Chapter 4 Estimation of "Potential" Gas Demand in Target Areas

4-1 Methodologies for Forecasting Actual Gas Demand

4-1-1 "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 4-3 below.

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 4-3.

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 4-3, 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.

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

Table 4-1-1 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.

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 4-1-4 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 for more details on the policy measures and to Chapter 6 (6-2) for their effects on gas prices.

4-1-3 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 4-1-2). For more details on assumptions, please refer to Chapter 4 (4-2).

Table 4-1-2 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[1] 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 4-1-3). 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 (Table 4-1-4).

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[2]. The LNG price after 2021 will

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

2) 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.

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 4-1-3(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 4-1-3(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 4-1-4 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 4-1-5(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 4-1-5(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[3) 4) 5)] (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[6)].

Table 4-1-6(1) Assumed Gas Sales Prices (2006) (High Case)

(US$/MMBtu)

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

3) Julius, D. and Mashayekhi, A., *The Economics of Natural Gas: Pricing, Planning and Policy*, 1990.

4) International Energy Agency, *Natural Gas Pricing in Competitive Markets*, 1998

5) International Energy Agency, *Natural Gas Distribution: Focus on Western Europe*, 1998

6) Japan International Cooperation Agency, *The Study on Master Plan of Urban Gas Development in the Republic of Indonesia*, 1997

Table 4-1-6(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

4-1-4 Establishing Two Options for Determining a Gas Distribution Plan

We have made two assumptions, namely, first, that about 500mmcfd of gas will be supplied from a domestic natural gas source (Camago/Malampaya gas field), and, second, that about 650mmcfd 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.

4-2 Prospects for the Philippine Economy until 2025

4-2-1 Past Trends

Economic developments in the Philippines have not been so successful for recent two decades. Real GDP was growing from US$56.34 Billion in 1980 to US$66.90 Billion in 1995, and US$82.11 Billion in 1998, showing the annual average growth rate of 2.11% for the eighteen years. Real GDP per capita, however, is US$1,166 in 1980, US$1,083 in 1990, and US$1,093 in 1998, showing a leveled-off trend for the period (Table 4-2-1).

Table 4-2-1 Some economic indicators in the Philippines

	Unit	1980	1985	1990	1995	1998
GDP	Billions, 1995US$	56.34	52.84	66.59	74.12	82.11
GDP per capita	1995US$	1,166	966	1,083	1,055	1,093
Sectional shares of real GDP						
Agriculture, fishery and forest	%	23.5	24.6	22.3	21.5	19.4
Industry	%	40.5	35.1	35.5	35.4	35.4
Services, etc.	%	36.0	40.4	42.2	43.1	45.2

Source: National Statistical Coordination Board.

In comparison, GDP per capita was increasing in other ASEAN countries, including Indonesia, Malaysia, Thailand, and Singapore for the same period, as shown in the following figures (Unit: 1995 年 US$).

Table 4-2-2 GDP per capita in ASEAN countries

(In 1995US$)

	1980	1985	1990	1998
Indonesia	507	597	773	969
Malaysia	2,359	2,643	3,243	4,408
Thailand	1,121	1,324	1,997	2,593
Singapore	11,088	14,549	17,885	25,454

(Source) The Institute of Energy Economics, Japan, "APEC Energy Statistics 1998"

No increase in GDP per capita in the Philippines means that total GDP has never increased at the higher rate than population for the two decades. Looking at GDPG in terms of the production function, we can find that the low growth rate of GDP in the

Philippines is the result of the low growth rates of "Capital" and "Technology."

According to an estimate made by the Institute of Energy Economics, Japan, real GDP showed the annual increase rate of 3.4% from 1985 to 1998, the two-thirds of which "Labor" contributed to, while "Capital" and "Technology" did to the one-forth and the one-eight, respectively. (Table 4-2-3).

In contrast, Indonesia and Malaysia achieved the GDP increase of 5.5% and 6.5% per annum during the same period, of which "Capital" and "Technology" contributed to more than 70% in both countries.

Table 4-2-3 Growth accounting based on production function

(1985 - 1998)

	GDP growth	Capital	Labor	Technology
Contribution to GDP Growth Rate (% per annum)				
Philippines	3.4	0.8	2.2	0.4
Indonesia	5.5	2.5	1.9	1.1
Malaysia	6.5	2.9	1.9	1.1
Contribution Ratio (%)				
Philippines	100%	24%	65%	12%
Indonesia	100%	38%	29%	33%
Malaysia	100%	38%	38%	33%

(Source) The Institute of Energy Economics, Japan

We can see the same developments in the trends of GDP by sector. In the Philippines, the share of industry (mining, manufacturing, electricity and water, and construction) in GDP declined from 40.5% in 1980 to 35.1% in 1985 and has been leveled off after that (Table 4-2-4). In addition, the share of manufacturing decreased from 25.5% in 1990 to 24.5% in 1999, although slightly.

Such developments mean that industrialization has hardly been progressed in this country. We can see in the background the fact that there have been political un-stabilities, including those raised by unti-governmental Islamic movements, and other obstacles against inviting investments.

In contrast again, the shares of industry in GDP has been increasing in three countries excluding Singapore (Shares of industry in GDP: %).

Table 4-2-4 Shares of industry in GDP in some ASEAN countries

(%)

	1980	1985	1990	1998
Indonesia	35.6	35.3	37.4	42.2
Malaysia	35.8	36.7	42.2	46.7
Thailand	30.1	31.6	37.8	40.9
Singapore	38.0	36.3	34.8	34.4

(Source) The Institute of Energy Economics, Japan, "APEC Energy Statistics 1998"

Looking at target areas in this Study, their shares of GDP are not showing large changes in the past fifteen years (Table 4-2-5). The table, however, shows only data for Regions to which each target area belongs, because there are no data for each target area excluding NCR (Area L-1).

Table 4-2-5 Shares of GDP

Region	1985	1990	1995	1999
Philippines	100%	100%	100%	100%
Metro Manila	29%	31%	30%	30%
Central Luzon	9%	9%	10%	9%
Southern Tagalog	14%	15%	16%	15%
Central Visayas	6%	7%	7%	7%
Southern Mindanao	8%	7%	7%	6%

(Source) National Statistical Coordination Board

We can see in Table 4-2-6 that South Mindanao is showing a down-word trend while other Regions leveled-off or slightly up-word trends. According to the table, the growth rate of GDP in South Mindanao was only 1.12% per annum from 1985 to 1999.

Table 4-2-6 Growth rates of Regional GDP

(% per annum)

Region	85-90	90-95	95-99	85-99
Philippines	4.73	2.18	2.71	3.43
Metro Manila	6.19	1.78	2.87	3.85
Central Luzon	4.88	2.83	1.36	3.23
Southern Tagalog	5.81	2.73	2.55	3.95
Central Visayas	5.71	2.09	3.77	4.12
Southern Mindanao	2.75	1.32	-0.94	1.12

(Source) National Statistical Cordination Board

4-2-2 Future prospects

We assume the following when making forecasts of the economy in the Philippines:

First, for the short term around 2001 to 2003, the economic growth rate will be lower than those of the government's mid-term forecast (NEDA's "2001 to 2005 forecast"). In the High Case, it will be 3.3% (4.5% in NEDA's) in 2001 and be lower than those of NEDA's in 2002 and 2003. In the Low Case, it will be 2.5% in 2001 and 3.5% in 2002 and 2003, respectively, which are much lower than in the High Case.

After that, economic growth rate will increase to reach the rates shown in the government's forecast (DOE's "2006 to 2011 forecast") in the High Case, while it will be much lower in the Low Case. Thus, in both cases, relatively low growth rates are assumed, taking into account the current economic situation in the world. However, the negative effects of the situation will be bigger and remain longer in the Low Case, while they will be smaller and remain for a shorter period in the High Case.

Second, the conditions negatively affecting the introduction of "Capital" and "Technology" mentioned in 4-2-1 above will not change so significantly until around 2010. After that, however, political instabilities will decrease gradually, and other obstacles to inviting investments will also be lower, resulting in a situation in which "Capital" and "Technology" mainly generated by foreign investments will contribute largely to GDP growth.

Specifically, manufacturing industries, mainly the so-called IT, agro-processing, and metal-processing industries, will grow, and the service sector will also show a rising tendency, promoted by IT-related service businesses including so-called call centers.

Third, the contribution of "Labor" to GDP growth will be lower, because of the reduced rate of population growth (For the rate of population growth, refer to 4-3 below). As a result, the growth rate after 2010 will be a little lower than that before.

(1) Area L

a) Area L-1

GDP in this area increased at the annual average rate of 3.85% from 1985 to 1999. This area has a high quality of labor and infrastructures already constructed, both of which can invite investments there. Relationships for cooperation in developing the IT industry has already being established between companies and universities/research institutions in this area.

However, we cannot expect larger additions and organizations on infrastructures in the future than in the past.

b) Area L-2

GDP in this area (South Tagalog) increased at the annual average rate of 3.95%, higher than that in Area L-1, from 1985 to 1999.

This area has also a high quality of labor like in Area L-1. In addition, such infrastructures as highway networks, ports and harbors, and industrial parks will be constructed like in Area L-3 as the results of regional development plans, which have also been studied and planned[7]). Such developments will invite investments by many companies, including those in the IT industry, which aim not only at Area L-1 but also at foreign markets.

c) Area L-3

GDP in this area (Central Luzon) increased at the annual average rate of 3.23% from 1985 to 1999.

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[7]) For instance, Japan International Cooperation Agency (JICA), *The Master Plan Study on the Project CALABARZON*, October 1991

This area has also a high quality of labor. Additionally, infrastructures, including high-way networks, ports and harbors, and international airports including Clark, will be constructed as the results of regional development plans, which have been studied and planned[8]. Such developments will invite investments by many companies, including those in the IT industry, which aim not only at Area L-1 but also at foreign markets.

(2) Area C-M

GDP in this area (Central Visayas) increased at the annual average rate of 4.12% from 1985 to 1999, which shows the highest among five target areas.

This area has also a high quality of labor and infrastructures already constructed as the results of regional development plans, which have been studied and planned[9]. The IT industry is also expected to grow in this area.

(3) Area D

As mentioned above, GDP in this area (South Mindanao) increased at the annual average rate of 1.12% from 1985 to 1999, which shows the lowest among five targets areas.

For the future, however, this area will have an advantage of facing large markets overseas, including countries in the Indian Ocean and South Pacific islands, in addition to BIMP-EAGR [(Brunei-Indonesia-Malaysia-Philippines)-(East Asia Growth Region)].

There are two main industrial zones in this area, which are one from Davao city to Panabo in Davao del Norte and the western part pf Samar Islands, according to regional development plans which have been studied and planned[10]).

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[8]) For instance, JICA, *The Master Plan Study for Central Luzon Development Programs*, September 1995

[9]) For instance, JICA, *The Master Plan Study for Cebu Regional Development Programs*, August 1993

[10]) For instance, JICA, *The Study on the Davao Integrated Development Program Master Planning*, March 1999

4-3 Energy Demand Forecast in the Philippines

4-3-1 Methodology of Demand Forecasting

An energy demand-forecasting model for all of the Philippines is built for estimating future natural gas demand. This model consists of macro-economy, energy demand, and transformation sector. Energy demand by sector and by fuel until 2025 is estimated using the model. Natural gas "potential" demand in the future in the target areas is estimated using the results of the model (refer to Figure 4-3-1). Only energy demand for all of the Philippines in the future is forecasted directly by the model.

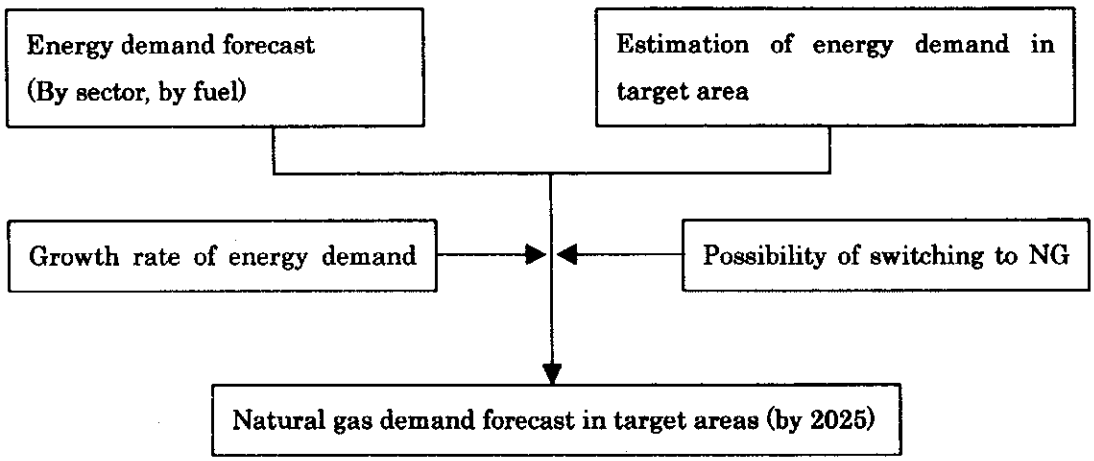


Figure 4-3-1 Flow of Natural Gas Demand Forecast

4-3-2 Framework of Energy Demand Model

To estimate energy demand in the future, we build an econometric model. The econometric model based on economic theory is shown by a mathematical equation. Necessary data for this model include macro-economy, energy consumption, and energy prices in the past. Using as much existing data as possible in the Philippines, we prepared an energy demand-forecasting model. Most of the economic data are obtained from the Philippine Statistical Yearbook. Energy price data are obtained from DOE (Department of Energy). Data to estimate government revenues are collected from DOF (Department of Finance). Energy consumption trend data in the Philippines are arranged from the data of IEA (International Energy Agency) and DOE.

In the macro-economic model, population growth rate, GDP growth rate, labor share of GDP, inflation of the world, and crude oil price are set as exogenous variables. In the energy-forecasting model, the energy mix in each sector and the number of vehicles are also exogenous variables.

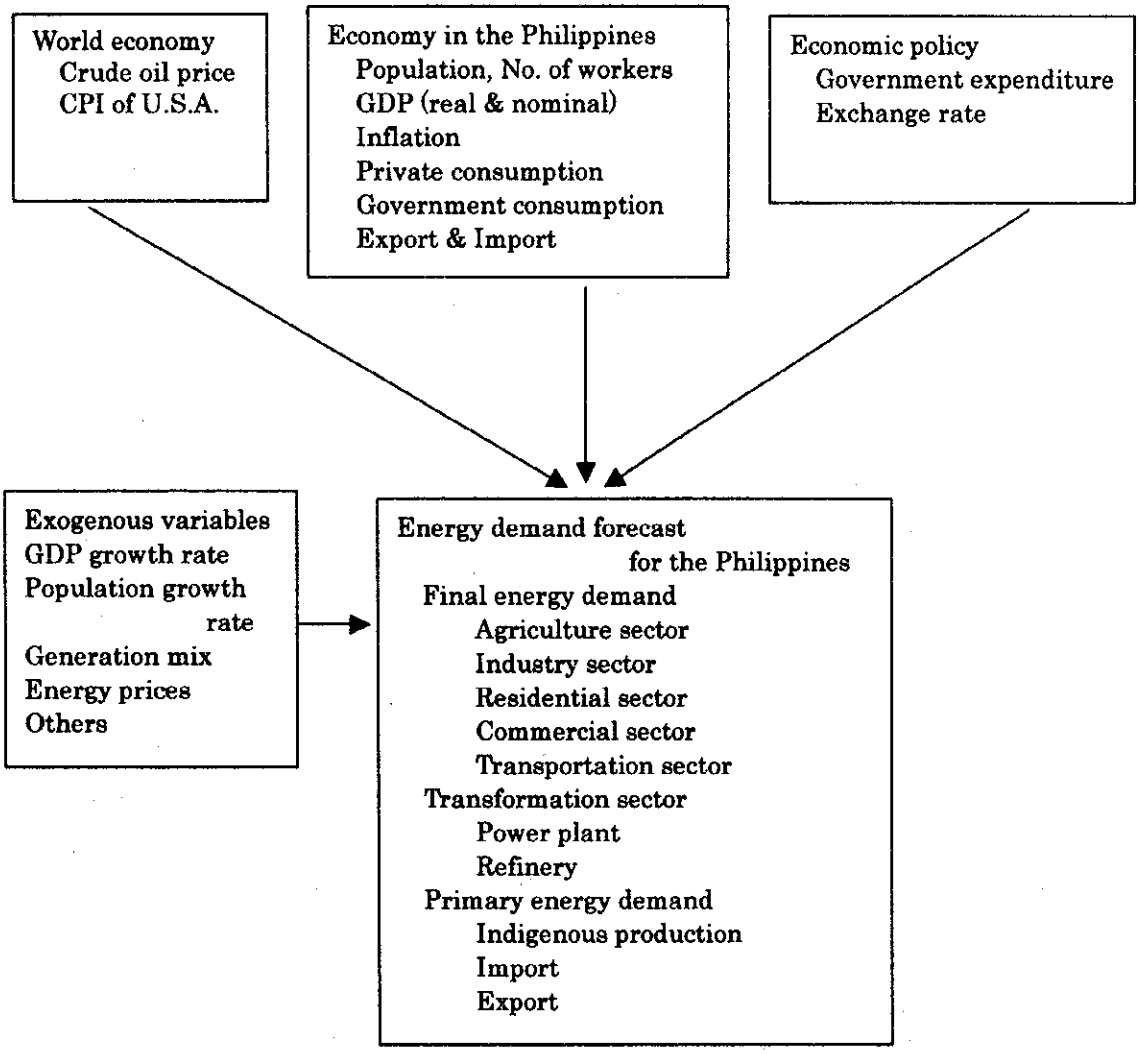


Figure 4-3-2 Flow of Energy Demand Forecasting Model

The exogenous variables shown in Table 4-3-1 are important factors for determining energy demand in the future. In particular, energy demand in the future is highly dependent on GDP growth rate.

4-3-3 Major Exogenous Variables

(1) Population

Population growth rate in the future is assumed from "1995 Census-Based National and regional Population Projection" (NSO) and "World Population Prospects" (United Nations). The growth rate of population gradually decreases from 2.1% in 2000 to 1.5% in 2025.

(2) GDP

Growth rate of GDP in 2000 rises by 4% although the average growth rate of GDP in past decade was around 3%. In this study, we assumed two economic growth rates, High Case and Low Case. In High Case, a growth rate of 6%, which is the government target, is achieved in 2006 and 6% of that is kept until 2010. After that, the GDP growth rate is assumed to be 5.5% from 2011 to 2020, and 5% from 2020 to 2025, because the economy will stagnate. GDP growth rates of Low Case are 4.0% from 2006 to 2010, 5.5% from 2011 to 2020, and 5.0% from 2021 to 2025. In general, after the economic growth is achieved, labor productivity stagnates if the industrial structure is not changed. Moreover, the growth rate of workers will go down with the decrease in population growth rate.

(GDP growth rate = workers growth rate + labor productivity growth rate).

(3) Global Consumer Price Index

It is defined that global consumer price index depends on the U.S. economy. Here, the inflation rate in the U.S. is assumed to be 1.0% to 3.0% in High Case and 0.5% to 2.5% in Low Case.

(4) Energy Prices

As for energy prices in the future, crude, coal, and LNG prices are exogenous variables. These energy prices are based on the "World Energy Outlook 2000" of IEA (refer to Table 4-3-1). In the model, these energies are indicated at nominal prices considering inflation.

(5) Other Exogenous Variables

Other major exogenous variables are labor distribution, structure of government revenue, and energy composition of each sector. These exogenous variables are assumed to continued at the present ratio into the future.

Figure 4-3-3 shows the assumptions for exogenous variables.

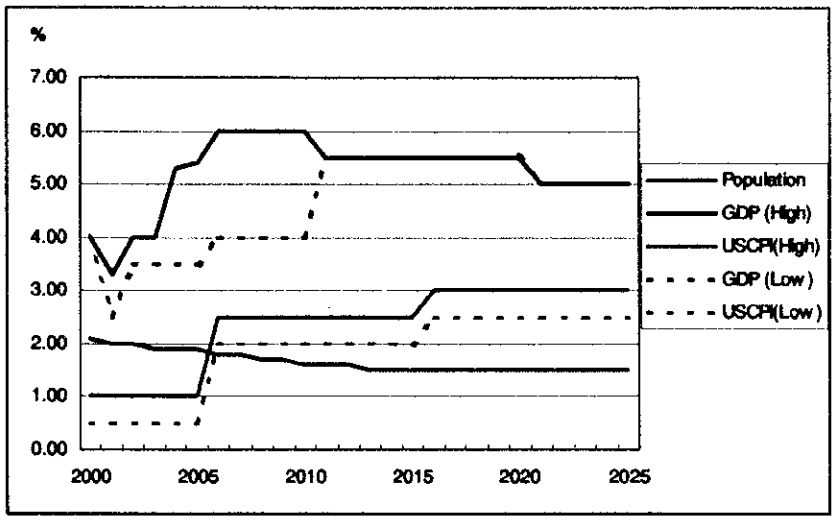
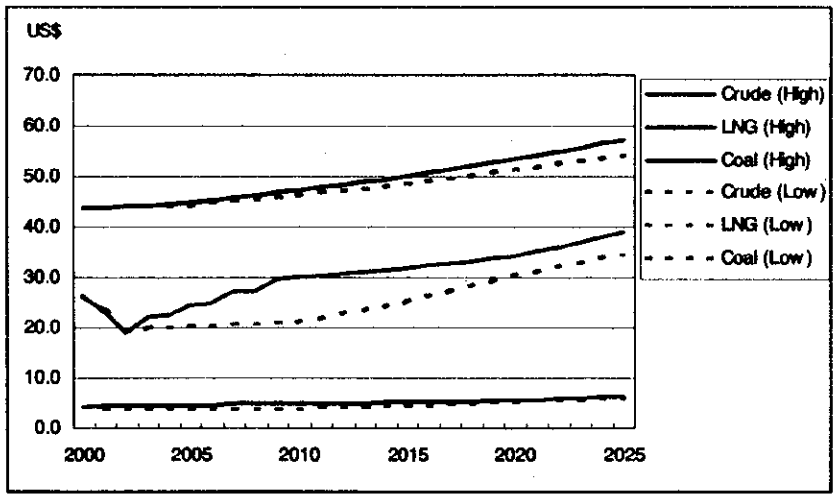


Figure 4-3-3 Macro-economy Exogenous Variables



(Note) Crude oil: US$/bbl, LNG: US$/MMBtu, Coal: US$/t

Figure 4-3-4 Energy Price Exogenous Variables

4-3-4 Data Availability

Availability of input data is very important for rolling and updating the model. It is necessary to input 125 categories of trend data into the energy-forecasting model. Table 4-3-2 shows data availability for the energy demand-forecasting model.

Table 4-3-1 Assumptions for Major Exogenous Variables

Year	Population growth rate (%)	High Case					Low Case				
		GDP Growth Rate	US CPI Growth Rate	Crude oil price Growth Rate	Natural gas price Growth Rate	Coal price Growth Rate	GDP Growth Rate	US CPI Growth Rate	Crude oil price Growth Rate	Natural gas price Growth Rate	Coal price Growth Rate
2000	2.1	4.0	1.0	52.0	0.0	27.6	4.0	0.5	52.0	0.0	27.6
2001	2.0	3.3	1.0	-12.0	12.3	0.0	2.5	0.5	-12.0	-6.8	0.0
2002	2.0	4.0	1.0	-17.4	0.0	0.0	3.5	0.5	-17.4	0.0	0.0
2003	1.9	4.0	1.0	15.8	0.0	0.0	3.5	0.5	5.3	0.0	0.0
2004	1.9	5.3	1.0	0.0	0.0	0.0	3.5	0.5	0.0	0.0	0.0
2005	1.9	5.4	1.0	9.1	0.0	0.0	3.5	0.5	0.0	0.0	0.0
2006	1.8	6.0	2.5	0.0	0.0	0.0	4.0	2.0	0.0	0.0	0.0
2007	1.8	6.0	2.5	8.3	0.0	0.0	4.0	2.0	0.0	0.0	0.0
2008	1.7	6.0	2.5	0.0	0.0	0.0	4.0	2.0	0.0	0.0	0.0
2009	1.7	6.0	2.5	7.7	0.0	0.0	4.0	2.0	0.0	0.0	0.0
2010	1.6	6.0	2.5	0.0	0.0	0.0	4.0	2.0	0.0	0.0	0.0
2011	1.6	5.5	2.5	0.0	0.0	0.0	5.5	2.0	2.7	1.8	0.0
2012	1.6	5.5	2.5	0.0	0.0	0.0	5.5	2.0	2.7	1.8	0.0
2013	1.5	5.5	2.5	0.0	0.0	0.0	5.5	2.0	2.7	1.8	0.0
2014	1.5	5.5	2.5	0.0	0.0	0.0	5.5	2.0	2.7	1.8	0.0
2015	1.5	5.5	2.5	0.0	0.0	0.0	5.5	2.0	2.7	1.8	0.0
2016	1.5	5.5	3.0	0.0	0.0	0.0	5.5	2.5	2.7	1.9	0.0
2017	1.5	5.5	3.0	0.0	0.0	0.0	5.5	2.5	2.7	1.9	0.0
2018	1.5	5.5	3.0	0.0	0.0	0.0	5.5	2.5	2.7	1.9	0.0
2019	1.5	5.5	3.0	0.0	0.0	0.0	5.5	2.5	2.7	1.9	0.0
2020	1.5	5.5	3.0	0.0	0.0	0.0	5.5	2.5	2.7	1.9	0.0
2021	1.5	5.0	3.0	1.4	1.4	0.0	5.0	2.5	1.5	1.0	0.0
2022	1.5	5.0	3.0	1.4	1.4	0.0	5.0	2.5	1.5	1.0	0.0
2023	1.5	5.0	3.0	1.4	1.4	0.0	5.0	2.5	1.5	1.0	0.0
2024	1.5	5.0	3.0	1.4	1.4	0.0	5.0	2.5	1.5	1.0	0.0
2025	1.5	5.0	3.0	1.4	1.4	0.0	5.0	2.5	1.5	1.0	0.0

Table 4-3-2 Data Availability for Energy Demand Forecasting Model

No. of Line	ITEMS 1	ITEMS 2	SECTORS	Data Availability
MACRO ECONOMIC MODEL (DATA)				
48	Census & Labour	Population	Population of Philippines	NSCB
50			Population over 15 years old	NSCB
52			Ratio of Labor per population over 15	NSCB
55		Household	Household of Philippines	NSCB
57		No. of Workers by Sector	Agriculture, Fishery, Forestry	NSCB
58			Mining & Manufacturing & Energy	NSCB
59			Construction	NSCB
60			Transportation & Communication	NSCB
61			Trading & Commercials	NSCB
62			Banking & Services	NSCB
63			Public & Others	NSCB
69	GDP	GDP by Sector (1985 price)	Agriculture, Fishery, Forestry	NSCB
70			Mining & Manufacturing & Energy	NSCB
71			Construction	NSCB
72			Transportation & Communication	NSCB
73			Trading & Commercials	NSCB
74			Banking & Services	NSCB
75			Public & Others	NSCB
102	Distribution & Wage	Distribution	Labor share of GDP	NSCB
110		Consumption & Save	Saving rate	NSCB
115	Government finance	Government Finance	Income tax rate(*Labor distribution)	DOF
116			Corporation tax rate(*Capital distribution)	DOF
117			Tariff rate(*Import)	DOF
118			Other tax rate(*GDP)	DOF
133	Inflation & Price	Inflation index	CPI of USA	IMF
134			Exchange rate	NSCB
135			WPI	NSCB
136			CPI	NSCB
142		Energy price	Crude oil price(Average import price)	DOE
143			Coal price(Average of Indonesia & Australia)	DOE
144			Natural gas price	DOE
155		Wage	Wage index	NSCB
158	Government finance	Government finance (nominal)	Total Government revenue	NSCB
159			Total Government Expenditure	NSCB
162	GDE	GDE by Sector (nominal)	Private consumption	NSCB
163			Government consumption	NSCB
164			Gross fixed formation	NSCB
165			Export	NSCB
166			Import	NSCB
167			Stocks	NSCB
168			Gross Domestic Expenditure	NSCB
ENERGY DEMAND FORECASTING MODEL (DATA)				
195	Prices	Energy prices	Gasoline(Regular)	DOE
196			Kerosene	DOE
197			Diesel	DOE
198			Fuel oil	DOE
199			LPG	DOE
200			Natural gas	DOE
201			Coal	DOE
204		Electricity prices	Electricity(Residential)	DOE
205			Electricity(Commercial)	DOE
206			Electricity(Industrial)	DOE
219	Energy demand	Agriculture energy demand	Naphtha	IEA, DOE
220			Kerosene	IEA, DOE
221			Diesel	IEA, DOE
222			Fuel oil	IEA, DOE
223			LPG	IEA, DOE
224			Natural gas	IEA, DOE
225			Coal	IEA, DOE
226			Cokes	IEA, DOE
227			Firewood & Others	IEA, DOE
229			Electricity	IEA, DOE
248		Industry energy demand	Naphtha	IEA, DOE
249			Kerosene	IEA, DOE
250			Diesel	IEA, DOE

No. of Line	ITEMS 1	ITEMS 2	SECTORS	Data Availability
ENERGY DEMAND FORECASTING MODEL (DATA)				
251	Energy demand		Fuel oil	IEA, DOE
252			LPG	IEA, DOE
253			Natural gas	IEA, DOE
254			Coal	IEA, DOE
255			Cokes	IEA, DOE
256			Firewood & Others	IEA, DOE
258			Electricity	IEA, DOE
277		Residential energy demand	Naphtha	IEA, DOE
278			Kerosene	IEA, DOE
279			Diesel	IEA, DOE
280			Fuel oil	IEA, DOE
281			LPG	IEA, DOE
282			Natural gas	IEA, DOE
283			Coal	IEA, DOE
284			Cokes	IEA, DOE
285			Firewood & Others	IEA, DOE
287			Electricity	IEA, DOE
306		Commercial energy demand	Naphtha	IEA, DOE
307			Kerosene	IEA, DOE
308			Diesel	IEA, DOE
309			Fuel oil	IEA, DOE
310			LPG	IEA, DOE
311			Natural gas	IEA, DOE
312			Coal	IEA, DOE
313			Cokes	IEA, DOE
314			Firewood & Others	IEA, DOE
316			Electricity	IEA, DOE
324	Transportation	Stock statistics	Registered vehicles of gasoline use	NSCB
325			Registered vehicles of diesel use	NSCB
336		Transportation energy demand	Road Gasoline	IEA, DOE
337			Diesel	IEA, DOE
339			Marine Diesel	IEA, DOE
340			Fuel	IEA, DOE
342			Air plane Jet	IEA, DOE
343			Aviation gasoline	IEA, DOE
TRANSFORMATION SECTORS (DATA)				
380	Yields	Petroleum products yields	LPG / Crude oil	DOE
381			Gasoline / Crude oil	DOE
382			Aviation gasoline / Crude oil	DOE
383			Jet Fuel / Crude oil	DOE
384			Naphtha / Crude oil	DOE
385			Kerosene / Crude oil	DOE
386			Diesel / Crude oil	DOE
387			Fuel oil / Crude oil	DOE
399	Power generation	Demand of electricity	Refinery	IEA, DOE
400			Others	IEA, DOE
404		Loss & In-plant consumption	Loss & In-plant consumption	IEA, DOE
407		Generation by Hydro, Geothermal	From Hydro Geothermal	IEA, DOE
408			From Others	IEA, DOE
417		Required energy for power generation	Diesel	IEA, DOE
418			Fuel oil	IEA, DOE
419			Natural gas	IEA, DOE
420			Coal	IEA, DOE
433	Refinery	In-plant consumption	Diesel	IEA, DOE
434			Fuel oil	IEA, DOE
453	Coal		For In-plant consumption	IEA, DOE
486	Primary energy demand	Import of Petroleum products	Gasoline	IEA, DOE
487			Kerosene	IEA, DOE
488			Diesel	IEA, DOE
489			Fuel oil	IEA, DOE
490			Naphtha	IEA, DOE
491			LPG	IEA, DOE
492			Aviation gasoline	IEA, DOE
493			Jet	IEA, DOE
496		Primary energy	Crude oil	IEA, DOE

4-3-5 Results of Model Simulation

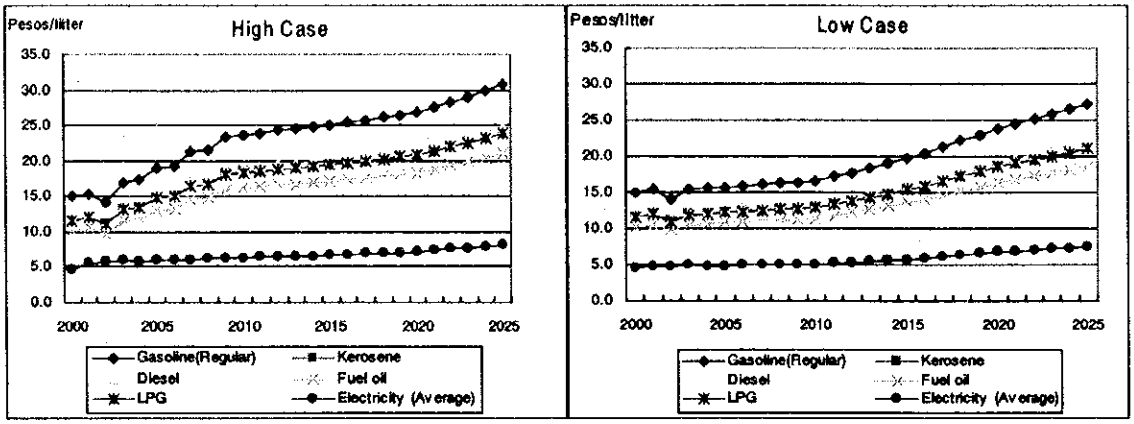
(1) Energy Wholesale Prices

Major energy prices in the future such as crude, coal, and LNG are given as exogenous variables. Other energy prices such as petroleum products and electricity are estimated by a definition equation. Wholesale prices of petroleum products in the future are linked to crude oil price. Average electricity tariff in the future is linked to crude, coal, and LNG prices. Moreover, in the case of electricity, the Electric Power Industry Reform Act is considered in the model.

The definition equations for energy prices are as follows.

$RPIGAS = RPIGAS_{-1} * (RPICRD/RPICRD_{-1})$
$RPIKER = RPIKER_{-1} * (RPICRD/RPICRD_{-1})$
$RPIDIE = RPIDIE_{-1} * (RPICRD/RPICRD_{-1})$
$RPIFUE = RPIFUE_{-1} * (RPICRD/RPICRD_{-1})$
$RPILPG = RPILPG_{-1} * (RPICRD/RPICRD_{-1})$
$RPILEL = RPILEL_{-1}*((PIMCRD+RPINGA+RPICOA)/(PIMCRD_{-1}+RPINGA_{-1}+RPICOA_{-1}))$

RPICRD: Crude oil price, $RPICRD_{-1}$: Crude oil price in the previous year
RPIGAS: Gasoline price, $RPIGAS_{-1}$: Gasoline price in the previous year
RPIKER: Kerosene price, $RPIKER_{-1}$: Kerosene price in the previous year
RPIDIE: Diesel price, $RPIDIE_{-1}$: Diesel price in the previous year
RPILPG: LPG price, $RPILPG_{-1}$: LPG price in the previous year
RPILEL: Average electricity price, $RPILEL_{-1}$: Average electricity price, in the previous year
RPINGA: LNG price, $RPINGA_{-1}$: LNG price in the previous year
RPICOA: Coal price, $RPICOA_{-1}$: Coal price in the previous year



(Note) Unit of Electricity is Ps/kWh

Figure 4-3-5 Energy Prices in the Future

(2) Electricity Demand Forecast by Sector

To forecast electricity demand, a correlation between past trends of electricity demand, GDP, and electricity price is considered, and equations for electricity demand forecast are made. These equations are as follows.

1) Agriculture sector (regression equation)

$$LOG(AGTELEW) = -0.0588 + 1.0128 * LOG((AGTELEW_{-1}) * (VAAGR/VAAGR_{-1}))$$

t-value (-0.919) (73.5)

R^2 : 0.999 DW : 2.99

AGTELEW: Electricity demand of the agriculture sector

$AGTELEW_{-1}$: Electricity demand in the previous year

VAAGR: GDP of the agriculture sector $VAAGR_{-1}$: GDP of agriculture in the previous year

2) Industry sector (definition equation)

As for industry, residential, and commercial sectors, we cannot find any correlation from past trends. Therefore, the future demand in each sector is estimated by a definition equation as follows.

$$MATELEW = MATELEW_{-1} * (VAMAN/VAMAN_{-1})$$

MATELEW: Electricity demand of the industry sector

$MATELEW_{-1}$: Electricity demand in the previous year

VAMAN: GDP of industry $VAMAN_{-1}$: GDP of industry in the previous year

3) Residential sector (regression equation)

RETELEW = -1157.2 + 247.56 * (GDEPC/POP)

t-value (-7.45) (10.3)

R^2 : 0.921 DW : 1.01

RETELEW: Electricity demand of the residential sector

GDEPC: Private final consumption expenditure POP: Population

4) Commercial sector (definition equation)

$COTELEW = COTELEW_{-1} * (VACOM/VACOM_{-1})$

COTELEW: Electricity demand of the commercial sector

$COTELEW_{-1}$: Electricity demand in the previous year

VACOM: GDP of commercial $VACOM_{-1}$: GDP of commercial in the previous year

Figure 4-3-6 shows the electricity demand forecast by 2025, which is obtained using the above equations. Growth rates of electricity demand in High Case are 5.4% from 2001 to 2005, 6.9% from 2006 to 2010, 5.9% from 2011 to 2015, 5.6% from 2016 to 2020, and 4.9% from 2021 to 2025 (Average growth rate from 2001 to 2025 is 5.8%). Electricity demand will rise from 32,919GWh in 1999 to 134,951GWh in 2025. Power generation will be larger than demand, because of power plants' own use and transmission and distribution losses. On the other hand, growth rate from 2001 to 2025 in Low Case is 5.1% and total demand in 2025 becomes 112,567GWh.

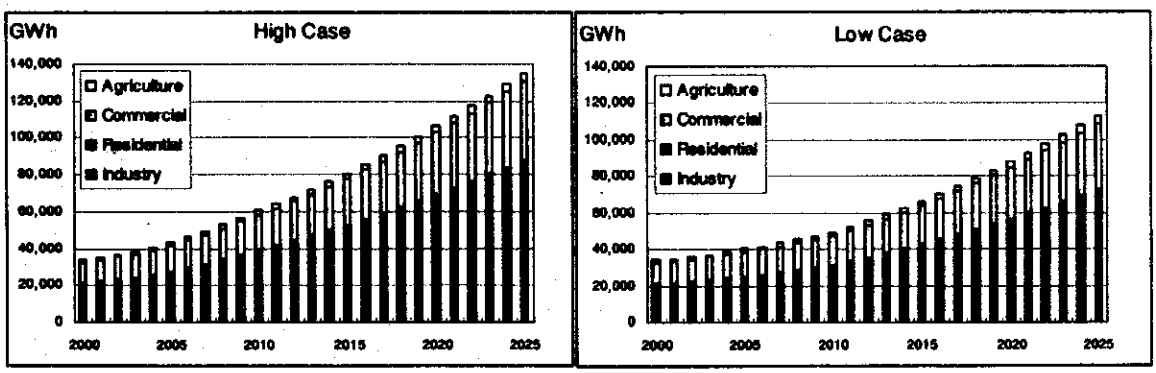


Figure 4-3-6 Electricity Demand Forecast by Sector

(3) Fossil Fuel Demand Forecast by Sector

1) Agriculture sector

As for fossil fuel demand in the agriculture sector, we cannot find any correlation from the past trend. Therefore, future demand is estimated using a definition equation as

follows.

$AGTTOTW = AGTTOTW_{-1} * (VAAGR/VAAGR_{-1})$

AGTTOTW: fossil energy demand of the agriculture sector

$AGTTOTW_{-1}$: Fossil energy demand in the previous year

VAAGR: GDP of the agriculture sector

$VAAGR_{-1}$: GDP of agriculture in the previous year

The main fuels in the sector are diesel fuel oil and heavy fuel oil. Annual average growth rate of fossil fuel demand from 2001 to 2025 is 4.3% of High Case and 4.0% of Low Case. Fossil fuel demand in agriculture is the smallest of all sectors; for instance, one-sixth of the industry sector.

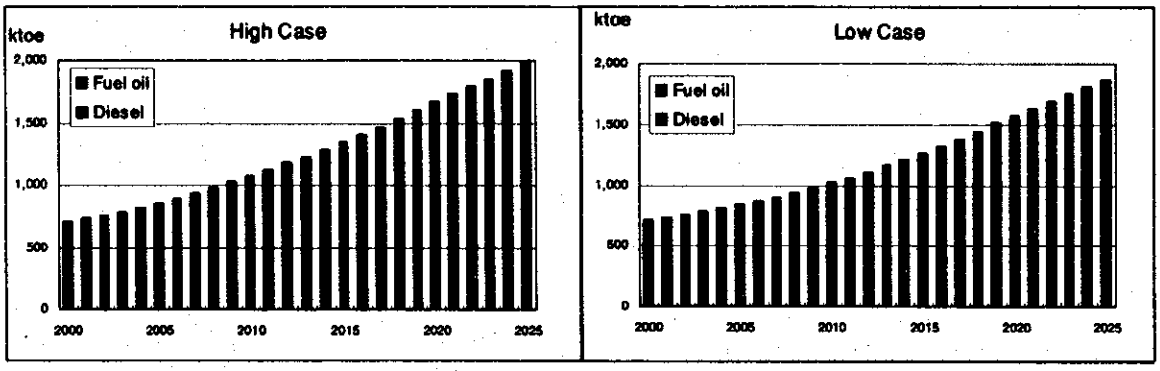


Figure 4-3-7 Fossil Fuel Demand Forecast in the Agriculture Sector

2) Industry sector

As for fossil energy demand of the industry sector, we cannot find any correlation from the past trend. Therefore, the equation for future demand is defined as follows.

$MATTOTW = MATTOTW_{-1} * (VAMAN/VAMAN_{-1})$

MATTOTW: fossil energy demand of the industry sector

$MATTOTW_{-1}$: Fossil energy demand in the previous year

VAMAN: GDP of the industry sector

$VAMAN_{-1}$: GDP of industry in the previous year

Figure 4-3-8 shows the fossil fuel demand forecast for the industry sector. The annual average growth rates of fossil energy demand from 2001 to 2025 are 5.6% of High Case and 4.9% of Low Case.

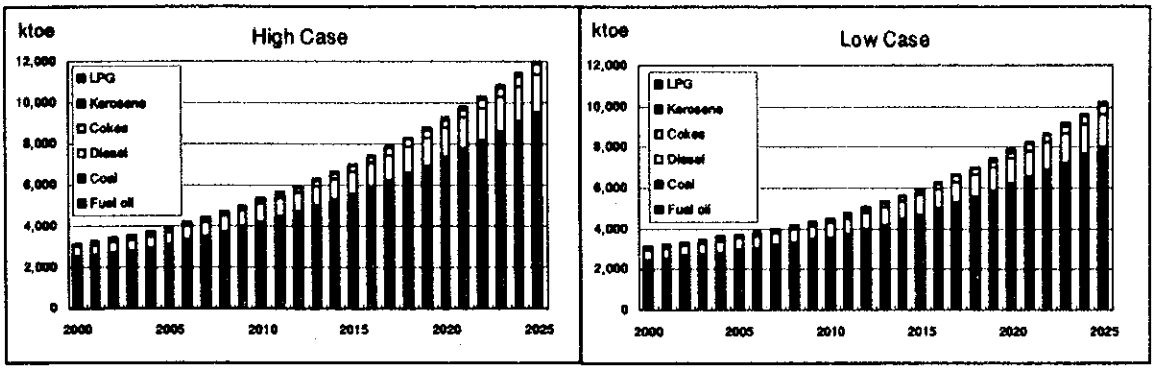


Figure 4-3-8 Fossil Fuel Demand Forecast in the Industrial Sector

3) Commercial sector

As for fossil energy demand of the commercial sector, we cannot find any correlation from the past trend. Therefore, the equation for future demand is defined as follows.

$COTTOTW = COTTOTW_{-1} * (VACOM/VACOM_{-1})$

COTTOTW: Fossil energy consumption of the commercial sector

$COTTOTW_{-1}$: Fossil energy consumption of the commercial sector in the previous year

VACOM: GDP of the commercial sector

$VACOM_{-1}$: GDP of the commercial sector in the previous year

Figure 4-3-9 shows fossil fuel demand forecast in the commercial sector. The annual growth rate of fossil fuel demand from 2001 to 2025 will be 5.6% of High Case and 4.9% of Low Case, following the growth of GDP in commercial sector.

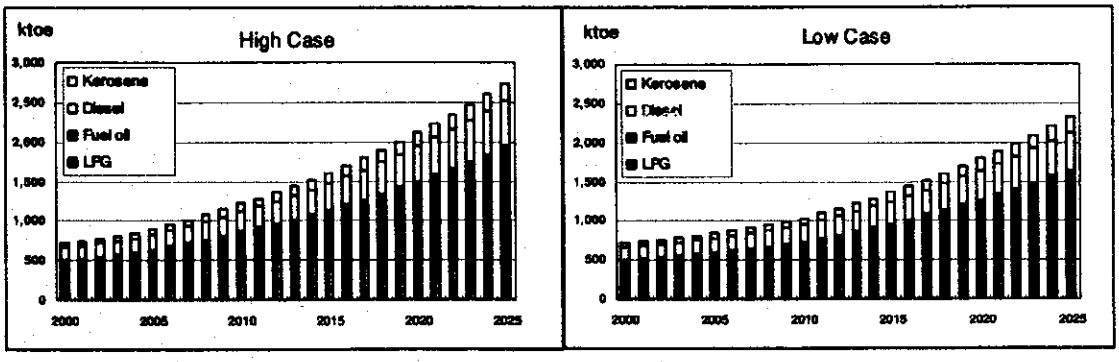


Figure 4-3-9 Fossil Fuel Demand Forecast in the Commercial sector

4) Residential sector

As for fossil energy demand of the residential sector, we cannot find any correlation from the past trend. Therefore, the equation for future demand is defined as follows.

$RETTOTW = RETTOTW_{-1} * (GDEPC/GDEPC_{-1})$

RETTOTW: Fossil energy consumption of the residential sector $RETTOTW_{-1}$: Fossil energy consumption of the residential sector in the previous year

GDEPC: Private final consumption expenditure

$GDEPC_{-1}$: Private final consumption expenditure in the previous year

The fuels used in the residential sector are kerosene, diesel fuel oil, and LPG. Fossil fuel demand in the future will increase at an annual rate of 6.0% in High Case and 5.2% in Low Case, following increasing income.

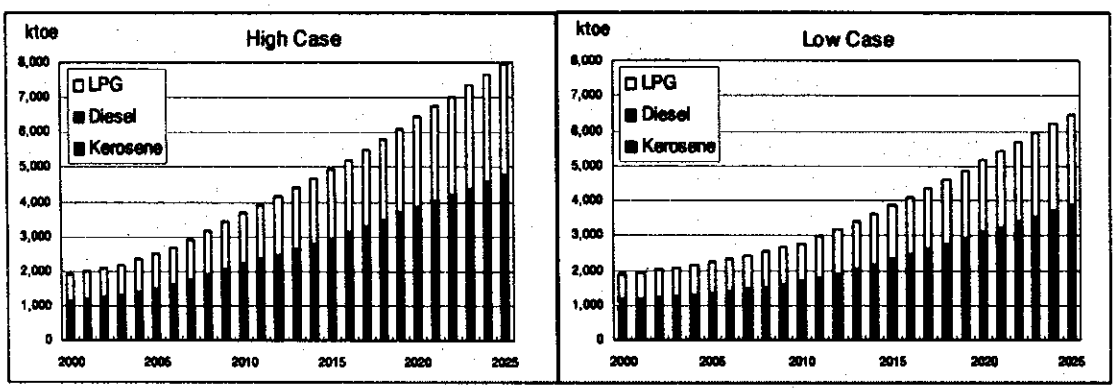


Figure 4-3-10 Fossil Fuel Demand Forecast in the Residential Sector

5) Transportation sector

Energy demand in the transportation sector is forecasted using an equation for each transport mode. Equations for gasoline and diesel vehicles are made by regression analysis. On other hand, equations for ships and aircraft are defined.

a) Gasoline vehicles (regression equation)

$LOG(TRTGASW) = 2.1996 + 0.5913 * LOG(STKGVL) - 0.3325 * LOG(RPIGAS/DFCPI)$

t -value (4.99) (7.49) (-3.66)

R^2 : 0.964 DW : 0.76

TRTGASW: Total fuel consumption for gasoline vehicles STKGVL: Number of gasoline vehicles

RPIGAS: Gasoline price DFCPI: Consumer Price Index

b) Diesel vehicles (regression equation)

LOG(TRTDIEW) = -0.8075 + 0.8845 * LOG(STKDVL) – 0.7584 * LOG(RPIDIE/DFWPI)

t -value (-0.49) (5.72) (-1.73)

R^2 : 0.852 DW : 1.61

TRTDIEW: Total fuel consumption for diesel vehicles STKDVL: Number of diesel vehicles

RPIDIE: Diesel price DFWPI: Wholesale Price Index

c) Ships (definition equation)

$TRTMAR = TRTMAR_{-1} * (VATOT/VATOT_{-1})$

TRTMAR : Total fuel consumption for ships $TRTMAR_{-1}$: Total fuel consumption for ships in the previous year VATOT : GDP $VATOT_{-1}$: GDP in the previous year

d) Aircraft (definition equation)

$TRTAIR = TRTAIR_{-1} * (VATOT/VATOT_{-1})$

TRTMAR : Total fuel consumption for aircraft $TRTMAR_{-1}$: Total fuel consumption for air plane in the previous year VATOT : GDP $VATOT_{-1}$: GDP in the previous year

Most fossil fuel demand in the transportation sector is for gasoline and diesel fuel oil for automobiles. Energy consumption in the transportation sector will go up, following increases in GDP and the number of vehicles. The growth rate of fossil fuel demand is 5.9% of High Case and 7.5% of Low Case up to 2010, and 5.5% of High Case and 4.5% of Low Case thereafter. Growth rate of Low Case in the first half is bigger than High Case because fuel price of Low Case is cheaper than that of High Case (impact of price elasticity).

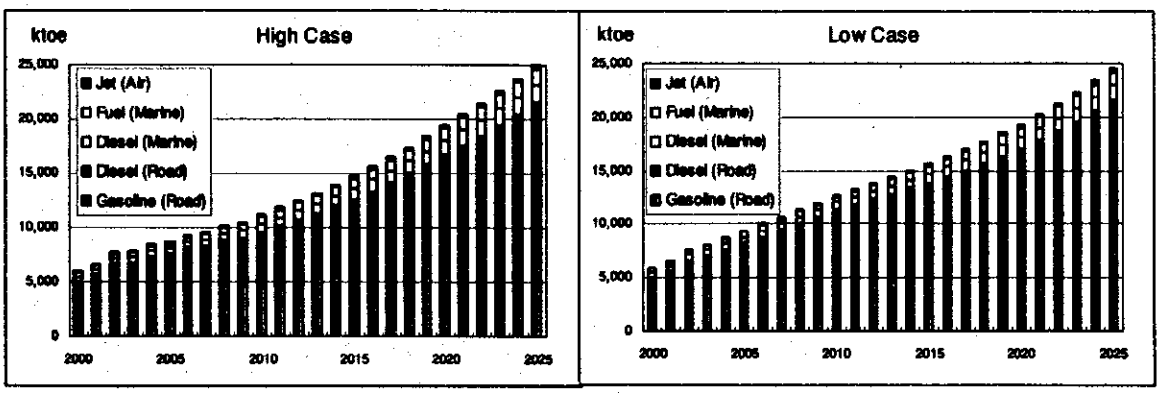


Figure 4-3-11 Fossil Fuel Demand Forecast in the Transportation Sector

(4) Summary of Macro-economy and Energy Demand

Table 4-3-3 shows a summary of macro-economy and energy supply and demand model. The average growth rate of population from 2000 to 2025 is 1.6%. The population will increase from 76.2 million in 2000 to 114.5 million in 2025. On the other hand, the average growth rate of GDP is 5.3% of High Case and 4.6% of Low Case. If an average labor productivity of 3.7% in High Case and 3.0% in Low Case is not achieved, it would be difficult to achieve a GDP growth rate of the simulation result.

The energy elasticity to GDP is 1.09 of High Case and 1.17 of Low Case. These figures are appropriate values.

Table 4-3-3 Summary of Exogenous Variables and the Results of Forecast

	2000	2010	2025	Growth rate (2000-2025)
Population (1,000)	76,235	91,392	114,486	1.6%
Labor force (1,000)	32,622	39,108	48,990	1.6%
Unemployment rate (%)	9.9	8.8	4.5	
Exchange rate (Ps/US$)	48.0	58.6	58.6	
No. of vehicles (1,000)	4,129	8,768	22,071	6.9%
High Case				
GDP (billion Ps) 1985 price	955	1,582	3,448	5.3%
Wage index	100	273	717	8.2%
WPI	100	175	255	3.8%
CPI	100	217	364	5.3%
GDP deflator	100	203	326	4.8%
Crude price (US$/bbl) nominal price	26.1	30.1	39.1	1.6%
LNG price (US$/kcf) nominal price	4.0	4.8	6.3	1.8%
Coal price (US$/t) nominal price	43.9	47.3	57.2	1.1%
Primary Energy Supply (ktoe)	23,971	37,474	71,764	4.5%
Total Final Consumption (ktoe)	12,084	22,208	49,337	5.8%
Low Case				
GDP (billion Ps) 1985 price	955	1,367	2,970	4.6%
Wage index	100	227	547	7.0%
WPI	100	168	229	3.4%
CPI	100	205	314	4.7%
GDP deflator	100	198	286	4.3%
Crude price (US$/bbl) nominal price	26.1	21.1	34.6	1.1%
LNG price (US$/kcf) nominal price	4.0	3.9	5.8	1.5%
Coal price (US$/t) nominal price	43.9	46.3	54.2	0.8%
Primary Energy Supply (ktoe)	23,971	34,584	65,496	4.1%
Total Final Consumption (ktoe)	12,084	21,609	44,813	5.4%

4-4 Potential Demand for Natural Gas (Part 1) ···· Power Sector

4-4-1 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, 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:

(1) 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).

(2) Low Case

We make the same assumption on domestic energy sources for power and 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 scenario 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.

4-4-2 Results of estimation (Domestic gas: 500 mmscfd)

Table 4-4-1 and 4-4-2 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 3,028 MW in 2005 (Actually, gas fired power plants of 2,725 MW will be commissioning in 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 4-4-1(1) Generation capacity by power source (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 4-4-1(2) Generation capacity by power source (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 4-4-2(1) Power generation by power source(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 4-4-2(2) Power generation by power source (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 4-4-3 and 4-4-4 below show potential gas demand by target area.

(1) High Case

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

Potential demand in Area L-2 will reach 787 mmcfd 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 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 mmcfd 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 52mmcfd, respectively, in 2025.

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

(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 4-4-3(2) Potential gas demand for power generation in each target area
(High Case)

(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 mmcfd in 2005 to 1,158 mmcfd in 2025.

Potential demand in Area L-2 will reach 713 mmcfd 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 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 374 mmcfd in 2025, because many power plants fired by imported gas, totaling to 3,600 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 52 mmcfd in 2025.

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

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

(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

4-4-3 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 4-4-5(1) Gas fired power plants in each target area
(High Case)

(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 4-4-5(2) Potential gas demand for power generation in each target area
(High Case)

(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 4-4-6(1) Gas fired power plants in each target area
(Low Case)

(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 4-4-6 (2) Potential gas demand for power generation in each target area (Low Case)

(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

4-5 Potential Demand for Natural Gas (Part 2)----Non-power Sector

4-5-1 Projection for Energy Demand in Each Sector

The Energy Demand Projection is the base data for estimating natural gas potential demand in the future. The total energy demand projection in 4-4 is the base data for the energy demand projection in target areas using the same methodology in 2-2-2.

The methodology explained in 2-2-2 needs a future projection of GRDP, per capita GRDP and population. First, the regional ratio of GRDP is assumed to be the same as 1999 actual data. The primary approximation factor of the past 10-year trend of population ratio by region is introduced to make the distribution of the forecasted total population, which is estimated using the model explained in 4-3, to the region including target areas. The results are shown in Figure 4-5-1 and 4-5-2.

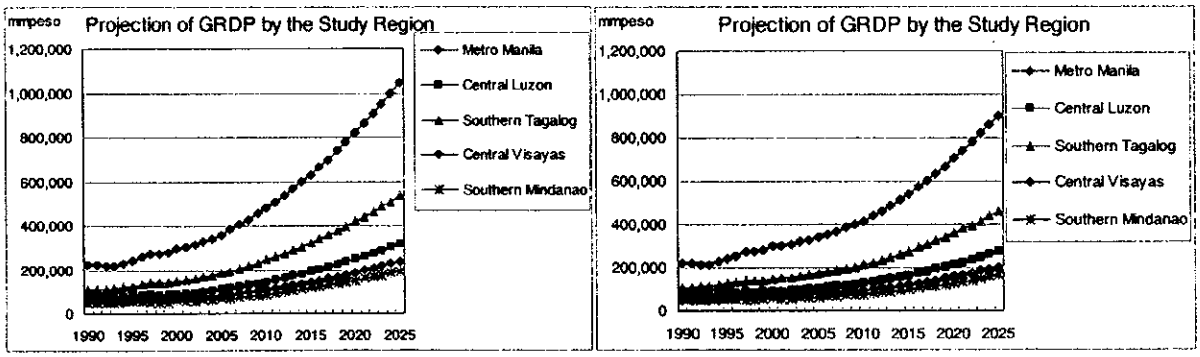


Figure 4-5-1 GRDP Projection in the Target Region (Left: High, Right: Low)

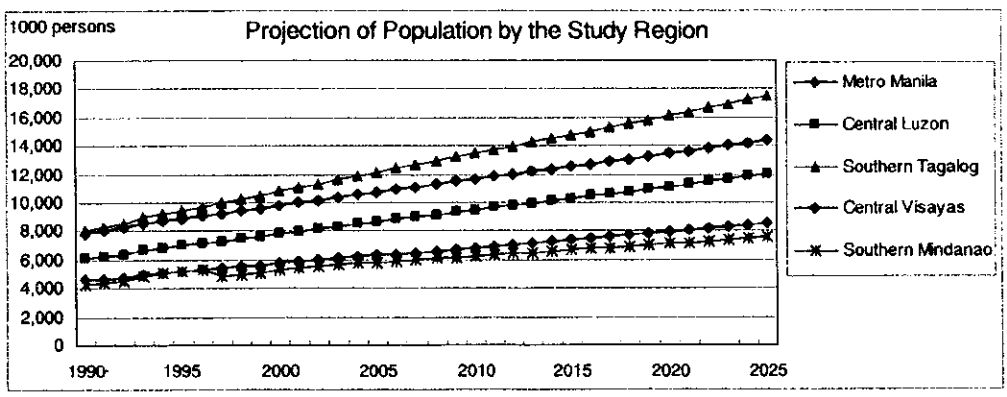


Figure 4-5-2 POP Projection in the Target Region (Both Cases)

Figure 4-5-3 and 4-5-5 are the results of distribution, which are estimated from the whole Philippines data to each region by using distribution factor based on the projection. Figure 4-5-3 shows that NCR has the largest share of energy consumption in commercial and residential sectors, because of its higher intensity on per capita GRDP. A large part of electricity and LPG consumption are distributed in NCR, reflecting its higher score for per capita GRDP than other Regions.

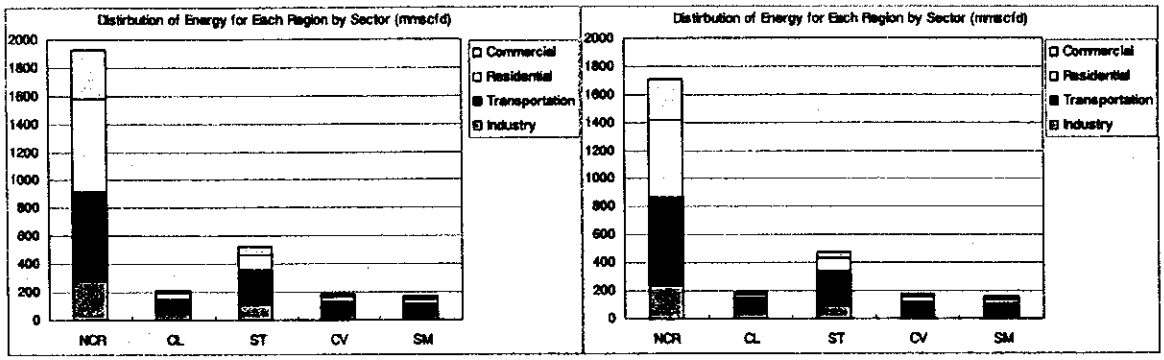


Fig. 4-5-3 Energy Consumption by Sector in Each Region in 2025 (Left: High, Right: Low)

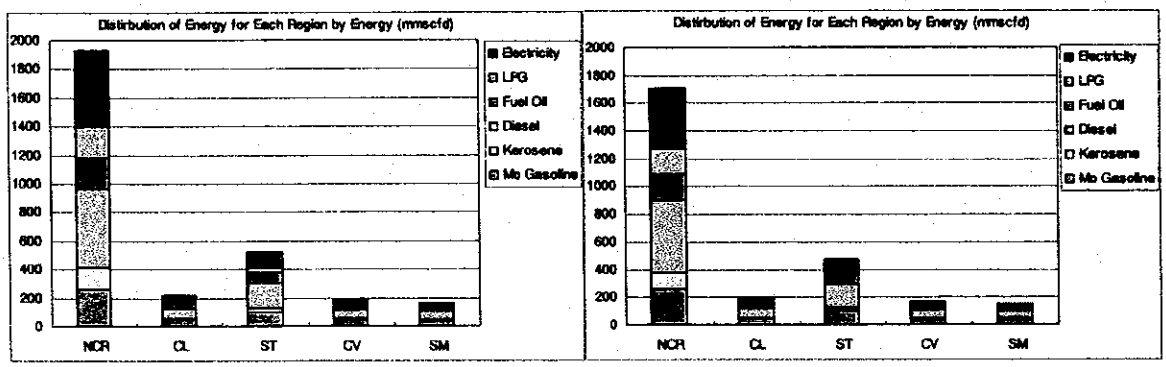


Figure 4-5-4 Consumption by Energy in Each Region in 2025 (Left: High, Right: Low)

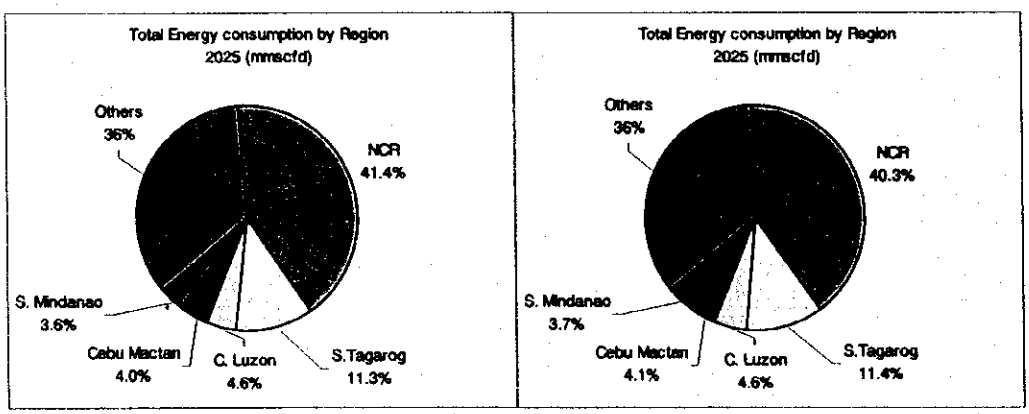
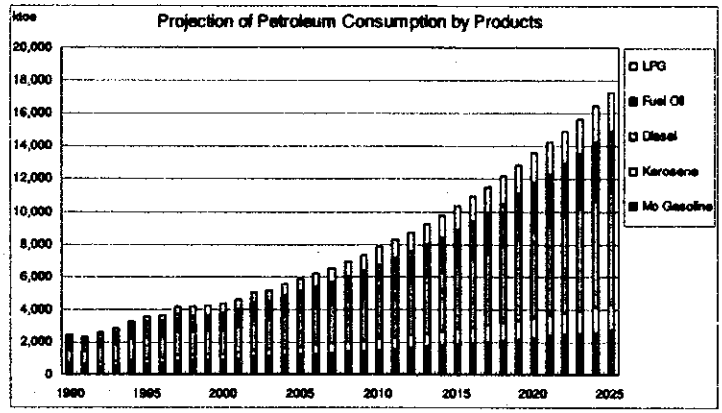


Figure 4-5-5 Energy Demand Share by Region in 2025 (Left: High, Right: Low)

The share of energy consumption in the target areas is 64% of the Philippines as a whole (Figure 4-5-5). Energy Demand Forecast in the target areas is as follows.

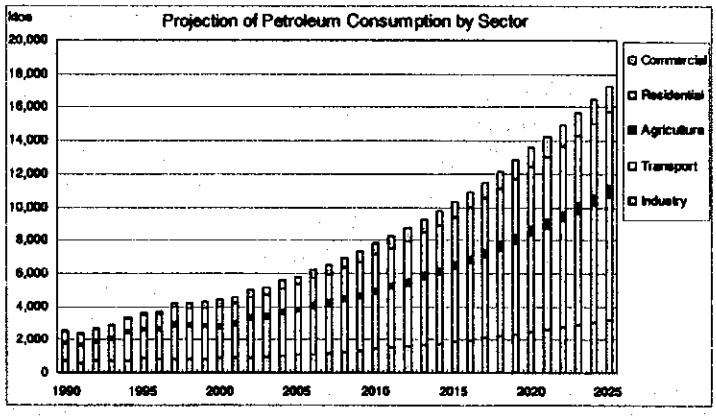
(1) Energy Demand Forecast of the Target Areas in Luzon

1) Energy Demand Forecast in NCR (L-1 Area)



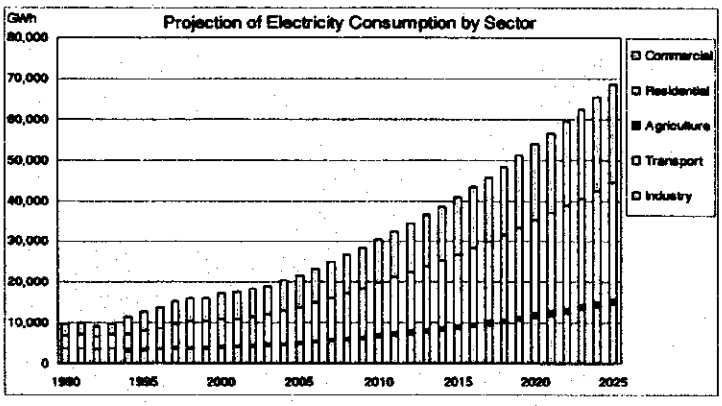
The average annual growth rate of petroleum product consumption in NCR is estimated to be 5.65%.

Figure 4-5-6 Petroleum Demand Forecast by Fuel in NCR (High Case)



The left figure shows the same trend above by sector.

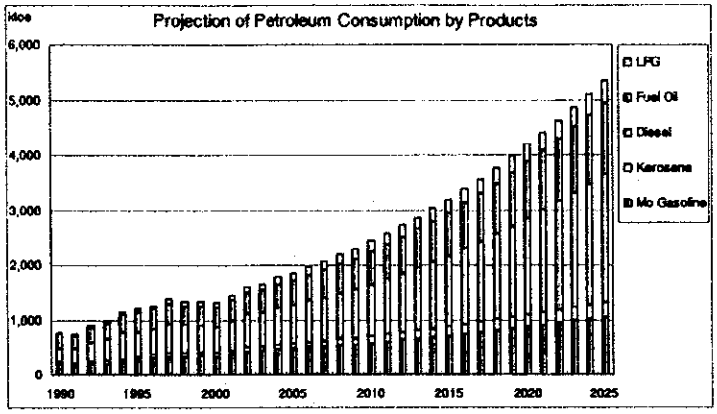
Figure 4-5-7 Petroleum Demand Forecast by Sector in NCR (High Case)



The average annual growth rate of electricity demand in NCR is estimated to be 5.68%.

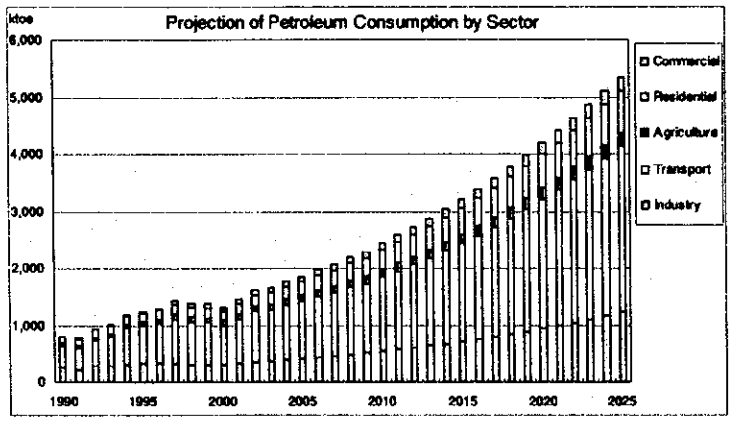
Figure 4-5-8 Electricity Demand Forecast by Sector in NCR (High Case)

2) Energy Demand Forecast of the Target Area in Southern Tagalog (Area L-2)



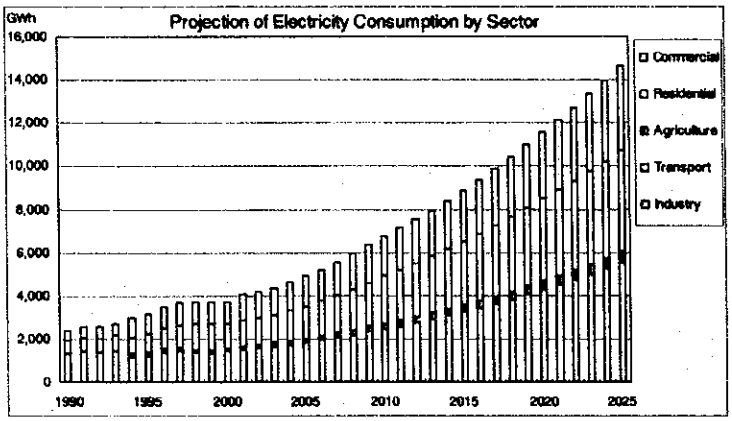
The average annual growth rate of petroleum product consumption in area L-2 is estimated to be 5.76%.

Figure 4-5-9 Petroleum Demand Forecast by Fuel in Area L-2 (High Case)



The left figure shows the same trend above by sector.

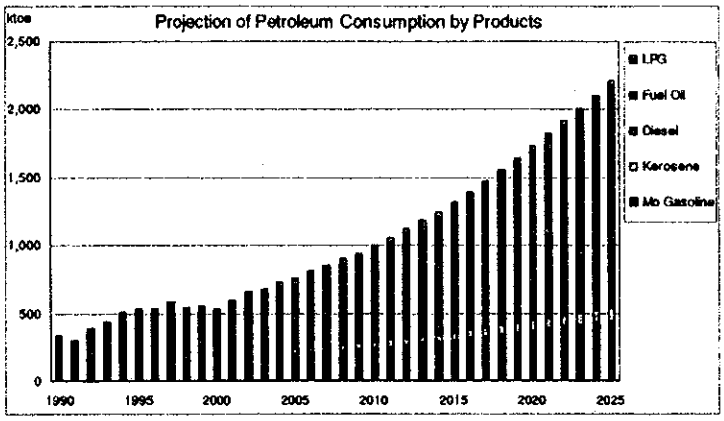
Figure 4-5-10 Petroleum Demand Forecast by Sector in Area L-2 (High Case)



The average annual growth rate of electricity demand in area L-2 is estimated to be 5.63%.

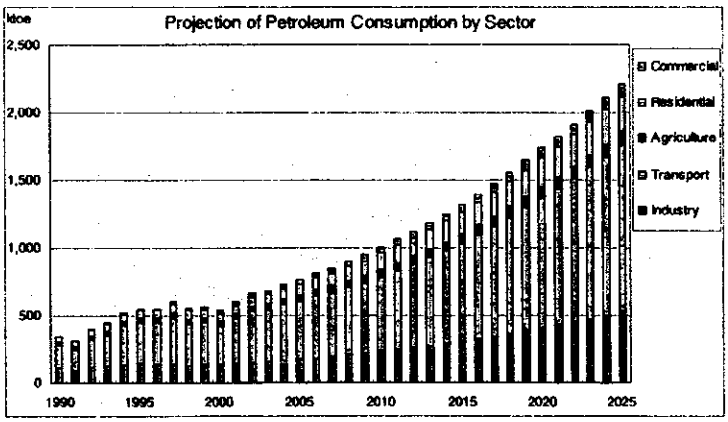
Figure 4-5-11 Electricity Demand Forecast by Sector in Area L-2 (High Case)

3) Energy Demand Forecast of the Target Area in Central Luzon (Area L-3)



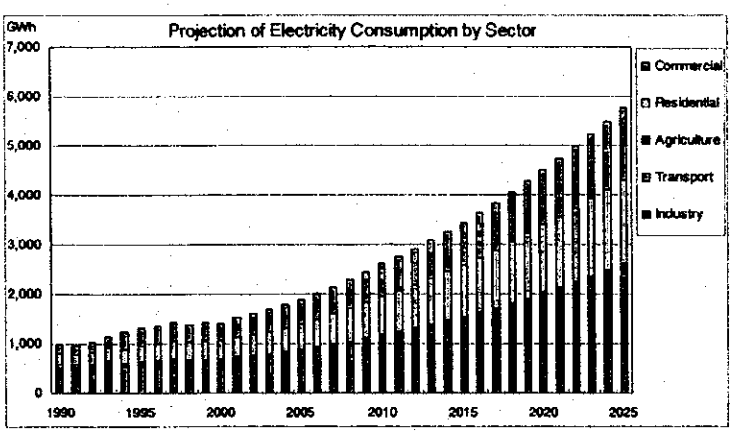
The average annual growth rate of petroleum products consumption in area L-3 is estimated to be 5.84%.

Figure 4-5-12 Petroleum Demand Forecast by Fuel in Area L-3 (High Case)



The left figure shows the same trend above by sector.

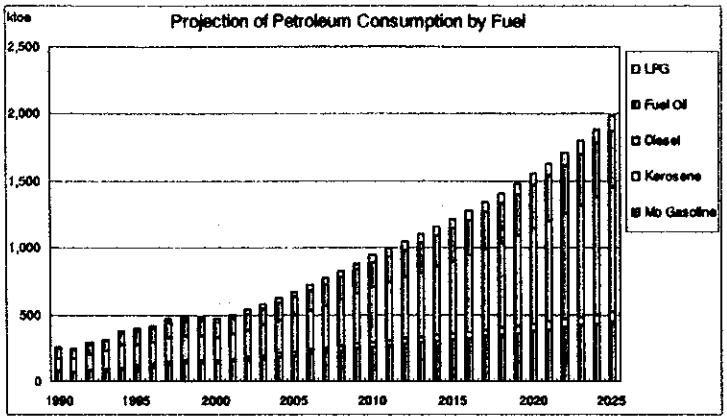
Figure 4-5-13 Petroleum Demand Forecast by Sector in Area L-3 (High Case)



The average annual growth rate of electricity demand in area L-3 is estimated to be 5.80%.

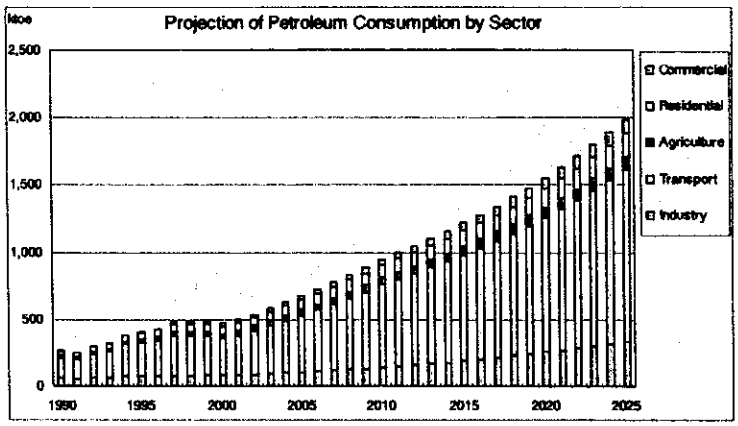
Figure 4-5-14 Electricity Demand Forecast by Sector in Area L-3 (High Case)

(2) Energy Demand Forecast of the Target Area in Cebu-Mactan (Area C-M)



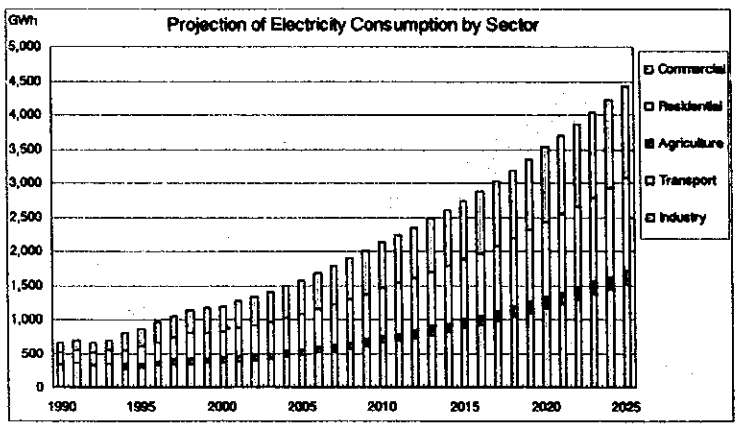
The average annual growth rate of petroleum products consumption in area C-M is estimated to be 5.74%.

Figure 4-5-15 Petroleum Demand Forecast by Fuel in Area C-M (High Case)



The left figure shows the same trend above by sector.

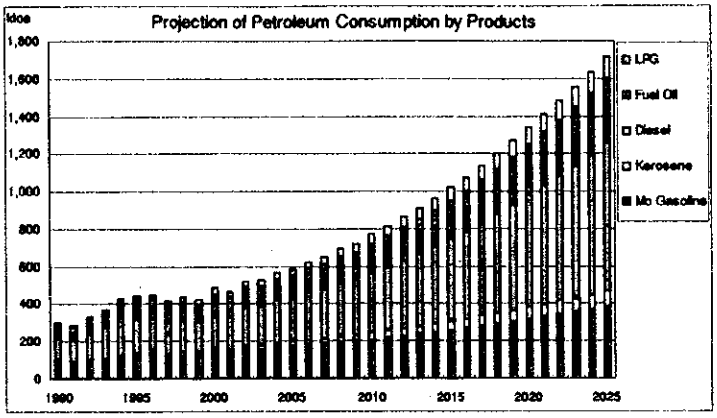
Figure 4-5-16 Petroleum Demand Forecast by Sector in Area C-M (High Case)



The average annual growth rate of electricity demand in area C-M is estimated to be 5.71%.

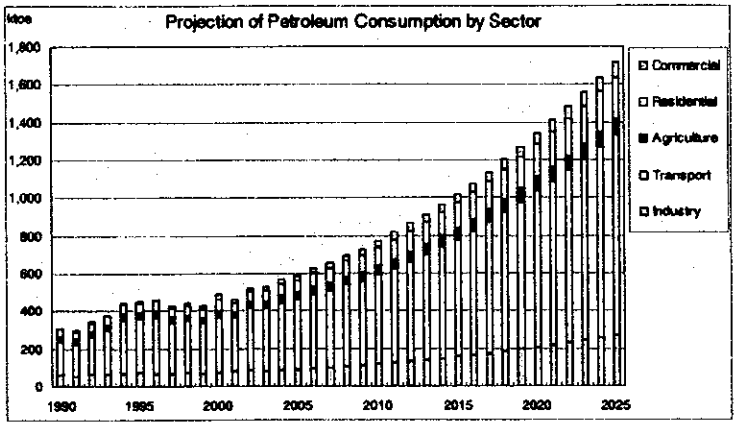
Figure 4-5-17 Electricity Demand Forecast by Sector in Area C-M (High Case)

(3) Energy Demand Forecast of the Target Area in Southern Mindanao (Area D)



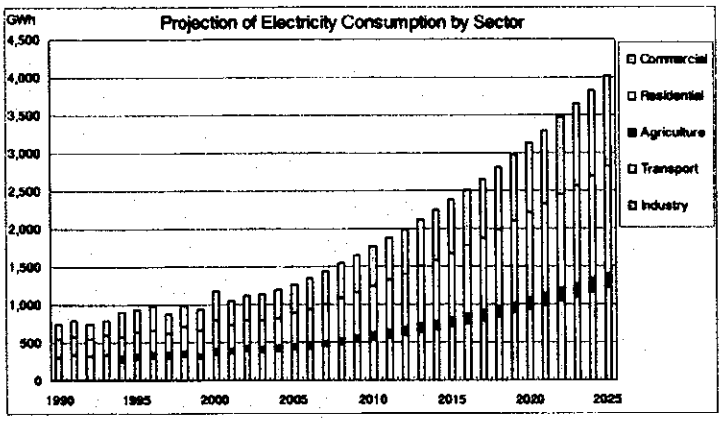
The average annual growth rate of petroleum products consumption in area D is estimated to be 5.18%.

Figure 4-5-18 Petroleum Demand Forecast by Fuel in Area D (High Case)



The left figure shows the same trend above by sector.

Figure 4-5-19 Petroleum Demand Forecast by Sector in Area D (High Case)



The average annual growth rate of electricity demand in Area D is estimated to be 5.03%.

Figure 4-5-20 Electricity Demand Forecast by Sector in Area D (High Case)

4-5-2 Methodologies for the Assumption of NG Potential Demand

(1) Target Sector

Among energy demand, which is estimated in 4-5-1, there are several sub-sectors, which are not suitable for substituting the current energy with Natural Gas according to the MEMSI Report, in which some energy uses are reported.

Table 4-5-1 Selection of Target Sector for Substituting Energy to NG

Sector	Sub-Sector		
Industrial	Beverage	Wood Product/Furniture	Cement
	Tobacco	Paper Product/Printing	Other Non Metallic Minerals
	Coco/Vegetable Oil	Chemical except Fertilizer	Base Metals
	Sugar	Fertilizer	Machinery/Equipment
	Other Food products	Rubber/Rubber Product	Mining
	Textile/Apparels	Glass/Glass Product	Construction
Transportation	Railway	Domestic Air Transport	
	Road Transport		
	Internal Water Transport		
Residential	Residential		
Commercial	Commercial		

(Source) DOE and MEMSI Report

Table 4-5-1 shows the target sectors for substituting the current energy with Natural Gas. The highlighted sub-sectors are defined as they have the possibility of substituting their current energy uses with Natural Gas. The sub-sectors, which cannot easily substitute their energy with natural Gas, are the following.

Industrial sector: Cement, Ceramics, Base Metals, Mining and Construction
Transport sector: Railway, Domestic Aviation, and Internal Waterway Vessels

(2) Target Energy for Substituting to Natural Gas in Each Sector

The ordinal energy uses in each sector and each industry are reported in the MEMSI report. The typical energy uses are summarized in Table 4-5-2, referring to the MEMSI report. The highlighted cells in the table mean the target energy for substitution. As for kerosene, its main uses are for initial igniting furnaces and boilers according to the MEMSI report; therefore, kerosene is excluded from the target energy. As for power generation, it has been fluctuating yearly in response to the purchase price of electricity. Fuel used for power generation is also excluded from the target, because it is rare to substitute fuel for gas turbine, for example.

Table 4-5-2 Target Energy and Substitution to NG

Industrial	LPG	Annealing	Heating	
	Fuel Oil	Generator	Furnace	Boiler
	Diesel	Generator	Boiler	
	Kerosene	Heating	Furnace	
	Electricity	Air Conditioning	Refrigerator	
Transportation	Mo Gasoline	Gasoline Engine		
	Diesel	Diesel Engine		
	Fuel Oil	Diesel Engine		
Residential	Kerosene	Cooking	Hot Water	
	LPG	Cooking	Hot Water	
	Electricity	Air Conditioning		
Commercial	Fuel Oil	Boiler	Absorption	
	LPG	Cooking	Boiler	Absorption
	Electricity	Air Conditioning	Refrigerator	

(Source) DOE and MEMSI Report

(3) Methodology for Estimating Potential Gas Demand

There are two stages in the estimation. One is for current energy uses and the other is for the future. The assumption for the future is explained in 4-5-4; the methodology is the same as for the current one except the definitions of factors.

The first priority in substituting current energy with NG is the lower price of NG than the current energy as a heat equivalent price, for example. In residential energy use, consumers sometimes prefer convenience in energy use, rather than energy price. So, that is included in the estimation.

On the other hand, when the natural gas price is low compared to other energies, the incentive to substitute energy carriers with natural gas is weak while the price difference is small. So, the formula for substitution with NG has a linear function for the price ratio. Generally, the starting point of substitution is the price ratio of 1 in calorific equivalence. Energy conversion will be accomplished with 100% of the conversion ratio defined later when the natural gas price becomes lower than a certain level. These factors define by sector and by energy carrier.

Consumers, who try to change their current energy to natural gas, need to invest on remodeling current facilities. For increasing demand in the future, additional investments for natural gas substitution will not always be necessary. The conversion factors for future demand should be different from that of the current demand in the formulas.

Table 4-5-2 Target Energy and Substitution to NG

Sector	Energy	Usage		
Industrial	LPG	Annealing	Heating	
	Fuel Oil	Generator	Furnace	Boiler
	Diesel	Generator	Boiler	
	Kerosene	Heating	Furnace	
	Electricity	Air Conditioning	Refrigerator	
Transportation	Mo Gasoline	Gasoline Engine		
	Diesel	Diesel Engine		
	Fuel Oil	Diesel Engine		
Residential	Kerosene	Cooking	Hot Water	
	LPG	Cooking	Hot Water	
	Electricity	Air Conditioning		
Commercial	Fuel Oil	Boiler	Absorption	
	LPG	Cooking	Boiler	Absorption
	Electricity	Air Conditioning	Refrigerator	

(Source) DOE and MEMSI Report

(3) Methodology for Estimating Potential Gas Demand

There are two stages in the estimation. One is for current energy uses and the other is for the future. The assumption for the future is explained in 4-5-4; the methodology is the same as for the current one except the definitions of factors.

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Consumers, who try to change their current energy to natural gas, need to invest on remodeling current facilities. For increasing demand in the future, additional investments for natural gas substitution will not always be necessary. The conversion factors for future demand should be different from that of the current demand in the formulas.

There are several items in the judgments for the energy substitution, such as investment cost, economic feasibility and implementation, but the approach to obtain actual data is quite difficult. Acquisition of useful and sufficient data is almost impossible. Some of sample data are obtained, but that is un-sufficient to estimate the total energy consumption, and is only for reference. Table 4-5-3 shows the defined conversion factor of energy substitution with natural gas.

Table 4-5-3 Conversion Factor Table

NG Conversion Factor by Usage for Existing Facilities				
	Gross CF	High Ratio	Low Ratio	Over High
Mo Gasoline				
Transportation Gasoline	0.06	0.6	0.3	0.001
Kerosene				
Residential Kerosene	0.08	2	0.9	0.01
Diesel				
Industrial Diesel	0.02	0.9	0.6	0.001
Transportation Diesel	0.06	0.6	0.3	0.001
Fuel Oil				
Industrial Fuel Oil	0.09	0.9	0.6	0.001
Transportation Fuel Oil	0.06	0.6	0.3	0.001
Commercial Fuel Oil	0.09	0.9	0.6	0.001
LPG				
Industrial LPG	0.50	0.95	0.9	0.001
Residential LPG	0.50	0.7	0.5	0.01
Commercial LPG	0.50	0.8	0.6	0.01
Electricity				
Industrial Electricity	0.01	0.6	0.4	0.01
Residential Electricity	0.01	0.6	0.4	0.01
Commercial Electricity	0.10	0.6	0.4	0.01
Mo Gasoline				
Transportation Gasoline	0.09	0.6	0.4	0.001
Kerosene				
Residential Kerosene	0.15	2	0.9	0.01
Diesel				
Industrial Diesel	0.05	0.9	0.7	0.001
Transportation Diesel	0.09	0.6	0.4	0.001
Fuel Oil				
Industrial Fuel Oil	0.25	0.9	0.7	0.01
Transportation Fuel Oil	0.09	0.6	0.4	0.01
Commercial Fuel Oil	0.25	0.9	0.7	0.01
LPG				
Industrial LPG	1.00	1	0.9	0.01
Residential LPG	1.00	0.8	0.7	0.01
Commercial LPG	1.00	0.9	0.8	0.01
Electricity				
Industrial Electricity	0.01	0.6	0.5	0.01
Residential Electricity	0.01	0.6	0.5	0.01
Commercial Electricity	0.10	0.6	0.5	0.01

In this table, the Gross CF (Gross Conversion Factor) means the ratio of total energy consumption that could be substituted with natural gas by sector and by energy, when it is feasible and practicable. High Ratio is the starting point of the price ratio to substitute energy with natural gas. It is "1" for equal price in calorific equivalence. Low Ratio means the price ratio when conversion by all of the Gross Conversion Factor (later explained) is possible under the lower price for natural gas. Over High means the ratio of substitution for other reasons within Gross CF when natural gas is available.

(4) Definition of the Price Ratio

1) Transportation Sector (Vehicles using Mo Gasoline and Diesel Oil)

Several expenses are required to remodel vehicles for compressed natural gas, so-called NGV. It is also necessary to get a suitable number of newly NG filling stations ready before introducing NGV. So, NG price, at the filling station, must be 60%, or more, lower than that of Mo Gasoline and Diesel Oil as the heat equivalent price (ref. 4-6). Therefore, the high ratio, which is the starting point for substitution with NG, is defined as 0.6 (NG price/current fuels price). The low ratio, which is the point at which all Gross CF may be substituted, is defined as 0.3 for current fuel used by vehicles and 0.4 for future fuel demand for vehicles that use Mo Gasoline and Diesel Oil.

2) Residential Sector (Kerosene, LPG)

Residential fuel use in the developing countries has generally been transferred from wood and bio to kerosene, as living condition improve. Then, it also changed again from kerosene to LPG, comparatively quickly. This change, especially from kerosene to LPG, is sometimes accelerated because of its convenience for home use, even though the price of LPG still is twice that of kerosene. So, the high ratio, the starting point of substitution with NG, is set at 2.0 and the low ratio is 0.9 for kerosene for home use. For LPG, the high ratio is defined as 0.7. The low ratio, which means all LPG within Gross CF, which will be substituted with NG is 0.5 for current LPG demand and 0.7 for future LPG demand.

3) Industrial Sector (LPG, Diesel Oil, Fuel Oil)

The main reason for LPG use in the industrial sector is to maintain the quality of products, even if the price of LPG is much higher than other fuels (ref. MEMSI report and visit survey during the Study). For this reason, all LPG consumption might be transferred to NG when NG will be supplied at a suitable price. The high ratio is set at 0.95 for current LPG demand and 1.0 (even price) for future LPG demand. The low ratio

is defined as 0.9. All LPG demand may be substituted with NG at this price ratio. Diesel Oil and Fuel Oil are fuels used in boilers and furnaces for heating. But, these facilities have generally been integrated into the production system and combustion systems have various designs in order to secure further heat utilization, so it may be difficult to estimate remodeling expense using a simple method. Therefore, the high ratio is 0.9 as a typical average for these facilities, and the low ratio is defined as 0.6 for current fuel demand and 0.7 for future demand.

4) Commercial Sector (LPG, Fuel Oil)

LPG is almost used for kitchen by MEMSI report. All of LPG use may be substituted with NG when the NG is supplied by suitable price. The high ratio is defined as 0.9 and the low ration is 0.6 for current demand and 0.7 for future demand. Fuel oil is mainly used for boilers or heating facilities, so the high ratio is defined as 0.9, and the low ratio is defined as 0.6 for current fuel demand and 0.7 for future demand.

5) Electricity

Electricity use for air conditioning is the target for substitution with NG. A gas cooling system is not suitable for a small air conditioning system. The investment cost to change electricity system to a gas cooling system may be as same as new facilities. COP (Coefficient of Performance) is an important factor to compare both systems. The average COP of a gas cooling system is assumed to be 1.0 and that of the electricity system is assumed to be 3.0 in the Study. The price ratio between NG and electricity should be modified by this COP; therefore, the high price ratio is defined as 0.6 and the low ratio is 0.4 for current demand and 0.5 for future demand.

(5) Definition of Gross CF

Gross CF is defined as the factor to substitute some amount of energy use with natural gas. Gross CF has three parameters. One is a ratio called "Focused", which is the target ratio of substitution with NG, and which has the technical possibility of substitution and also the reason for its usage. The second is a ratio called "Economical", which means the ratio of the energy usage to make an economical evaluation within "Focused" by its actual operating situation, which are remaining life, operation factors of the facilities, etc. The third is a ratio called "Accomplished", which means the actual implementation ratio within "Economical" of substitution with NG. Gross CF is defined as the ratio multiplied by these three parameters by sector and by energy.

1) Focused: target ratio of substitution with NG among total energy use

This parameter means the fundamental possibility of substituting current energy with natural gas. It is also defined by sector and energy, adding technical and energy usage.

a) Mo Gasoline

The target use is commercial vehicles, not for private use, because it is rare to replace Mo gasoline with other fuels. The share of commercial vehicles was 25% of the total in 1999 from NSO statistics. The share is growing continuously year-by-year. So, the focused ratio of Mo gasoline is defined as 25% for current demand and 35% for future demand.

b) Kerosene

The target sector for kerosene use is residential. The fuel used in the residential sector has generally been kerosene replacing wood and bio in developing countries, along with their economic growth. Kerosene has been quickly replaced by LPG as mentioned before.

But actual kerosene demand around the Study area, where a gas supply system is assumed to be installed in the future, may mostly have already been converted to LPG, even though actual data could not be obtained directly. In this way, 15% of kerosene demand in the Study area is assumed to be the target for substitution with NG. This is the Focused parameter of kerosene in the residential sector to define "Gross CF".

c) Diesel Oil

Diesel Oil is mostly used for diesel engine-driven power generation including emergency Gen-sets in the industrial sector. It is also used for the initial starting fuel of boilers and the regular fuel of small facilities. The target share of Diesel Oil use in the industrial sector is defined as 20% for current and future demand, referring to the MEMSI report. The factor of diesel oil use in the transportation sector is as same as that of Mo Gasoline. It is 25% for current demand and 35% for future demand.

d) Fuel Oil (Bunker Oil)

Fuel oil in the industrial sector is mainly used for boilers and furnaces, although some fuel oil is also used for engine-driven power generators. So, 100% of fuel oil use in the industrial sector is defined as "Focused" for current and future demand.

The factor of fuel oil use in the transportation sector is as same as that of Mo Gasoline. That is 25% for current demand and 35% for future demand.

The commercial sector is also using fuel oil for combustion in boilers. Then, 100% of fuel oil use in the commercial sector is defined as the target energy for substitution, for current and future demand.

e) LPG

The total of LPG use in all sectors is defined as the substitution target for NG.

f) Electricity

The power source for air-conditioning is the substitution target for NG among the various usages of electricity. Generally, air-conditioning powered by electricity is best for a small, distributed system.

A gas-cooling system is generally suitable for district cooling/heating systems, which are comparatively large systems, such as large housing units, large malls/shopping centers, hospitals, concentrated office areas and large new towns.

In the industrial sector, several kinds of cold energy system, such as large air-conditioning system, freezing system, and deep tilling system, are sometimes designed using gas fuel. The system is closely integrated into process facilities with sophisticated engineering designs for the rational use of total energy. Large-scale chemical complexes, which have steam cycle co-generation systems in their energy systems, may introduce gas turbines as the top turbines of its energy cycle using natural gas.

In the Study, 5% of electricity consumption in the industrial sector is defined as "Focused" parameter, because there are various usages of electricity in the industrial sector. Around half of electricity consumption in residential sector is assumed to be for air-conditioning, so the target ratio for the residential sector is defined as 10%, which means 20% of electricity used for air-conditioning is focused. For the commercial sector, 60% of total electricity consumption is assumed to be for air-conditioning, and then 40%, two third of it, of electricity consumption is defined as the target.

2) Economical: availability share for economical evaluation

The lower price of natural gas is the first priority to substitute natural gas for the current energy. The judgment should basically be made based on payback period estimated on the investment cost for substitution vs. running cost merits (fuel consumption multiplied by price difference between energy carriers).

Generally, the running ratio and the remaining commercial lives of the facilities are important items for estimating the running merits of the economical evaluation, besides modification costs. It is also generally true that the maximum limit of payback period is three years when facilities will be used after five years at full load. The payback period of three years is considerably difficult for a small company, whose business circumstances often change. It is realistic for them to spend their limited expenses for utilities equipment within a one-year payback period.

The price differences between the current energy and natural gas are reflected in "High Ratio" and "Low Ratio" in the formulas.

a) Mo Gasoline

The target use of substitution is commercial vehicles. The available share of the economical evaluation is defined as 50% for current demand and for future demand.

b) Kerosene

For kerosene use in the residential sector, the economical target is defined as 50% of current demand within "Focused", and 100% for future demand of it.

c) Diesel Oil

In the industrial sector, Diesel Oil purely for combustion is focused as the target. The combustion systems in the industrial sector vary, so the average economical target, within "Focused", is defined as 30% for current use and 50% for future demand. In the transportation sector, the target usage is diesel engine vehicles, so the parameter is as same as that of Mo Gasoline.

d) Fuel Oil (Bunker Oil)

Fuel oil use in the industrial sector is for combustion, so the parameter is as same as that of Diesel Oil. In the transportation sector, all parameters are the same as that of Diesel Oil. The economical parameter for the commercial sector is the same as that for

the industrial sector.

e) LPG

The economical parameter of LPG is defined as 50% for current use and 100% for future demand in all sectors.

f) Electricity

The target use of electricity is limited to air-conditioning and deep tilling system in the industrial and commercial sectors. Then, the economical parameter is defined as 50% for current and future demand. That of the residential sector is more limited at 30% of all demand.

3) Accomplished: ratio of actual implementation

When some energy uses are evaluated as being feasible for conversion to substitute to natural gas, consumers will not always give first priority to making that investment. They will choose and make their decision from among many choices of capital investment. So, the actual implementation ratio should be provided. These are basically defined as 100% or 50% or 30%, depending on the character of energy usage in each sector and the amount of energy consumption respectively.

a) Mo Gasoline

The implementation ratio in the transportation sector is defined as 50% of economically feasible measures.

b) Kerosene

In the residential sector, 100% of the feasible measures will be implemented.

c) Diesel Oil

The implementation ratio of economically feasible measures in the transportation sector is defined as 30% for current demand and 50% for future demand. The parameter of the transportation sector is as same as Mo Gasoline.

d) Fuel Oil (Banker Oil)

All fuel oil use is assumed to be for combustion in the industrial sector. The implementation ratio for current demand is defined as 30% and 50% for future demand. In the transportation sector, the ratio is as same as that of Mo Gasoline. The ratio of the

commercial sector is defined as same as that of the industrial sector because the usage of fuel oil is the same.

e) LPG

A total of LPG use in the industrial sector is assumed to convert to natural gas when the measures are economically feasible. For the residential and commercial sectors, the implementation ratio is defined as 50% for current demand and 100% for future demand.

f) Electricity

The implementation ratio is defined as 50% for current and future demand in the industrial and commercial sectors. That of the residential sector is defined to be more limited as 30% of all demand.

Table 4-5-4 shows the definition of Gross CF.

Table 4-5-4 Definition of Gross CF

	Current Demand		Focused	Economical	Accomplished	Future Demand		Focused	Economical	Accomplished
Mo Gasoline										
Transportation	0.06	0.063	0.25	0.5	0.5	0.09	0.088	0.35	0.5	0.5
Kerosene										
Residential	0.08	0.075	0.15	0.5	1	0.15	0.150	0.15	1	1
Diesel										
Industrial	0.02	0.018	0.2	0.3	0.3	0.05	0.050	0.2	0.5	0.5
Transportation	0.06	0.063	0.25	0.5	0.5	0.09	0.088	0.35	0.5	0.5
Fuel Oil										
Industrial	0.09	0.090	1	0.3	0.3	0.25	0.250	1	0.5	0.5
Transportation	0.06	0.063	0.25	0.5	0.5	0.09	0.088	0.35	0.5	0.5
Commercial	0.09	0.090	1	0.3	0.3	0.25	0.250	1	0.5	0.5
LPG										
Industrial	0.50	0.500	1	0.5	1	1.00	1.000	1	1	1
Residential	0.25	0.250	1	0.5	0.5	1.00	1.000	1	1	1
Commercial	0.25	0.250	1	0.5	0.5	1.00	1.000	1	1	1
Electricity										
Industrial	0.01	0.013	0.05	0.5	0.5	0.01	0.013	0.05	0.5	0.5
Residential	0.01	0.009	0.1	0.3	0.3	0.01	0.009	0.1	0.3	0.3
Commercial	0.10	0.100	0.4	0.5	0.5	0.10	0.100	0.4	0.5	0.5

commercial sector is defined as same as that of the industrial sector because the usage of fuel oil is the same.

e) LPG

A total of LPG use in the industrial sector is assumed to convert to natural gas when the measures are economically feasible. For the residential and commercial sectors, the implementation ratio is defined as 50% for current demand and 100% for future demand.

f) Electricity

The implementation ratio is defined as 50% for current and future demand in the industrial and commercial sectors. That of the residential sector is defined to be more limited as 30% of all demand.

Table 4-5-4 shows the definition of Gross CF.

Table 4-5-4 Definition of Gross CF

	Gross Conversion Factor		Ratio			Gross Conversion Factor		Ratio		
	Current Demand		Focused	Economical	Accomplished	Future Demand		Focused	Economical	Accomplished
Mo Gasoline										
Transportation	**0.06**	0.063	0.25	0.5	0.5	**0.09**	0.088	0.35	0.5	0.5
Kerosene										
Residential	**0.08**	0.075	0.15	0.5	1	**0.15**	0.150	0.15	1	1
Diesel										
Industrial	**0.02**	0.018	0.2	0.3	0.3	**0.05**	0.050	0.2	0.5	0.5
Transportation	**0.06**	0.063	0.25	0.5	0.5	**0.09**	0.088	0.35	0.5	0.5
Fuel Oil										
Industrial	**0.09**	0.090	1	0.3	0.3	**0.25**	0.250	1	0.5	0.5
Transportation	**0.06**	0.063	0.25	0.5	0.5	**0.09**	0.088	0.35	0.5	0.5
Commercial	**0.09**	0.090	1	0.3	0.3	**0.25**	0.250	1	0.5	0.5
LPG										
Industrial	**0.50**	0.500	1	0.5	1	**1.00**	1.000	1	1	1
Residential	**0.25**	0.250	1	0.5	0.5	**1.00**	1.000	1	1	1
Commercial	**0.25**	0.250	1	0.5	0.5	**1.00**	1.000	1	1	1
Electricity										
Industrial	**0.01**	0.013	0.05	0.5	0.5	**0.01**	0.013	0.05	0.5	0.5
Residential	**0.01**	0.009	0.1	0.3	0.3	**0.01**	0.009	0.1	0.3	0.3
Commercial	**0.10**	0.100	0.4	0.5	0.5	**0.10**	0.100	0.4	0.5	0.5

4-5-3 Potential Demand for Natural Gas

(1) Energy Price Forecast

Figure 4-5-21 shows the purchasing price forecast for petroleum products and natural gas, which is estimated using the model built in the Study. The potential demand is estimated based on the price forecast.

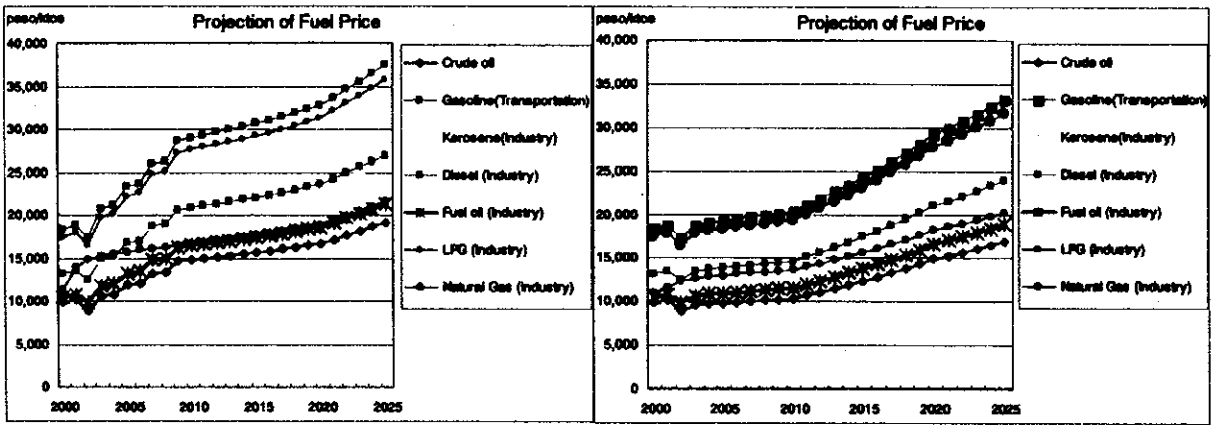

Figure 4-5-21 Price Projection of Petroleum and Natural Gas (left: High, right: Low)

The price of natural gas is that for which the gas supply side can secure an IRR of 12% (average US$10.69/kscf in High case, US$8.98/kscf in low case, in 2010). This explains that fuels compatible with natural gas are Mo Gasoline, LPG, Kerosene, and Diesel Oil. It will be also comparatively easy to convert kerosene to LPG or Natural gas due to its convenience. Figure 4-5-22 shows the customer purchase price projection of electricity in each sector.

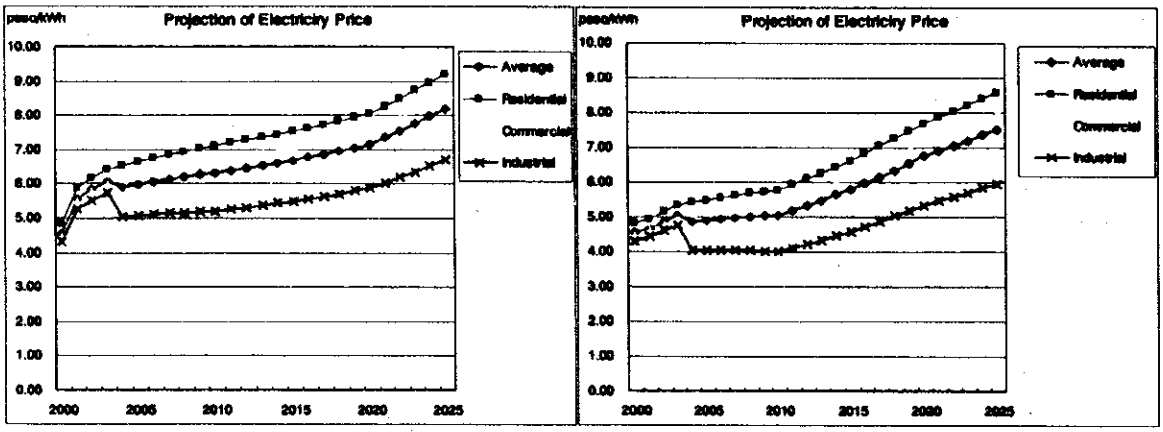

Figure 4-5-22 Projection of Purchase Price of Electricity (left: High, right: Low)

The price ratio defined by the assumption of energy prices above, which is used in the estimation of natural gas potential demand by sector and by fuels, is shown in Figure 4-5-23 (High case) and figure 4-5-24 (Low case)

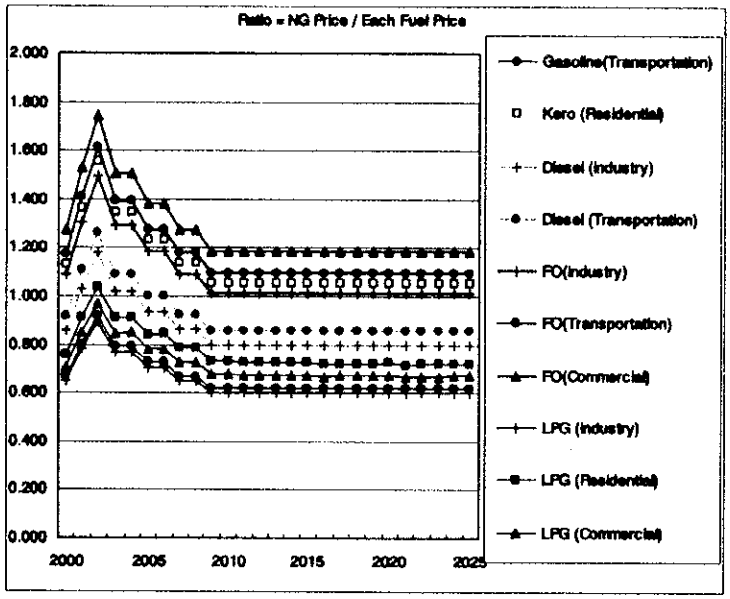

Figure 4-5-23 Price Ratio for Potential Demand Estimation (High case)

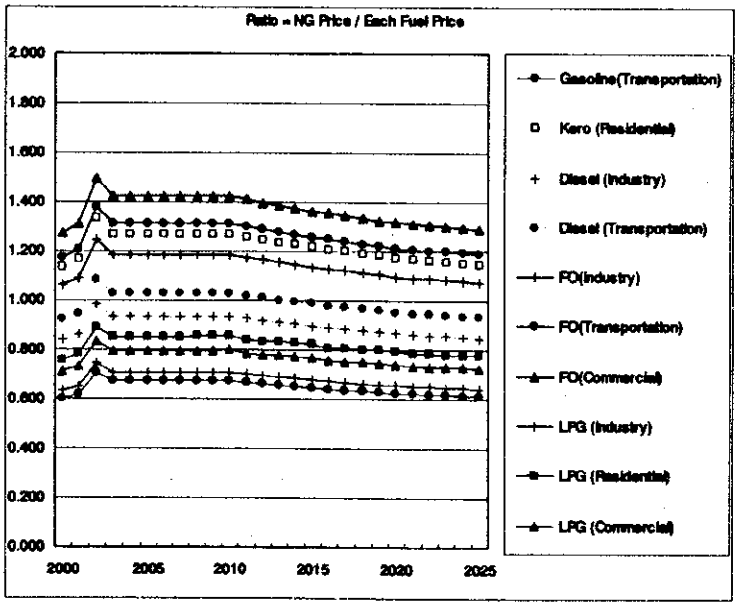

Figure 4-5-24 Price Ratio for Potential Demand Estimation (Low case)

(2) Potential Demand for Natural Gas (High case)

The potential demand for natural gas is estimated by special formulas using the natural gas conversion factors explained in 4-5-2, based on the energy demand projection described in 4-5-1 and the energy price projection (Figure 4-5-21 & 4-5-22). The result of the estimation for High case is shown in Table 4-5-5 (daily average unit: mmscfd).

Table 4-5-5 Potential Gas Demand in the Philippines (High case)

Philippine Total						mmscfd
Mo Gasoline						
Transportation Gasoline	0.02	0.02	0.03	0.04	0.05	0.07
Kerosene						
Residential Kerosene	3.64	4.21	8.43	13.35	19.22	25.16
Diesel						
Industrial Diesel	0.00	0.00	0.12	0.36	0.67	1.06
Transportation Diesel	0.01	0.02	0.03	0.05	0.07	0.10
Fuel Oil						
Industrial Fuel Oil	0.01	0.01	0.13	0.28	0.47	0.71
Transportation Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00
Commercial Fuel Oil	0.00	0.00	0.03	0.06	0.11	0.16
LPG						
Industrial LPG	0.29	0.36	0.61	0.92	1.34	1.84
Residential LPG	0.37	0.48	16.82	52.69	98.72	146.48
Commercial LPG	5.47	1.48	10.68	23.55	40.52	61.19
Electricity						
Industrial Electricity	0.01	0.01	0.01	0.01	0.02	0.02
Residential Electricity	0.01	0.01	0.02	0.03	0.03	0.04
Commercial Electricity	0.09	0.12	0.16	0.21	0.28	0.36
Potential Substitution Total to NG	9.92	6.73	37.06	91.56	161.50	237.17
Total Energy Consumption (mmscfd)	1,190.67	1,631.39	2,181.66	2,886.49	3,799.82	4,830.82

The total final energy consumption in 2010 is estimated to be 2,182 mmscfd (as for natural gas daily average consumption) and the potential demand of natural gas is estimated 37 mmscfd. Also, the total consumption and the potential demand for natural gas is estimated to be 237 mmscfd in 2025, based on total energy consumption, which is estimated to be 4,830 mmscfd.

(2) Potential Demand for Natural Gas (High case)

The potential demand for natural gas is estimated by special formulas using the natural gas conversion factors explained in 4-5-2, based on the energy demand projection described in 4-5-1 and the energy price projection (Figure 4-5-21 & 4-5-22). The result of the estimation for High case is shown in Table 4-5-5 (daily average unit: mmscfd).

Table 4-5-5 Potential Gas Demand in the Philippines (High case)

Philippine Total						mmscfd
	2000	2005	2010	2015	2020	2025
Mo Gasoline						
Transportation Gasoline	0.02	0.02	0.03	0.04	0.05	0.07
Kerosene						
Residential Kerosene	3.64	4.21	8.43	13.35	19.22	25.16
Diesel						
Industrial Diesel	0.00	0.00	0.12	0.36	0.67	1.06
Transportation Diesel	0.01	0.02	0.03	0.05	0.07	0.10
Fuel Oil						
Industrial Fuel Oil	0.01	0.01	0.13	0.28	0.47	0.71
Transportation Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00
Commercial Fuel Oil	0.00	0.00	0.03	0.06	0.11	0.16
LPG						
Industrial LPG	0.29	0.36	0.61	0.92	1.34	1.84
Residential LPG	0.37	0.48	16.82	52.69	98.72	146.48
Commercial LPG	5.47	1.48	10.68	23.55	40.52	61.19
Electricity						
Industrial Electricity	0.01	0.01	0.01	0.01	0.02	0.02
Residential Electricity	0.01	0.01	0.02	0.03	0.03	0.04
Commercial Electricity	0.09	0.12	0.16	0.21	0.28	0.36
Potential Substitution Total to NG	**9.92**	**6.73**	**37.06**	**91.55**	**161.50**	**237.17**
Total Energy Consumption (mmscfd)	1,190.67	1,631.39	2,181.66	2,886.49	3,799.82	4,830.82

The total final energy consumption in 2010 is estimated to be 2,182 mmscfd (as for natural gas daily average consumption) and the potential demand of natural gas is estimated 37 mmscfd. Also, the total consumption and the potential demand for natural gas is estimated to be 237 mmscfd in 2025, based on total energy consumption, which is estimated to be 4,830 mmscfd.

Table 4-5-6 shows the results of estimated natural gas potential demand in the Philippines as a whole and the target area. The natural gas potential demand in the Philippines as a whole is estimated to be 237.17 mmscfd in 2025, and that of the target area total is estimated to be 176.37 mmscfd as a result.

Table 4-5-6 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 Area	**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 Area	**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 Area	**Total**	0.96%	0.48%	1.95%	3.63%	4.87%	5.63%

The ratio of 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 NCR, 4.02% in Area C-M, 3.90% in Area L-2, 3.86% in Area D, and 3.57% in Area L-3.

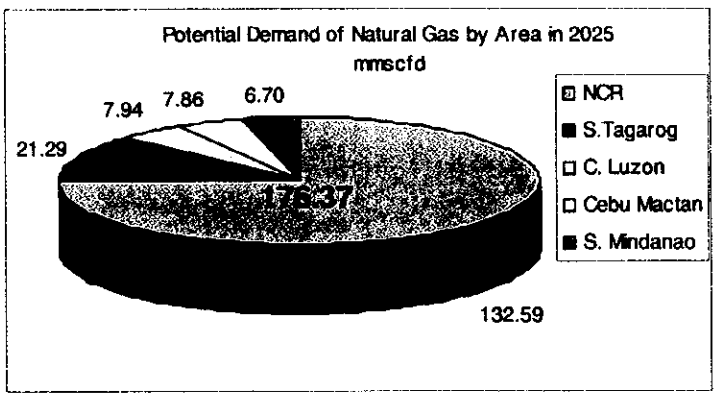

Figure 4-5-25 Potential Gas Demand in the Target Areas (High Case)

Table 4-5-6 shows the results of estimated natural gas potential demand in the Philippines as a whole and the target area. The natural gas potential demand in the Philippines as a whole is estimated to be 237.17 mmscfd in 2025, and that of the target area total is estimated to be 176.37 mmscfd as a result.

Table 4-5-6 Potential Gas Demand by Target Area (High Case)

(mmscfd)

		2000	2005	2010	2015	2020	2025
<Potential Gas Demand>							
Philippines	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NCR	L-1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S. Tagalog	L-2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
C. Luzon	L-3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cebu Mactan	C-M	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S. Mindanao	D	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Target Area	**Total**	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
<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 Area	**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 Area	**Total**	**0.96%**	**0.48%**	**1.95%**	**3.63%**	**4.87%**	**5.63%**

The ratio of 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 NCR, 4.02% in Area C-M, 3.90% in Area L-2, 3.86% in Area D, and 3.57% in Area L-3.

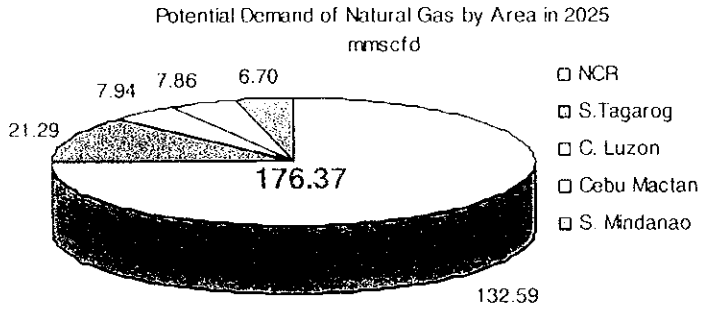

Figure 4-5-25 Potential Gas Demand in the Target Areas (High Case)

Table 4-5-7 shows the same result but, by sector. Substitution in the industrial and transportation sectors are very slow, but natural gas use is expected in the residential and commercial sectors.

Table 4-5-7 Projection of Potential Gas Demand by Sector (High case)

(mmscfd)

		2000	2005	2010	2015	2020	2025
<Potential Gas Demand>							
Total		7.54	5.01	27.60	68.16	120.17	176.37
Industrial		0.21	0.26	0.59	1.07	1.70	2.47
Transportation		0.02	0.02	0.03	0.05	0.07	0.09
Residential		3.07	3.52	18.86	49.27	87.91	127.85
Commercial		4.25	1.20	8.11	17.76	30.48	45.96
<Target Energy Demand>							
Total		**739.85**	**998.27**	**1,348.08**	**1,790.77**	**2,361.59**	**3,007.64**
Industrial		125.46	158.66	214.21	282.75	373.06	483.18
Transportation		275.40	411.26	520.93	686.43	910.33	1,169.09
Residential		213.84	275.18	406.23	549.10	718.99	890.70
Commercial		125.14	153.17	206.71	272.49	359.21	464.68
<Conversion Ratio>							
Total		**1.02%**	**0.50%**	**2.05%**	**3.81%**	**5.09%**	**5.86%**
Industrial		0.16%	0.16%	0.28%	0.38%	0.46%	0.51%
Transportation		0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
Residential		1.43%	1.28%	4.64%	8.97%	12.23%	14.35%
Commercial		3.40%	0.78%	3.92%	6.52%	8.49%	9.89%

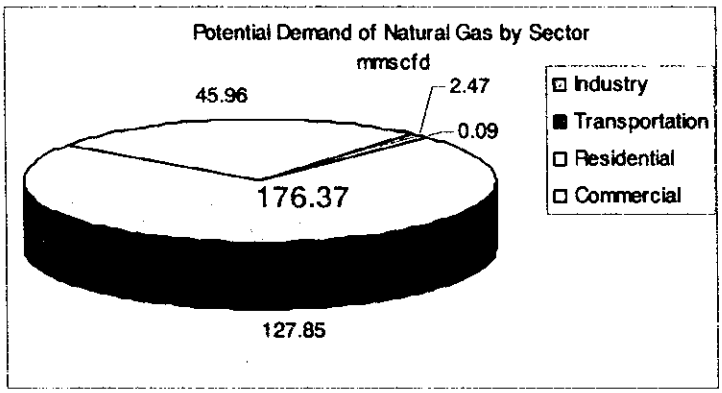

Figure 4-5-26 Potential Gas Demand by Sector (High Case)

Table 4-5-8 shows the projection by energy carriers. Substitution for LPG is the highest following kerosene. The potential demand for natural gas among others is very small and limited.

Table 4-5-8 Projection of Potential Gas Demand by Energy (High Case)

(mmscfd)

		2000	2005	2010	2015	2020	2025
<Potential Gas Demand >							
Total		7.54	5.01	27.60	68.16	120.17	176.37
Mo Gasoline		0.01	0.01	0.02	0.02	0.03	0.04
Kerosene		2.78	3.15	6.30	9.97	14.34	18.75
Diesel		0.01	0.01	0.10	0.27	0.50	0.78
Fuel Oil		0.01	0.01	0.11	0.24	0.40	0.61
LPG		4.65	1.72	20.94	57.47	104.66	155.89
Electricity		0.08	0.10	0.14	0.18	0.24	0.31
<Target Energy Demand>							
Total		**739.85**	**998.27**	**1,348.08**	**1,790.77**	**2,361.59**	**3,007.64**
Mo Gasoline		158.55	218.86	265.45	326.22	401.78	484.83
Kerosene		49.54	63.04	91.57	123.01	160.78	199.76
Diesel		180.35	272.79	369.95	513.27	709.09	936.15
Fuel Oil		92.87	116.65	157.48	207.81	274.12	354.95
LPG		75.31	95.24	136.90	183.43	240.02	299.88
Electricity		183.23	231.70	326.72	437.03	575.79	732.08
<Conversion Ratio>							
Total		**1.02%**	**0.50%**	**2.05%**	**3.81%**	**5.09%**	**5.86%**
Mo Gasoline		0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
Kerosene		5.61%	5.00%	6.88%	8.11%	8.92%	9.39%
Diesel		0.00%	0.00%	0.03%	0.05%	0.07%	0.08%
Fuel Oil		0.01%	0.01%	0.07%	0.11%	0.15%	0.17%
LPG		6.18%	1.81%	15.29%	31.33%	43.60%	51.98%
Electricity		0.05%	0.04%	0.04%	0.04%	0.04%	0.04%

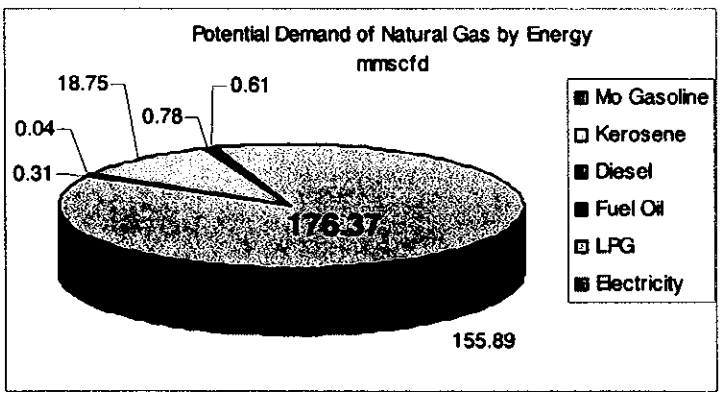

Figure 4-5-27 Potential Gas Demand by Energy Carrier (High Case)

Figure 4-5-28 and 4-5-29 show the sensitivity of natural gas potential demand to natural gas customer price. The price set for the potential demand estimation is located just at the critical point, and potential demand for natural gas quickly drops with only 5% higher price than that original. On the other hand, potential demand increase gradually along with the decrease in the price set. Mo gasoline price set is slightly higher than that of other petroleum products, because of the current actual selling price, therefore, the starting point for converting gasoline vehicles to NGV comes when the NG price is under 95% of the original price set and the growth of potential demand for natural gas becomes more rapid. It will also become much higher when the natural gas price reaches less than 90% of the original price set.

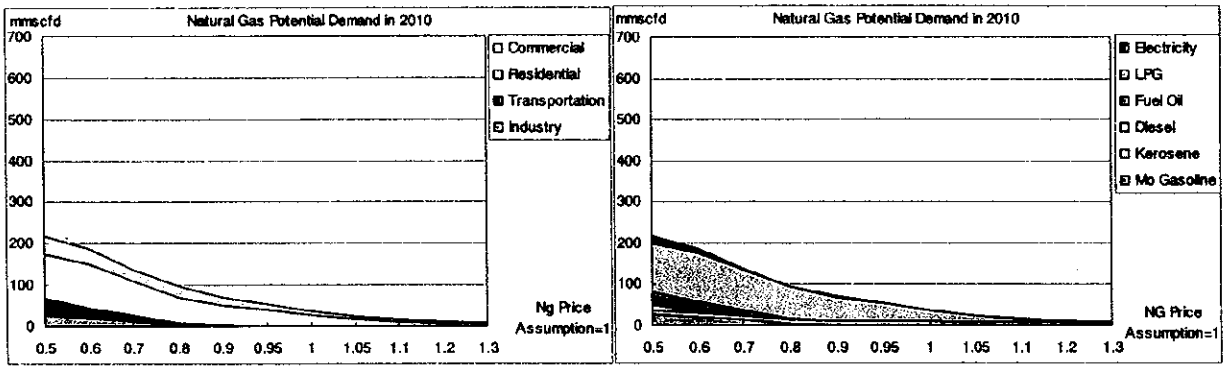

Figure 4-5-28 Potential Demand for NG in the Philippines for NG Price in 2010 (High Case)

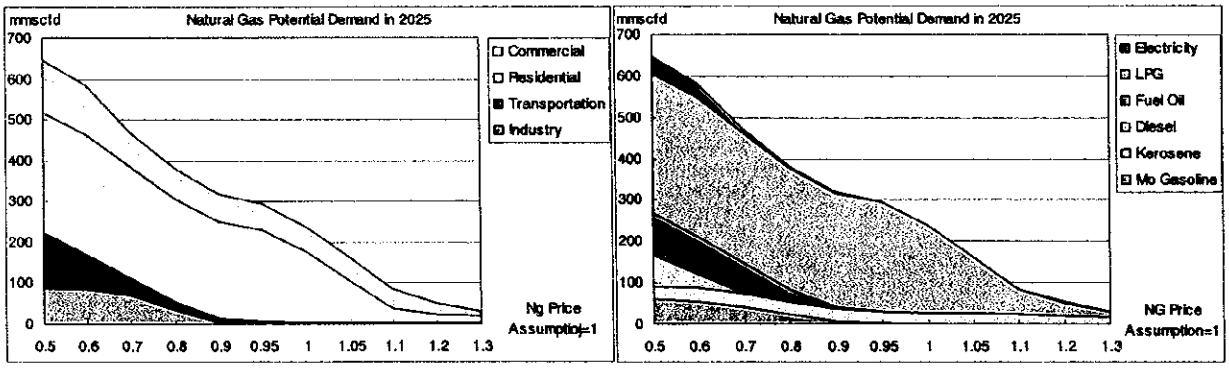

Figure 4-5-29 Potential Demand for NG in the Philippines for NG Price in 2025 (High Case)

The figures above are for the Philippines as a whole. Potential demand in the target areas is roughly estimated at around 74% of it.

(2) Potential Demand for Natural Gas (Low case)

As for the Low Case, the results pf estimation is shown in Table 4-5-9.

Table 4-5-9 Potential Gas Demand in the Philippines (Low Case)

Philippine Total						(mmscfd)
	2000	2005	2010	2015	2020	2025
Mo Gasoline						
Transportation Gasoline	0.02	0.02	0.03	0.04	0.05	0.06
Kerosene						
Residential Kerosene	3.64	3.58	5.25	8.69	13.02	17.56
Diesel						
Industrial Diesel	0.00	0.00	0.00	0.00	0.01	0.09
Transportation Diesel	0.01	0.02	0.04	0.05	0.07	0.10
Fuel Oil						
Industrial Fuel Oil	0.01	0.01	0.08	0.20	0.37	0.57
Transportation Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00
Commercial Fuel Oil	0.00	0.00	0.02	0.05	0.09	0.13
LPG						
Industrial LPG	0.29	0.34	0.49	0.75	1.10	1.52
Residential LPG	0.37	0.43	0.64	1.07	2.26	12.70
Commercial LPG	5.47	0.48	3.65	10.49	21.49	36.58
Electricity						
Industrial Electricity	0.01	0.01	0.01	0.01	0.01	0.02
Residential Electricity	0.01	0.01	0.01	0.02	0.03	0.03
Commercial Electricity	0.09	0.11	0.13	0.18	0.23	0.30
Potential Substitution Total to NG	9.92	5.03	10.36	21.55	38.73	69.66
Total Energy Consumption (mmscfd)	1,190.18	1,631.49	2,120.91	2,715.00	3,456.89	4,390.34

In this table, the total final energy consumption in 2010 is estimated to be 2,121 mmscfd (as for natural gas daily average consumption) and the potential demand of natural gas is estimated around 10 mmscfd. Also, the total consumption and the potential demand for natural gas is estimated to be 70 mmscfd in 2025, based on total energy consumption, which is estimated to be 4,390 mmscfd.

Table 4-5-10 shows the results of estimated natural gas potential demand in the Philippines as a whole and the target area. The natural gas potential demand in the Philippines as a whole is estimated to be 69.79 mmscfd in 2025, and that of the target area total is estimated to be 51.79 mmscfd as a result.

Table 4-5-10 Potential Gas Demand by Area (Low Case)

(mmscfd)

		2000	2005	2010	2015	2020	2025
<Potential Gas Demand>							
Philippine	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 Area	**Total**	7.54	3.73	7.68	16.00	28.75	51.71
<Total Energy Demand>							
Philippine	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 Area	**Total**	**785.58**	**1,040.51**	**1,344.06**	**1,731.87**	**2,216.18**	**2,815.18**
<Conversion Ratio>							
Philippine	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 Area	**Total**	**0.96%**	**0.36%**	**0.57%**	**0.92%**	**1.30%**	**1.84%**

The ratio of natural gas potential 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 NCR, 1.28% in Area C-M, 1.27% in Area L-2, 1.23% in Area D, and 1.16% in Area L-3.

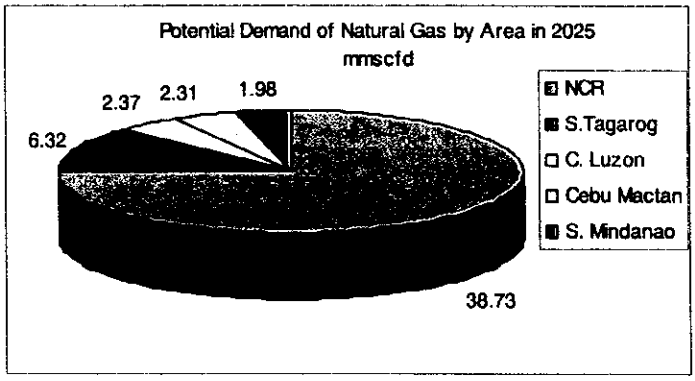

Figure 4-5-30 Potential Gas Demand in the Target Area (Low Case)

Table 4-5-11 shows the result of projection of potential gas demand by sector. Substitution in the industrial and transportation sectors are very slow, but natural gas use is expected in the residential and commercial sectors.

Table 4-5-11 Projection of Potential Gas Demand by Sector (Low case)

(mmscfd)

		2000	2005	2010	2015	2020	2025
<Potential Gas Demand>							
Total		7.54	3.73	7.68	16.00	28.75	51.71
Industrial		0.21	0.24	0.39	0.66	1.02	1.50
Transportation		0.02	0.03	0.04	0.05	0.07	0.09
Residential		3.07	3.01	4.41	7.30	11.42	22.56
Commercial		4.25	0.45	2.84	7.98	16.24	27.56
<Target Energy Demand>							
Total		**739.57**	**987.49**	**1,279.60**	**1,651.45**	**2,115.63**	**2,695.09**
Industrial		125.46	149.18	181.42	239.03	315.38	408.48
Transportation		275.12	449.86	617.00	752.77	921.30	1,171.61
Residential		213.84	244.41	306.11	428.86	574.71	721.44
Commercial		125.14	144.04	175.08	230.79	304.24	393.56
<Conversion Ratio>							
Total		**1.02%**	**0.38%**	**0.60%**	**0.97%**	**1.36%**	**1.92%**
Industrial		0.16%	0.16%	0.22%	0.28%	0.32%	0.37%
Transportation		0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
Residential		1.43%	1.23%	1.44%	1.70%	1.99%	3.13%
Commercial		3.40%	0.31%	1.62%	3.46%	5.34%	7.00%

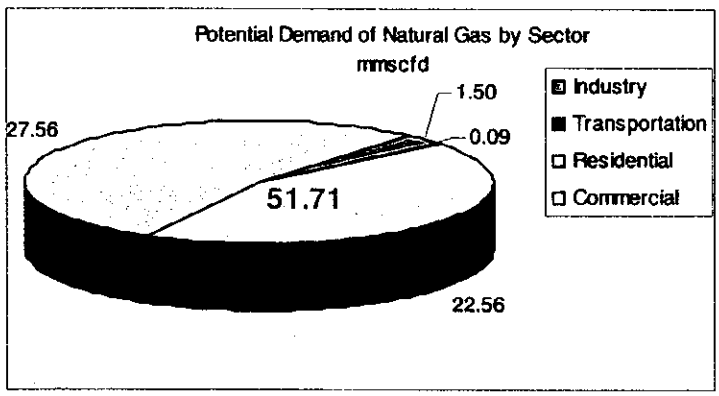

Figure 4-5-31 Potential Gas Demand by Sector (Low Case)

Table 4-5-12 shows the projection by energy carrier. Substitution for LPG is the highest following kerosene in Low case as well as in High case.

Table 4-5-12 Projection of Potential Gas Demand by Energy (Low Case)

(mmscfd)

		2000	2005	2010	2015	2020	2025
<Potential Gas Demand>							
Total		7.54	3.73	7.68	16.00	28.75	51.71
Mo Gasoline		0.01	0.01	0.02	0.02	0.03	0.04
Kerosene		2.78	2.68	3.92	6.49	9.72	13.09
Diesel		0.01	0.01	0.02	0.03	0.05	0.12
Fuel Oil		0.01	0.01	0.07	0.17	0.31	0.49
LPG		4.65	0.92	3.53	9.12	18.43	37.71
Electricity		0.08	0.10	0.12	0.16	0.21	0.26
<Target Energy Demand>							
Total		739.57	987.49	1,279.60	1,651.45	2,115.63	2,695.09
Mo Gasoline		158.42	231.00	293.07	342.61	401.37	480.44
Kerosene		49.54	56.49	70.19	97.16	129.54	162.81
Diesel		180.20	291.87	414.09	533.28	683.61	898.55
Fuel Oil		92.87	109.69	133.38	175.75	231.84	300.19
LPG		75.31	85.96	106.45	146.30	194.74	245.77
Electricity		183.23	212.47	262.43	356.35	474.54	607.33
<Conversion Ratio>							
Total		1.02%	0.38%	0.60%	0.97%	1.36%	1.92%
Mo Gasoline		0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
Kerosene		5.61%	4.75%	5.59%	6.68%	7.50%	8.04%
Diesel		0.00%	0.00%	0.01%	0.01%	0.01%	0.01%
Fuel Oil		0.01%	0.01%	0.05%	0.10%	0.14%	0.16%
LPG		6.18%	1.07%	3.32%	6.24%	9.47%	15.34%
Electricity		0.05%	0.05%	0.04%	0.04%	0.04%	0.04%

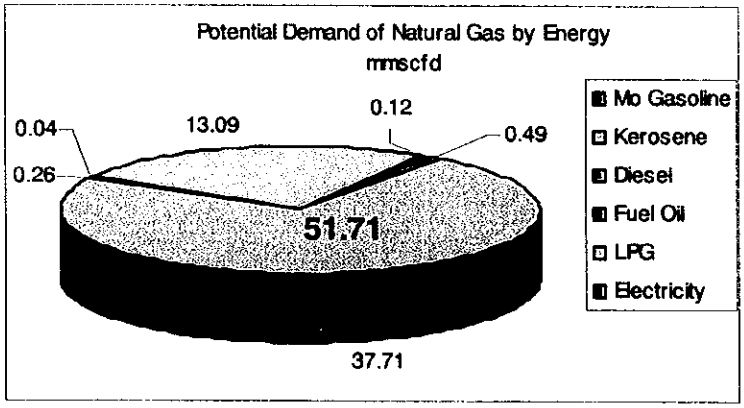

Figure 4-5-32 Potential Gas Demand by Energy Carrier (Low Case)

The sensitivity of potential demand of natural gas along with natural gas price is described above; it is also sensitive in the Low case. The estimated potential demand will increase sharply from 70 mmscfd in 2025 for current estimation to 200 mmscfd when natural gas price become only 10% lower than original setting.

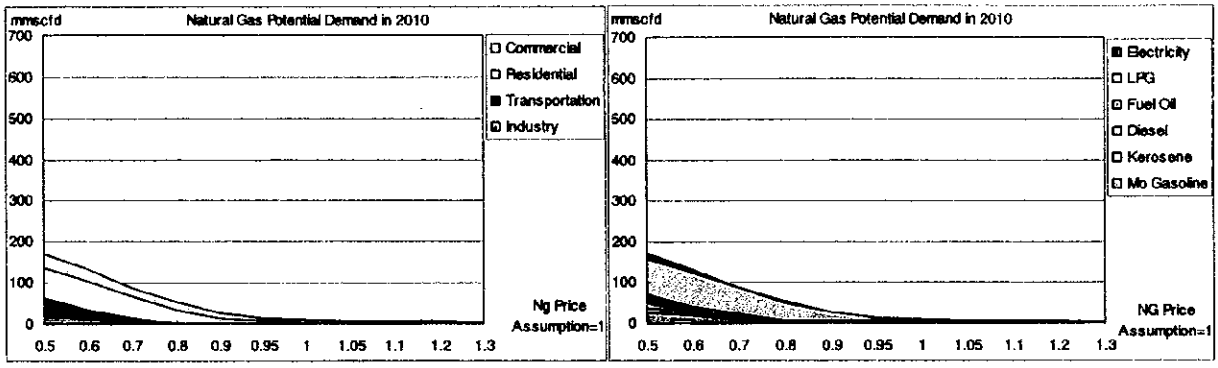

Figure 4-5-33 Potential Demand for NG in the Philippines for NG Price in 2010 (Low Case)

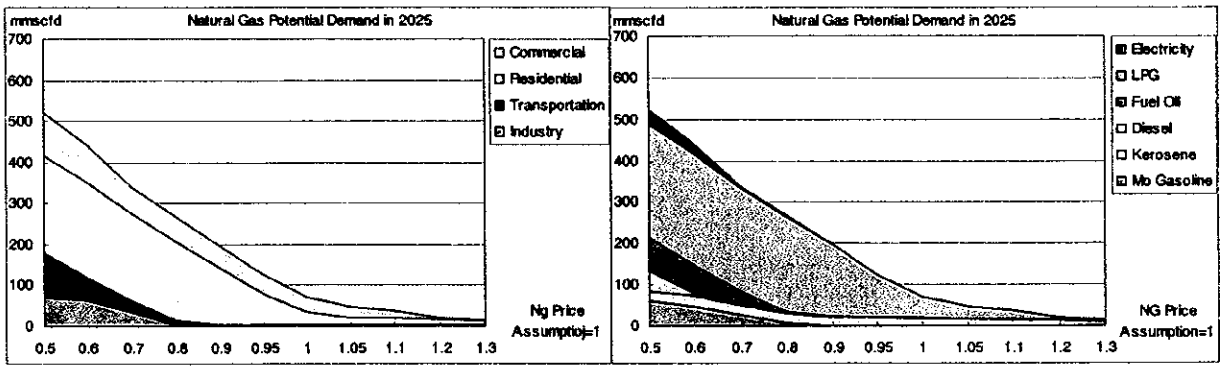

Figure 4-5-34 Potential Demand for NG in the Philippines for NG Price in 2025 (Low Case)

The figures above are for the Philippines as a whole. Potential demand in the target areas is roughly estimated at around 74% of it.