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
Summary

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.

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,

Kimura Toru

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

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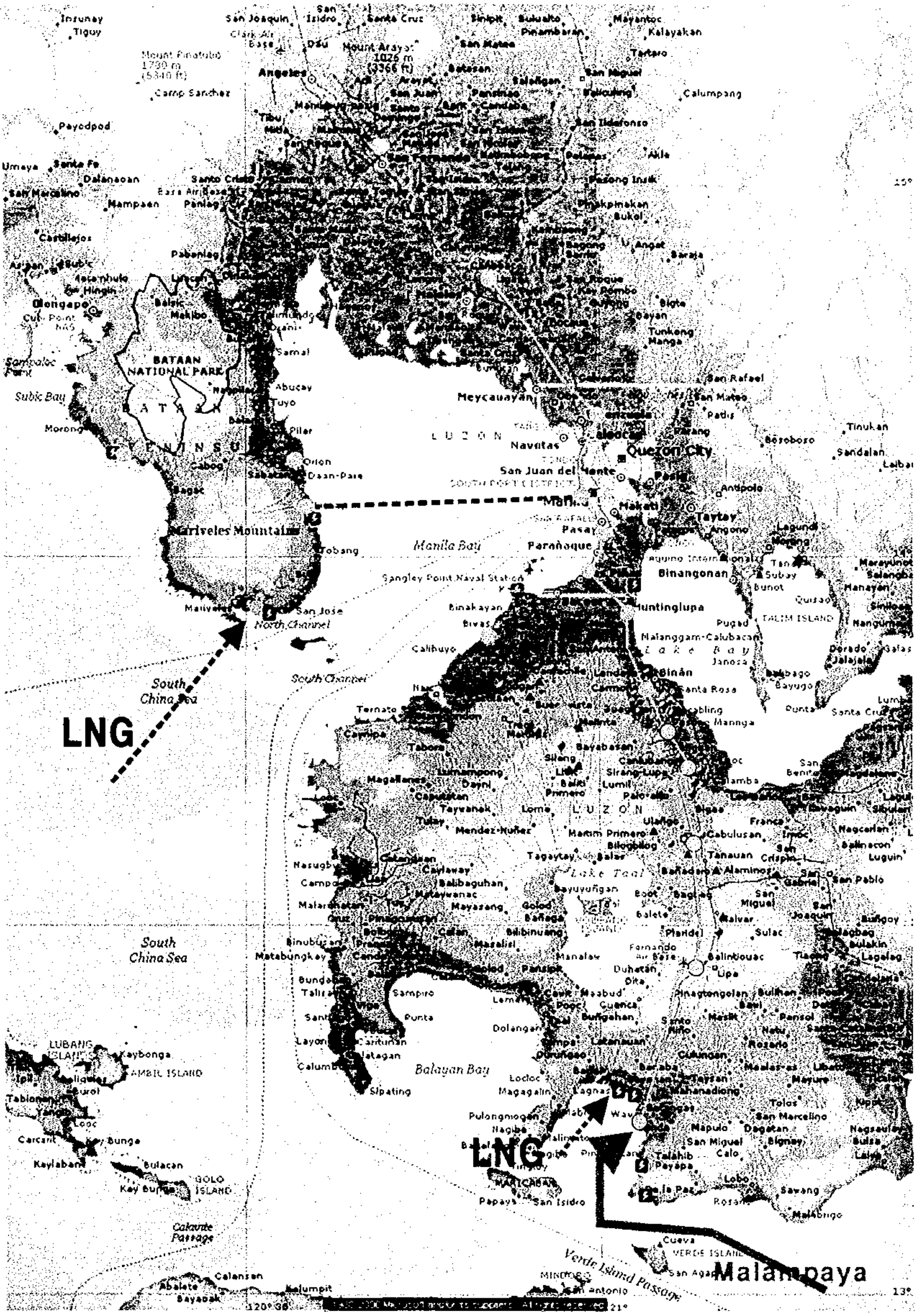
LNG
LNG
Malampaya
South China Sea
South China Sea
Manila Bay
Subic Bay
Balayan Bay
Verde Island Passage
Calavite Passage
North Channel
South Channel
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Ambil Island
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Verde Island
Sangley Point Naval Station
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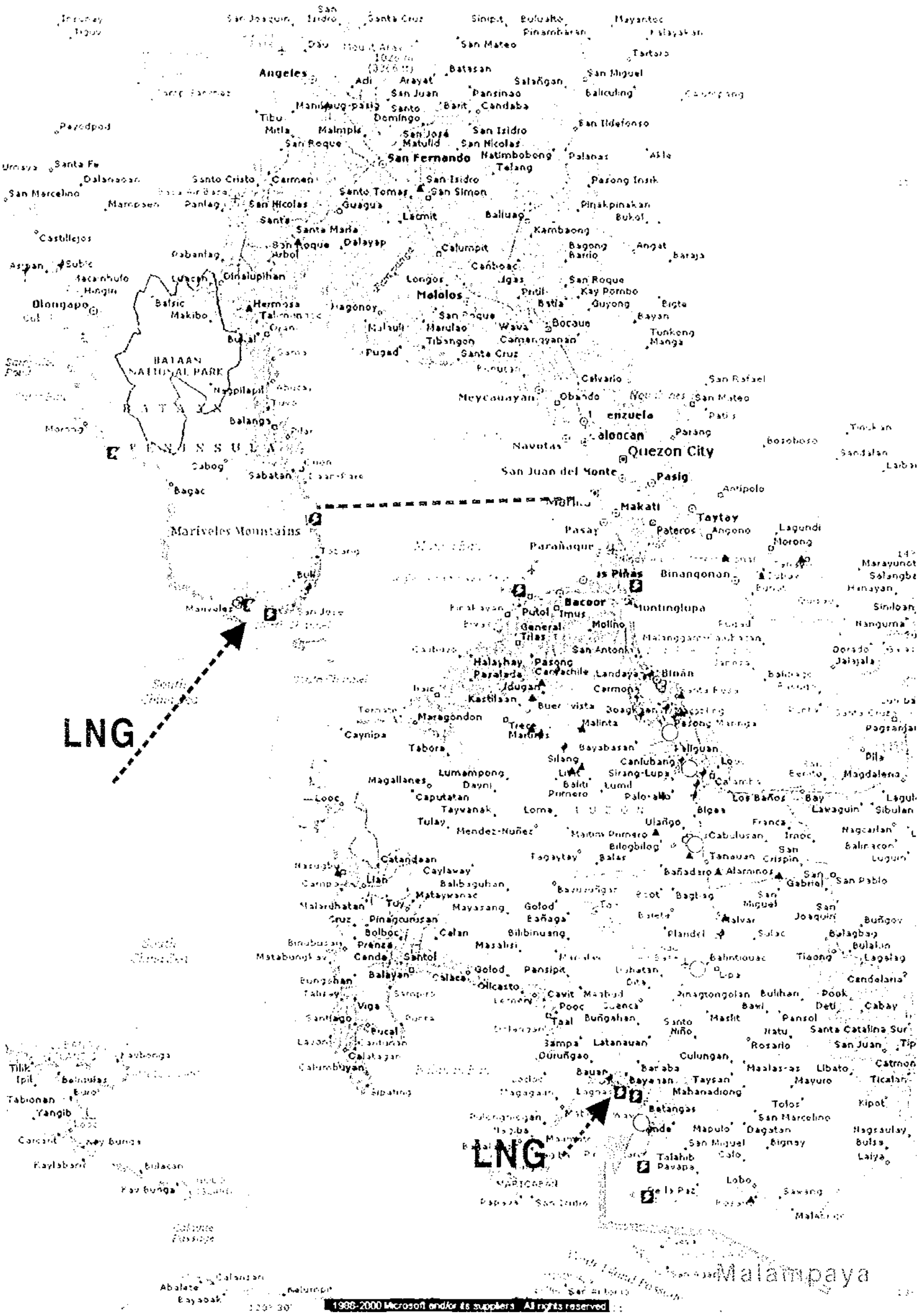
Assumed Pipeline Route



Assumed Pipeline Route

1 Objectives and Contents of the Study

1-1 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 use 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 for themselves.

The time horizon of the master plan is 25 years. 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 for preparing a master plan, developing a natural gas demand-forecasting model, optimizing supply and demand, and evaluating projects in economic and financial terms, among others.

1-2 Target Areas

The following are the target areas of this study (Figures 1-1, 1-2, 1-3, and 1-4).

(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

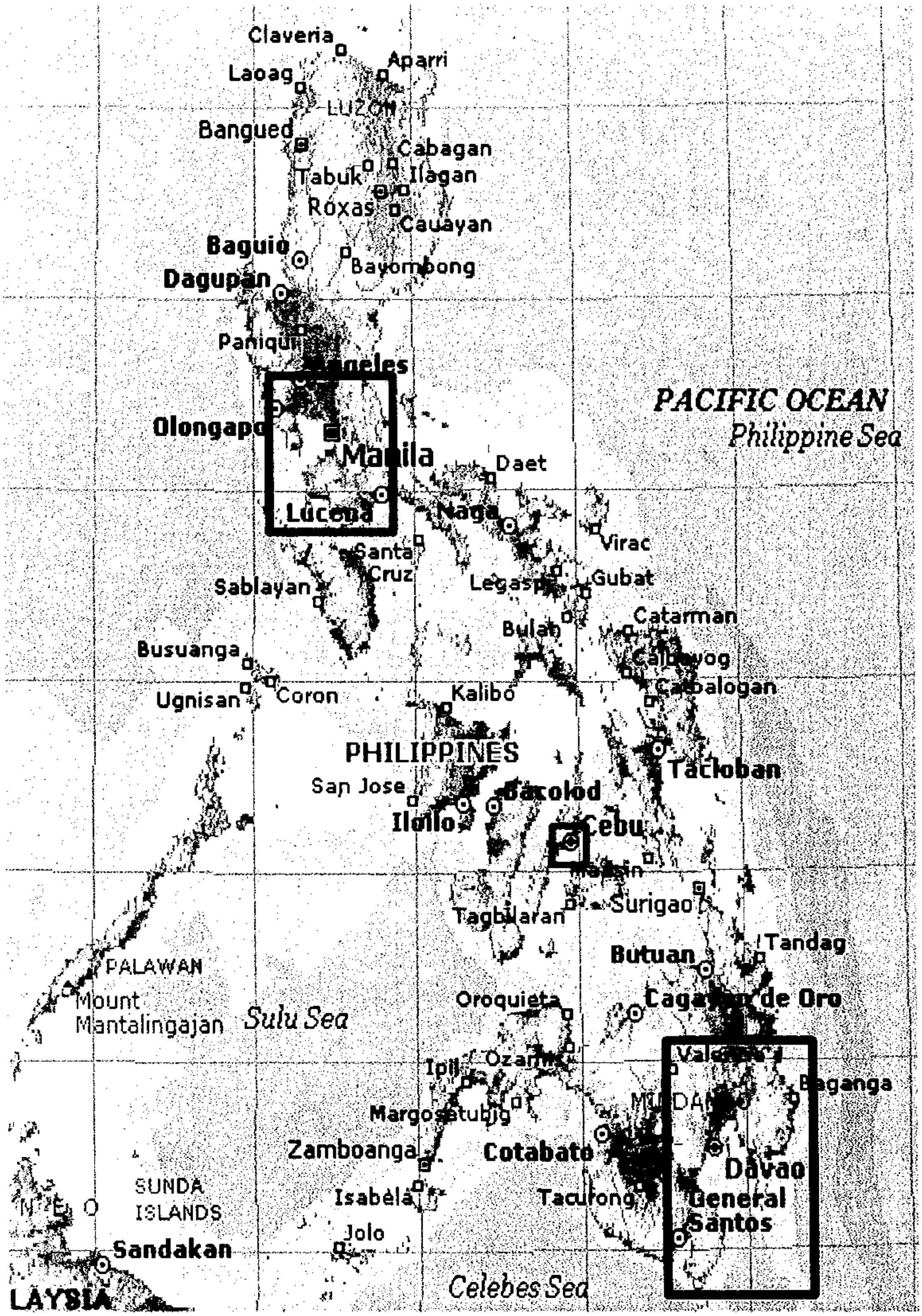


Figure 1-1 Target Areas in the Study

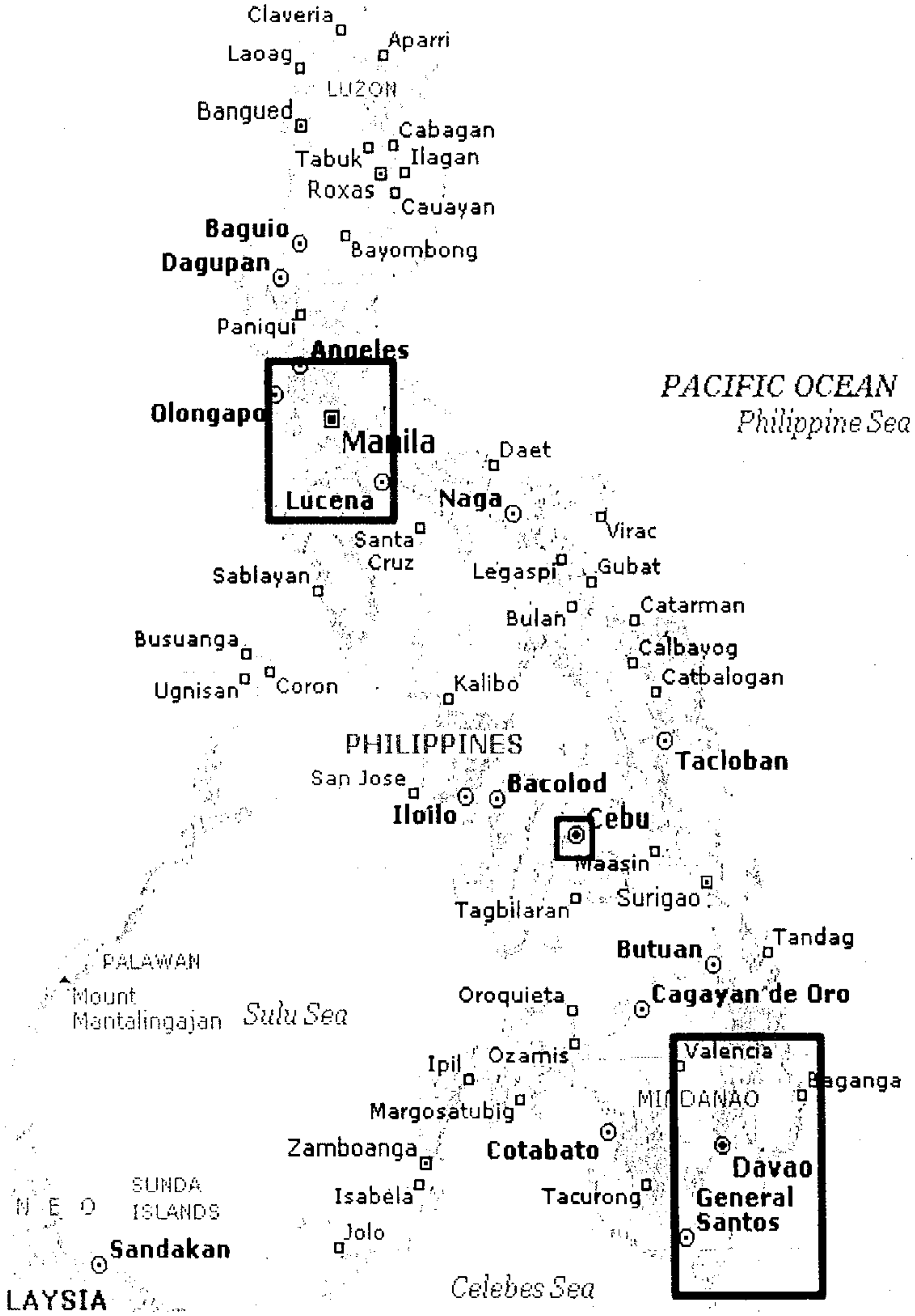


Figure 1-1　Target Areas in the Study

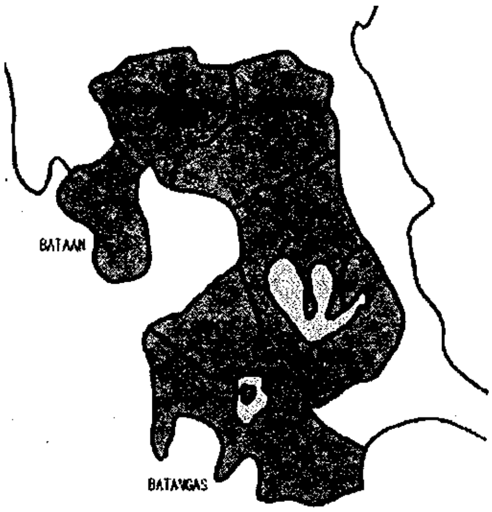


Figure 1-2 Target Area in Luzon

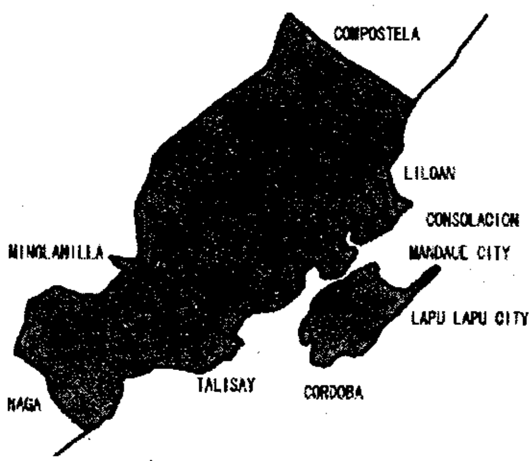


Figure 1-3 Target Area in Cebu

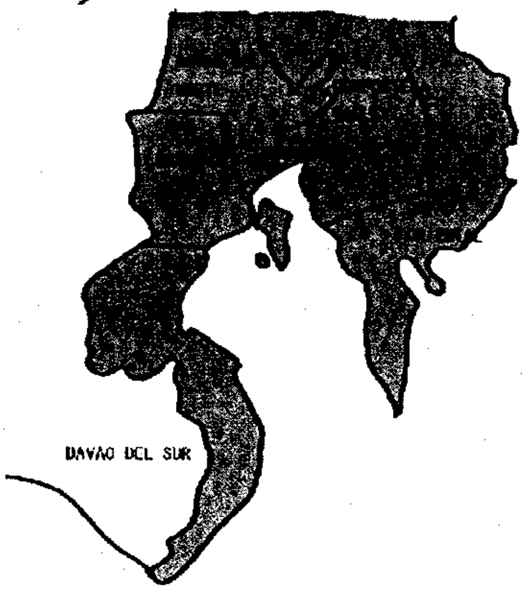


Figure 1-4 Target Area in Mindanao

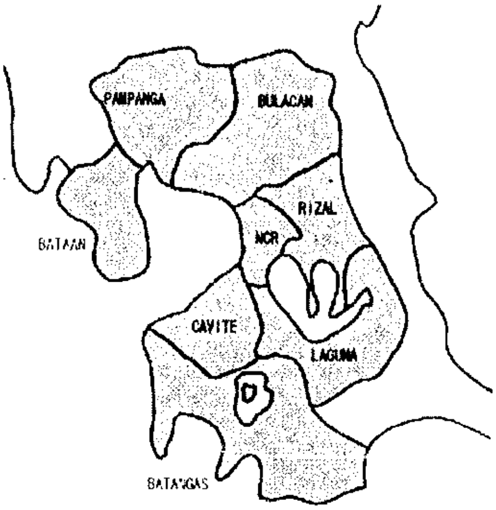


Figure 1-2 Target Area in Luzon

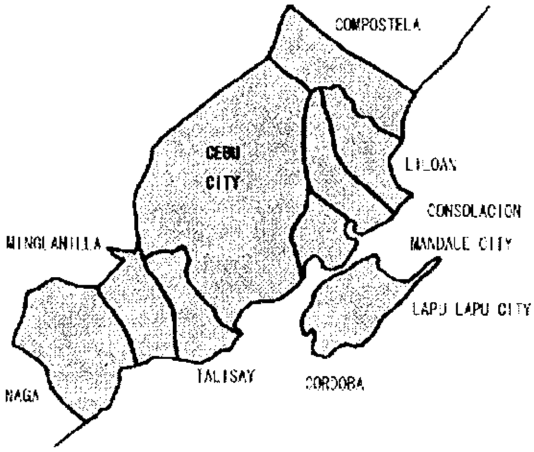


Figure 1-3 Target Area in Cebu

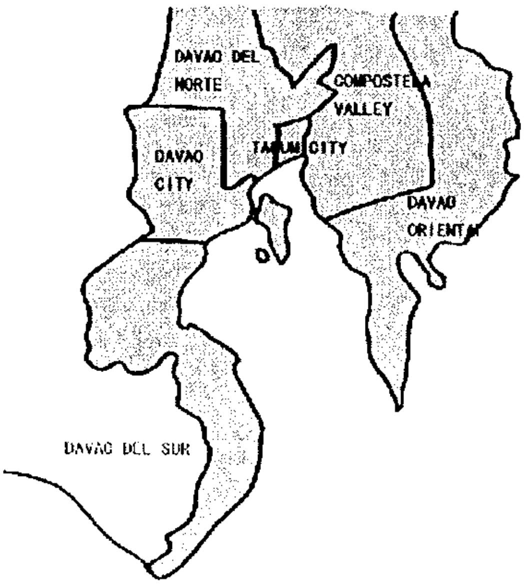


Figure 1-4 Target Area in Mindanao

-- 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 Program (DIDP) Area.

-- Davao (City)

-- Davao Oriental

-- Davao del Norte

-- Compostela Valley

-- Davao del Sur

1-3 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 (Phase 1).

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

Phase 1 consists of Steps 1 to 4, and Phase 2 consists of Steps 5 and 6. Including major study items, their interrelations, and overall study flow, the profile of this study is summarized in Figure 1-5.

(1) 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.

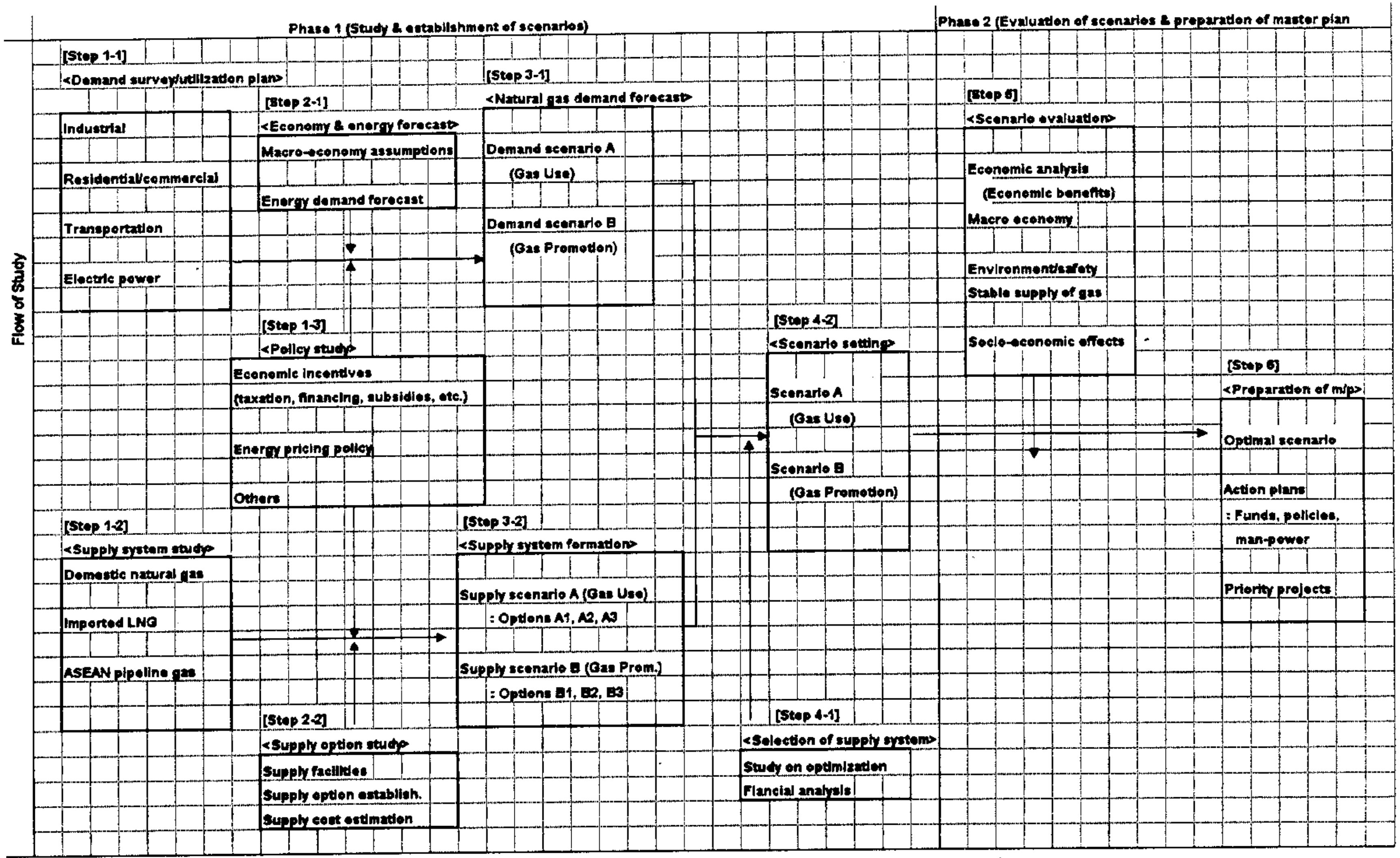


Figure 1-5 Study Profile (major study items and study flow)

<Step 2>

Step 2 comprises "macro-economic assumptions and energy demand forecast" and "supply option study."

In the "macro-economic 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 petroleum products, 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-economic 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 the systems formed according to the demand scenarios. Taking "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 supply options, focusing on pipelines, 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 would be based on a certain policy package, which includes policy measures and institutions/organizations, among other factors.

This is 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, employment, and government budget)
·····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) "An Action Plan," which states the 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 part (ii) is prepared in the form of yearly programs (for the first 10 years).

Of these, (i) the optimal "GDS Scenario" has been selected in Step 5.

Next, in regard to (ii) the "Action Plan," the preceding work produces 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 the 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.

1-4 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 2-2 below for more detail).

1-4-1 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.

1-4-2 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 1-4-1 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 1-4-1.

(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.

1-4-3 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 2 in this Summary).

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 2 of this Summary) 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 5 and 7 in the Summary).

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.

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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

The master plan for the Central Luzon area had basically the same aim as that of the 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.

2 Cases, Scenarios, and Options for Analyzing Gas Demand / Supply

2-1 "Potential" demand and "Actual" demand

When forecasting demand for gas, first, we estimate "potential" demand, and then, based upon that demand, forecast "actual" demand, which means the volume of gas actually utilized by consumers.

"Potential" demand for gas means the volume of gas,

- we estimate consumers will actually use, taking into consideration several conditions to determine the conversion of fuel to gas in existing facilities or equipment and the adoption of gas for newly built or installed facilities, including economics, environmental effects, and convenience of use,
- assuming that gas is available for consumers through pipelines,
- in current and future years (2000 to 2025).

We estimate the "potential" demand for gas, based upon forecasted energy demand for the Philippines, which is presented in Chapter 4 (In the Main Report. Hereinafter the same).

We need an estimate of the demand by small (or divided) area, which means north, central, and south of L-1 or NCR, for example, for us to prepare the "Gas Distribution Plan" mentioned below.

For the power generation sector, our estimate is based upon the power generation necessary to meet the power demand forecasted in Chapter 4.

For the industrial, commercial, transportation, and residential sectors, we estimate it as a portion of future demand for energy (electricity and petroleum products) forecasted in Chapter 4, which can be converted into gas.

Finally, based upon the "potential" demand thus estimated, the "actual" demand by year and small area is estimated according to the "Gas Distribution Plan," which shows a plan for constructing gas pipelines to supply gas to customers.

2-2 Cases, scenarios, and options

We establish two cases of gas demand, two gas supply options, and two policy scenarios for demand and supply of gas when analyzing gas demand and supply in the future (Table 2-1).

Table 2-1 Cases, Scenarios, and Options for Demand and Supply Analysis

Cases (Economic growth / Crude oil price)	Scenarios (Policy)	Options	
		Maximum supply (mmscfd)	Supply system
High Case	Gas Use	500	Option 1
		500	Option 2
	Gas Promotion	500	Option 1
		500	Option 2
High Case	Gas Use	650	(*)
		650	(*)
	Gas Promotion	650	(*)
		650	(*)
Low Case	Gas Use	500	Option 1
		500	Option 2
	Gas Promotion	500	Option 1
		500	Option 2
Low Case	Gas Use	650	(*)
		650	(*)
	Gas Promotion	650	(*)
		650	(*)

(*) To be studied only on gas demand for power generation.

First, we estimate potential gas demand according to the two cases: "High" Case and "Low" Case. The High Case is the case in which the growth rate of the Philippine economy is high and energy prices are also high, while the Low Case is the case in which the growth rate of the Philippine economy is low and energy prices are also low (Table 2-1).

Here, we assume that the trend of the world economy will have significant effects on energy demand in the world and also the growth of the Philippine economy, namely that a higher growth rate of the world economy will make global energy demand higher, resulting in higher energy prices, and also will have a positive effect on the Philippine economy.

Second, assuming that the supply limit of domestic gas will be around 500 mmscfd, we examine the locations of LNG terminals and LNG-fired power plants, and gas pipeline routes (Options 1 and 2) (See 2-4 below). In addition, assuming that the supply limit of domestic gas will be increased to around 650 mmscfd by an increase of pipeline capacity, we examine the delay of LNG importation in the future.

Third, we establish a scenario ("Gas Promotion" Scenario) in which some policy measures are introduced for improving the profitability of gas-related businesses, including gas pipelines, LNG supply, and gas-fired power plants, in addition to another scenario ("Gas Use" Scenario), in which no policy measures are taken. Please refer to Chapter 3 of the Main Report for more details on the policy measures and to Chapter 6 (6-2) for their effects on gas prices.

2-3 Assumption of economic growth rates and energy prices in the Philippines

(1) Assumption of economic growth rates

We assume that the average annual growth rate of the Philippine economy will be 5.3% in the High Case and 4.6% in the Low Case in real terms from 2000 to 2025 (Table 2-2). For more details on assumptions, please refer to Chapter 4 (4-2-2).

Table 2-2 Assumptions of growth rate of the Philippine economy and price of imported crude oil

	GDP growth rate		Crude oil price	
	High (% / year)	Low (% / year)	High (US$/bbl)	Low (US$/bbl)
2000	4.0	4.0	26.14	26.14
1	3.3	2.5	23.00	23.00
2	4.0	3.5	19.00	19.00
3	4.0	3.5	22.00	20.00
4	5.3	3.5	22.00	20.00
5	5.4	3.5	24.00	20.00
6	5.9	4.0	24.00	20.00
7	5.9	4.0	26.00	20.00
8	5.9	4.0	26.00	20.00
9	5.9	4.0	28.00	20.00
10	5.9	4.0	28.00	20.00
11	5.5	5.5	28.00	20.53
12	5.5	5.5	28.00	21.08
13	5.5	5.5	28.00	21.64
14	5.5	5.5	28.00	22.21
15	5.5	5.5	28.00	22.80
16	5.5	5.5	28.00	23.41
17	5.5	5.5	28.00	24.03
18	5.5	5.5	28.00	24.67
19	5.5	5.5	28.00	25.33
20	5.5	5.5	28.00	26.00
21	5.0	5.0	28.39	26.39
22	5.0	5.0	28.79	26.78
23	5.0	5.0	29.19	27.18
24	5.0	5.0	29.60	27.59
25	5.0	5.0	30.00	28.00

(2) Assumption of energy and gas prices

First, we assume the prices of imported energies, referring to an outlook[3] made by International Energy Agency (IEA). The reason we use it as a reference is that it is one of the most representative outlooks, which has been used in many related studies. The High Case in our study is based on the "High Price Scenario" in the outlook, and the Low Case on the *"Reference Scenario."* We, however, assume prices after 2020, because IEA deals with the period only from 2000 to 2020 (Table 2-3). Prices shown below are real price in 2000.

The imported prices of crude oil will change at the same rates as those in the IEA outlook, starting from the actual price of crude oil imported to the Philippines in 2000. We, however, have revised the IEA's outlook on the prices during the period from 2001 to 2010, assuming, in the High Case, a) that the import price of crude oil will be 23 US$/bbl in 2001 by estimating the prices in November and December in 2001, b) that it will be US$4.00 per bbl lower in 2002 than that in 2001 referring to the forecasts of oil experts in the world, and c) that it will increase gradually US$2.00 per bbl every two years until 2010. In the Low Case, we assume that the import price of crude oil will not increase significantly from around 2004 to around 2010, mainly because of the low growth rate of the world economy.

LNG price is estimated to be US$4.00 per MMBtu in 2000, from which future prices are calculated as an average of two prices estimated in the following: one is estimated taking into account shipping costs from an original source both to Japan and the Philippines, based upon actual imported prices in 2000 to Japan, which is the largest LNG importer in the world; another is the imported LNG price to the Philippines in the near future, say in 2006, which is estimated according to various information on LNG prices. We select Australia as the original source to Japan above, considering the geographical relations between the Philippines and Australia

LNG import price to the Philippines from 2002 to 2010 is estimated to be as an average of the assumed import price to the Philippines mentioned above and the import price of Australian LNG, which is estimated from IEA's outlook[4]. The LNG price after 2021

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3) International Energy Agency, *World Energy Outlook 2001*, October 2001.

4) IEA assumes Japan's LNG import price to be 4.1, 5.5, and 5.5 US$/MMBtu in the "High Price Scenario" and 4.1, 3.9, and 5.5 US$/MMBtu in the *"Reference Scenario"* in 1997, 2010, 2020, respectively.

will change at the same rates as that of crude oil.

The prices of steaming coal will be leveled off, starting from the actual imported price of Indonesian coal.

Table 2-3(1) Assumed Energy and Gas Prices (High Case)

(In 2000 price)

	Unit	1997	2000	2002	2005	2010	2015	2020	2025	2030	2035
< IEA "World Energy Outlook 2001" >											
Crude oil	US$/Bbl	20.00	n.a.	30.00	30.00	30.00	30.00	30.00	31.65	33.40	35.24
LNG	US$/MMBtu	4.10	n.a.	5.50	5.50	5.50	5.50	5.50	5.80	6.12	6.46
Coal	US$/t	n.a.	46.50	46.50	46.50	46.50	46.50	46.50	46.50	46.50	46.50
< Import prices to the Philippines >											
Crude oil	US$/Bbl	18.80	26.10	19.00	24.00	28.00	28.00	28.00	30.00	31.65	33.40
LNG	US$/t		206.44	231.60	231.60	231.60	231.60	231.60	248.14	261.83	276.27
	US$/MMBtu		4.00	4.49	4.49	4.49	4.49	4.49	4.81	5.07	5.35
Coal	US$/t		43.90	43.90	43.90	43.90	43.90	43.90	43.90	43.90	43.90

Table 2-3(2) Assumed Energy and Gas Prices (Low Case)

(In 2000 price)

	Unit	1997	2000	2002	2005	2010	2015	2020	2025	2030	2035
< IEA "World Energy Outlook 2001" >											
Crude oil	US$/Bbl	20.00	n.a.	21.00	21.00	21.00	23.37	28.00	29.54	31.17	32.89
LNG	US$/MMBtu	4.10	n.a.	3.90	3.90	3.90	4.63	5.50	5.80	6.12	6.46
Coal	US$/t	n.a.	46.50	46.50	46.50	46.50	46.50	46.50	46.50	46.50	46.50
< Import price to the Philippines >											
Crude oil	US$/Bbl	18.80	26.10	19.00	20.00	20.00	22.80	26.00	28.00	29.54	31.17
LNG	US$/t		206.44	192.38	192.38	192.38	210.33	231.60	244.37	257.85	272.07
	US$/MMBtu		4.00	3.73	3.73	3.73	4.08	4.49	4.73	5.00	5.27
Coal	US$/t		43.90	43.90	43.90	43.90	43.90	43.90	43.90	43.90	43.90

Table 2-4 Assumed Price of LNG (2000)

(US$/MMBtu)

	Current (2000)		Future (2006-)		
	Average	Australia	Low	Middle	High
CIF Japan	4.72	4.52			
Shipping costs (Aust. to Japan)	0.5	0.5			
FOB Australia	4.22	4.02			
Shipping costs (Aust. to Philippines)	0.25	0.25			
CIF Philippines	4.47	4.27	3.50	3.75	4.00
< Average of the current and future prices>					
3.5 for the future price	3.99	3.89			
3.75 for the future price (Note)	4.11	**4.01**			
4.0 for the future price	4.24	4.14			

(Note) 3.75 US$/MMBtu means around 12% cost reduction from 2000 price above.

Second, we assume the prices of petroleum products, electricity, and gas to be used directly for demand forecasts. For petroleum products, we assume that their estimated prices to customers in 2000 will change at the same rates as those of crude oil. Future electricity prices are assumed taking into account the effects on prices resulting from the new electric power industry law.

Table 2-5(1) Assumed Prices of Petroleum Products (High Case)

(In 2000 price)

	Unit	2000	2002	2005	2010	2015	2020	2025	2030	2035
< IEA "World Energy Outlook 2001" >										
Crude oil	US$/Bbl	16.50	30.00	30.00	30.00	30.00	30.00	31.65	33.40	35.24
< Import price to the Philippines >										
Crude oil	US$/Bbl	26.10	19.00	24.00	28.00	28.00	28.00	30.00	31.65	33.40
< Consumer prices >										
Petroleum products										
D.F.O. (Industry)	P/liter	12.06	8.78	11.09	12.94	12.94	12.94	13.86	14.63	15.43
(Commercial)	P/liter	12.14	8.84	11.16	13.02	13.02	13.02	13.95	14.72	15.54
(Transport)	P/liter	12.14	8.84	11.16	13.02	13.02	13.02	13.95	14.72	15.54
H.F.O. (Industry)	P/liter	10.26	7.47	9.43	11.01	11.01	11.01	11.79	12.44	13.13
Kerosene	P/liter	11.65	8.48	10.71	12.50	12.50	12.50	13.39	14.13	14.91
LPG (Industry)	P/liter	11.61	8.45	10.67	12.45	12.45	12.45	13.34	14.08	14.85
(Commercial)	P/liter	12.40	9.03	11.40	13.30	13.30	13.30	14.25	15.04	15.87
(Residential)	P/liter	12.90	9.39	11.86	13.83	13.83	13.83	14.82	15.64	16.50
Regular gasoline	P/liter	14.97	10.90	13.77	16.06	16.06	16.06	17.21	18.16	19.16

Table 2-5(2) Assumed Prices of Petroleum Products (Low Case)

(In 2000 price)

	Unit	2000	2002	2005	2010	2015	2020	2025	2030	2035
< IEA "World Energy Outlook 2001" >										
Crude oil	US$/Bbl	n.a.	21.00	21.00	21.00	23.37	28.00	29.54	31.17	32.89
< Import price to the Philippines >										
Crude oil	US$/Bbl	26.10	19.00	20.00	20.00	22.80	26.00	28.00	29.54	31.17
< Consumer prices >										
Petroleum products										
D.F.O. (Industry)	P/liter	12.06	8.78	9.24	9.24	10.54	12.01	12.94	13.65	14.40
(Commercial)	P/liter	12.14	8.84	9.30	9.30	10.61	12.09	13.02	13.74	14.50
(Transport)	P/liter	12.14	8.84	9.30	9.30	10.61	12.09	13.02	13.74	14.50
H.F.O. (Industry)	P/liter	10.26	7.47	7.86	7.86	8.96	10.22	11.01	11.61	12.25
Kerosene	P/liter	11.65	8.56	8.93	8.93	10.18	11.61	12.50	13.19	13.91
LPG (Industry)	P/liter	11.61	8.45	8.89	8.89	10.14	11.56	12.45	13.14	13.86
(Commercial)	P/liter	12.40	9.03	9.50	9.50	10.83	12.35	13.30	14.04	14.81
(Residential)	P/liter	12.90	9.39	9.88	9.88	11.27	12.85	13.83	14.60	15.40
Regular gasoline	P/liter	14.97	10.90	11.47	11.47	13.08	14.91	16.06	16.95	17.88

We assume gas prices to each consuming sector according to the "cost plus" method[5)] [6)] [7)] (Table 2-6). Note that the price to each sector does not contain all direct costs for the sector (For example, costs for the residential sector are partly met by the industrial sector). We can see this kind of price structure at the initial stage of the development of the gas industry, as in Indonesia in the mid-1990s[8)].

Table 2-6(1) Assumed Gas Sales Prices (2006) (High Case)

(US$/MMBtu)

Gas price at Tabangao	5.23	
Gas sales prices (Supplied by pipeline)	Industry	7.25
	Commercial	8.48
	Residential	9.42
	Transport	7.82
	Power	7.06

Table2-6(2) Assumed Gas Sales Prices (2006) (Low Case)

(US$/MMBtu)

Gas price at Tabangao	4.77	
Gas sales prices (Supplied by pipeline)	Industry	6.15
	Commercial	7.19
	Residential	7.98
	Transport	6.63
	Power	5.99

5) Julius, D. and Mashayekhi, A., *The Economics of Natural gas: Pricing, Planning and Policy*, 1990.
6) International Energy Agency, *Natural Gas Pricing in Competitive Markets*, 1998
7) International Energy Agency, *Natural Gas Distribution: Focus on Western Europe*, 1998
8) Japan International Cooperation Agency, *The Study on Master Plan of Urban Gas Development in the Republic of Indonesia*, 1997

2-4 Establishing three Options for Determining a Gas Distribution Plan

We have made two assumptions, namely, first, that about 500 mmscfd of gas will be supplied from a domestic natural gas source (Camago/Malampaya gas field), and, second, that about 650 mmscfd of gas will be supplied from domestic natural gas sources. Imported LNG will meet gas demand beyond the volume.

The former is based upon the proven reserves of gas in the Camago/Malampaya gas field, which have been disclosed. The latter is based upon the assumption that the reserves will be increased or reserves in other gas fields will be proven.

For determining a gas distribution plan, we assume the following two options on locating LNG terminals and laying pipelines after making several preparatory examinations, referring to some plans disclosed in reports and others.

- Option 1: To locate LNG terminals both in Bataan and Batangas area. A pipeline is constructed to reach NCR from Batangas area, to areas beyond which an onshore pipeline laid along Manila bay will supply gas.

- Option 2: To locate LNG terminals both in Bataan and Batangas area. A pipeline is constructed to reach NCR from Batangas area, to areas beyond which an offshore pipeline laid from Bataan to NCR in Manila bay will supply gas. A pipeline will be laid to supply gas to areas north of the LNG terminal located in Bataan.

The reasons why we assume the two options, in which two-gas supply origins are incorporated, are as follows:

First, to secure a stable supply of gas for the long term, it is not appropriate that the gas supply origin is situated only in one area, Batangas.

Second, also to secure a stable supply of electricity for the long term, it is problematic that many power plants are located mainly in Batangas area, even though we neglect relatively short-term problems related to the transmission capacity of electricity from this area to NCR, the large consuming center.

3 Consideration of Gas Use Scenario

3-1 Potential Demand for Natural Gas: Power Sector

3-1-1 Methodologies for Estimating Potential Demand

We estimate potential gas demand for power generation in the following methodologies.

First, we estimate total power generation capacity necessary for meeting future power demand, which is forecasted in Section 4-3 of Chapter 4 of the Main Report, referring to power generation at present and in every year through 2025. Specifically, we assume the capacity in every year as one, which can meet peak demand with at least 20% reserves.

Second, we estimate the power generation capacity by energy source and power generated by each power source. These are estimated as follows:

We select power sources taking into consideration some criteria shown below.

- Stable supply of electricity(By the way of diversifying power sources, in particular)
- Environmental preservation(By selecting clean energy carriers and technologies)
- Economics (Mainly by selecting power sources with lower generation costs)
- Maximum utilization of domestic power sources(Geothermal, hydro, domestic coal and gas)

In addition,

- We estimate future power mix referring to "Philippine Energy Plan: 2001-2011" of DOE.
- Power generation capacities in Luzon, Visayas, and Mindanao grids will account for nearly the same shares in the future as at present, respectively.
- We assume that the capacity factors of the power plants estimated in the way shown above will operate according to the same principle as that for selecting power sources.

More specifically, we consider the following in selecting power sources:

In the High Case, we assume that domestic energy sources for power, including geothermal, hydro, biomass, and gas from Camago/Malampaya and coal from Semirara, for instance, will be developed and utilized to the maximum supply capability.

In addition, we assume, following a basic policy of the Philippine government, that oil-fired power plants will be developed to a minimum level needed.

Then, we assume that, on two imported energy sources (coal and gas), these power plants will be constructed to have around the same generation capacity from the viewpoint of economics (on the basis of power generation costs).

In the Low Case, we make the same assumption on domestic energy sources for power and on oil-fired power plants as that in the High Case. Note that, on the two imported energy sources mentioned above, more gas-fired power plants will be constructed than coal-fired ones from the viewpoint of economics (on the basis of power generation costs).

Third, we estimate annual gas consumption, based upon estimated power generation through 2025.

Thus, annual potential gas demand is estimated for power generation from 2000 to 2025.

In addition, we have made the same assumption on power development for the "Gas Use" scenario and the Gas Promotion Scenario in both Cases. The reason is that policy measures or economic incentives contained in the latter are mainly targeted to promoting gas use in non-power sectors, and, therefore, we do not consider they have large effects on gas use for power generation.

3-1-2 Results of estimation (Domestic gas: 500 mmscfd)

Table 3-1 and 3-2 show future power generation capacities and power generation by energy source in the Philippines.

First, in the High Case, the total generation capacity will increase from 12,541MW in 2000 to 18,690MW in 2010, 29,791MW in 2020, and 37,841MW in 2025, while, in the Low Case, it will increase to 16,458MW in 2010, 24,749MW in 2020, and 31,599MW in

2025.

Second, in the High Case, the capacity of power plants fired by domestic gas will increase from 3,028MW in 2005 (Actually, gas fired power plants of 2,725MW will be commissioning in the Batangas area in 2002) to 3,960MW in 2010, after which the capacity will be leveled off. In contrast, the capacity of power plants fired by imported gas will increase from 300MW in 2010 (Actually, 300MW will be commissioning in 2009) to 8,900MW in 2025.

In the Low Case, the capacity of power plants fired by domestic gas will increase from 3,028 MW in 2005 to 3,060MW in 2010 and 3,983MW in 2015, after which the capacity will be leveled off. The capacity of power plants fired by imported gas will increase from 600MW in 2015 (Actually, 300MW will be commissioning in 2013) to 7,400MW in 2025.

Table 3-1(1) Generation capacity by power source in the Philippines (High Case)

(MW)

	2000	2005	2010	2015	2020	2025
Geo., hydro & others	4,167	4,606	4,719	5,798	6,242	6,492
Domestic coal	505	455	455	500	500	450
Domestic gas	3	3,028	3,960	3,983	3,983	3,983
Oil	5,016	4,557	5,606	5,827	7,017	7,316
Imported gas	0	0	300	2,100	4,500	8,900
Imported coal	2,850	2,850	3,650	5,550	7,550	10,700
Grand total	12,541	15,496	18,690	23,758	29,791	37,841
Domestic	4,675	8,089	9,134	10,281	10,725	10,925
Imported	7,866	7,407	9,556	13,477	19,067	26,916

Table 3-1(2) Generation capacity by power source in the Philippines (Low Case)

(MW)

	2000	2005	2010	2015	2020	2025
Geo., hydro & others	4,167	4,606	4,719	6,248	6,692	6,942
Domestic coal	505	455	455	530	530	480
Domestic gas	3	3,028	3,060	3,983	3,983	3,983
Oil	5,016	4,525	5,174	4,945	5,895	5,844
Imported gas	0	0	0	600	3,800	7,400
Imported coal	2,850	2,850	3,050	3,250	3,850	6,950
Grand total	12,541	15,464	16,458	19,556	24,749	31,599
Domestic	4,675	8,089	8,234	10,761	11,205	11,405
Imported	7,866	7,375	8,224	8,795	13,545	20,194

Table 3-2(1) Power generation by power source in the Philippines(High Case)

(Gwh)

	2000	2005	2010	2015	2020	2025
Geo., hydro & others	13,141	13,315	14,882	18,285	19,684	20,472
Domestic coal	2,855	2,098	2,552	2,816	2,883	2,422
Domestic gas	0	17,062	24,656	24,797	24,797	24,797
Oil	13,182	9,182	12,276	12,760	15,367	16,022
Imported gas	0	0	1,708	11,957	27,594	48,712
Imported coal	16,112	13,143	20,473	31,252	43,539	57,590
Grand total	45,290	54,801	76,547	101,867	133,864	170,015
Domestic	15,996	32,476	42,090	45,897	47,364	47,691
Imported	29,294	22,325	34,457	55,970	86,500	122,325

Table 3-2(2) Power generation by power source in the Philippines (Low Case)

(Gwh)

	2000	2005	2010	2015	2020	2025
Geo., hydro & others	13,141	12,105	14,882	21,018	22,417	23,205
Domestic coal	2,853	1,844	2,201	3,042	2,856	2,453
Domestic gas	13	17,075	18,966	24,810	24,810	24,810
Oil	13,182	7,928	11,330	12,128	14,459	14,334
Imported gas	0	0	0	4,100	25,765	41,487
Imported coal	16,101	11,550	14,751	18,651	20,743	35,524
Grand total	45,290	50,502	62,129	83,749	111,049	141,814
Domestic	16,007	31,024	36,048	48,870	50,082	50,468
Imported	29,283	19,478	26,081	34,879	60,967	91,346

Table 3-3 and 3-4 below show potential gas demand by target area.

(1) High Case

Potential demand in Area L will increase rapidly from 343 mmscfd in 2005 to 1,249 mmscfd in 2025.

Potential demand in Area L-2 will reach 787 mmscfd to account for nearly 60% of the total in Area L in 2025. It is because LNG terminals will be located not only in Limay/Mariveles area but also in Batangas area, where power plants fired by imported gas will also be constructed.

On the other hand, potential demand in Area L-3 will be 436 mmscfd in 2025, because many power plants fired by imported gas, totaling to 4,300 MW in 2025, will be constructed in Area L-3.

In contrast, potential demand for gas in Areas L-1, C-M, and D will be only 71, 52, and 52mmscfd, respectively, in 2025.

Table 3-3(1) Gas fired power plants in each target area (High Case) (500 mmscfd)

(MW)

Option/Target Area	2000	2005	2010	2015	2020	2025
Option 1 and 2						
L-1	0	0	600	600	600	600
L-2	0	3,025	3,357	4,280	5,180	6,980
L-3	0	0	300	1,200	2,300	4,300
L-total	0	3,025	4,257	6,080	8,080	11,880
C-M	0	0	0	0	200	500
D	0	0	0	0	200	500
Total	0	3,025	4,257	6,080	8,480	12,880

Table 3-3(2) Potential gas demand for power generation in each target area (High Case) (500 mmscfd)

(mmscfd)

Option/Target Area	2000	2005	2010	2015	2020	2025
Option 1 and 2						
L-1	0	0	71	71	71	71
L-2	0	343	419	517	627	787
L-3	0	0	32	127	261	436
L-total	0	343	522	714	959	1,294
C-M	0	0	0	0	23	51
D	0	0	0	0	23	51
Total	0	343	522	714	1,004	1,395

(2) Low Case

Potential demand in Area L will increase rapidly from 343 mmscfd in 2005 to 1,158 mmscfd in 2025.

Potential demand in Area L-2 will reach 713 mmscfd to account for more than 60% of the total in Area L in 2025. It is because LNG terminals will be located not only in Limay/Mariveles area but also in the Batangas area, where power plants fired by imported gas will also be constructed.

On the other hand, potential demand in Area L-3 will be 374 mmscfd in 2025, because many power plants fired by imported gas, totaling to 3,600MW in 2025, will be constructed in Area L-3.

In contrast, potential demand for gas in Areas L-1, C-M, and D will be only 71, 52, and 52 mmscfd in 2025.

Table 3-4(1) Gas fired power plants in each target area (Low Case) (500 mmscfd)

(MW)

Option/Target Area	2000	2005	2010	2015	2020	2025
Option 1 and 2						
L-1	0	0	0	600	600	600
L-2	0	3,025	3,057	3,380	4,580	6,180
L-3	0	0	0	600	2,200	3,600
L-total	0	3,025	3,057	4,580	7,380	10,380
C-M	0	0	0	0	200	500
D	0	0	0	0	200	500
Total	0	3,025	3,057	4,580	7,780	11,380

Table 3-4(2) Potential gas demand for power generation in each target area (Low Case) (500 mmscfd)

(mmscfd)

Option/Target Area	2000	2005	2010	2015	2020	2025
Option 1 and 2						
L-1	0	0	0	71	71	71
L-2	0	343	382	422	573	713
L-3	0	0	0	76	276	374
L-total	0	343	382	569	920	1,158
C-M	0	0	0	0	25	52
D	0	0	0	0	25	52
Total	0	343	382	569	970	1,261

3-1-3 Results of estimation (Domestic gas: 650 mmscfd)

LNG importation will be delayed several years, if domestic gas supply increases by 150 mmscfd. In the High Case, LNG will be imported for the first time in 2012 instead of 2009, while, in the Low Case, it will be imported in 2017 instead of 2013. For the details of power sources, power generation, gas consumption for generation, and others, please refer to "Appendix B: Forecast of Potential Gas Demand for Power Generation" in this study report.

The following tables show gas-fired power plants and potential gas demand for power generation in each target area.

Table 3-5(1) Gas fired power plants in each target area (High Case)(650 mmscfd)

(MW)

Option/Target Area	2000	2005	2010	2015	2020	2025
Option 1 and 2						
L-1	0	0	600	600	600	600
L-2	0	3,025	3,657	4,580	5,780	7,980
L-3	0	0	0	1,200	2,000	3,600
L-total	0	3,025	4,257	6,380	8,380	12,180
C-M	0	0	0	0	200	500
D	0	0	0	0	200	500
Total	0	3,025	4,257	6,380	8,780	13,180

Table 3-5(2) Potential gas demand for power generation in each target area (High Case)(650 mmscfd)

(mmscfd)

Option/Target Area	2000	2005	2010	2015	2020	2025
Option 1 and 2						
L-1	0	0	71	71	71	71
L-2	0	343	457	572	707	909
L-3	0	0	0	127	224	357
L-total	0	343	528	770	1,002	1,337
C-M	0	0	0	0	22	50
D	0	0	0	0	22	50
Total	0	343	528	770	1,047	1,436

Table 3-6(1) Gas fired power plants in each target area (Low Case) (650 mmscfd)

(MW)

Option/Target Area	2000	2005	2010	2015	2020	2025
Option 1 and 2						
L-1	0	0	0	600	600	600
L-2	0	3,025	3,057	3,980	5,580	6,980
L-3	0	0	0	0	1,200	2,800
L-total	0	3,025	3,057	4,580	7,380	10,380
C-M	0	0	0	0	200	500
D	0	0	0	0	200	500
Total	0	3,025	3,057	4,580	7,780	11,380

Table 3-6 (2) Potential gas demand for power generation in each target area (Low Case)(650 mmscfd)

(mmscfd)

Option/Target Area	2000	2005	2010	2015	2020	2025
Option 1 and 2						
L-1	0	0	0	71	71	71
L-2	0	343	382	497	678	818
L-3	0	0	0	0	127	286
L-total	0	343	382	568	875	1,175
C-M	0	0	0	0	21	51
D	0	0	0	0	21	51
Total	0	343	382	568	917	1,277

3-2 Potential Demand for Natural Gas: Non-power Sectors

3-2-1 Methodologies for Estimating Potential Demand

We begin by estimating current energy consumption by energy carrier, consuming sector, and target area (actually sub-target area) in the Philippines. This is because these data have never been available, although they are indispensable for estimating "potential" gas demand.

The first step for the estimation is to estimate current energy consumption in the Philippines by energy carrier (electricity and petroleum product) and sector. We made this estimation using several kinds of energy data available from DOE, data from IEA and APERC, and the results of a "Questionnaire survey" on the industrial, commercial, and some power sectors entrusted to MEMSI, a consulting firm in the Philippines.

The second step is to allocate current energy consumption thus estimated for the Philippines into Regions, Cities/Provinces, and, furthermore, sub-areas, into which the target areas are divided as mentioned above. This has been done mainly using the following macro data: Regional GDP (RGDP), RGDP per capita, Regional GVA (Gross Value Added), total GVA by industry, and population in sub-areas.

Next, we estimate future energy consumption by target area, sector, and energy carrier to extend current energy consumption by target area, sector, and energy carrier to the future, following growth trends in the forecast of future energy demand, which is made in Section 4-3 of Chapter 4.

Finally, we estimate how much energy (petroleum products and electricity) consumed in the future can be converted into gas in each sector by the following method.

First, we select target sub-sectors. Among sub-sectors in the target sectors, there are those in which energy carriers currently used are thought to be un-convertible to natural gas, considering technical, economic, and other conditions. Sub-sectors, which cannot easily convert to gas firing, are the following.

Industrial sector: Cement, Other Non-Metallic Minerals, Basic Metals, Mining, and Construction

Transportation sector: Railway, Domestic Air transport, and Internal Water Transport

Second, we select target energy carriers, which are convertible to gas in each sector. For instance, looking at power generation in factories for own use, it has fluctuated yearly in response to changes in the purchased price of electricity. Therefore, fuel use for power generation is also excluded from the targets, because we assume it is very rare for factories to introduce gas turbine facilities for fuel conversion, for example.

Third, we assume "gas conversion factors" for each energy carrier in the sub-sector, taking into account such elements for judging possible energy conversion to gas as technically convertible portions, economics, and others.

The reason we adopt this kind of macro method is the un-availability of sufficient data and information necessary for adopting micro or bottom-up method for all of target sectors. Even for the industrial sector, such detailed and specific data could not be collected by the MEMSI's questionnaire survey.

For the commercial, transportation, and industrial sectors, however, we can confirm the availability of some data and information necessary for adopting the micro or bottom-up method. The results of the estimation are presented in Chapter 4 (4-6) of the Main Report. Particularly, we use this method, as a substitute for the macro method, for estimating the effects of introducing strong policy measures in the transport sector.

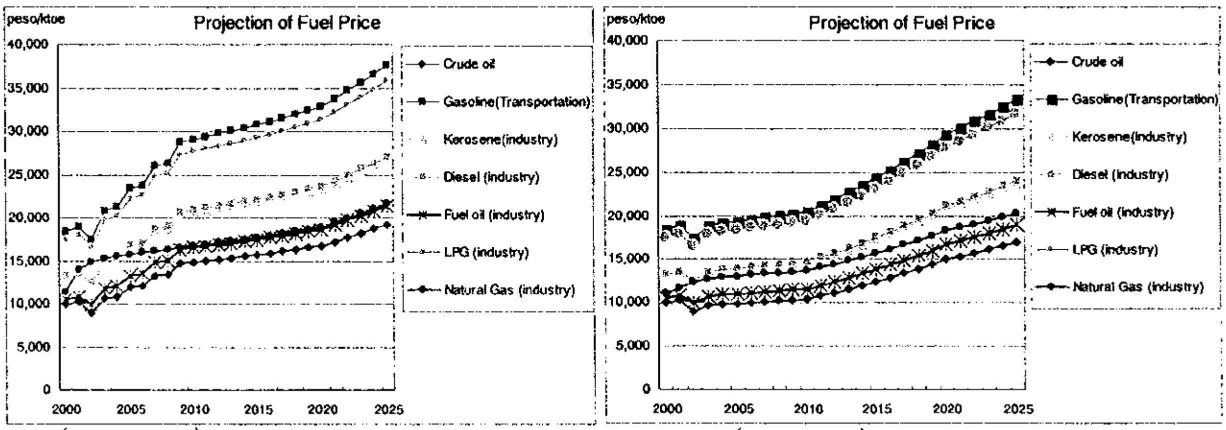
3-2-2 Estimation of Potential Demand for Natural Gas

(1) High Case

Table 3-7 Estimation of Potential Gas Demand by Target Area (High Case)

(mmscfd)

		2000	2005	2010	2015	2020	2025
<Potential Gas Demand>							
Philippines	N	9.92	6.73	37.06	91.55	161.50	237.17
NCR	L-1	5.60	3.68	20.60	51.08	90.23	132.59
S.Tagalog	L-2	0.96	0.68	3.47	8.38	14.62	21.29
C. Luzon	L-3	0.33	0.24	1.27	3.09	5.43	7.94
Cebu Mactan	C-M	0.32	0.23	1.23	3.04	5.35	7.86
S. Mindanao	D	0.33	0.18	1.03	2.56	4.54	6.70
Target Areas	**Total**	7.54	5.01	27.60	68.16	120.17	176.37
<Total Energy Demand>							
Philippines	N	1,190.67	1,631.39	2,181.66	2,886.49	3,799.82	4,830.82
NCR	L-1	501.14	661.39	899.58	1,195.03	1,573.52	1,997.80
S.Tagalog	L-2	134.48	188.81	249.86	328.42	430.52	546.17
C. Luzon	L-3	53.29	76.11	100.76	132.79	174.60	222.18
Cebu Mactan	C-M	47.82	66.74	88.44	116.76	153.67	195.44
S. Mindanao	D	49.13	58.80	77.81	103.11	136.05	173.67
Target Areas	**Total**	785.86	1,051.86	1,416.44	1,876.11	2,468.37	3,135.26
<Conversion Ratio>							
Philippines	N	0.83%	0.41%	1.70%	3.17%	4.25%	4.91%
NCR	L-1	1.12%	0.56%	2.29%	4.27%	5.73%	6.64%
S.Tagalog	L-2	0.71%	0.36%	1.39%	2.55%	3.40%	3.90%
C. Luzon	L-3	0.62%	0.32%	1.26%	2.33%	3.11%	3.57%
Cebu Mactan	C-M	0.68%	0.34%	1.40%	2.60%	3.48%	4.02%
S. Mindanao	D	0.68%	0.31%	1.32%	2.49%	3.34%	3.86%
Target Areas	**Total**	0.96%	0.48%	1.95%	3.63%	4.87%	5.63%



(High Case) (Low Case)

Figure 3-1 Assumed Prices of Petroleum Products and Natural Gas

Table 3-7 and Figure 3-1 show the results of estimated potential gas demand in the Philippines as a whole and in target areas. The potential gas demand in the Philippines as a whole is estimated to be 237.2 mmscfd in 2025, and that in target areas is estimated to be 176.4 mmscfd. The ratio of natural potential gas demand for total energy demand in 2025 is 4.91% for the Philippines as a whole, 5.63% in target areas, with 6.64% in Area L-1, 3.90% in Area L-2, 3.57% in Area L-3, 4.02% in Area C-M, and 3.86% in Area D.

Figure 3-1 shows the assumed sales prices of natural gas, which are used for the estimation of the potential demand. LPG and motor gasoline are in the same price zone as natural gas. In addition, we consider that kerosene is converted to natural gas (or LPG) more easily than others, because of its convenience in use, even if its price is higher to some extent.

(2) Low Case

Table 3-8 and Figure 3-1 show the results of estimated potential gas demand in the Philippines as a whole and in target areas. The potential gas demand in the Philippines as a whole is estimated to be 69.7 mmscfd in 2025, and that and in target areas is estimated to be 51.7 mmscfd.

The ratio of natural potential gas demand for total energy demand in 2025 is 1.59% for the Philippines as a whole, 1.84% in target areas, with 2.19% in Area L-1, 1.27% in Area L-2, 1.16% in Area L-3, 1.28% in Area C-M, and 1.28% in Area D.

Table 3-8 Estimation of Potential Gas Demand by Target Area (Low Case)

(mmscfd)

		2000	2005	2010	2015	2020	2025
<Potential Gas Demand>							
Philippines	N	9.92	5.03	10.36	21.55	38.73	69.66
NCR	L-1	5.60	2.73	5.69	11.91	21.46	38.73
S.Tagalog	L-2	0.96	0.51	0.99	2.02	3.57	6.32
C. Luzon	L-3	0.33	0.18	0.37	0.75	1.33	2.37
Cebu Mactan	C-M	0.32	0.17	0.35	0.72	1.29	2.31
S. Mindanao	D	0.33	0.14	0.29	0.61	1.09	1.98
Target Areas	**Total**	7.54	3.73	7.68	16.00	28.75	51.71
<Total Energy Demand>							
Philippines	N	1,190.18	1,631.49	2,120.91	2,715.00	3,456.89	4,390.34
NCR	L-1	500.98	646.61	831.84	1,081.73	1,393.29	1,771.30
S.Tagalog	L-2	134.43	189.47	245.08	311.31	394.02	499.10
C. Luzon	L-3	53.27	76.74	99.80	126.77	160.56	203.84
Cebu Mactan	C-M	47.80	67.62	88.47	112.29	142.04	180.23
S. Mindanao	D	49.11	60.08	78.86	99.78	126.27	160.70
Target Areas	**Total**	**785.58**	**1,040.51**	**1,344.06**	**1,731.87**	**2,216.18**	**2,815.18**
<Conversion Ratio>							
Philippines	N	0.83%	0.31%	0.49%	0.79%	1.12%	1.59%
NCR	L-1	1.12%	0.42%	0.68%	1.10%	1.54%	2.19%
S.Tagalog	L-2	0.71%	0.27%	0.40%	0.65%	0.91%	1.27%
C. Luzon	L-3	0.62%	0.24%	0.37%	0.59%	0.83%	1.16%
Cebu Mactan	C-M	0.68%	0.25%	0.39%	0.64%	0.91%	1.28%
S. Mindanao	D	0.68%	0.23%	0.37%	0.61%	0.87%	1.23%
Target Areas	**Total**	**0.96%**	**0.36%**	**0.57%**	**0.92%**	**1.30%**	**1.84%**

4 Natural Gas Supply Systems

4-1 Natural Gas Supply Systems by Source

4-1-1 Indigenous Natural Gas

Table 4-1 Natural Gas Supply Sources

	Gas Fields	Minimum (BCF)	Prospective (BCF)	Maximum (BCF)
Proven	Camago/Malampaya	2,528	3,340	4,277
	San Martin	243	359	454
	San Antonio		4	
Potential	Mindoro/Cuyo	2,720	7,060	11,210
	Cotabato	60	1,158	1,760
	Cagayan	176	322	518
	Central Luzon	78	637	2,594

(Source) PNOC

Potential reserves are not well confirmed and relevant gas fields need exploration and examination. This study will count only on proven fields.

Further, as San Antonio has very few proven reserves, we will consider only Camago/Malampaya, and San Martin.

4-1-2 Supply and Demand Balance of Indigenous Natural Gas

Natural gas from Camago/Malampaya will be supplied to three power plants (total power generation capacity: 2,725 MW) shown in Table 4-2.

Table 4-2 Power Plants for Natural Gas from Camago/Malampaya

	Ilijan	Santa Rita	San Lorenzo
Capacity (MW)	1,200	1,000	525
Company	KEPCO Ilijan Corp.	First Gas Power Corp.	First Gas Power Corp.
Off taker	NPC	Meralco	Meralco
Commencement	2002	2000	2002

If we assume the capacity factor of the plants to be 75% and power generation efficiency to be 45% (based on a high heating value), it would amount to 365 mmscfd in terms of gas. At present, the Camago/Malampaya gas field has a platform capacity of 500 mmscfd and a sub-sea pipeline capacity of 650 mmscfd. From these figures, we calculate that there is a 135 mmscfd surplus supply of domestic gas (equivalent to 1,000 MW of power generation).

In this study, we examine demand and supply assuming that 500mmscfd gas will be supplied from Camago/Malampaya gas fields. Please refer to 3-1 above for the delay of LNG import in the Case of 650mmscfd gas supply from Camago/Malampaya and to Chapter 5 (5-5) for the effects of additional gas reserves proven in other gas fields.

4-1-3 LNG Supply and Demand Balance Estimated

Figure 4-1 shows the LNG supply / demand balance based on an outlook with three demand cases; i.e., high, base, and low. The balance in the base demand case in 2010 approximately coincides with the aggregate supply availability of existing and planned projects. In the low demand case, there will be a surplus of 5 mta in supply. In the high demand case, an additional 17 mta may be required from further planned projects, which in aggregate have a capacity of 78.6 mta, causing almost no shortage.

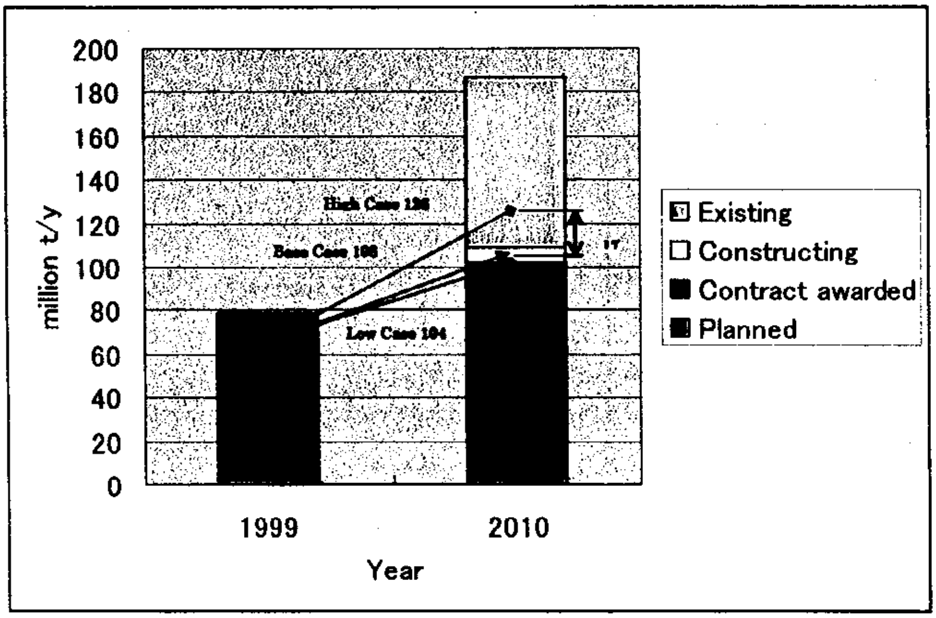


Figure 4-1 LNG Supply and Demand Balance in Asia

Cases: Base: IEEJ (May 2000); High and Low: other institutes

(Source) IEEJ 2000

Thus, looking at future demand and supply of LNG in the world, we can foresee that a situation of excessive supply will be continuing at least until 2010.

4-1-4 Trans ASEAN Pipeline (TAP) Gas

TAP gas will be originated in Indonesia and Malaysia, where a huge volume of gas can be developed. We can expect that gas enough for meeting future demand in the Philippines will be available, if the developments of gas are made effectively.

4-2 Pipeline

4-2-1 Area L – Option 1

The LNG terminal constructed for power plants in Area L-3 will be connected to the landing terminal for domestic natural gas in Area L-2 through a transmission pipeline along the coast of Manila Bay.

Gas will be supplied to Areas L-1 and L-2 first, and finally to Area L-3 .

Phase 1: Priority will be given to Areas L-1 and L-2. Domestic gas will be transported from the landing terminal for domestic gas in the Batangas area.

Phase 2: By 2016 in the High Case and by 2012 in the Low Case, when the capacity of the transmission pipeline in the above-mentioned section reaches its limit, a new pipeline will be constructed along the coast of Manila Bay to connect the LNG terminal in Area L-3 and the Phase 1 transmission pipeline.

Thereby, the double-source and two-terminal system for domestic and imported natural gas will be established and ensure a gas stable supply.

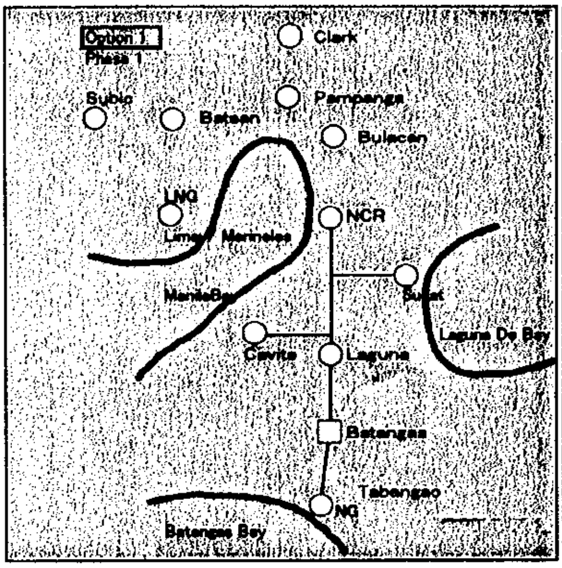


Figure 4-2　Area L -Option 1 (Phase 1)
(2006 to 2015)—High Case
(2006 to 2011)—Low Case

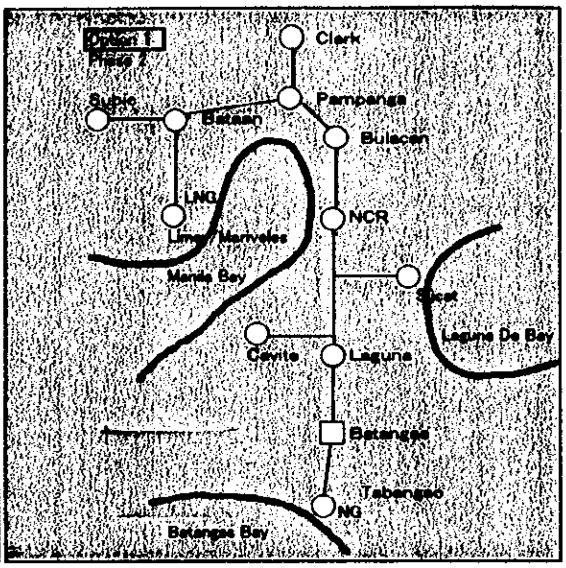


Figure 4-3　Area L–Option 1 (Phase 2)
(2016 to 2025)···High Case
(2012 to 2025)···Low Case

4-2-2　Area L – Option 2

The LNG terminal constructed in Area L-3 will be connected to the landing terminal for domestic natural gas in Area L-2 through a transmission pipeline across Manila Bay.

Gas will be supplied to Areas L-1 and L-2 first, and finally to Area L-3.

Phase 1: Priority will be given to Areas L-1 and L-2. Domestic gas will be transported from the landing terminal for domestic gas in the Batangas area.

Phase 2: By 2016 in the High Case and by 2012 in the Low Case, when the capacity of the transportation pipeline in the above-mentioned section reaches its limit, a new transmission pipeline will be constructed undersea across Manila Bay to connect the LNG terminal in Area L-3 and the 1st phase transmission pipeline.

Phase 3: Another new pipeline will be extended from the northern NCR and the LNG terminal (Limay/Mariveles), and supply gas to Area L-3.

Thereby, a double-source and two-terminal system for domestic and imported natural gas will be established and ensure stable gas supply.

The undersea pipeline to be constructed in the Phase 2 will be able to flexibly respond to the increase of gas demand in Areas L-1 and L-2 by enlarging the diameter of the pipeline. So, it will be important to fix the demand forecast when planning the pipeline.

The pipelines in the Phase 3 can be laid at any year until the target year after the Phase 2. Therefore, the pipelines can flexibly support the increase of gas demand in Area L-3.

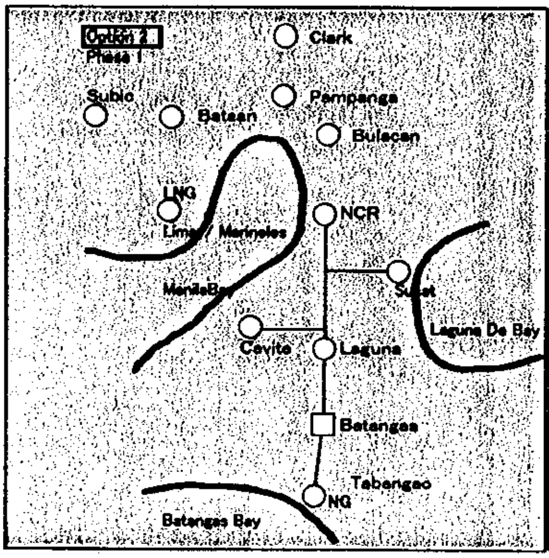


Figure 4-4 Area L – Option 2 (Phase 1)
(2006 to 2015)—High Case
(2006 to 2011)—Low Case

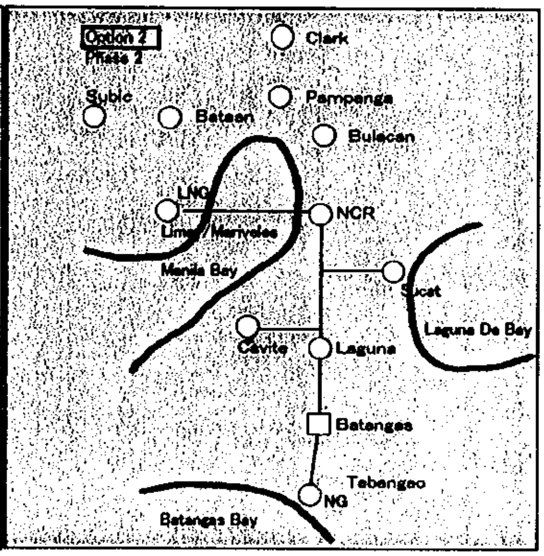


Figure 4-5 Area L – Option 2 (Phase 2)
(2016 to 2020)··· High Case
(2012 to 2020)··· Low Case

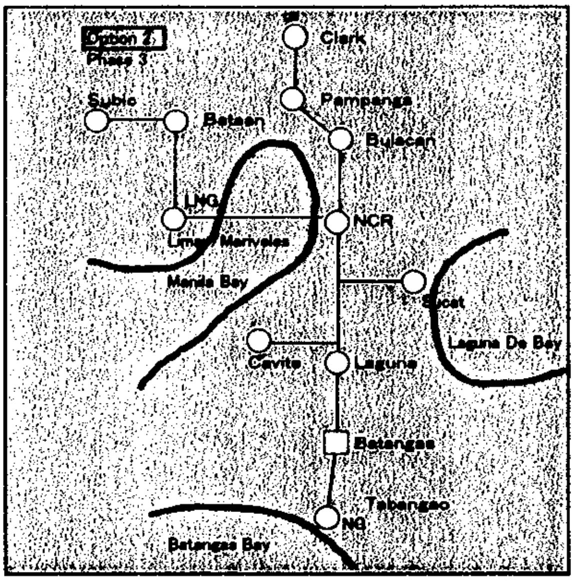


Figure 4-6 Area L – Option 2 (Phase 3)
(2021 to 2025)··· High Case, Low Case

4-2-3 Areas C-M and D

Three natural gas sources are studied using demand figures forecasted.

(1) Using Camago/Malampaya Gas

Gas will be supplied through a national pipeline from the Camago/Malampaya domestic gas-landing terminal in Batangas area to Area C-M and Area D. The route is shown in Figure 4-7.

The route crosses a shallow ocean area and extends to Davao via Cebu Island, Iligan and Cagayan de Oro in Mindanao Island. Routes to Mindoro Island intersect the Camago/Malampaya submarine pipeline. Therefore, none of these routes is adopted.

As a result of a pipeline network analysis premised on the condition that the total length is 1,400 km and the maximum demand is 102 mmscfd, it is concluded the diameter of the transmission pipeline can be 16 inches.

It is such a long-distance transmission pipeline that careful planning is required to decide the diameter of the pipeline in consideration of possible new demand or a change in the demand in Area C-M and Area D.

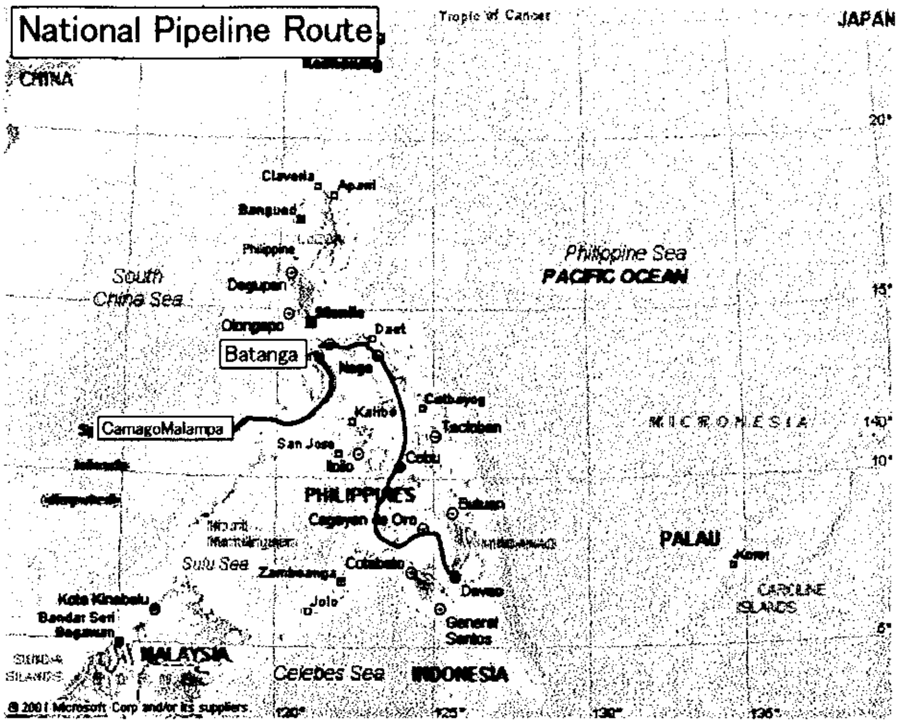


Figure 4-7 National Pipeline Route

(2) Construction of LNG Terminal

Gas will be supplied directly to the supply area through a high-pressure distribution pipeline from the LNG terminals near Cebu and Davao. The supply point cannot be forecasted now. Therefore, the network analysis has not been studied.

(3) Using Trans-ASEAN Pipeline

In the Second Trans-ASEAN Gas Pipeline Forum (2001), which was held in the Philippines, a route to Luzon Island via Malaysia and Parawan Island was advocated. This route crosses the shallow ocean area, and is considered to be feasible (See Figure 4-8). On condition that a landing terminal of the Trans-ASEAN pipeline will be in the Batangas area, gas will be supplied to Area C-M and Area D through the national pipeline mentioned above.

As a result of the analysis, provided that the total length of the pipeline is 1,500 km and the demand is 411 mmscfd, the transmission pipeline network can be established with a booster station installed at the middle of the pipeline route.

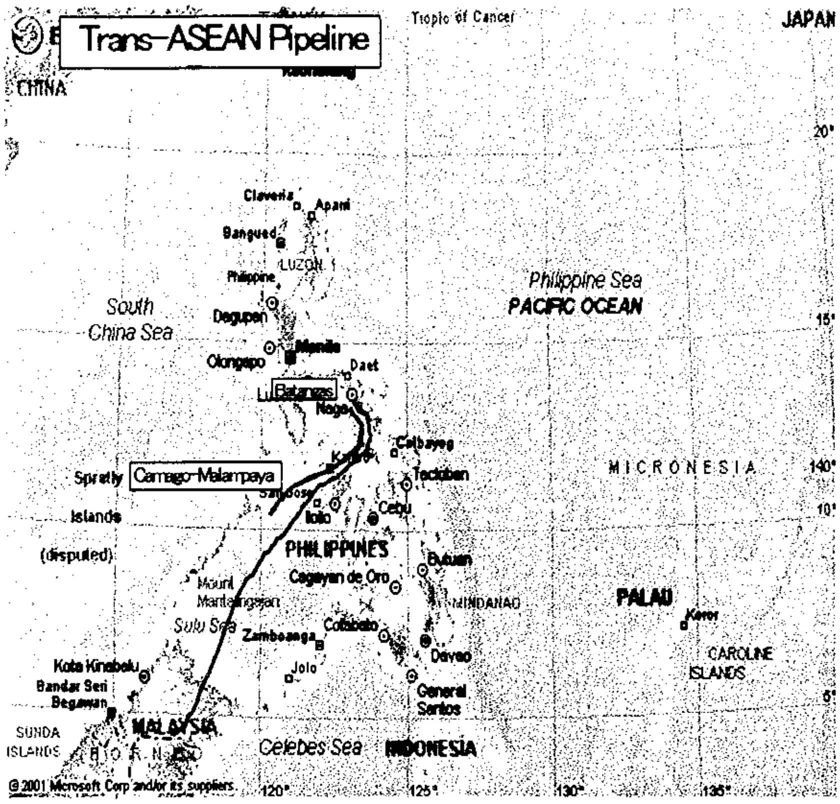


Figure 4-8 Trans-ASEAN Pipeline Route

4-3 LNG

4-3-1 Conditions for a LNG Receiving Terminal

The following conditions will be considered for receiving terminals:

- Harmony with/ Acceptance by Local Community

  How to maintain local environment after accepting the sitting of an LNG receiving terminal will be important for secure operation. This requires the confidence of local residents regarding safety, protecting preferred local distinctions such as natural landscape and monuments, and maintaining the everyday lives of the residents. It is preferred not just to maintain them but to improve them when introducing terminals.

- Proximity to Transmission and Use

  The location of an LNG terminal should accommodate easy connection to gas transmission, and eventual distribution and end use.

- Easy Reception of LNG Ships

The size of generally used LNG ships is 130,000 to 140,000 m^3. Ships of this scale should be easily accepted and operated safely and securely in the seaport to accommodate the terminal.

- Supply Security

When two or more geographically separate markets or distribution areas are conceived, and thus two or more terminals are planned, such terminals should be located in a certain distance from each other to accommodate a good gas network balance to raise security, and thus eventual economies.

The following are candidates of LNG terminal locations.

(1) Area L-2 ···· Batangas area
(2) Area L-3 ···· Limay/Mariveles area
(3) Area C-M ···· Talisay, and an area from Talisay to Naga
(4) Area D ···· Sta. Cruz, Malalag, and Panabo

4-3-2 Volume of LNG on the Basis of Gas Demand

The volume of LNG that would need to be imported based on the forecast of natural gas supply and demand is shown in Tables 4-3 and 4-4.

Table 4-3 (1) Required LNG imports for Area L (High Case) (million t /year)

		2009	2013	2017	2021	2025
Option 1	L-2	0.00	0.34	1.25	2.48	3.52
	L-3	0.26	1.22	1.89	2.95	4.42
Option 2	L-2	0.00	0.34	1.24	2.47	3.52
	L-3	0.26	1.22	1.88	2.93	4.42

Table 4-3 (2) Required LNG imports for Area L (Low Case) (million t /year)

		2013	2017	2021	2025
Option 1	L-2	0.00	0.61	1.65	2.54
	L-3	0.30	1.22	2.48	3.31
Option 2	L-2	0.00	0.61	1.65	2.54
	L-3	0.30	1.21	2.48	3.31

Table 4-4 (1) Required LNG imports for Areas C-M and D (High Case) (million t /year)

	2019	2022	2025
Area C-M	0.23	0.23	0.49
Area D	0.22	0.22	0.48

Table 4-4 (2) Required LNG imports for Area C-M and D (Low Case) (million t /year)

	2020	2024	2025
Area C-M	0.22	0.20	0.45
Area D	0.22	0.20	0.45

In comparison of Option 1 with Option 2 in Area L, required LNG imports are almost the same in both the High and Low Cases.

In the High Case, the volume of LNG that would need to be supplied to Area L-2 and Area L-3 in 2025 would reach 3.5 million t and 4.4 million t annually, respectively.

In the Low Case, demand would be 2.5 million t to Area L-2 and 3.3 million t to Area L-3, respectively.

On the other hand, Area C-M and D would need approximately 500,000 t each.

Thus, we base our projections for the size of the LNG terminal on 4 million t/y for Area L-2 and 5 million t/y for Area L-3 in the High Case, and on 3 million t for Area L-2 and 4 million t for L-3 in the Low Case.

Areas C-M and D would need one million t/y.

The LNG volume for each Case in the Gas Use Scenario would be applicable in the Gas Promotion Scenario.

5 Evaluation of Two Options in Gas Use Scenario

5-1 Actual demand for gas

We estimate actual demand for gas, based upon the gas distribution plan determined in 4 above (Table 5-1). Gas demand in the target areas on 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 whole period from 2006 to 2025.

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.

Thus, future actual gas demand depends upon that for power generation, but almost all gas demand for power is not used for determining the gas distribution plan, because we assume that power plants, except for two plants on Luzon Island, will be supplied gas through designated pipelines.

Table 5-1(1) Estimated actual gas demand in Area L (High Case)

(mmscfd)

	2006	2010	2015	2020	2025
Power (a)	362	597	791	1,036	1,371
Others	1	10	39	90	162
Total (b)	363	606	830	1,126	1,533
a / b	1.00	0.98	0.95	0.92	0.89

Table 5-1(2) Estimated actual gas demand in Area L (Low Case)

(mmscfd)

	2006	2010	2015	2020	2025
Power (a)	362	386	646	997	1,268
Others	1	3	10	23	47
Total (b)	363	388	656	1,020	1,316
a / b	1.00	0.99	0.98	0.98	0.96

5-2 Pipeline Networks

We assume pipeline networks corresponding to actual demand in Options 1 and 2. The networks for both Options 1 and 2 will be constructed in two and three phases, respectively (For details, see 4-2 above).

5-3 Evaluation of Two Options

5-3-1 Evaluation by the Optimal Supply Model

We build an optimum supply model, based on future potential demand for natural gas, as well as pipeline routes and their construction costs, to evaluate two options. We examine areas where natural gas can be supplied through pipelines. The model focuses on gas pipeline networks, which distribute gas mainly to non-power users.

Therefore, natural gas demand does not include that of power plants, which are located in the Batangas and Bataan areas and for which designated pipelines are laid. Only Sucat power plant and a small power plant for an industrial park in Santo Tomas are targeted by the model, because gas is supplied to the above two power plants by the pipeline networks.

Table 5-2 shows the net present value (NPV) of total profit from 2007 to 2025 and the cost-benefit ratios, which is profit divided by investments. The ratios in Option 2 are higher than those in Option 1 in both cases.

Accordingly, Option 2 is preferable to Option 1 if we look at the cost-benefit ratio.

Table 5-2 Comparison of two Options in NPV and Cost-benefit Ratio

Case/Option	Economically supplied area	NPV of profit (2007-2025) Million US$	Cost-benefit ratio (Benefit/Cost)
High Case Option 1	Sucat (2009) – Pasay (2015)—North NCR (2018)	364	1.091
High Case Option 2	Sucat (2009) – Pasay (2014)—North NCR (2016)— Snta Rita (2020) – San Fernando (2025)	514	1.133
Low Case Option 1	Santo Tomas (2011) – Sucat (2012) – Pasay (2018) —North NCR (2024)	160	1.066
Low Case Option 2	Santo Tomas (2011) – Sucat (2012) – Pasay (2018) —North NCR (2021)	167	1.073

5-3-2 Evaluation by the financial analysis

(1) High Case

1) Area L

The results of the financial analysis are shown in the following table.

Table 5-3 Results of the Financial Analysis (High Case: Option 1)

	LNG sector	Pipeline sector	Power sector	Project total
Investment	1,180 Million US$	794 Million US$	7,991 Million US$	9,965 Million US$
FIRR	12.0%	10.3%	12.5%	14.0%
DCR	0.9	0.9	1.0	1.9

LNG sales prices are set to maintain a FIRR of 12% in the LNG sector (Hereinafter the same).

In this Option, the FIRR of the pipeline sector is 10.3%. We consider that the profitability of the pipeline sector is not maintained in the Option. The FIRR of the power sector is 12.5%, which maintains profitability.

The results of the financial analysis in Option 2 are shown in the following table.

Table 5-4 Results of the Financial Analysis (High Case: Option 2)

	LNG sector	Pipeline sector	Power sector	The total
Investment	1,180 Million US$	788 Million US$	7,991 Million US$	9,958 Million US$
FIRR	12.0%	10.9%	12.5%	14.1%
DCR	0.9	1.0	1.0	2.1

The FIRR of the pipeline sector is 10.9%. We consider that the profitability of the pipeline sector is not maintained in Option 2. The FIRR of the power sector is 12.5%, which we can say maintains profitability.

2) Area C-M

The results of the financial analysis for Area C-M are shown in the following table.

Table 5-5 Results of the financial analysis (Area C-M) (High Case)

	LNG sector	Pipeline sector	Power sector	The total
Investment	392 Million US$	60 Million US$	397 Million US$	849 Million US$
FIRR	12.0%	Infeasible	Infeasible	6.3%
DCR	1.5	Infeasible	Infeasible	0.6

The FIRR of the total project is 6.3%. Therefore, gas-related businesses in Area C-M are not profitable.

3) Area D

The results of the financial analysis for Area D are shown in the following table.

Table 5-6 Results of the financial analysis (Area D) (High Case)

	LNG sector	Pipeline sector	Power sector	The total
Investment	392 Million US$	102 Million US$	397 Million US$	891 Million US$
FIRR	12.0%	Infeasible	Infeasible	5.9%
DCR	1.5	Infeasible	Infeasible	0.4

The FIRR of the project total is 5.9%. Therefore, gas-related businesses in Area D are not profitable.

(2) Low Case

1) Area L

The results of the financial analysis for Area L are shown in the following table.

Table 5-7 Results of the Financial Analysis (Low Case: Option 1)

	LNG sector	Pipeline sector	Power sector	Project total
Investment	1049 Million US$	311 Million US$	6,230 Million US$	7,590 Million US$
FIRR	12.0%	11.0%	19.5%	18.6%
DCR	0.8	1.0	1.7	3.0

In this Option, the FIRR of the pipeline sector is 11.0%. We consider that the profitability of the pipeline sector is not maintained in the Option. The FIRR of the power sector is 19.5%, which can maintain profitability.

The results of the financial analysis in Option 2 are shown in the following table.

Table 5-8 Results of the Financial Analysis (Low Case: Option 2)

	LNG sector	Pipeline sector	Power sector	The total
Investment	1,049 Million US$	289 Million US$	6,231 Million US$	7,569 Million US$
FIRR	12.0%	12.7%	19.5%	19.0%
DCR	0.8	1.3	1.7	3.1

The FIRR of the pipeline sector is 12.7%. We consider that the profitability of the pipeline sector is maintained in Option 2. The FIRR of the power sector is 19.5%, which can maintain profitability.

2) Area C-M

Table 5-9 Results of the Financial Analysis (Area C-M) (Low Case)

	LNG sector	Pipeline sector	Power sector	The total
Investment	372 Million US$	58 Million US$	376 Million US$	847 Million US$
FIRR	12.0%	Infeasible	Infeasible	3.9%
DCR	1.5	Infeasible	Infeasible	0.1

The FIRR of the total project is 3.9%. Therefore, gas-related businesses in Area C-M are not profitable.

3) Area D

Table 5-10 Results of the Financial Analysis (Area D) (Low Case)

	LNG sector	Pipeline sector	Power sector	The total
Investment	373 Million US$	96 Million US$	376 Million US$	845 Million US$
FIRR	12.0%	Infeasible	Infeasible	9.2%
DCR	1.5	Infeasible	Infeasible	1.3

The FIRR of the project total is 9.2%. Therefore, gas related businesses in Area D are not profitable.

5-4 Conclusion

The following are the conclusions of the evaluation.

5-4-1 High Case

On Luzon Island, Option 2 is superior to Option 1 in terms of profitability, but it is not sufficient for gas-related businesses, including LNG supply, gas pipeline, and gas-fired power generation, to be operated with economic viability.

On the other hand, in Areas C-M and D, gas-related businesses will not be economically feasible, assuming that gas demand is as low as estimated for the target period (2000 to 2025).

5-4-2 Low Case

On Luzon Island, Option 2 is superior to Option 1 in terms of profitability, and it is also sufficient for gas-related businesses, including LNG supply, gas pipeline, and gas-fired power generation, to be operated with economic viability.

On the other hand, in Areas C-M and D, as in the High Case, gas-related businesses will not be economically feasible, assuming that gas demand is as low as estimated for the target period (2000 to 2025).