emergency shut down system
FIRR	Financial internal rate of return
FOB	free on board
g/cc	Gram per cubic centimeter
GDP	Gross domestic product
GHP	Gas heat pump
GRDP	Gross regional domestic product
GTL	Gas to Liquid
GVA	Gross value added
GWh	Giga Watt hours
HHV	Higher heating value
HOA	Heads of Agreement
IBRD	International Bank for Reconstruction and Development
IEA	International Energy Agency
IEEJ	The Institute of Energy Economics, Japan
IFC	International Finance Corporation
IIS	Integrated information system
IPCC	Inter-governmental panel on climate change
IPP	Investment priority plan
IPP	Independent power producer
IRR	Internal rate of return
IRR	Implementing rules and regulations
IT	Information technology
ITH	Income tax holiday
JBIC	Japan Bank for International Cooperation
JEJODAP	Federation of Jeepney Operators and Drivers Association of the Philippines
JICA	Japan International Cooperation Agency
kcf	1000 cubic feet
kLi/y	1000 litters per year
kscf	1000 standard cubic feet
LHV	Lower heating value
LNG	Liquefied natural gas
LOI	Letter of intent
LP	Linear programming
LPG	Liquid petroleum gas
LRMC	Long range marginal cost
MLNG	Malaysia Liquid Natural Gas
MMBFOE	Million barrel fuel oil equivalent
MMBtu	Million British thermal unit
mmscfd	Million standard cubic feet per day
MMS	Marine monitoring system

MOT	Mandatory open access
MOU	Memorandum of understanding
MPa	Mega Pascal
mta	million ton per annum
MW	Mega Watts
MWh/d	Mega Watt hours per day
NAPHIRE	National Post-harvest Institute for Research and Extension
NCR	National Capital Region
NEA	National Electrification Administration
NEDA	National Economic Development Agency
NG	Natural gas
NGV	Natural gas vehicles
Nm3	Normal cubic meter
NPC	National Power Corporation
NPV	Net present value
NSCB	National Statistical Coordination Board
NSO	National Statistics Office
NWS	North West Shelf
O&M	Operation and maintenance
OECD	Organization for Economic Cooperation and Development
OPEX	Operation expense concept word including variable and fixed cost
PDP	Power development program
PEP	Philippine energy plan
PL	Pipeline
PM	Particulate matters
PMS	Unloading and position monitoring system
PNOC	Philippine National Oil Company
PNOC-EC	Philippine National Oil Company - Exploration Corporation
PNOC-PC	Philippine National Oil Company - Petrochemicals
PPA	Power purchase agreement
Ps	Peso
PTT	Petroleum Authority of Thailand
PVC	Polyvinyl chloride
QGPC	Qatar Governmental Petroleum Company
ROW	Right of way
RPM	Revolution per minute
RT	Refrigerant Tons
SCS	Supervision computing system
SSS	Safety and security system
TBM	Tertiary butyl mercaptan
TSP	Total specific particulate matters
UV	Utility vehicles
VAT	Value added tax
ZOCA	Zone of Corporation A



Assumed Pipeline Route



Assumed Pipeline Route

Introduction

1 Study Objectives

The objectives of this study are twofold. One is to prepare a comprehensive medium- and long-term master plan for promoting natural gas utilization in the Philippines. The other is technology transfer, so that our Philippine counterpart can evolve the master plan and continue its effective use by making necessary reviews and modifications themselves.

The time horizon of the master plan is 25 years. But, with the first ten years particularly highlighted, we will plan the first-decade portion specifically and pragmatically as much as possible.

In addition, through technology transfers, we will help our counterpart acquire the necessary methodologies or preparing a master plan, developing a natural gas demand-forecasting model, optimizing supply and demand, and evaluating a project in economic and financial terms, among others.

2 Target Areas

(1) "Batangas-Manila-Bataan including Subic and Clark" (Area L)

This area consists of the following three sub-areas:

a) "Manila" (Area L-1)

The same area as that called "Metro Manila" or "National Capital Region (NCR)."

b) "Batangas" (Area L-2)

Four Provinces in Southern Luzon.

c) "Bataan including Subic and Clark" (Area L-3)

Three Provinces, including Subic and Clark, situated on the north side of Area L-1.

(2) "Cebu/Mactan" (Area C-M)

Three Cities and seven Municipalities.

(3) "Davo" (Area D)

Davao City and four Provinces, which is the same as the Davao Integrated Development Area (DIDP).

3 Basic Structure of the Study

The overall study project is divided into the two phases described below.

1) Preparatory work is done to provide "Gas Demand and Supply Scenarios." The work includes natural gas demand forecasting, supply system study, supply-demand optimization and evaluation, and study of supply and demand-related policy measures.

2) Each of the resultant scenarios is evaluated by the criteria of macro-economy, environmental impact, and energy supply and demand. Then, a "master plan for promoting natural gas use" (including An Action Plan and Priority Projects) will be prepared based on the evaluation results.

This is a two-part study comprising Phases 1 and 2. Further, Phase 1 consists of Steps 1 to 4, and Phase 2 consists of Steps 5 and 6. Including major study items, their interrelations, overall study flow, and the development of models, tools, etc., the profile of this study is summarized in Figure 1.

(2) Phase 1

<Step 1>

Step 1 comprises "demand survey/utilization plan," "supply system study" and "policy study."

With the "demand survey/utilization plan," we study potential natural gas demand in the electric power sector, the industrial sector, the commercial and residential sector, and the transportation sector in each of three target areas selected.

In the "supply system study," we examine the supply potential of domestic natural gas, imported LNG, and Trans-ASEAN pipeline gas, taking into account supply costs.

In the "policy study," we examine various policy measures and institutions involved in the promotion of natural gas use.

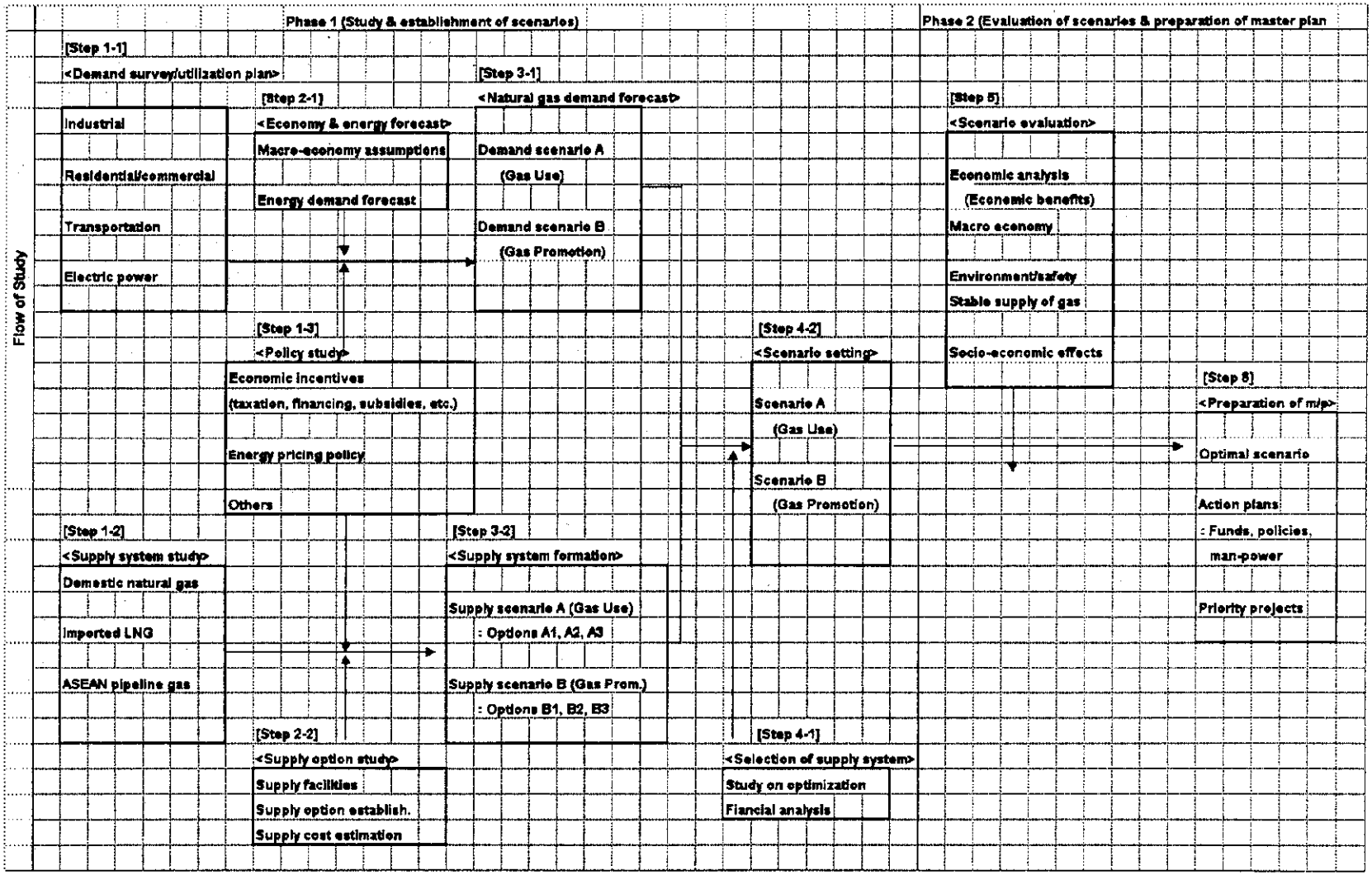


Figure 1 Study Profile (major study items and study flow)

<Step 2>
Step 2 comprises "macro-economy assumptions and energy demand forecast" and "supply option study."

In the "macro-economy assumptions and energy demand forecast," we first assume an economic forecast, which provides the basis for forecasting gas demand. Then, based on economic assumptions, we make an energy demand forecast. Demand for gas, which occupies part of the overall energy needs, is forecast in the next Step 3.

In the "supply option study," we examine natural gas supply facilities (pipelines, storage facilities, LNG receiving terminals, etc.), including distribution systems, based on the results of "supply system study," but in a more specific manner than in Step 1. Also, in this step, we estimate the supply cost to meet potential gas demand identified in the "demand survey/utilization plan" in Step 1.

The cost estimation is preparatory work for comparing the economics of natural gas and rival energies, typically oil and coal, which is essential for quantifying gas demand in the future.

<Step 3>
Step 3 comprises "natural gas demand forecast" and "supply system formation."

In the "natural gas demand forecast," we project gas demand for the three target areas based on the study results of the preceding Steps 1 and 2, including "demand survey/utilization plan," "policy study," "macro-economy assumptions and energy demand forecast," and "supply option study." In this step, we prepare demand scenarios. Two scenarios are prepared. One is "Gas Use," in which no policy measures are taken for promoting gas use, and the other is "Gas Promotion," which contains stepped-up policy measures for encouraging gas use.

In the "supply system formation," we prepare various supply systems to meet gas demand in the three selected areas. Then, we check systems formed according to the demand scenarios. Taking the "Gas Use" as an example, a number of supply scenarios, including B_1 (domestic gas supply alone), B_2 (a combination of domestic gas and imported LNG), and B_3 (a triple combination of domestic gas, imported LNG, and Trans-ASEAN pipeline gas), are examined.

In this way, we prepare a number of supply scenarios for a single demand scenario, so that we can choose the optimal one for each demand scenario, among the plural supply scenarios, in the subsequent Step 4.

<Step 4>
Step 4 comprises "supply system selection" and "Gas Demand and Supply (GDS) Scenario setting."

In "supply system selection," we evaluate two supply cases, focusing on pipelines, by using the results of the financial analysis and others.

Next, in the "GDS Scenario setting," we select an optimal supply scenario for each demand scenario by adopting the evaluation method described above. If set in this way, the Scenarios would not merely be a combination of demand and supply scenarios, but be based on a certain policy package, which includes policy measures and institutions/organizations, among other factors.

This is a preparatory work for choosing, in Step 5 in the subsequent Phase 2, the optimal "GDS Scenario."

(2) Phase 2

<Step 5>
In Step 5, we select an optimal "GDS Scenario" by evaluating individual scenarios using the following criteria:

·····Economic evaluation of the project
·····Effects on macro-economy (to compare effects of individual scenarios on the Philippine economy, in such points as GDP growth, income levels, and government budget balance)
·····Environment and safety (to compare negative impacts and/or favorable effects of individual scenarios on local and global environment)
·····Comparison of gas supply and demand features (to compare the contribution of individual scenarios to the stable supply of gas)
·····Comparison of other socio-economic impacts or effects

<Step 6>

In Step 6, we prepare a "master plan for promoting gas use." The master plan consists of three parts. It contains (i) an optimal "GDS Scenario," (ii) "Action Plans," which state necessary conditions for effectively implementing the Scenario (incl. fund raising method, how to establish policy measures and institutions/organizations, and how to develop manpower), and (iii) a proposal for specific gas-related projects to be advanced on a preferential basis ("priority projects"). The second (ii) part is prepared in the form of yearly programs (for the first 10 years).

Of these, the optimal "GDS Scenario" is selected in Step 5.

Next, in regard to the "Action Plans," the preceding work produces the most of the necessary information and data. First, for a fund raising method, we put forth a specific plan and policy based on the economic evaluation in Step 5. Also, for the establishment of institutions and organizations, we prepare an "Action Plan" by reviewing what organizations will be in charge of the respective policy measures examined in Step 1 and what institutions need to be prepared for implementing them.

We also propose the "priority projects" based on the preceding studies, such as "supply system study," "supply option study," and "supply system formation." The preceding work has already roughly examined technical and financial feasibility of gas related projects to enable us to produce a short list of selected projects from among those on a long list.

4 Main Findings in the Study

We have established two Cases for gas demand, two Options for gas supply system, and two Scenarios for policy measures in analyzing gas demand and supply in the future (See Chapter 4 for more details).

4-1 High Case

(1) Gas Demand

1) Gas demand in the target areas of Luzon Island is estimated to increase from 363 mmscfd in 2006 to 1,533 mmscfd in 2025. Demand in the power sector will account for the predominant share, which is at least around 90% of the total for the entire period from 2006 to 2025.
2) We can see a similar picture in Areas C-M and D, where the power sector will also account for the predominant share of total gas demand. However, the financial analysis shows that gas-related businesses are estimated to be unfeasible, assuming gas demand as estimated for the areas. Accordingly, there will actually be no gas demand by 2025 in both areas.
3) Given gas supply costs, which we have estimated, no gas for Natural Gas Vehicle (NGV) will be used in the transport sector, even if policy measures shown in items a) to d) in (3)-2) below are implemented. For gas to be used for NGV, the government needs to hammer out powerful policy measures as shown in item e) in (3)-2) below.

(2) Gas Supply

1) We assume that about 500 mmscfd of gas will be supplied from a domestic natural gas source (Camago/Malampaya gas field) and imported LNG will meet gas demand beyond that volume.
2) Given such an assumption, we consider that the following supply system is the most desirable for Luzon Island: a system in which LNG terminals are constructed both in Bataan and Batangas areas, and not only onshore pipelines along the Manila bay but also an offshore line across the bay from the Bataan LNG terminal to NCR are laid to meet gas demand in areas beyond NCR (Option 2).
3) In addition, we estimate how long LNG importation will be delayed if domestic gas supply is increased to about 650 mmscfd. LNG will be imported in 2012 in the case of

650 mmscfd, instead of 2009 in the case of 500mmscfd.

(3) Gas Promotion Policy Measures

1) Much of the gas demand will not necessarily be created in sectors other than power, as can be seen in NGV, assuming the gas prices we have estimated. In addition, gas-related businesses, including gas supply through pipelines, LNG supply, and power generation using gas, cannot earn sufficient profits. Accordingly, we consider that the government should take some supportive measures for the businesses (the Gas Promotion Scenario).
2) The following are the policy measures we propose for gas-use promotion:
   a) 10-year tax holiday for corporate tax (32% of profit) for the pipeline sector
   b) Tax exemption of LNG import duty (5% of import value) for the LNG sector
   c) Tax exemption for machine/materials (5% of import value) for the pipeline sector.
   d) Applying low-interest rates from international development financial institutions.
   < Items a) to d) above are included in the Gas Promotion Scenario >
   e) A discount for natural gas price and an investment tax credit for gas filling stations to promote gas use for NGV.
   f) Investment tax credits for gas cogeneration, gas air-conditioning, and fuel conversion to gas.

(4) Priority Projects

To promote gas use, we propose the following gas-related projects to be implemented preferably in the near future, in addition to the Action Plan for the next ten years, including: a) construction of gas-related projects, b) investments and their financing, c) development of manpower, and, d) policy and institutional measures:

1) Construction of a gas pipeline from Tabangao to Sucat
2) Construction of a LNG terminal in Limay/Mariveles area on Bataan peninsula
3) Construction of a gas filling station for NGV in NCR
4) Construction of a LNG terminal in the Batangas area
5) Construction of an offshore pipeline from a LNG terminal in Bataan peninsula to NCR.

4-2 Low Case

(1) Gas Demand

1) Gas demand in the target areas on Luzon Island is estimated to increase from 363 mmscfd in 2006 to 1,316 mmscfd in 2025. Demand in the power sector will account for the predominant share, which is at least around 95% of the total for the whole period from 2006 to 2025.
2) We can see a similar picture in Areas C-M and D, where the power sector will also account for the predominant share of total gas demand. However, the financial analysis shows that gas-related businesses are estimated to be unfeasible, assuming gas demand estimated for the areas. Accordingly, there will actually be no gas demand by 2025 in both areas.
3) Given gas supply costs, which we have estimated, no gas for Natural Gas Vehicle (NGV) will be used in the transport sector, even if policy measures shown in items a) to d) in (3)-2) of 4-1 above are implemented. For gas to be used for NGV, the government needs to hammer out powerful policy measures as shown in item e) in (3)-2) of 4-1.

(2) Gas Supply

1) We assume that about 500 mmscfd of gas will be supplied from a domestic natural gas source (Camago/Malampaya gas field) and that imported LNG will meet gas demand beyond that volume.
2) Given such an assumption, we consider that the following supply system is the most desirable for Luzon Island: a system in which LNG terminals are constructed both in Bataan and Batangas areas, and not only onshore pipelines along the Manila bay but also an offshore line across the bay from the Bataan LNG terminal to NCR are laid to meet gas demand in areas beyond NCR (Option 2).
3) In addition, we estimate how long LNG importation will be delayed if domestic gas supply is increased to about 650mmscfd. LNG will be imported in 2017 in the case of 650 mmscfd, instead of 2013 in the case of 500 mmscfd.

(3) Gas Promotion Policy Measures

1) Assuming the gas prices we have estimated, gas-related businesses, including gas

supply through pipelines, LNG supply, and power generation using gas, can earn sufficient profit. Accordingly, we consider that the government needs to take no supportive measures for the businesses (the Gas Use Scenario).

2) The only one exception is gas use for NGV, as mentioned in (1)-3) above.

(4) Priority Projects

To promote gas use, we propose the following gas-related projects to be implemented preferably in the near future, in addition to the Action Plan for the next ten years, including: a) construction of gas-related projects, b) investments and their financing, c) development of manpower, and, d) policy and institutional measures:

1) Construction of a gas pipeline from Tabangao to Sucat
2) Construction of a LNG terminal in Limay/Mariveles area in Bataan peninsula
3) Construction of a gas filling station for NGV in NCR
4) Construction of an offshore pipeline from an LNG terminal in Bataan peninsula to NCR.

4-3 Other Issues to be Studied

It is essential for the Philippine government to take measures necessary for effectively and efficiently implementing the Action Plan and the Priority Projects mentioned above, after considering them more thoroughly and concretely.

Important issues to be considered for implementation are as follows:

(1) Considerations at the level of feasibility study

We think that the following studies at the level of a feasibility study should be done based on this Study, which has been done at the level of a master plan study.

1) Estimation of potential gas demand

In this study, we established two cases ···· the High and Low Cases ····, for which economic growth rates and energy prices are incorporated, to estimate potential gas demand (In Chapter 4).

To estimate potential gas demand when actually laying pipelines, however, it is not only necessary for us to make forecasts or assumptions of demand more thoroughly and concretely, but also to grasp current energy use in target sectors and areas using data and information that reflect the actual conditions of energy use more completely.

2) Evaluation of pipeline routes

In this Study, to select the optimum pipeline route, we established two supply options (In Chapter 5) to conclude that Option 2, which includes the offshore pipeline across the Manila Bay, is superior to Option 1, by evaluating them in terms of the costs/benefit ratio and financial internal rate of return (FIRR) (In Chapter 6).

The difference between the costs/benefit ratio and FIRR, however, is not necessarily as large for the two Options. Accordingly, we think that, when actually laying pipelines in the future, the costs/benefit ratio and FIRR should be investigated more deeply using the results of the study mentioned in 1) above.

(2) Considerations at the level of master plan study

Next, we think that studies on regional development plans for Areas L-2 and L-3 should be done at the level of a master plan study to supplement this Study.

Some studies, including JICA studies[1) and 2)], have already been done on the regional development plans for the areas.

The master plan for the Southern Luzon (CALABARZON) area was originally planned by the Department of Trade and Industry, aiming at the industrialization of areas neighboring Metro Manila, into which population and investments had been concentrated. A JICA study report, which was finalized in October 1991, proposed plans for the development of ports and harbors including the Batangas port, as well as those for roads and highways including the Southern highway, in addition to those for urban and rural development, social development, and environmental management.
The master plan for the Central Luzon area had basically the same aim as that of the

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1) Japan International Cooperation Agency (JICA), *The Master Plan Study on the Project CALABARZON*, October 1991

2) JICA, *The Master Plan Study for Central Luzon Development Programs*, September 1995

plan for the Southern Luzon above. Another JICA study report, which was finalized in September 1995, proposed plans for the re-development of Clark and Subic, both of which had been returned by the U.S. early in 1990s, and that for the Central Luzon highway, which was planned to connect Subic, Clark, and Tarlac.

The reasons we insist upon the necessity of doing additional studies on regional development for Areas L-2 and L-3 are as follows:

First, we have proposed in this study the construction of pipelines, LNG terminals, and LNG-fired power plants in the near future in these areas, all of which occupy a major part of the two areas mentioned above, respectively. Naturally, these projects will possibly have effects and impacts on regional development in these areas. Accordingly, we consider that the economic, social, and environmental effects and impacts of these projects should be more deeply examined than have been done in this study

Second, we consider that, if we look at only the period to 2010 targeted by the two JICA studies mentioned above, plans proposed in the studies should be reviewed, taking into account new projects that have been implemented or planned until recently, as well as recent developments related to formulating the plans, including, for instance, current and future economy of the Philippines and prospects for global energy prices.

Third, we consider that plans in the JICA studies should be reviewed as those that will target the period to 2025, because projects proposed in this study target the period to 2025.

In addition, we think that these reviews will contribute to promoting gas use in the Philippines through, for instance, an improved estimate of potential gas demand in consuming sectors, which is indispensable for preparing plans for constructing pipelines.

Chapter 1 Present Status of Energy Demand and Supply and Energy Policies

1-1 Present Status of Energy Demand and Supply

In 1999, imported energy accounted for 56% of total primary energy consumption (In particular, imported oil alone accounted for 50% of the total), while indegenious fossil fuels accounted for only 15% in the Philippines. Two thirds of indigenious energy were accounted for by renewable energy, which includes bagasse, coconut husk/shell, rice husk, wood/wood waste, charcoal, and others (Table 1-1-1).

Table 1-1-1 Primary Energy Consumption in the Philippines

(Thousand Barrels of Fuel Oil Equivalent, MBFOE)

Primary Energy	1999	Percent Share (%)
Indigenous Energy	106,168	43.51
Conventional	35,949	14.73
Oil	173	0.07
Coal	3,965	1.63
Hydro	13,504	5.53
Geothermal	18,280	7.49
Gas	27	0.01
Renewable Energy	70,220	28.78
Bagasse	10,400	4.26
Coconut Husk / Shell	9,558	3.92
Rice Husk	6,372	2.61
Wood / Wood waste	39,300	16.11
Charcoal	4,470	1.83
Others	120	0.05
Imported Energy	137,829	56.49
Oil	122,481	50.20
Coal	15,348	6.29
Total Energy	243,998	100.00
Oil	122,654	50.27
Non-oil	121,344	49.73
Coal	19,313	7.92

(Source) DOE

Among petroleum products, which accounted for half of total primary energy consumption, diesel fuel oil and fuel oil accounted for major parts (34% and 32%, respectively). Both are fired for power generation. In addition, the former is used in the transport sector (for driving vehicles and shipping), and the latter for shipping and manufacturing (Table 1-1-2).

Luzon area, which has the largest consumer of petroleum products among the main

areas including Visayas and Mindanao, accounted for two thirds of the total. In particular, Metro Manila accounted for 42%, which is equivalent to more than twice the share of North Luzon (18%) and South Luzon (15%). In contrast, petroleum consumption is much smaller in the other two areas (Figure 1-1-1).

Table 1-1-2 Petroleum Products Consumption (1999)

(Thousand Barrels, MB)

Products	Metro Manila	North Luzon	South Luzon	Visayas	Mindanao	Total
Premium Gasoline	4,891.31	2,473.53	2,130.30	1,965.32	1,609.82	13,070.28
Unleaded Gasoline	2,791.04	476.70	745.62	547.98	281.33	4,842.67
Regular Gasoline	192.22	1,858.98	1,322.68	749.53	1,296.84	5,420.24
Diesel Oil	11,435.16	9,635.96	8,015.99	6,165.20	6,144.02	41,396.33
Fuel Oil	25,188.70	3,672.84	3,509.64	5,073.76	1,778.66	39,223.60
Kerosene	1,497.79	931.25	862.83	881.07	1,004.63	5,177.56
LPG	4,283.31	3,559.14	1,757.00	1,258.12	1,046.88	11,904.45
Avturbo	1,958.02	45.46	1.23	3.60	3.92	2,012.23
Total	52,237.54	22,653.86	18,345.28	16,644.57	13,166.10	123,047.35

(Source) DOE

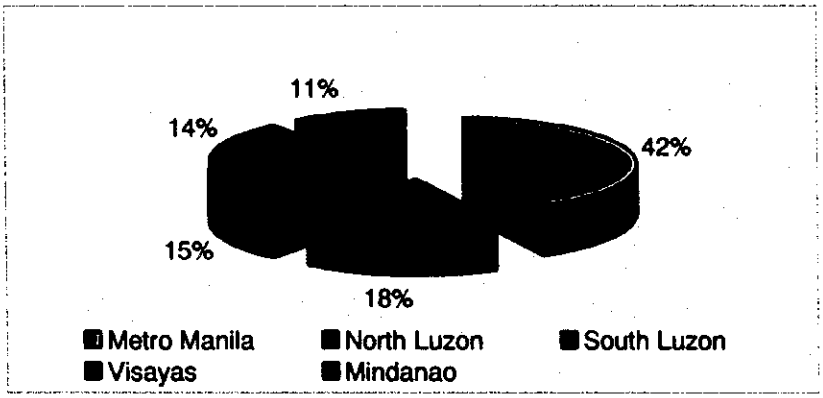


Figure 1-1-1 Oil Consumption by Area, 1999

1-2 Energy Policies

The accelerated development of indegenious energy is one of the most important current energy policy directions in the Philippines, mainly because it is importing nearly 60% of primary energy consumption from foreign countries, as mentioned above.

Thus, it is expected that natural gas, commercial reserves of which have been proved in the sea off the Palawan Island, will be one of promising energy sources for solving the problem of developing indigenious energy, and it will open the door for a large scale utilization of natural gas.

According to "Philippine Energy Plan 2000-2009," which was prepared by the Department of Energy, the share of natural gas in primary energy consumtion will increase from only 0.01% in 2000 to 5.97% in 2004 and 5.72% in 2009 (Table1-2-1). In addition, increased oil production from oil fields around Palawan Island and others is also forecast. Such increases in oil and gas production will reduce the dependency of the Philippines on imported energy from 57.8% in 2000 to 49.9% in 2004 and 52.7% in 2009, although dependency will increase again during the period from 2004 to 2009.

Table 1-2-1 Energy Mix in the Future

(In Million Barrels of Fuel-Oil-Equivalent, MMBFOE)

	2000		2004		2009	
	Volume	%Share	Volume	%Share	Volume	%Share
INDIGENOUS ENERGY	108.17	42.20	156.46	49.36	175.61	39.51
OIL	0.00	0.00	16.92	5.34	9.71	2.18
GAS	0.02	0.01	18.93	5.97	25.41	5.72
COAL	3.20	1.25	3.57	1.13	3.82	0.86
HYDRO	12.85	5.01	14.40	4.54	19.55	4.40
GEOTHERMAL	19.98	7.80	22.16	6.99	24.80	5.58
NEW AND RENEWABLE ENERGY	72.11	28.14	80.48	25.39	92.32	20.77
FUELWOOD	40.29	15.72	44.30	13.98	49.48	11.13
BAGASSE	10.68	4.17	11.81	3.73	13.33	3.00
CHARCOAL	4.56	1.78	4.91	1.55	5.33	1.20
AGRIWASTE	16.48	6.43	19.10	6.03	22.05	4.96
OTHERS	0.11	0.04	0.36	0.11	2.13	0.48
IMPORTED ENERGY	148.14	57.80	158.15	49.90	234.36	52.73
OIL	116.50	45.45	125.89	39.72	189.82	42.70
COAL	31.63	12.34	32.26	10.18	44.55	10.02
OTHERS*	0.00	0.00	2.34	0.74	34.53	7.77
TOTAL ENERGY	256.31	100.00	316.95	100.00	444.50	100.00
GROWTH RATE, %	4.56		5.45		7.00	
ENERGY SAVINGS**	4.12		11.50		15.71	
TOTAL ENERGY W/ENERCON	252.19		305.45		428.79	
POWER USE	74.72		97.57		152.83	
self-sufficiency %	42.20		49.36		39.51	

*Unidentified capacity additions for private sector participation **Estimated energy savings from energy efficiency program

1-3 Natural Gas Policies

Natural gas reserves at Camago/Malanpaya field is estimated to be around 3TCF, which is equivalent to the energy necessary for operating thermal power plants with a total capacity of 3,000 MW for twenty years. Gas, which is equivalent to that for operating 2,725 MW power plants, has already been fixed for power generation, and the construction of pipelines transporting natural gas to power plants has already be completed. All three power plants, which have a total capacity of 2,725W, are combined cycle gas turbine power plants, and are or will be located in Southern Luzon.

- Ilijan : 1,200MW
- Sta. Rita : 1,000MW
- San Lorenzo : 525W

The Government of the Philippines hopes that the remaining gas equivalent to 300 MW will be utilized in other power plants and/or manufacturing factories around Manila, while it is accelerating the exploration of domestic natural gas resources. It has established a policy direction for accelerating natural gas utilization, taking into consideration imported LNG, as well as gas through the Trans-ASEAN Pipeline, to respond to future demand for natural gas. Table 1-3-1 shows the forecast of natural gas demand in its "Philippine Energy Plan 2000 – 2009."

Table 1-3-1 Forecast of Natural Gas Demand

	2000	2004	2009
Gas Demand (BCF)	0.13	105.15	141.18
Power	0.13	105.15	127.82
Non-Power	0.00	0.00	13.36
Gas Production (BCF)	0.30	146.57	255.80

(Source) DOE

Chapter 2 Current Energy Consumption in Target Areas

2-1 Three Target Areas

The following are target areas in this study.

(1) "Batangas-Manila-Bataan including Subic and Clark" (Area L)

This area consists of the following three sub-areas:

a) "Manila" (Area L-1)

This is the same area as that called "Metro Manila" or "National Capital Region (NCR)."

b) "Batangas" (Area L-2)

It includes the following four Provinces in Southern Luzon:

-- Batangas
-- Laguna
-- Cavite
-- Rizal

c) "Bataan including Subic and Clark" (Area L-3)

It includes the following three Provinces, including Subic and Clark, situated on the north side of Area L-1.

-- Bataan
-- Bulacan
-- Pampanga

(2) "Cebu-Mactan" (Area C-M)

This area consists of the following three Cities and seven Municipalities:

<Cities>
-- Cebu
-- Mandaue
-- Lapu-lapu (Mactan)

<Municipalities>
-- Consolacion
-- Cordova
-- Compostera
-- Liloan
-- Minglanilla
-- Naga
-- Talisay

(3) "Davao" (Area D)

It consists of the following one City and four Provinces, which is the same as the Davao Integrated Development Area (DIDP).

-- Davao (City)

-- Davao Oriental

-- Davao del Norte

-- Compostela Valley

-- Davao del Sur

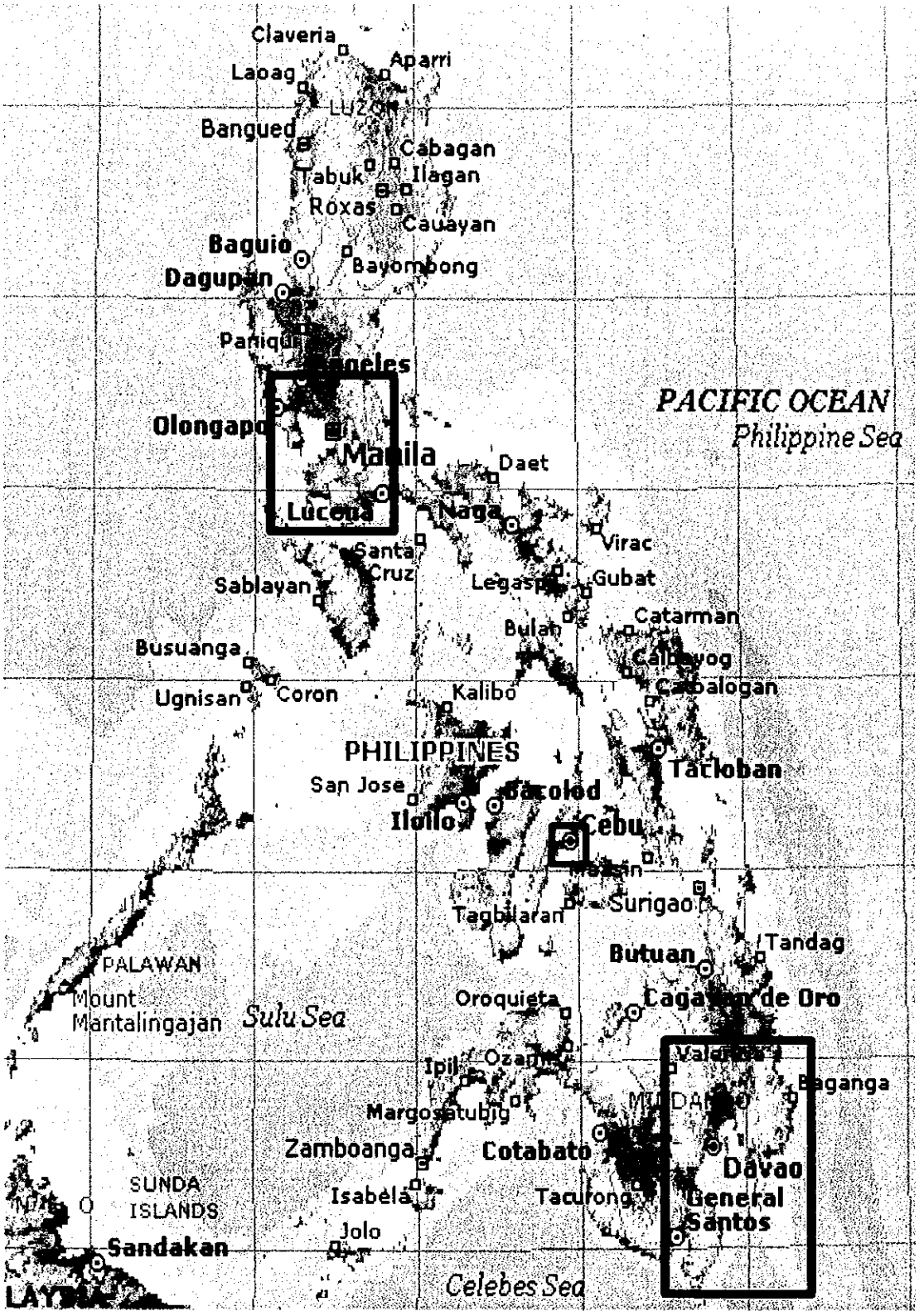


Figure 2-1-1 Target Areas in the Study

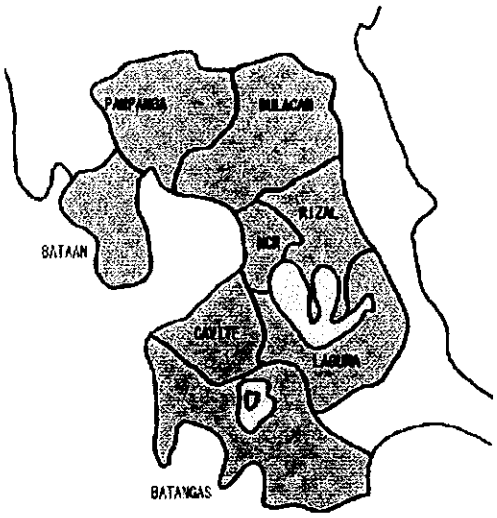


Figure 2-1-2 Target Area in Luzon

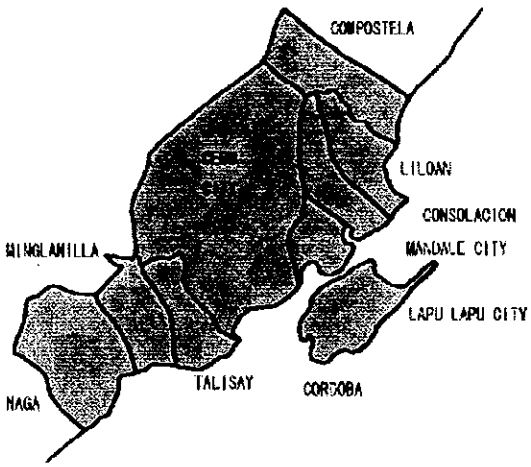


Figure 2-1-3 Target Area in Cebu

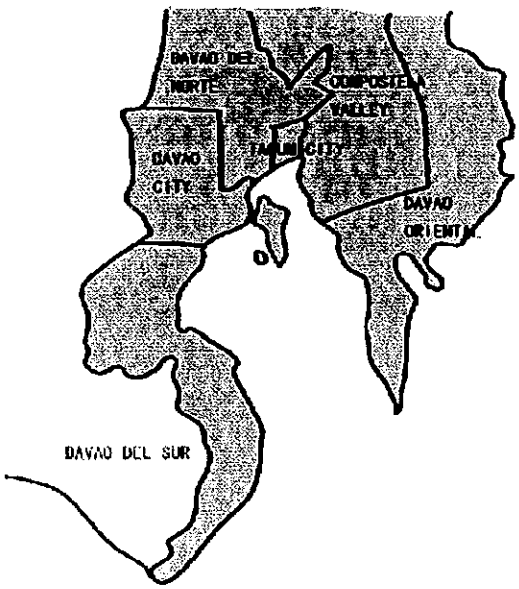


Figure 2-1-4 Target Area in Mindanao

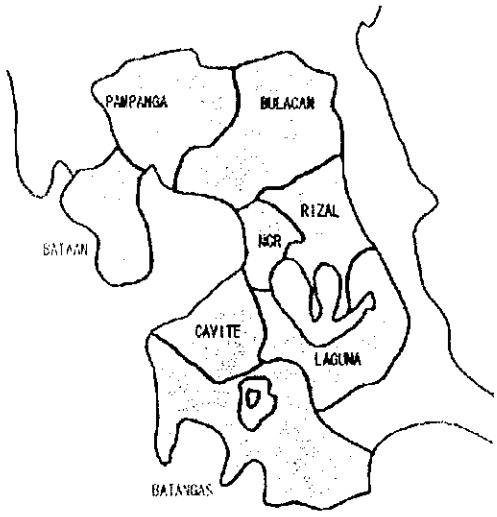


Figure 2-1-2 Target Area in Luzon

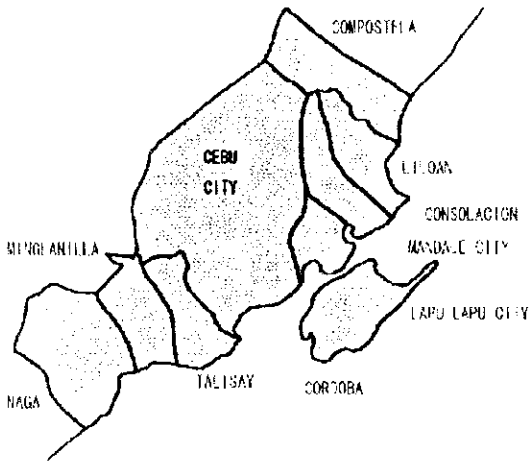


Figure 2-1-3 Target Area in Cebu

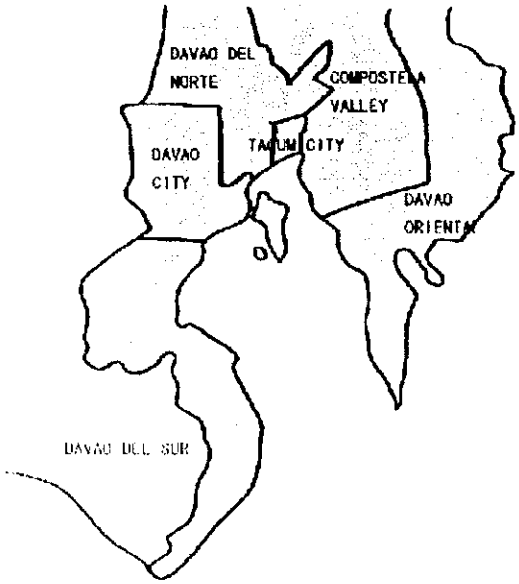


Figure 2-1-4 Target Area in Mindanao

2-2 Assumption of Current Final Energy Consumption in Target Areas

2-2-1 Final Energy Consumption in the Philippines

(1) Data Collection

It is necessary for the Study to obtain historical trend of final energy consumption, on which the demand projection model will be built and make the projection of future energy demand. The essential data sources are National Statistics 2000 issued by NSCB and DOE original data. The delivering amount of electricity and petroleum products from several Power Companies and Petroleum Companies are also utilized as auxiliary data. The APERC Database and The IEA Database are basically the back up data on the energy demand/supply balance point of view.

The several part of data concerning about the actual Study Area are obtained through DOE and other data sources. But these are too partial to use as basic database for the future projection model, therefore the regional data were estimated from national wide macro data of Philippine by defining several macro-economical parameter to distribute the whole country data into the provinces in Target Areas through the region level estimation.

(2) Data Sources

The Macro Economical Data are obtained from The Philippine Year Book 2000 adding special extracting data from NSO Database by NSO.

The energy consumption data of the industry sector that is arranged by DOE for their routine purpose (1988-1999) and the all supply data of petroleum products (1996-1999) by delivering categories for all Philippines and big regions that is arranged by EIAB (Energy Industry Administration Bureau) are main data sources for the Study respectively. The APERC Database and the IEA Database cover un-known or not clear parts of data analysis for the classification or the sector consumption.

(3) Data Processing

The data processing flow is explained in Figure 2-2-1. The original data had various format and unit using, so the re-arrangements are necessary such as unit conversion to unified unit (oe: oil equivalent as 10,000kcal/kg) and unification of the format. After that, comparing the data definition and source with actual and theoretical energy flow, especially petroleum consumption by sector, all the data of energy consumption are re-defined based on EIAB data evaluated by APERC Database and IEA Database.

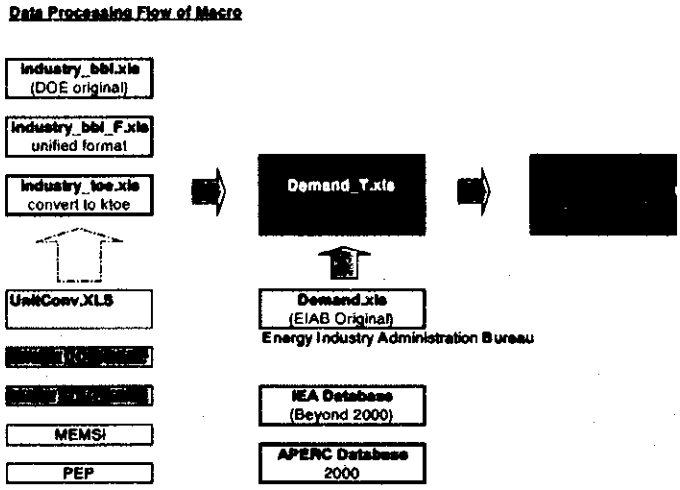
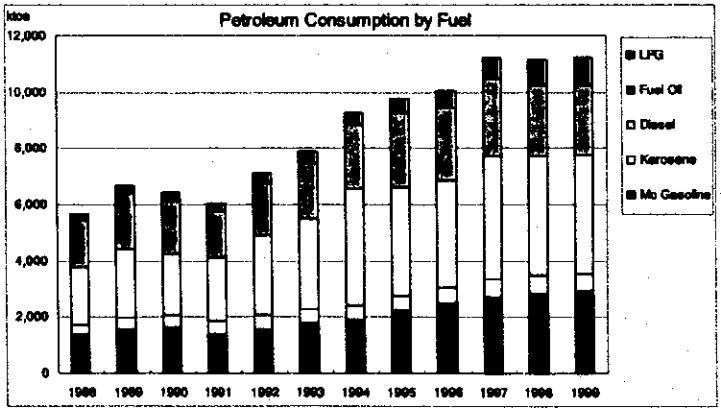
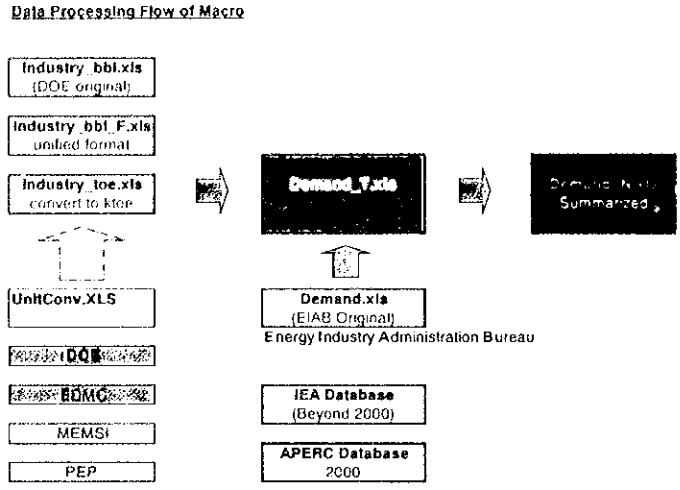


Figure 2-2-1 Data Processing Flow from Original Data to Final Energy Consumption

There are some inconsistencies in Diesel Oil data by sector. The preliminary amount of Diesel Oil consumption in the transportation looks like shorten than its actual figure. Therefore, after re-arranging the sector data of Diesel Oil consumption, some part of Diesel Oil use in private sector for generation and in agriculture is transferred to the transportation sector after checking Diesel Oil use assumed by ordinal efficiency of Diesel generation and also using DOE data of Diesel Oil consumption in agriculture.
Figure 2-2-2 shows the trend of petroleum products final consumption by fuel; Figure 2-2-3 shows that of by sector.



(Source) JICA calculated from DOE/EIAB, IEA/APERC Database, 2001
Figure 2-2-2 Petroleum Products Final Consumption by Fuel



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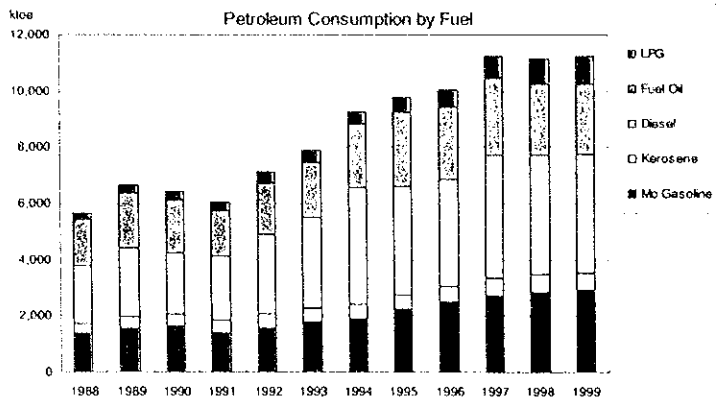
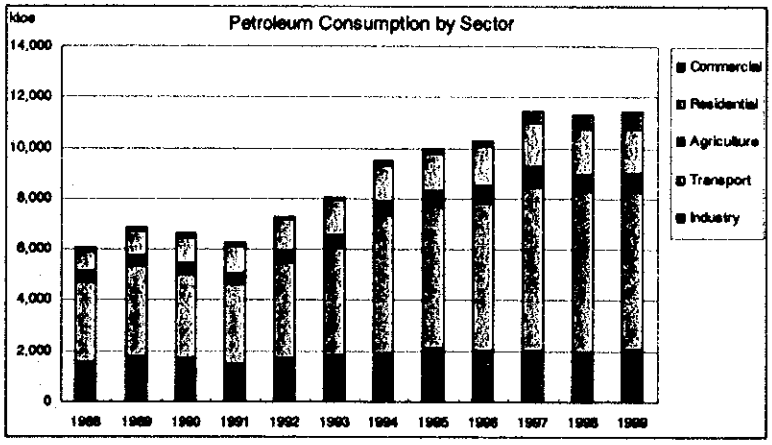
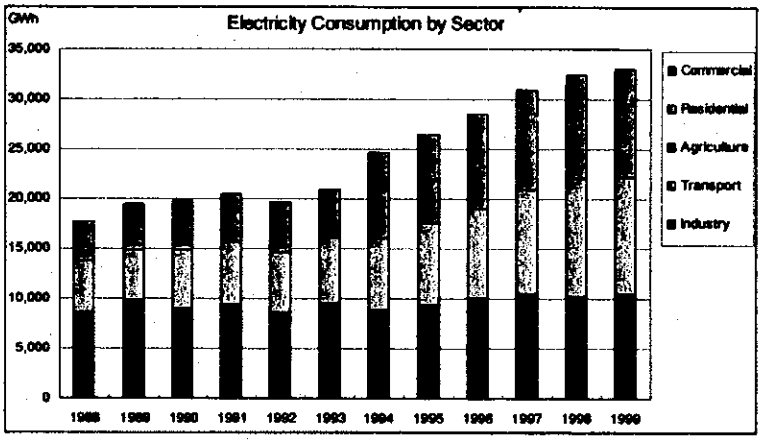


(Source) JICA calculated from DOE/EIAB, IEA/APERC Database, 2001
Figure 2-2-2 Petroleum Products Final Consumption by Fuel



(Source) JICA calculated from DOE/EIAB, IEA/APERC Database, 2001

Figure 2-2-3 Petroleum Products Final Consumption by sector

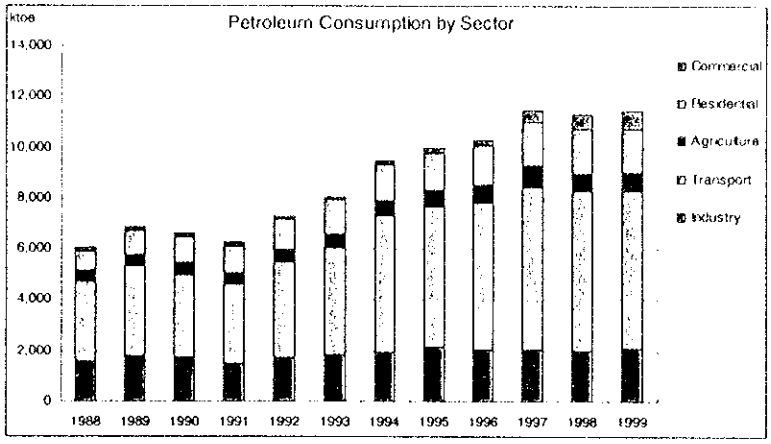


(Source) JICA calculated from DOE/EIAB, IEA/APERC Database, 2001

Figure 2-2-4 Electricity Final Consumption by Sector

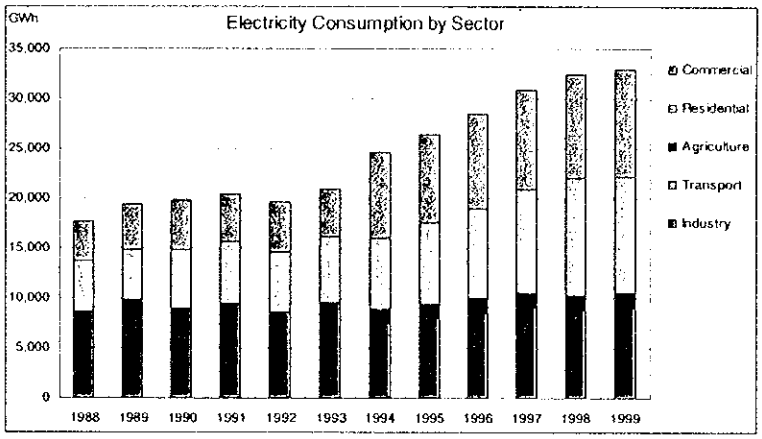
Thus, the energy consumption data based on the original source from the counterpart could be used through the Study instead of simply utilizing general published database such as IEA and so on.

The Excel file, called "Demand_N.xls", is the database of final energy consumption in all Philippine at this stage. The data is used in the Demand Forecasting Model in the Study. Final result is to obtain the potential demand of natural gas through several method explained later.



(Source) JICA calculated from DOE/EIAB, IEA/APERC Database, 2001

Figure 2-2-3 Petroleum Products Final Consumption by sector



(Source) JICA calculated from DOE/EIAB, IEA/APERC Database, 2001

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2-2-2 Energy Consumption in Target Areas

(1) Situation for Collecting Necessary Data in Target Areas

There are insufficient detailed data concerning energy consumption directly referring to target areas that is necessary for the Study to obtain future projections of energy demand in the areas. The Study requires such data from which to make assumptions. So, the necessary data is estimated from the Philippine total data that is defined in 2-2-1

The necessary data, for distributing the national total energy data to regional energy consumption data, are basically macro-data such as GRDP trend of the region, per capita GRDP and the regional population. As for the regional composition of industries and the differences in economic activities in each region, the necessary data are regional value-added production by industry, per capita income, number of vehicles, floor area of buildings, number of households, population density, and labor force. The data obtained by dividing the total data into regional or provincial data are estimated by several parameters using such macro-economic data. But, the data finally obtained are GRDP and per capita GRDP at a regional level as the complete data for the estimation. The other data are based on nationwide data except population. There still remains a lack of the data to obtain an accurate estimation of regional energy consumption by sector.

Table 2-2-1 The Definition of Region in National Statistical Year Book

Mark	Region Name	Target Area
NCR	Metro Manila	
CAR	Cordillera Administrative	
1	Ilocos Region	
2	Cagayan Valley	
3	Central Luzon	Including Target Areas
4	Southern Tagalog	Including Target Areas
5	Bicol Region	
6	Western Visayas	
7	Central Visayas	Including Target Areas
8	Eastern Visayas	
9	Western Mindanao	
10	Northern Mindanao	
11	Southern Mindanao	Including Target Areas
12	Central Mindanao	
ARMM	Autonomous Region in Muslim Mindanao	
13	Caraga	

(Source) NSO Year Book 2000

The 16 administrative districts are defined in the Philippines as shown in Table 2-2-1, and the highlighted cells are Target Areas in Table 2-2-1 and 2-2-2.

Table 2-2-2 Target Areas and Administrative Regions in the Philippines

Target Region		Target Area	Name of Target Area
Region		Province	
NCR	Metro Manila		L-1
CAR	Cordillera Administrative		
1	Ilocos Region		
2	Cagayan Valley		
3	Central Luzon	Zambales	
		Tarlac	
		Nueva Ecija	
		Pampanga	L-3
		Bataan	
		Bulacan	
4	Southern Tagalog	Aurora	
		Rizal	L-2
		Cavite	
		Laguna	
		Batangas	
		Quezon	
		Mindro Occidental	
		Mindro Oriental	
		Marinduque	
		Romblon	
		Palawan	
5	Bicol Region		
6	Western Visayas		
7	Central Visayas	Negros Oriental	
		Cebu	C-M
		Bohol	
		Siquijor	
8	Eastern Visayas		
9	Western Mindanao		
10	Northern Mindanao		
11	Southern Mindanao	Surigao del Sur	
		Davao Oriental	D (Compostela Valley)
		Davao	
		Davao del Norte	
		Davao del Sur	
		South Cotabato	
12	Central Mindanao		
ARMM	Autonomous Region in Muslim Mindanao		
13	Caraga		

(Source) NSO Year Book 2000

The target area is defined at a province level while the municipality level is requested for the C-M area. However, the availability of data at these levels is insufficient. A huge statistical data collection effort will be needed to obtain the necessary data.

MEMSI (Madecor Environmental Management Systems, Inc.), a consulting firm in the

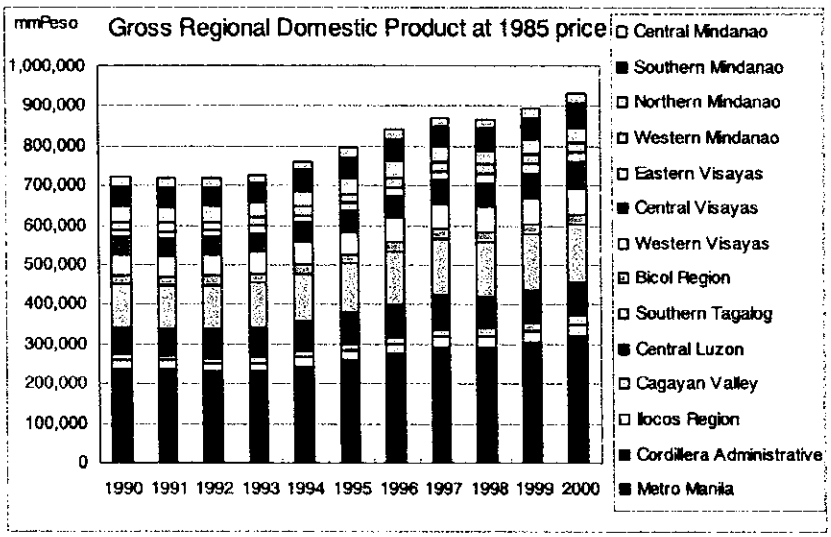
Philippines, has done a questionnaire survey for this Study, obtaining some detailed data on energy consumption by sector and also by sub-sector. However, it is difficult to refer these data directly to the statistical data, which is gathered at national or regional level.

Therefore, the estimations of energy consumption in target areas are calculated utilizing GRDP, per capita GRDP, and population data

(2) The Methodology of Assumptions for obtaining Regional Energy Consumption

The estimation begins from final energy consumption data in the Philippines, the file named "Demand_N.xls" defined in Chapter 2-2-1, correlated at a regional level using some macro-economical indices of the Philippines such as GRDP, per capita GRDP by region, and GVA (Gross Value Added Production)

The assumption is calculated using GRDP, per capita GRDP, the regional GVA and GVA by industry for all of the Philippines to clarify differences in the economic situation between Regions that include target areas.



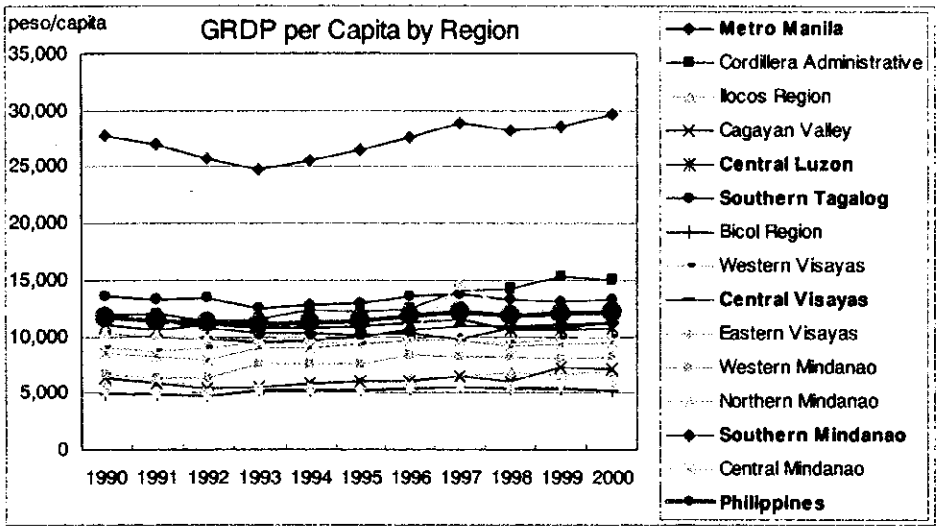
(Source) NSO Year Book 2000

Figure 2-2-5 Trend of Gross Regional Domestic Product by Region (in 1985 prices)

Figure 2-2-5 shows GRDP trend and composition by region. The GRDP of Metro Manila has a 30% or more shares the entire Philippines, following Southern Tagalog, Central Luzon, Western Visayas, Central Visayas and Southern Mindanao. The Study Areas are five regions of these excluding Western Visayas. GRDP is the result of economic activity in each region, and it is normal to basically distribute energy data for all of the

Philippines into the each region using the GRDP ratio.

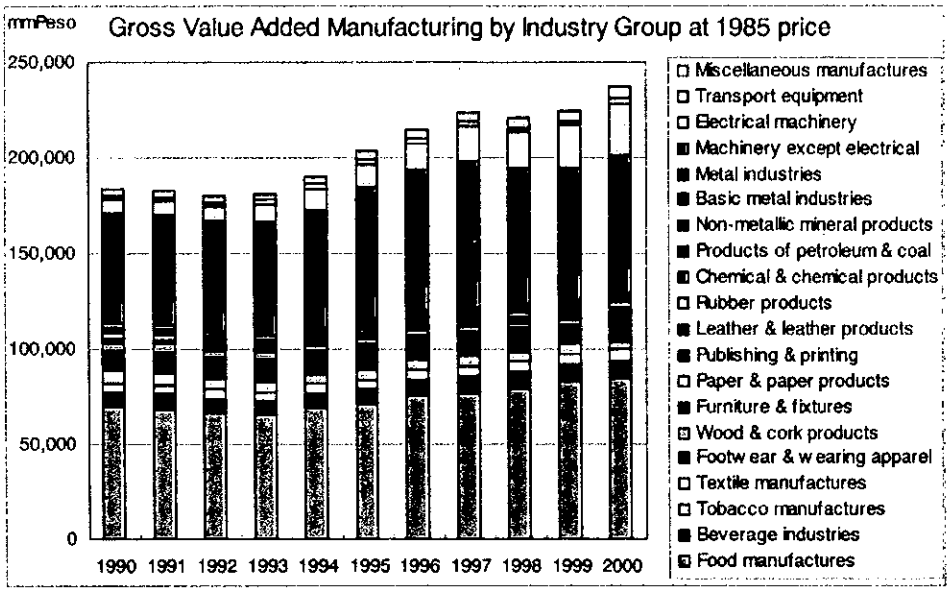
The trend of per capita GRDP is shown in Figure 2-2-6. This explains some differences among the Regions for each economic situation. Actually, there is a need to fix the several different factors by region to adjust for the differences in the development or economic circumstances among the Regions, while assuming regional energy consumption from consumption for all of the Philippines.



(Source) NSO Year Book 2000

Figure 2-2-6 Trend of GRDP per Capita by Region

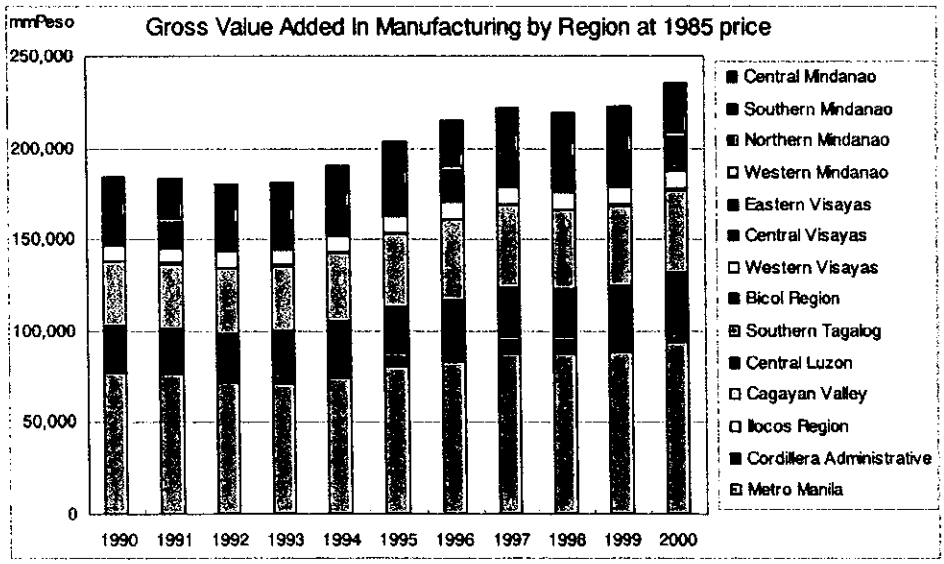
Figure 2-2-7 explains the trend for value-added products by industry nationwide in the Philippines. As for Manufacturing, the estimation of energy consumption by Region is divided into the final energy consumption of each manufacturing sector in all of the Philippines, as obtained in Chapter 2-2-1, using the regional GVA ratio of total manufacturing. It will be possible to clarify regional differences of manufacturing composition after obtaining related data such as the trend of GVA by manufacturing sector by Region.



(Source) NSO Year Book 2000

Figure 2-2-7 Gross Value-Added in Manufacturing by Industry

Figure 2-2-8 shows the Gross Value-added of total Manufacturing by Region. It is possible to obtain a database including the differences in the composition of industries among the Regions when the regional data on Gross Value-added for Manufacturing by industry is available.



(Source) NSO Year Book 2000

Figure 2-2-8 Gross Value-Added in Manufacturing by Region

Table 2-2-3 The Example of Distributing Factor

Region	GVA Ratio	GRDP Ratio	Enhanced GRDP Ratio
Metro Manila	0.389	0.3035	0.5424
Cordillera Administrative	0.033	0.0243	0.0234
Ilocos Region	0.007	0.0311	0.0130
Cagayan Valley	0.003	0.0232	0.0106
Central Luzon	0.119	0.0913	0.0620
Southern Tagalog	0.199	0.1545	0.1290
Bicol Region	0.002	0.0281	0.0094
Western Visayas	0.046	0.0712	0.0441
Central Visayas	0.057	0.0685	0.0474
Eastern Visayas	0.021	0.0241	0.0088
Western Mindanao	0.010	0.0279	0.0141
Northern Mindanao	0.041	0.0431	0.0378
Southern Mindanao	0.034	0.0555	0.0340
Central Mindanao	0.032	0.0272	0.0162

(Source) NSO Year Book 2000

The energy consumption in the residential and commercial sector obtained from the Final Energy Consumption, which is defined in 2-2-1, using the enhanced GRDP ratio to emphasize regional development and economic differences. As for transportation and agriculture, energy consumption data are divided simply using the GRDP ratio. Figure 2-2-9 shows this data-processing flow.

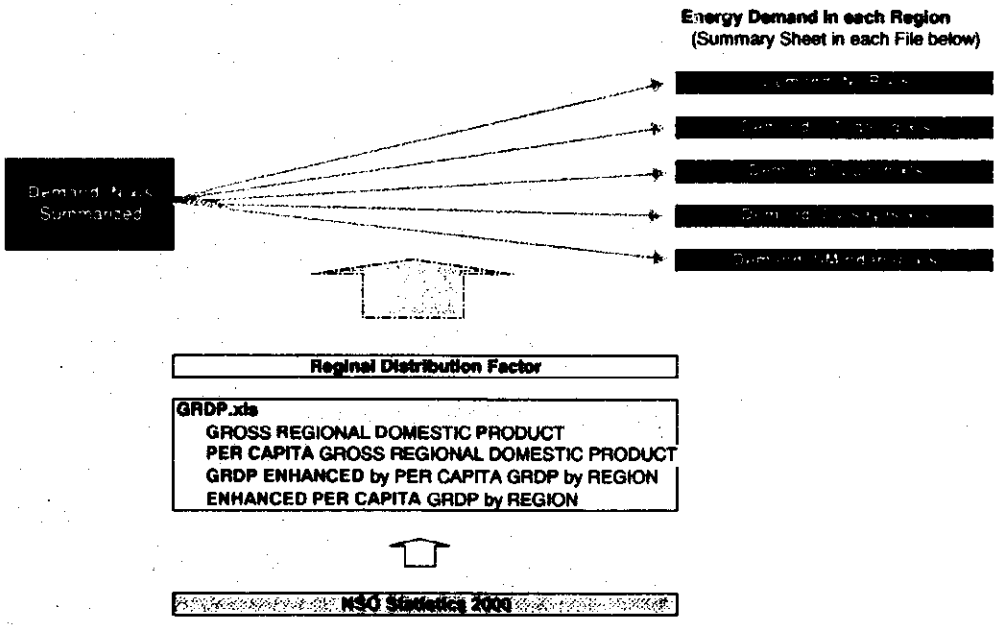


Figure 2-2-9 Data-processing Flow from Final Energy Consumption to Regional Consumption

2-2-3 Energy Demand in Target Areas

Because each target area consists of several Provinces and/or Cities and Municipalities in a Region, as shown in Table 2-2-2, energy demand data should be arranged at least at the Province level. There are no statistical energy data directly referring to this level. Therefore, energy demand in target areas must be estimated from regional data utilizing statistical data.

Generally, it is slightly difficult to distribute the statistical data on economic activities to this level, because of the population flow in daytime and actual relation between energy consumption and production depending on data registration.

On the other hand, it is quite difficult to directly collect the necessary data for target areas with the same accuracy. It is also difficult to arrange the partial available data to obtain an overall evaluation of the energy situation in target areas using some statistical method, even if such data are important. The data directly collected are utilized with its partial accuracy to verify the results of the assumption from macro-data that has consistency from an overall point of view. The residential population, registered car numbers, and floor areas of buildings in each area are consistent with nationwide statistical data.

Energy demand in each target area and Province is estimated in the following two steps:

First, we break down energy consumption in each Region, which is estimated in 2-2-2, into that in each target area. For the breakdown, it is necessary to define a kind of factor ("Development Ratio") reflecting the specific economic situation of the area based on population, for instance.

Table 2-2-4 shows an example of the factor for Southern Tagalog. The regional data are divided into target areas by the assumed GRDP ratio, which is defined as a modified population ratio by the factor above that we assume tentatively to be 1.2.

Second, we break down energy demand in each target area thus estimated into that in each Province in target areas. For the breakdown, it is necessary to define another kind of factor ("Sensitivity") reflecting the differences between economic activities in the Provinces. The "Distribution Factor," which is the factor above revised by, for instance, population ratios for Provinces, is finally used to estimate energy demand in each

Province (The factors are tentatively assumed to be 1).

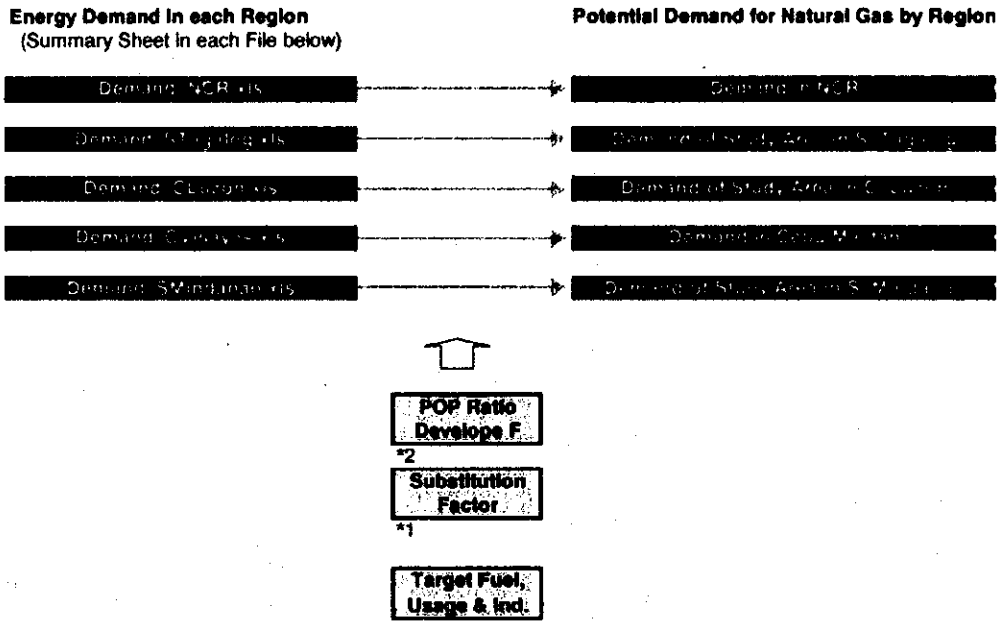
Table 2-2-4 The Example of Distribution Factor in Southern Tagalog

Region and province	Population 2000 p (May 1; in '000)	1995 (Sep 1)	1990 (May 1)	1980 (May 1)
4 Southern Tagalog	11,321	9,765,345	8,112,575	6,010,740
Aurora	173	159,621	139,573	107,145
Batangas	1,885	1,658,567	1,476,783	1,174,201
Cavite	1,907	1,610,324	1,152,534	771,320
Laguna	1,747	1,631,082	1,370,232	973,104
Marinduque	217	199,910	185,524	173,715
Occidental Mindoro	378	339,605	282,593	222,431
Oriental Mindoro	669	608,616	550,049	446,938
Palawan	737	640,486	528,287	371,782
Quezon	1,460	1,359,991	1,221,931	1,021,397
Rizal	1,689	1,312,489	977,448	555,533
Romblon	263	244,654	227,621	193,174
Lucena City	196	177,751	150,624	107,880
Study Area Ratio	0.6384595	0.6361743	0.6134916	0.5779917
Development Ratio	1.2	1.2	1.2	1.2
Assumed GRDP Ratio	0.7661514	0.7634092	0.73619	0.6935901

Ratio of POP	
Batangas	0.2608
Cavite	0.2638
Laguna	0.2417
Rizal	0.2337
Sensitivity	
Batangas	1
Cavite	1
Laguna	1
Rizal	1
Distribution Factor	
Batangas	0.2608
Cavite	0.2638
Laguna	0.2417
Rizal	0.2337
	1.0000
Assumed GRDP Ratio	
Batangas	0.2608
Cavite	0.2638
Laguna	0.2417
Rizal	0.2337

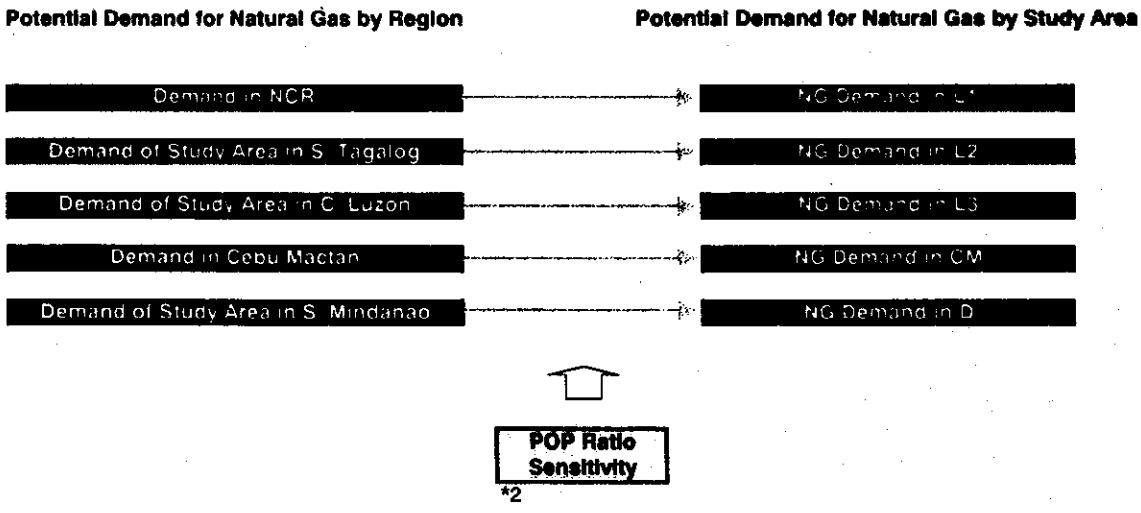
(Source) NSO Year Book 2000

The data processing from the regional level to target areas is shown in Figure 2-2-10 and 2-2-11.



Note **1: target fuels for substitution to Natural Gas (ref. 2.2)*
**2: reflection of economic differences in target areas by Region.*

Figure 2-2-10 The Data-processing Flow from the Regions to the Provinces



Note **1: target fuels for substitution to Natural Gas (ref. 2.2)*
**2: reflection of economic differences in target areas by Region.*

Figure 2-2-11 The Data Processing Flow from the Provinces to Target Areas

The results of the assumption above are shown from (1) at the top of the next page, by target area as L-1、L-2、L-3、C-M、D. The data do not include Coal and Bio.

(1) The Final Petroleum Consumption in Target Areas

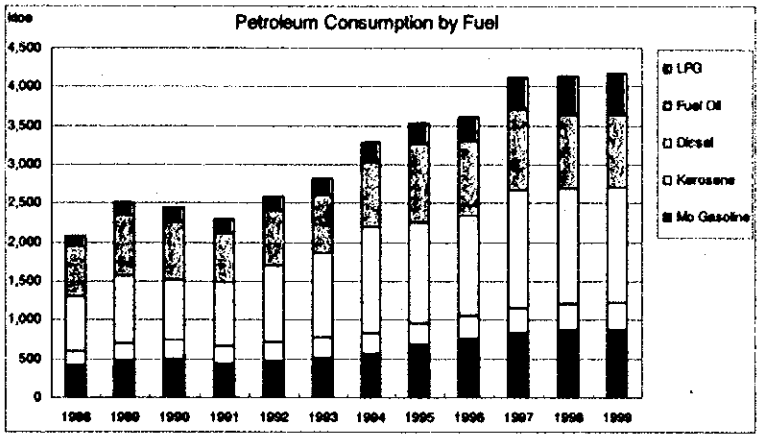


Figure 2-2-12 Petroleum Consumption by Fuel in NCR

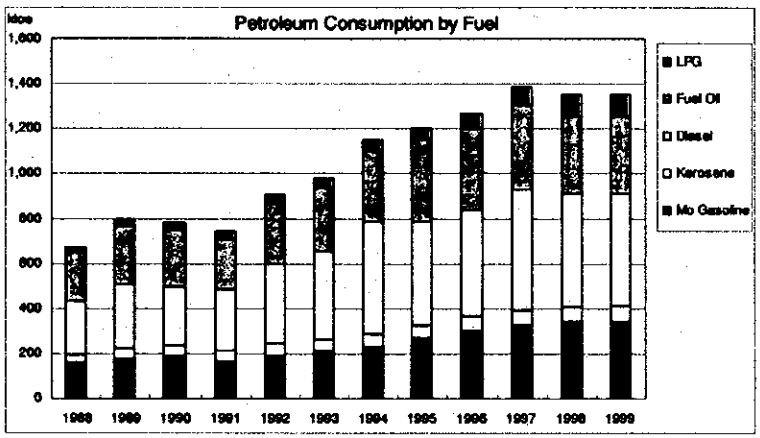


Figure 2-2-13 Petroleum Consumption by Fuel in Area L-2

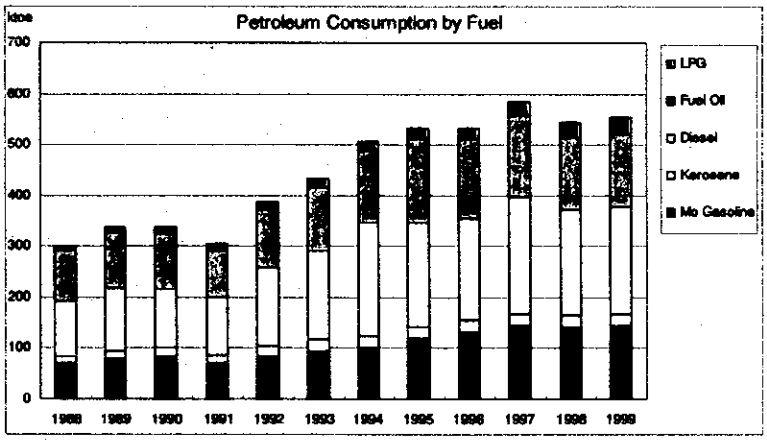


Figure 2-2-14 Petroleum Consumption by Fuel in Area L-3

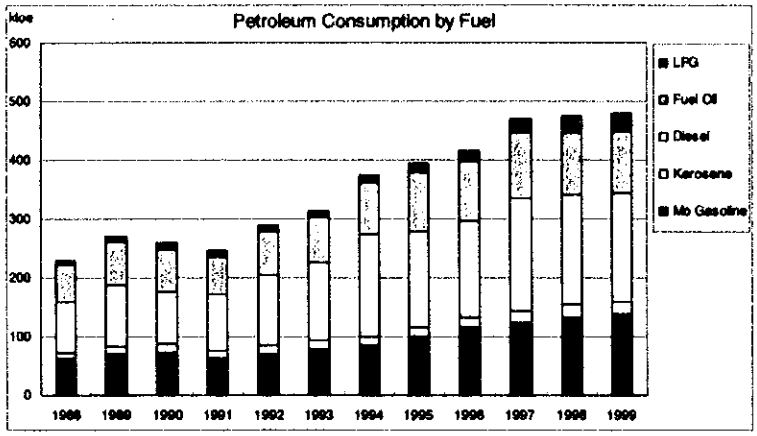


Figure 2-2-15 Petroleum Consumption by Fuel in Area C-M

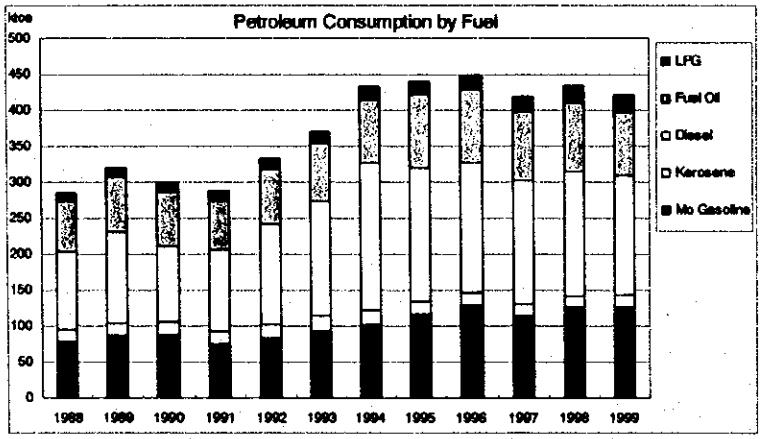


Figure 2-2-16 Petroleum Consumption by Fuel in Area D

(2) Final Electricity Consumption in Target Areas

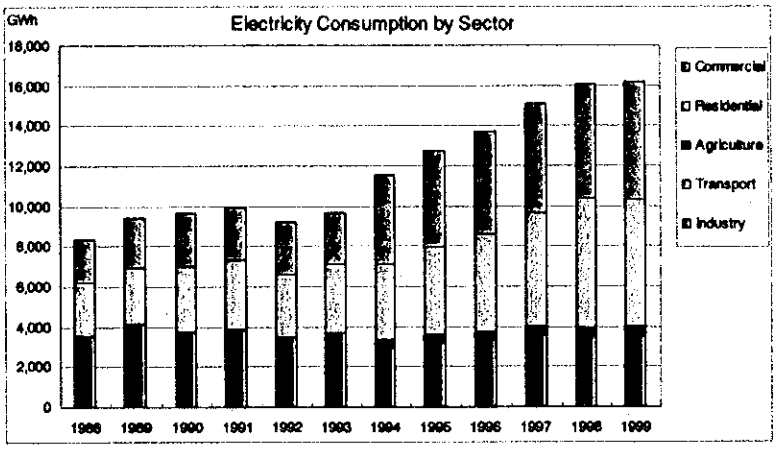


Figure 2-2-17 Electricity Consumption by Sector in NCR

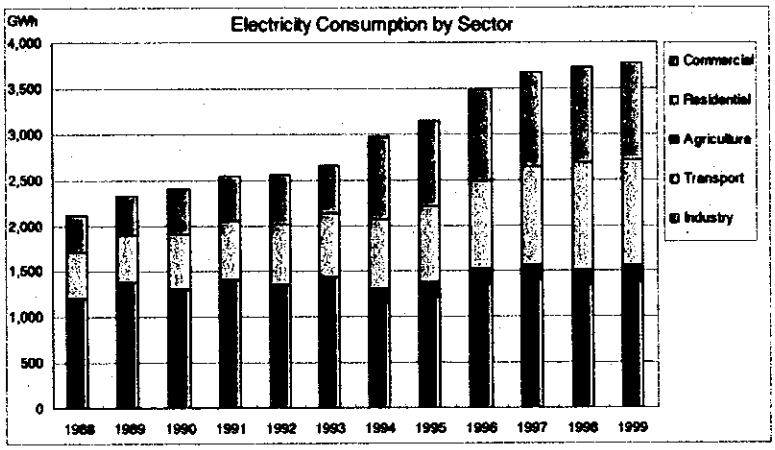


Figure 2-2-18 Electricity Consumption by Sector in Area L-2

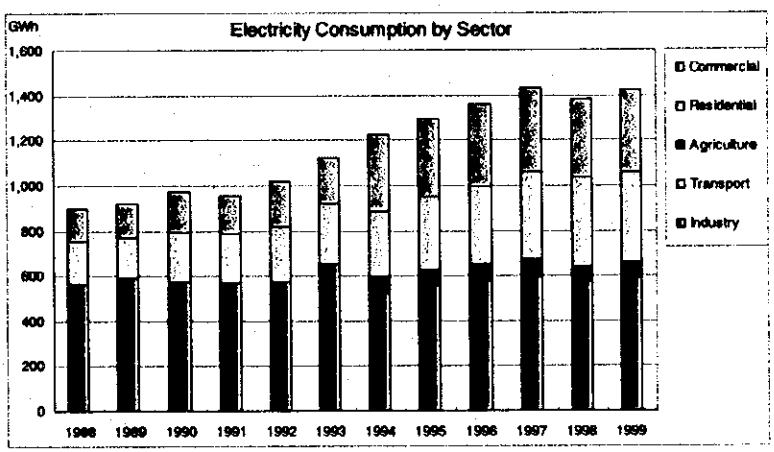


Figure 2-2-19 Electricity Consumption by Sector in Area L-3

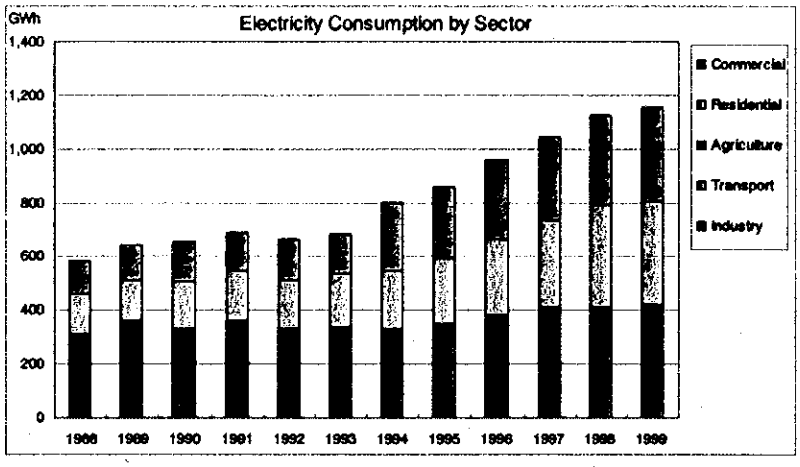


Figure 2-2-20 Electricity Consumption by Sector in Area C-M

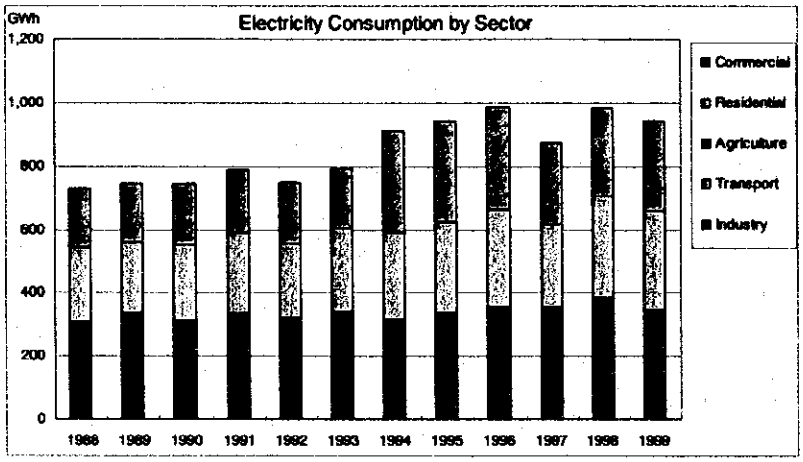


Figure 2-2-21 Electricity Consumption by Sector in Area D