PART II

MASTER PLAN

Chapter 7

Principles of the Master Plan

PART II MASTER PLAN

7. Principles of the Master Plan

7.1 Master Plan Area

The Team has defined the coverage area of the Master Plan as the area comprising Jatabek (Metropolitan area comprising Jakarta, Tangerang and Bekasi) and Kab. Karawang, and covers the houses, commercial facilities and industrial customers located within 5 to 10km radius from the existing main pipelines.

Furthermore, the potential demand in Kab.Serang area will be also considered in discussing gas supply and transmission capacities of the Sumatra-Java pipelines under planning.

7.2 Major Contents of the Master Plan

The Master Plan includes potential gas demand projections under the gas network constraints (we define it as the "possible gas demand"), distribution network plans, business improvement plans, economic and financial analyses, environmental and social assessment and recommendations.

7.3 Starting Year and Demands

The strategy for sale of urban gas given in this Study may be fruitful as the result of actual sale, at the earliest, from 1998. Therefore, this Master Plan assumes that the relevant marketing activity and pipeline expansion work will be carried out in 1997 and the results be reflected in the annual gas sales in the next year.

PGN's 1996 actual gas sales amount and 1997 expected gas sales amount, in rounded figures, will be employed as the base before adding the demand estimates of this Master Plan beginning in 1998.

Table 7-1-1 Actual and Expected Gas Sales Amount by PGN

		1994	1995	1996	1997 (Expected)
Gas sales in volume unit (Km^3)	Residential	2,478	2,490	2,274	2,766
	Commercial	6,838	7,469	10,234	13,212
	Industrial	613,305	750,734	877,599	960,411
	Total	622,621	760,693	890,107	976,389
Number of customers	Residential	8,874	9,057	9,670	11,135
	Commercial	266	186	168	162
	Industrial	159	186	211	215
	Total	9,299	9,429	10,049	11,512

Source : PGN

Chapter 8

Residential Gas Market

8. Residential Gas Market

In 1994, energy demand in Indonesia was 47.29 million toe (ton oil equivalent), with consumption of the residential sector accounting for 21.2 % of the total. The annual growth rate of this sector's consumption was about 6.23% for the period during 1985 to 1994.

The number of households in 1994 was 40.86 million. Energy consumption per household was 0.64 toe including non-commercial energy. This figure is equal to about 1/4 to 1/5 of Japan's consumption for the same year.

8.1 Current Situation of Energy Demand in the Residential Sector

(1) Structure of Fuel Demand

In Indonesia, the bulk of fuel demand in the household is mainly accounted for by home cooking. Table 8-1-1 shows the structure of cooking fuel demand in both urban and rural households. The table indicates different fuel sources in each household. Urban households depend on kerosene as its major fuel source, while rural households on firewood. Looking at energy sources for cooking in urban households, the whole of Indonesian urban households depend on kerosene by 66%, followed by firewood by 16%, and urban gas & LPG (hereinafter lumped together as "gas") by 10%. On the other hand, households in DKI Jakarta depend on kerosene for 72% of total fuel consumption and 19% on gas.

Table 8-1-1 Fuel-Mix for Cooking by Source

1994 (Unit :%)

Urban	Electricity	Gas/LPG	Kerosene	Firewood	Charcoal	Others	Total
DKI Jakarta	5.85	19.34	72.00	0.30	0.60	1.92	100
Jawa Barat	6.28	12.30	73.19	6.84	0.36	1.02	100
Indonesia	5.73	10.47	65.91	16.21	0.47	1.21	100
Rural	Electricity	Gas/LPG	Kerosene	Firewood	Charcoal	Others	Total
DKI Jakarta	-	-	-	-	-	-	-
Jawa Barat	3.71	0.56	7.47	87.67	0.15	0.43	100
Indonesia	2.85	0.71	14.37	81.37	0.36	0.33	100
Total	Electricity	Gas/LPG	Kerosene	Firewood	Charcoal	Others	Total
DKI Jakarta	5.85	19.34	72.00	0.30	0.60	1.92	100
Jawa Barat	5.03	5.27	49.18	39.74	0.21	0.58	100
Indonesia	3.85	4.10	32.24	58.78	0.40	0.63	100

Source: Housing and Settlement Statistics 1995

(2) Fuel for Cooking by Household Expenditure

Table 8-1-2 shows inter-relations between monthly urban household expenditure and cooking fuel sources. This table indicates that 42% of the household with expenditure over 500,000 Rupiah depend on gas while households with expenditures less than 40,000 Rupiah never depend on gas. This table explains that the choice of energy source is inter-related with the economic level of households.

Table 8-1-2 Fuel-Mix for Cooking by Monthly Expenditure (1994)

Urban Area (Unit: %)

Monthly Expenditure Range - Rp	Electricity	Gas/LPG	Kerosene	Firewood	Charcoal	Others
<30.000	-	-	29.11	69.03	-	1.86
30,000 - 39,999	2.51	-	45.33	52.16	-	-
40,000 - 49,999	5.96	0.84	32.81	55.72	-	4.67
50,000 - 74,999	4.42	0.75	42.46	50.45	0.98	0.95
75,000 - 99,999	5.99	0.54	47.15	42.36	0.65	3.31
100,000 - 149,999	5.89	0.96	58.23	32.23	0.40	2.29
150,000 - 199,999	5.18	1.37	68.28	23.25	0.21	1.71
200,000 - 299,999	6.35	3.76	74.50	13.98	0.26	1.15
300,000 - 399,999	6.32	9.46	75.52	7.70	0.38	0.61
400,000 - 499,999	4.68	19.59	69.87	4.63	0.68	0.54
>500,000	5.15	41.63	49.75	2.07	1.14	0.26
Indonesia	5.73	10.47	65.91	16.21	0.47	1.21

Source: Housing and Settlement Statistics 1995

8.2 Method and Results of the Survey

8.2.1 Method of the survey

Questionnaire and interview surveys were conducted in addition to collecting and analyzing statistical data on energy consumption. Many residential estates were developed and are under planning to result in population concentration to DKI Jakarta. Particularly, the concentration has been serious in Tangerang, Western Bekasi and Southern Jakarta. These 3 regions were selected for this study.

Following discussions with PGN, questionnaire sheets were distributed among 45 study areas considering the characteristics of each region (income level, family size, type of house, etc.).

For the interview survey, 207 families in 33 districts were visited. Research was made on consumption of fuels and electricity and energy using equipment. The possibility of use of urban gas was discussed with each family. The interview survey was divided into five income levels because there is a big difference in energy consumption between income levels in Indonesia.

8.2.2 Results of the Survey

Using the results of the questionnaire and interview surveys, the present situation of the energy demand is summarized in Table 8-2-3. As shown in this table, for the high-income families(monthly household income of which is more than 5 million Rupia), electricity consumption per household averages 1,527 kWh/month. All families in this category use gas at an average of 335Mcal monthly. For low-income families (the monthly income of less than 400 thousand Rupia), the electricity consumption per household averages 150 kWh/month. And gases are used by 21% of the low-income families.

Table 8-2-3 Results of Questionnaire Survey and Interview

Monthly Income Range Thousand Rupia	Simple Size	Fuel Consumption per Household	Electricity Consumption Per Household	Share of each fuels LPG	Kerosen	Urban Gas
Questionnaire Survey						
		kcal	kWh	%	%	%
<200	125	215,602	121	28.45	45.69	25.86
>200 and <400	257	241,774	158	32.78	29.46	37.76
>400 and <1,000	258	244,617	291	76.92	12.82	10.26
>1,000 and <5,000	283	332,703	903	97.62	1.98	0.40
>5,000	67	435,875	1,649	80.00	0.00	20.00
Interview Survey						
Monthly Income Range Thousand Rupia	Simple Size	Fuel Consumption per Household	Electricity Consumption Per Household	Share of each fuels LPG	Kerosen	Urban Gas
		kcal	kWh	%	%	%
<200	19	245,287	150	21.05	57.89	21.05
>200 and <400	75	269,874	160	40.00	53.33	6.67
>400 and <1,000	61	255,004	233	73.77	21.31	4.92
>1,000 and <5,000	25	266,356	450	88.00	12.00	0.00
>5,000	27	334,549	1,527	59.26	0.00	40.74

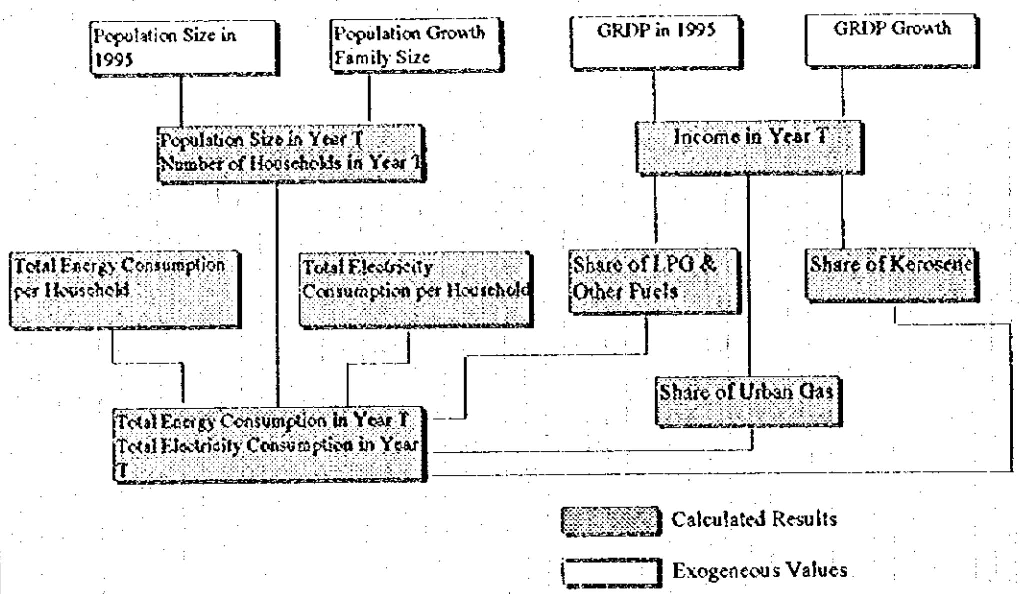
Source: By JICA Team

8.3 Forecasting Energy Demand in the Residential Sector

8.3.1 Methodology of Forecasting Demand

There are two main methods for forecasting energy demand; one is called the engineering method, which is basically the bottom-up method using the energy efficiency and the specific energy consumption, and the other called the econometric method, which uses macro-economic and energy indexes. In this study, the latter was mainly applied for forecasting demand. Fig. 8-3-1 shows a flow chart for forecasting energy demand.

Fig. 8-3-1 Flow Chart of Urban Gas Demand Model



8.3.2 Model for Forecasting Energy Demand

In forecasting energy demand, we employed the bottom-up method only for the volume of demand for urban gas for the period of 1997-2004. For other fuels, a functional formula on the demand based on the figures of 1995 was used in forecasting.

The following procedures were used in forecasting household energy demand:

(1) Bottom-up Model (for the period 1997-2004)

1) The following bottom-up method is applied to the volume of urban gas demand:

Urban gas demand = Σ (Number of urban gas customers × the specific fuel consumption per household)

2) The urban gas demand (1997-2004) forecast according to the above method is to be used as the known figures for the econometric model below.

(2) Econometric model (for the period 1995-2020)

The energy demand in the residential sector is divided into electricity and fuel in the model. They are forecast, respectively, using the following functions:

1) **Electricity Demand = F (GRDP per capita, (average) family size, Electricity consumption in the previous year)**

2) **Fuel Demand = F (GRDP per capita, family size, fuel consumption per household)**

3) In summing up demand volumes of electricity and fuels, total energy demand for the household is obtained. Additionally, the total energy demand itself is forecast according to the following function:

Total Energy Demand = F (GRDP per capita, family size, energy consumption in the pervious year)

4) Taking competition among fuels into consideration, the shares of demand for LPG, kerosene, and other fuels are estimated according to the following function:

Share of each fuel = F (GRD per Capita, LPG, kerosene, other fuels)

5) Finally, under a constraint condition within which other fuel demands are computed, the demand volume of urban gas is forecast according to the following function with yearly lags built-in for making a super-long-term demand forecast.

Urban Gas Demand = F (GRDP per capita, family size, urban gas consumption in the previous year)

The model is simulated in three cases which are (a) Base case, (b) High case, and (c) Low case. Exogenous valuables are shown in the table 8-3-1.

Table 8-3-1 Scenario Setting

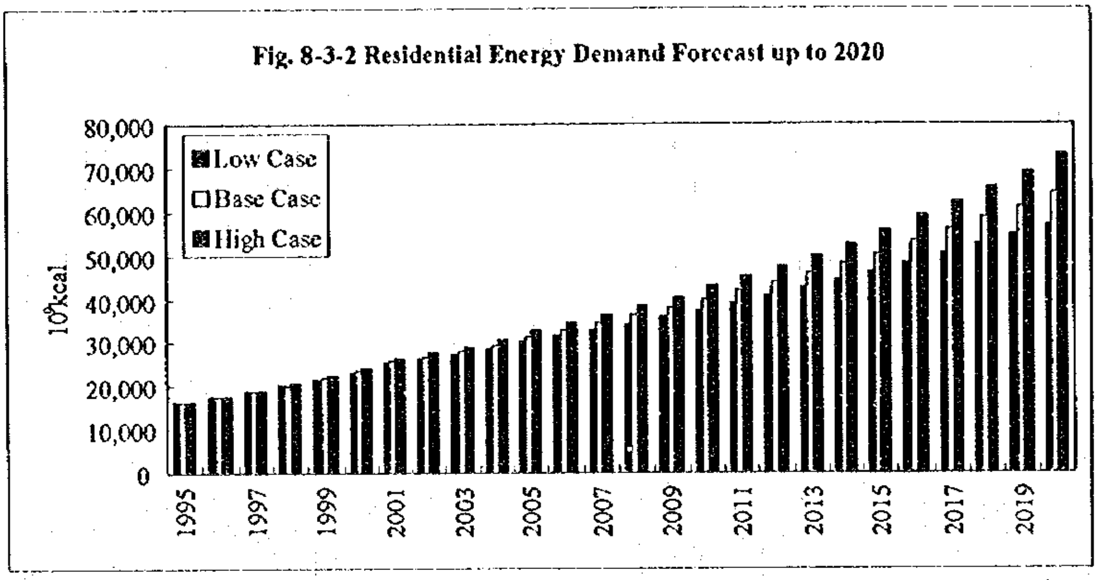
	Until 2000	2001-2010	2011-2020
Population Growth Rate	5,0	2,5	2,5
Family Size	4,8	4,6	4,5
GRDP Growth Rate:			
High Case	8,1	8,3	10,3
Base Case	7,7	7,6	7,9
Low Case	7,3	6,7	5,3

Source: JICA Team

8.3.3 Energy Demand Forecast

(1) Total of Energy Demand

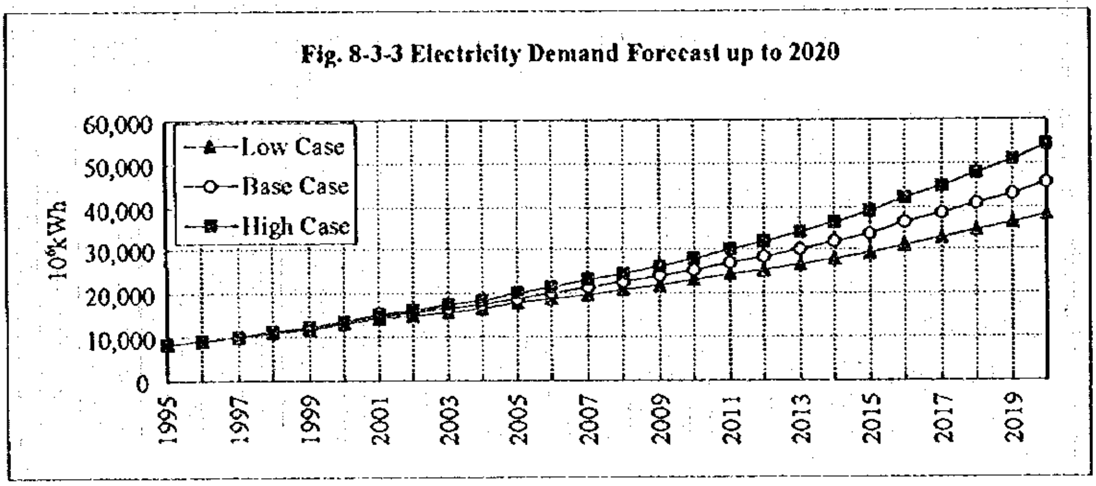
Fig. 8-3-2 presents the total of energy demand up to 2020. In the Base case, the total energy demand will reach 6.43 Mtoe (million tons oil equivalent, 1toe=10^7kcal) in the DKI Jakarta region.



Source: JICA Team

(2) Electricity Demand

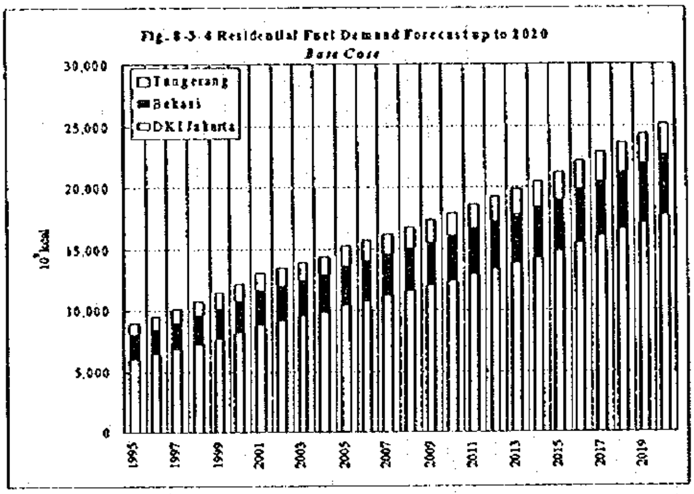
Fig. 8-3-3 shows the forecast of the demand until the year 2020 using each scenario (Low, Base and High case). In the Base case, 8,389 GWh recorded in 1995 is likely to rise to 45,468 GWh by 2020. The average growth rate is 6.99% per year.



Source: JICA Team

(3) Fuel Demand

The highest demand growth is noted in DKI Jakarta, where the demand is likely to grow from 0.6 Mtoe in 1995 to 1.4 Mtoe by 2005 (up 5.6% per year) and to 1.8 Mtoe (up 3.6% per year) by 2020 in the Base case (See Fig. 8-3-4).

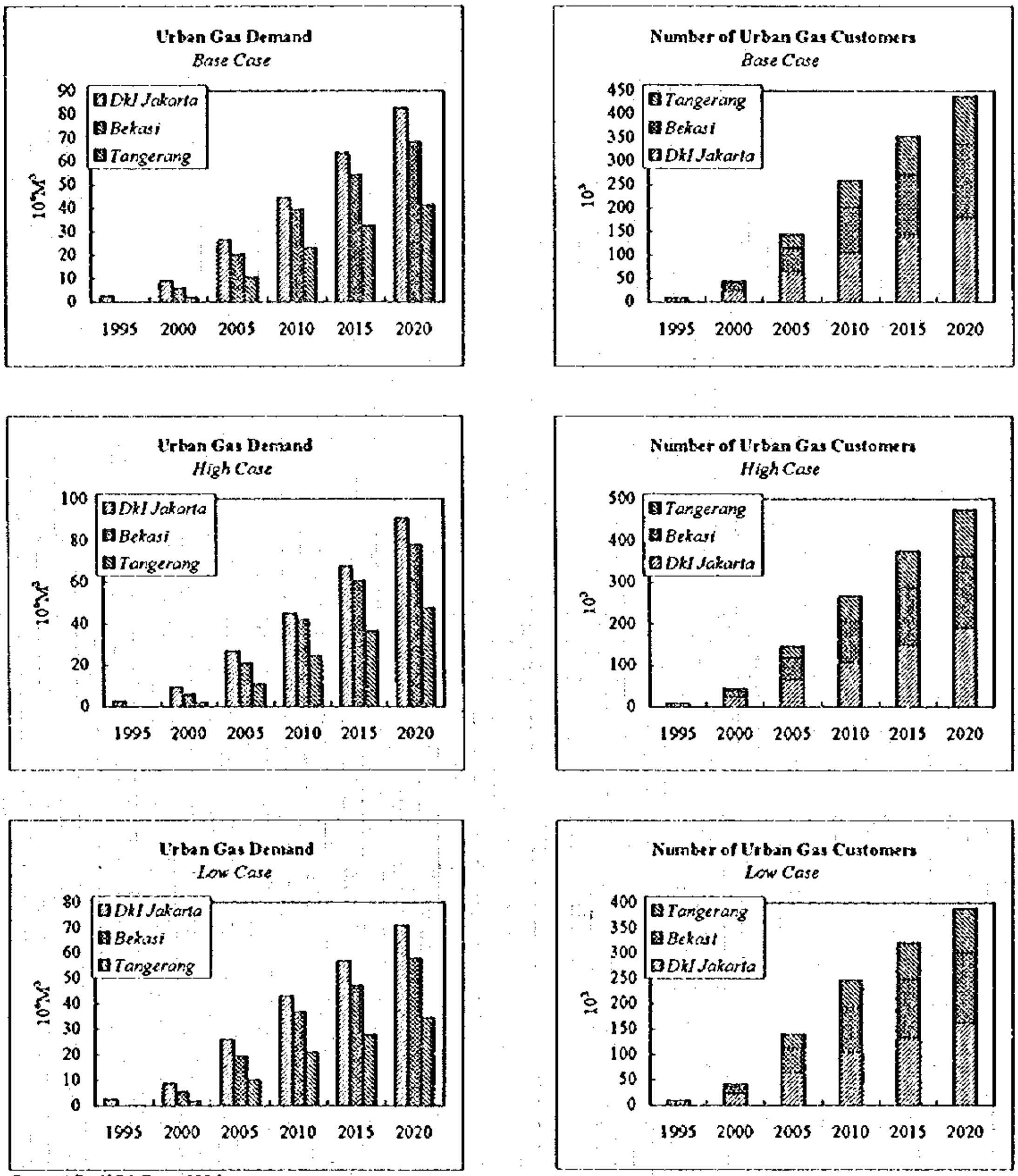


Source: By JICA Team

(4) Urban Gas Demand

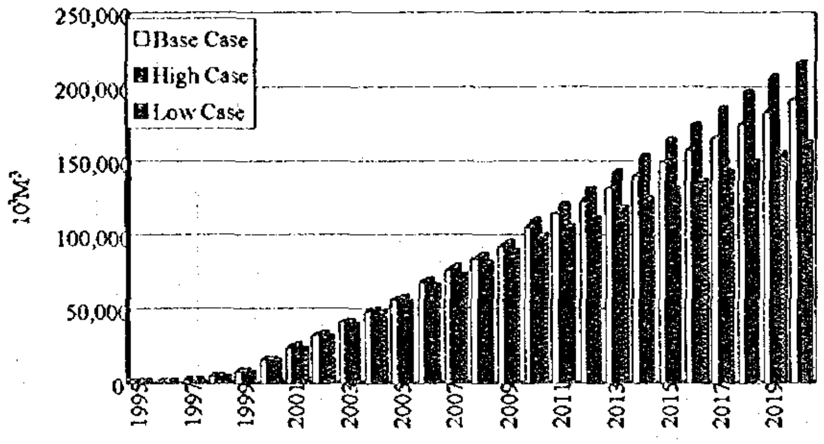
The forecast of demand is summarized in Fig. 8-3-5, which also shows the forecast of number of customers up to the year 2020 by scenario (Low, Base and High cases). Forecast of the demand for urban gas by scenario is also shown in Fig. 8-3-6. Fig. 8-3-7 shows the demand forecast by region (Base case).

Fig. 8-3-5 Urban Gas Demand Forecast up to 2020



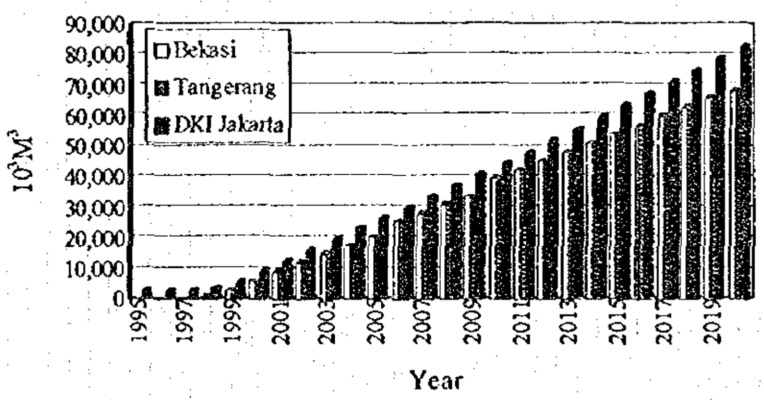
Source: By JICA Team 1996

Fig. 8-3-6 Urban Gas Demand up to 2020



Source: by JICA Team

Fig. 8-4-7 Urban Gas Demand by Region (Base Case)



Source: JICA Team

8.4 Conclusion

Based on the above forecasts, the residential gas demand in the Jakarta area will grow by 36.8% per year from 2.49Mm^3 (million cubic meters) in 1995 to 57.19Mm^3 by 2005. This represents 22.97 times the demand in 1995. From 2005 and on, the demand will increase by 8.4% per year to reach 192.04Mm^3 by 2020,which is 3.4 times the 2005 demand.

Not surprisingly, deviations from the base case keep widening in the every target year. The results of the urban gas demand forecast by region are summarized in table 8-4-1.

Table 8-4-1 Result of Simulation

Unit: 10^3M^3

Area	Case	Actual	Projection		Growth Rate	
		1995	2005	2020	05/95	20/05
Beksia	Base	0	20,298	68,182		8.4
	High	0	21,016	78,083		9.1
	Low	0	19,195	57,881		7.6
Tangerang	Base	109	10,536	41,386	58.0	9.5
	High	109	10,926	47,659	58.5	10.3
	Low	109	10,062	34,469	57.2	8.6
DKI Jakarta	Base	2,381	26,353	82,475	27.2	7.9
	High	2,381	26,585	90,713	27.3	8.5
	Low	2,381	25,707	70,670	26.9	7.0

Source: By JICA Team

1) DKI Jakarta

In the Base case, regional demand for the residential sector is assumed to be 26.4 Mm^3 with the projected growth rate at 27.18% per year until 2005. With a projected growth rate of 7.9% per year between 2005 and 2020, demand will reach 82.6 Mm^3 in 2020.

2) Bekasi

Bekasi is the largest prefecture in West Java. The area is characterized by the presence of many big low-mid income residential estates near the existing urban gas pipelines. The regional demand for the residential sector is forecast to be 6 Mm^3 in 2000, and 20.3 Mm^3 in 2005. With a projected growth rate of 8.4% per year between 2005 and 2020, demand will reach 68.18 Mm^3 in 2020.

3) Tangerang

Tangerang is to the west of DKI Jakarta and has a new city of the same name in it. There are many new residential estates being developed by private developers there. The local government is planning to develop four sub-cities before the year 2010. Urban gas demand for the residential sector is forecast to be 10.54 Mm^3 in 2005, and 41.39 Mm^3 in 2020. The average growth rate is 9.5% per year between 2005 and 2020.

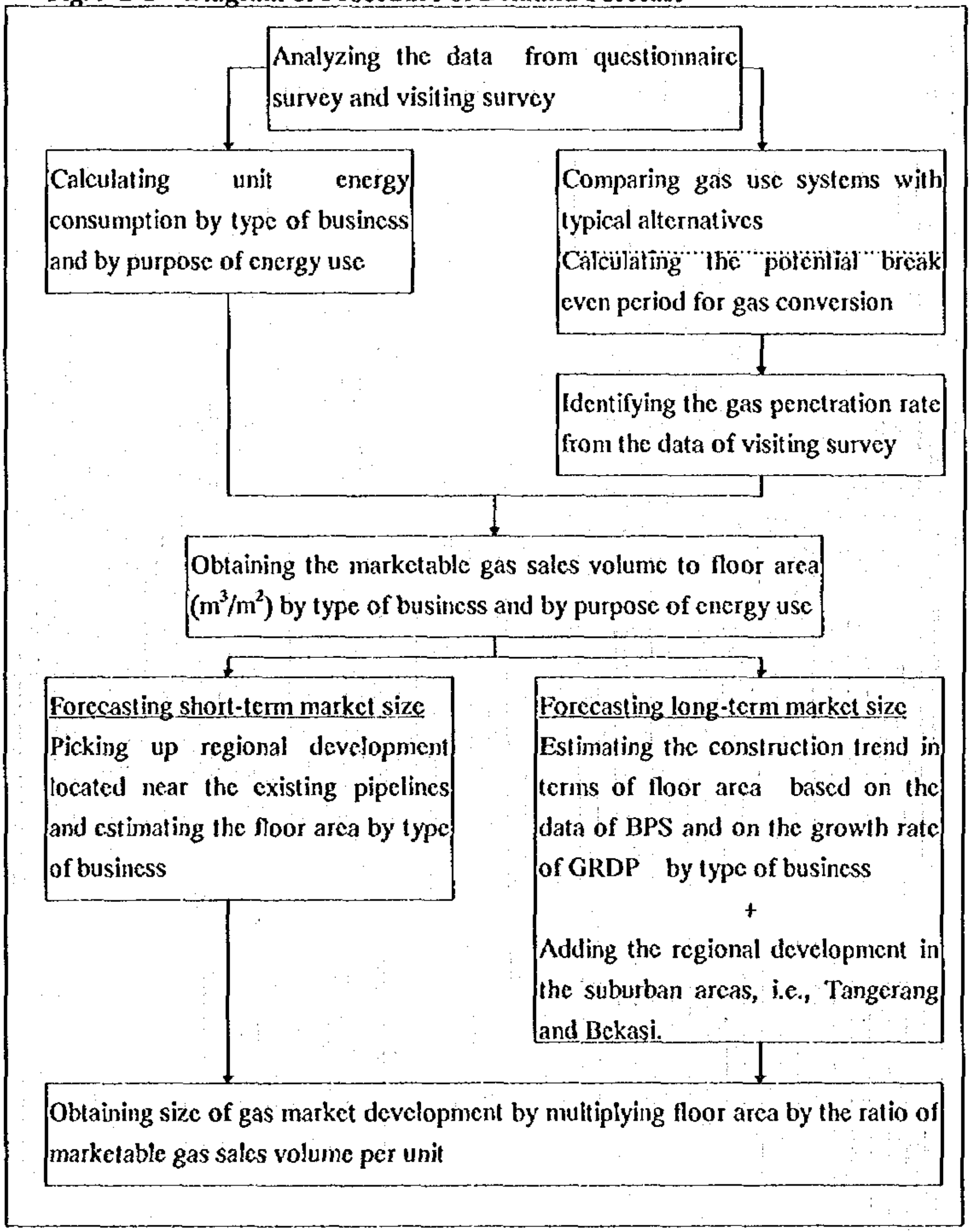
Chapter 9

Commercial Gas Market

9. Commercial Demand Projection

9.1 Methodology of Demand Forecasting in the Commercial Sector

Fig. 9-2-1 Diagram of Procedure of Demand Forecast



Source: JICA Team

9.2 Findings in the Survey

9.2.1 Unit Energy Consumption by Type of Business and Gas Use

Unit energy consumption by type of business is indicated by thermally equivalent gas volume:

Table 9-2-1 Unit Energy Consumption by Type of Business (m3/m2.y)

	Cooking	Boiler	A.C.Abs.	Power Gen.
Office	1.50	-	23.303	24.81
Hotel	3.45	15.93	32.006	73.72
Hospital	1.44	11.07	30.299	39.48
Shopping	3.09	-	38.073	70.83

Source: JICA Team

9.2.2 Marketable Gas Sales Volume Unit

Using the energy consumption per unit floor area and the rate of gas penetration, the marketable gas sales volume per unit area is determined.

Table 9-2-2 Marketable Gas Sales Per Unit Area ($m^3/m^2.y$)

	Cooking	Boiler	A.C.Abs.	A.C.GHP	Power Gen.
Office	1.50	-	9.39	0	0
Hotel	3.45	13.54	27.08	0	0
Hospital	1.44	4.43	13.77	0	0
Shopping	3.09	-	27.96	3.46	0

Source: JICA Team

9.3 Urban Gas Demand in the Commercial Sector

9.3.1 Projection of Gas Market Development until 2000 (Short-term Estimation)

New land development are located near existing pipelines have been selected for study.

Table 9-3-1 Land Developments Located Near Existing Pipelines

	Number of sites	Average ha	Total ha	Estimating floor area (m2)			
				Office	Hotel	Hospital	Shopping
Tangeran	7	Over 1000	16,000	2,324,200	386,000	439,040	2,152,440
	3	750					
	2	357					
	4	175					
	4	75					
DKI	1	1,000	6,625	192,125	172,250	212,000	470,375
	5	750					
	1	375					
	6	175					
	6	75					
Bekasi	2	1,000	3,475	100,775	90,350	111,200	246,725
	1	750					
	2	175					
	5	75					

Source: RUMAH UNTUK ANDA 1195 (Note) Detail of the land development in Tangerang over 1,000 ha is shown in Appendices

Assuming that a regional development lasts 20 years, annual gas demand is calculated as the total demand divided by 20.

Table 9-3-2 Short-term Gas Market Development (1,000m^3/y)

	Cooking	Boiler	Air Conditione	Total
1997	0	0	0	0
1998	806	608	158	1,573
1999	806	608	317	1,731
2000	806	608	475	1,890

Source: JICA Team

9.3.2 Projection of Gas Market Development after 2005 (Long-term Estimation)

We estimated the volume of gas market development per year in the suburban areas as follows:

Table 9-3-3 Gas Market Development in Suburban Areas (1,000m3/y)

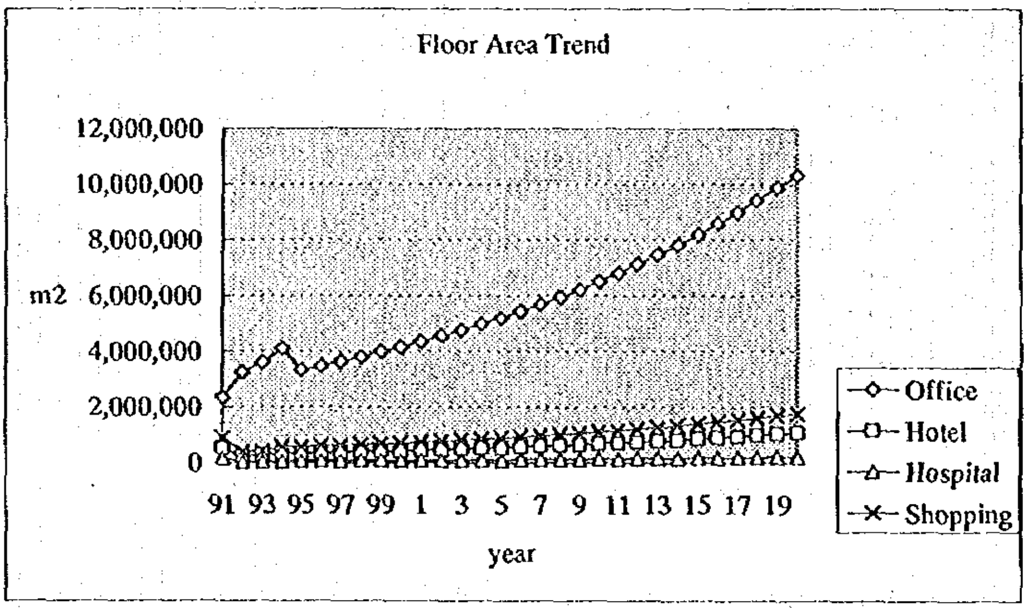
	Cooking	Boiler	r Conditio	Total
Tangerang	605	359	5,297	6,261
Bekasi	69	86	634	789
Total	674	444	5,931	7,049

Source: JIKA Team

Below, we explain the demand estimation in DKI, and then we discuss the total gas market development adding the figures of Table 9-3-3.

The results of the estimation of floor areas are shown in Fig. 9-3-1 for the Base Case by type of business.

Fig. 9-3-1 Construction Forecast by Case



source : STATISTIK BANGUNAN/KONSTRUKSI 1994

We calculate the long-term gas market development, which means the increase of gas sales each year, using the forecast of the floor areas by type of business (Fig. 9-3-1), unit of marketable gas sales (Table 9-2-2) and the density of gas pipelines. The result is shown in Table 9-3-4.

Table 9-3-4 Long-term Gas Market Development in DKI by Case (1,000m3/y)

Case	Item	2005	2006	2007	2008	2009	2010	2015	2020
Base	Cooking	2,016	2,174	2,341	2,520	2,710	2,913	4,168	5,879
	Boiler	1,268	1,367	1,472	1,585	1,704	1,832	2,621	3,697
	Air Conditionin	14,899	16,065	17,307	18,628	20,034	21,530	30,807	43,457
	Total	18,182	19,606	21,121	22,734	24,449	26,274	37,596	53,034
High	Cooking	2,080	2,252	2,436	2,632	2,842	3,067	4,698	7,096
	Boiler	1,308	1,416	1,532	1,655	1,787	1,929	2,955	4,462
	Air Conditionin	15,376	16,646	18,005	19,457	21,010	22,669	34,729	52,451
	Total	18,764	20,314	21,972	23,745	25,640	27,664	42,382	64,009
Low	Cooking	1,942	2,083	2,232	2,390	2,558	2,734	3,630	4,750
	Boiler	1,221	1,310	1,404	1,503	1,608	1,719	2,282	2,987
	Air Conditionin	14,353	15,396	16,500	17,669	18,904	20,210	26,828	35,109
	Total	17,515	18,789	20,137	21,562	23,070	24,664	32,740	42,846

Source: JICA Team

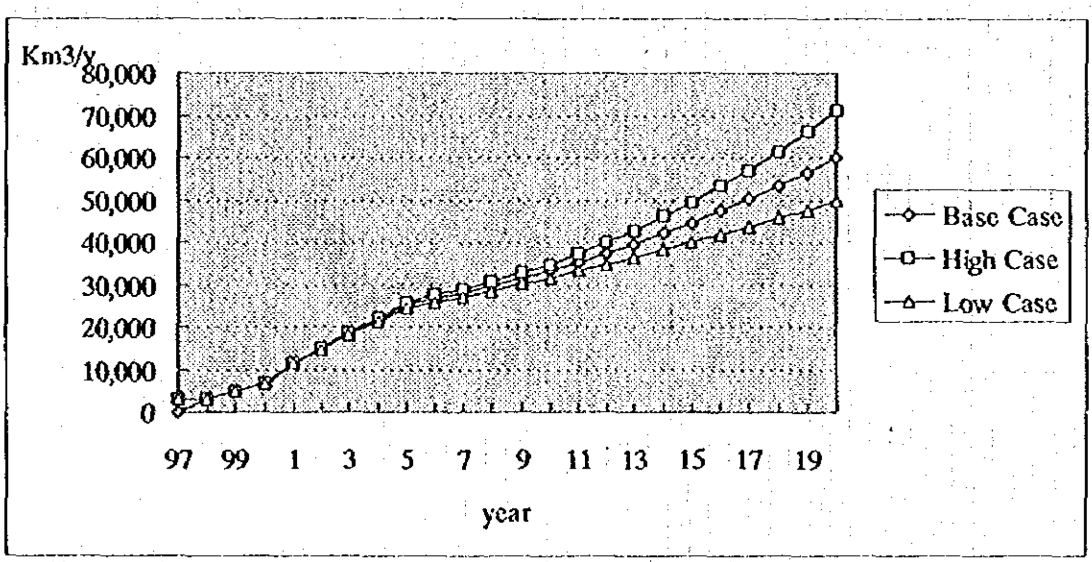
9.3.3 Projection of Gas Market Development from 1997 until 2020

The total gas development from 2005 until 2020 in Jatabek was calculated by adding the figures in Table 9-3-3 and those in Table 9-3-4.

We linked 2000 and 2005 by a strait line.

Gas market development by year from 1997 until 2020 is shown in Fig. 9-3-2.

Fig. 9-3-2 Gas Market Development by Case

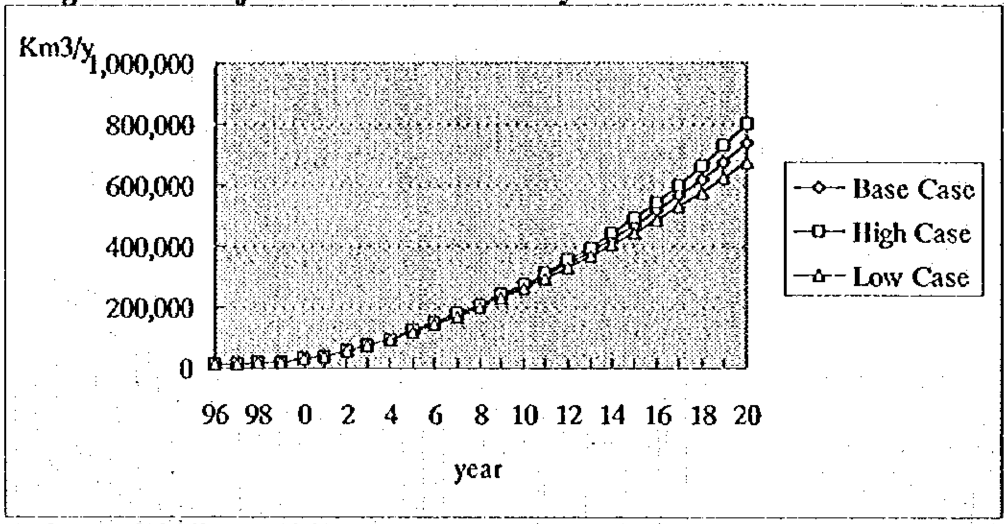


Source: JICA Team; K=1,000

9.3.4 Cumulative Gas Demand Projection

In 1996 gas sales volume for the commercial sector was 10 million m^3 and that in 1997 is estimated as 13.212 million m^3 by PGN. From 1998 until 2020, using the result of the estimation of gas development, cumulative gas demand is calculated and the result is shown in Fig. 9-3-3.

Fig. 9-3-3 Projection of Gas Demand by Case



Source: JICA Team K=1,000

9.4 Assumption on Major Commercial Gas Appliances

Table 9-4-1 Assumption on Major Gas Appliances

			1997	1998	2000	2005	2010	2015	2020
Cooking	Max. gas flow rat	Increase	0	806	806	2,690	3,587	4,842	6,554
	m3/h	Cumulativ	0	806	2,419	12,102	28,132	49,676	78,812
Boiler	Ton/h	Increase	0	6.6	6.6	16.6	21.8	29.2	39.2
		Cumulativ	0	6.6	19.9	83.0	181.0	311.3	485.9
	Max. gas flow rat	Increase	0	502	502	1,253	1,648	2,200	2,953
		Cumulativ	0	502	1,505	6,257	13,656	23,482	36,649
Air Con.	RT	Increase	0	1,822	5,466	24,055	32,039	43,211	58,443
		Cumulativ	0	1,822	10,932	96,941	240,180	432,492	692,374
	Max. gas flow rat	Increase	0	625	1,875	8,251	10,990	14,821	20,046
		Cumulativ	0	625	3,750	33,251	82,382	148,345	237,484

Source: JICA Team

9.5 Projection of Numbers of Customers

Table 9-5-1 Projection of Numbers of Customers

		1997	1998	2000	2005	2010	2015	2020
Cooking	Increase	0	27	27	126	172	237	324
	Cumulativ	0	27	80	511	1,274	2,320	3,755
Boiler	Increase	0	4	4	7	9	11	15
	Cumulativ	0	4	11	39	79	130	198
Air Con.	Increase	0	3	10	57	77	105	143
	Cumulativ	0	3	20	215	556	1,021	1,656

Source: JICA Team

Chapter 10

Industrial Gas Market

10. Industrial Gas Market

10.1 Current Situation of Energy Supply and Demand in the Industrial Sector

(1) Study area and energy supply and demand

Industrial areas in five prefectures (Kapupatens) including DKI Jakarta, Tangerang, Bekasi, Karawang and Purwakarta in West Java were selected for this study. They are covered by PGN Jakarta Branch. Besides these areas, Kapupatens Serang and Bogor in West Java have also developed number of large industrial estates.

In recent years, the fuel demand for industrial use in the areas described above has rapidly increased following the growth of newly developed industrial estates and the growth of energy intense industries such as chemical, glass, paper/pulp and bricks. Diesel oil and kerosene have been mainly used in these industries. However, conversion to different fuels has been rapidly progressing since 1991. Conversion has been occurring from these fuels to urban gas and C grade heavy oil, the share of which has been about 70 % of total fuel use in factories in some areas.

(2) Changes in energy supply and demand structure in the industrial sector

Types of fuels used in factories in the industrial estates in the various Kabupatens of West Java Province and DKI Jakarta are currently in transition from diesel fuel oil and kerosene to urban gas and C grade heavy oil. Diesel fuel oil and kerosene have been traditionally the primary industrial fuels in these regions. Gradual change to urban gas, however, began in the latter half of the 1980s. In the Study area, rapid and large-scale change to C grade heavy oil began approximately three years ago, and this fuel is now used as the fuel in factories in a quantity almost equal to the quantity of urban gas used in factories

Industries currently using C grade heavy oil include such a great number of industries as glass, textile, chemical, and metalworking. C grade heavy oil is also used in a variety of applications including furnaces, boilers, and in-house power generating plants. The fact that the use of this fuel is not limited to any specific industrial sector or application is shown in the Indonesian Statistical Office (BPS) "Quantity of fuel and lubricant industrial code, 1985-1994".

(3) Fuel selection in factories

It is presumed that a primary factor behind the ongoing fuel conversion is price differences among fuels. Two kinds of diesel fuel oil, HSD (High Speed Diesel) and IDO (Industrial Diesel Oil), were delivered at the prices of 4.59 US$/mmBtu and 4.25 US$/mmBtu in 1993, respectively. And the price of kerosene was 3.47 US$/mmBtu

(1993). On the other hand, the sales price of urban gas by PGN was 2.45-2.85 US$/mmBtu (1994) and the price of C grade heavy oil was 2.69 US$/mmBtu (1993).

Consequently, the idea of fuel conversion from diesel fuel oil and kerosene to C grade heavy oil and the urban gas attracted many factories in Indonesia.

10.2 Results of the Site Survey

10.2.1 Method of the Site Survey

The examination of factory fuel use in the Study areas was carried out through two methods - the questionnaire survey and interview survey. The number of factories examined are as follows:

Number of factories which received questionnaires	300
Number of factories which responded to questionnaires	139
Number of factories interviewed	54
Number of industrial estate offices interviewed	8

10.2.2 Characteristics of the Study areas

According to the interview survey with operating factories, firms constructing factories and industrial estate offices, the prospects for future industrial development in West Java can be summarized as follows:

In Tangerang, factories can be constructed and expanded mainly in existing estates. Because the initial industrial development plan for Tangerang was insufficient, factories and agricultural villages were established mixed by, causing considerable traffic congestion and adverse effects on environment. In the future, Tangerang will be developed for residential and commercial purposes to serve DKI Jakarta.

Construction of factories on new sites is not encouraged in Tangerang and DKI Jakarta. The construction of new factories in West Java will be approved, however, with their construction in existing industrial estates being given priority. In contrast, large industrial estates have been approved in Bekasi, Karawang, Purwakarta and Serang, and their development is making progress. Factories have begun operation in some estates, while additional sites are currently being prepared.

Factory relocation from West Java, and construction of new factories in industrial regions outside West Java are strongly promoted. In this case, constructions in existing industrial estates and industrial zones are given priority.

It is recognized that consistent industrial development in West Java is advancing under the administrative guidance of central and local governments.

The total area of the industrial estates is 23,500 hectares, of which 14,100 hectares (excluding estate management and residential sites) are available for purely industrial purposes.

There is still room for constructing factories, however, in suitable lands in the eastern part of Serang close to Tangerang, and in industrial zones in the western part of Serang, and Purwakarta. But the government plans to limit industrial development in West Java to a specific level and to develop industry in other provinces. It is uncertain if the area of industrial estates in West Java will be further increased .

10.2.3 Results of the Site Survey

(1) Fuel choice by process and use

In a glass factory visited during this survey, C grade heavy oil was being used in the primary melting furnace, with urban gas being used in the annealing furnace of a down-stream process. This is a result of differing technical requirements, i.e. in a large melting furnace the long, bright flame produced by bunker C grade heavy oil is desirable, while in the annealing furnace, where precise temperature control is required, urban gas is used.

In a food processing factory, an oven used for baking biscuits was initially heated with diesel fuel oil; it was then converted to urban gas to take advantage of the fuel's cleanliness and convenience of use, which are the points emphasized by the operator. The use of urban gas is also effective in small and medium-sized boilers. Users well appreciate that the benefit of this fuel is the clean and simple operation it allows, with consequent labor-saving advantages, and the fact that no associated equipment, such as storage tanks, is required.

The parts of the industrial sector which find the performance of urban gas desirable cover a wide range of equipment such as ovens in the food processing, machining, and glass industries, annealing furnaces for CRT manufacturing, annealing furnaces for high-quality ceramics, small and medium-size boilers, and precise air-conditioning and rapid drying after dyeing in the textile industry.

The number of sectors demanding urban gas will increase with upgrades in the level of industrial technology, quality requirements, and increased labor saving demands. Presentation to factory management of new trends in technology, and new examples of the use of gas will be helpful for promoting fuel conversion by customers. Selling gas to factories requires prior marketing and the introduction of new technology.

(2) Energy intensity

According to the details obtained from the questionnaire and interview surveys, the data of the specific energy consumption per product (energy intensity) in the same industry type differ and disperse widely in the range of double digits (for example, 1~100kl/t).
We tried to estimate energy consumption for each factory by multiplying the standard energy intensity for each product (ton) by production quantity. The results of the above were intended for application in factories that have yet to be constructed. The relationship between energy consumption and production quantity, however, was not established from such kind of data.

10.3 Energy Demand Forecast in the Industrial Sector

10.3.1 Methodology of Demand Forecast

Two methods for forecasting demand were combined. For the near future (1997-2004), a micro-method using an end-use model (cumulative or bottom-up method) was employed. For the long term (2005-2020), a macro-method using an econometric model (top-down method) was employed.

The econometric model used in long-term (2005-2020) forecasting employed the BPS statistical data (1985-1994) for the total industrial added values (industrial GRDP) of all of West Java and DKI Jakarta, and the "industrial GRDP" data of each area under the jurisdiction of the PGN Jakarta Branch. Since the available data is insufficient for forecasting demand in prefectures which are only in the initial stages of industrial development, the data for 1997-2004, estimated by the end -use method, are applied to the long-term macro-analysis.

PGN already markets urban gas to some factories. For the rest of the existing factories, PGN has produced a list of potential customers by investigating factors such as facilities they operate and their fuel consumption, locations, and distances from gas distribution pipelines. Sales of urban gas to these potential customers are expected to be realized over the next few years, and annual newborn sales volumes have been allocated for each year.

(1) Short-term demand forecasting (1997-2004)

1) Applying the bottom-up method, gas demand is calculated by cumulating the expected

demand of potential customers listed and gas demand per customer.

2) The gas demand obtained as such is given to the next econometric model as the known data.

(2) Long-term demand forecasting (2005-2020)

1) Electricity demand in the industrial sector is projected by use of the demand function of industrial GRDP and the previous year's demand.

2) Fuel demand in the industrial sector is projected by using the demand function of industrial GRDP and the previous year's demand.

3) Energy demand in the industrial sector is computed by summing-up electricity and fuel demand.

4) Taking into consideration the competition among fuels, the respective shares of C grade heavy oil and other fuels are introduced. Fuel demand is then computed based on the share.

5) Finally, the urban gas demand is projected by use of the demand function involving industrial GRP (added values) and the previous year's demand under the constraint condition within which other fuel demand was computed.

10.3.3 Result of Demand Projection

Table 10.3.1 and Fig. 10.3.1 show projections of urban gas demand to be sold by PGN Jakarta Branch in the Study area in the future. The first two rows (1995 and 1996) show actual selling amount by PGN, while the next several rows (from 1997 to 2004) show short term projection by the bottom-up method.

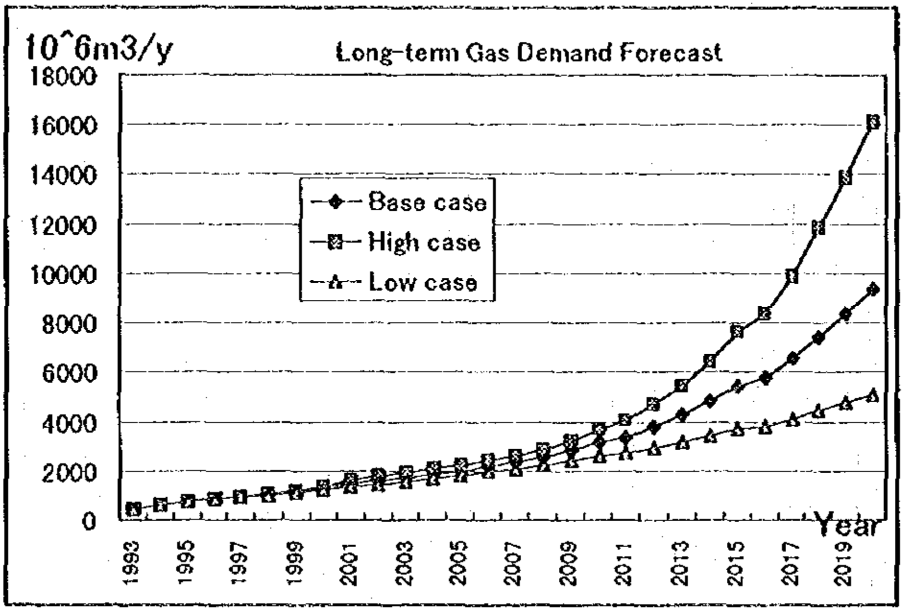
Table10-3-1 Projection of Urban Gas Use in the Industrial Sector

(Unit : $10^6 m^3/y$)

年	Base Case	High case	Low case
1995	751	751	751
1996	878	878	878
1997	960	960	960
1998	1,033	1,051	1,015
1999	1,135	1,178	1,091
2000	1,300	1,384	1,215
2001	1,461	1,586	1,336
2002	1,622	1,786	1,456
2003	1,748	1,944	1,550
2004	1,882	2,113	1,652
2005	1,982	2,217	1,802
2006	2,185	2,392	1,960
2007	2,341	2,588	2,074
2008	2,548	2,847	2,228
2009	2,833	3,201	2,443
2010	3,149	3,657	2,635
2011	3,365	4,019	2,701
2012	3,797	4,702	2,931
2013	4,265	5,488	3,160
2014	4,829	6,465	3,430
2015	5,477	7,639	3,726
2016	5,770	8,379	3,759
2017	6,562	9,949	4,086
2018	7,474	11,845	4,445
2019	8,404	13,896	4,782
2020	9,376	16,157	5,111
2000/1995	11.6% (1.5)	13.0% (1.6)	10.1% (1.4)
2010/2000	9.3 (1.2)	10.2 (1.2)	8.0 (1.2)
2020/2010	11.5 (1.5)	16.0 (1.6)	6.8 (1.3)
2020/1995	10.6 (1.4)	13.1 (1.5)	8.0 (1.3)

Source: JICA Team ( ): GRDP elasticity

Fig. 10-3-1 Long Term Urban Gas Demand Projection of the Industrial Sector



Source: JICA Team

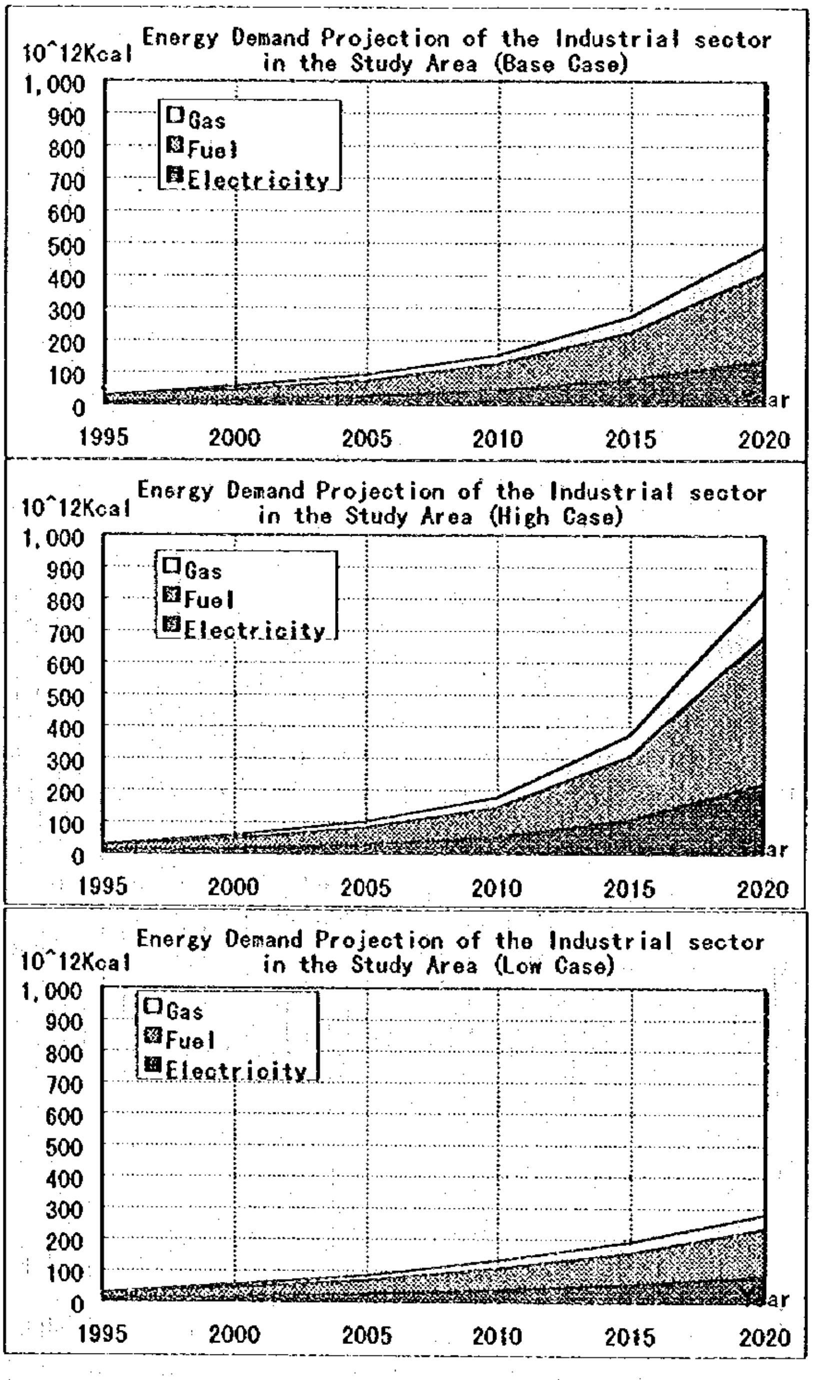
According to the projections, the amount of urban gas to be sold in the Study area (which was 0.75 billion m3/y in 1995), will be 1.98 billion m3/y in 2005, 2.6 times the 1995 level in Base Case, 3.1 billion m3/y in 2010, 2.6 times the 1995 level and 9.4 billion m3/y in 2000, or 12.5 times the 1995 level.

In Low Case, urban gas demand is forecast to reach 5.1 billion m3/y, 6.8 times the 1995 figure and in High Case, it is forecast to reach 16.2 billion m3/y, or 21.5 times the 1995 level.

The annual average growth rate will be 10.6% in Base Case, 8.0% in Low Case and 13.1% in High Case. The GRDP elasticity of urban gas demand of the industrial sector will be 1.4 in Base Case, 1.3 in Low Case and 1.5 in High Case from 1995 to 2020. The description of the characteristics of each area is as follows:

a) The development of urban gas demand of the industrial sector in DKI Jakarta and Tangerang will begin to saturate from around 2020 as shown in the second half part of an S type grown-up curve. The amount of the urban gas projected for the year 2020 will thus be considered the maximum value of the demand in these areas.

Fig. 10-3-2 Energy Demand Projection of the Industrial Sector in the Study Area



Source: Calculated by the JICA Team

b) The urban gas demand of the industrial sector in Bekasi, Karawang and Purwakarta will increase continuously between 2010 and 2020. The factories in the industrial estates already approved will start operation. So, the urban gas demand in the industrial sector in the Study area will be also growing by 2020, even if DKI Jakarta and Tangerang are included.

c) However, following government's policy to promote the relocation of industry from West Java to other provinces or islands in the future, expansion of industrial estates by twice or 3 times the current size will not be approved. Therefore, the urban gas demand around the Study area will show a form of S -type grown-up curve, and it is likely to trace the second half part of this grown-up curve starting 2020.

d) As for Bekasi and Tangerang, fuel conversion from diesel fuel oil / kerosene to C fuel oil / natural gas, occurred more rapidly in recent years than in other prefecture in the Study area. The ratio (share) of gas and bunker C fuel oil together to all the fuel consumption in the industrial sector (replacing diesel fuel oil/kerosene) rose to 1/3 in 1994 in these two Kapupatens.

On the other hand, every year, the shares of the use of diesel fuel oil and kerosene have been rapidly decreasing, and is expected to become only 10-15% in 2005, assuming the current trend continues.

Chapter 11

New Technologies to Promote Gas Utilization

11. New Technologies to Promote Gas Utilization

11.1. Outline of the Work

The Team has examined the applicability of new technologies to promote efficient use of urban gas. Evaluation from the economic view point is emphasized. Gas cooling systems, cogeneration systems, self power generators and natural gas vehicles (NGV) have been selected as new technologies.

11.2. Absorption Chiller

Absorption chillers are more economical as well as cleaner than turbo chillers and are considered the most promising new technology to promote urban gas utilization. The simplified investment pay-back years for model cases for each application are in Table 11-2-1.

Table 11-2-1 Pay-back Time for Model Cases

Facility	Pay-back years for model cases
Hotel	2.7
Office Building	3.6
Shopping Center	2.1
Hospital	3.9
Factory (case of IPP customer)	5.0

Source: JICA Team

The current non-penetration of the gas chillers in Indonesia is due to lack of knowledge about the technology. Indonesia is phasing out CFCs and it can be expected that an absorption chiller will be accepted for that reason, too. PGN should definitely take a promoting role for the penetration as soon as possible.

11.3. GHP (Gas Heat Pump)

This technology was developed as an alternative air-conditioner for the air source package chillers in small buildings. Annual operating costs become higher than those of air source package chiller, though the running costs of GHP are cheaper than those of air source package chiller. This is because the equipment cost of GHP is higher and so the depreciation cost is high. The GHP may penetrate to some extent, though the rate might not be large.

11.4. Cogeneration System

Installation of the system for hotels and factories is expected to be economical. The results of the economic evaluation for these facilities are shown in Table 11-4-1. It might be difficult to judge that the installation for these facilities is economical. The application of the cogeneration system for a factory receiving the power from a private sector power co. is evaluated. For a factory receiving the PLN power, the installation of the system might not be economical. This is because PLN power price for industry is low.

Table 11-4-1 Pay-back Time for Model Cases

Facility	Pay-back years for model case
Hotel	5.4
Factory (case of IPP customer)	4.7

Source: JICA Team

Though the diesel engine cogeneration system would be a strong competitor for the gas engine cogeneration system, this technology would penetrate in the future because of the reliability of a stable power supply, the cleanliness and others.

11.5. Self Power Generator

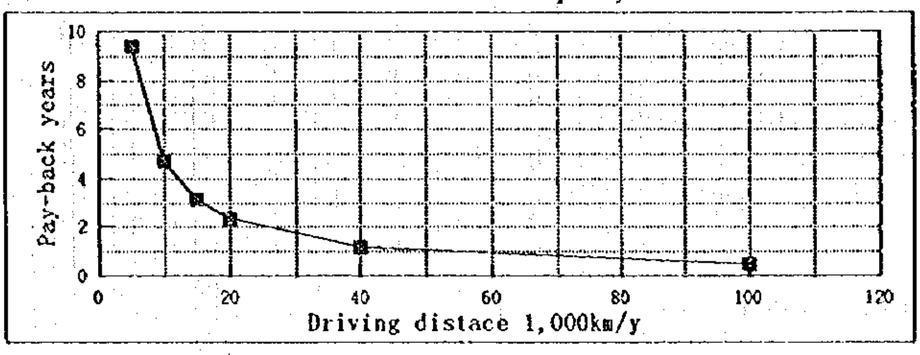
The pay-back time of the gas engine system for a hotel model case is 6.1 years and the diesel engine system, 2.5 years. This means that the possibility of the adoption of gas engine generators is small, unless there are not any limitation such as environmental restriction, lack of space of diesel oil storage tanks and others.

11.6. Natural Gas Vehicle (NGV)

The fuel conversion from gasoline to CNG is relatively easy by applying a conversion kit. The price of the kit is about Rp 2 million for a 2,000 cc class engine. The pay-back time of the conversion kit is in Figure 11-6-1. To penetrate NGV, it is said that the pay-back timer should be less than 1 year and a good target might be those cars that drive more than 50,000 km per year.

Fig. 11-6-1 Pay-back time of Conversion Kit for a Gasoline Engine

up to 2,000 cc



Source: JICA Team

The following policy is considered to be effective to promote NGV penetration:
「 to set regulation for CNG use by taxi cabs, MIKROLET and central and local government cars to be at least 50 % 」
To implement this policy, it is necessary to prepare low interest long term loans, and other incentive systems

The rate of reduction of exhaust gas pollutant and the saving rate of petroleum fuel for cars are estimated at around 3 % in the transportation sector. The rate of reduction is not large. But this might have a large influence on CNG penetration for regular cars other than taxi and MIKROLET.

Chapter 12

Master Plan of Demand and Distribution

12. Master Plan of Demand and Distribution

12.1 Integrated Gas Demand Scenarios

Three cases of Base, High, and Low in the Master Plan are based on GRP, and three scenarios accordingly. The characteristic of each scenario is shown in Table 12-1-1.

Table 12-1-1 Demand Projection Scenario

Alternative	Scenario image	GRP
Scenario 1 Base Case	Standard economic development will be achieved. To cope with the responding growth in urban gas demand, PGN will need systematic and strategic activities.	Middle
Scenario 2 High Case	High economic development exceeding the standard will be achieved. To respond to the high growth in urban gas demand, PGN's strategic activities will be near the maximum limit.	High
Alternative 3 Low Case	Standard economic development will be achieved, but the systematic strategic activities will be below standard.	Low

Gas producers and transmitters cannot provide a limitless supply to meet all demands. On the assumption that all of the projects now being planned to supply natural gas to Java Island go on smoothly, the degree of progress and the planned completion period are used as the constraints to the growth in natural gas supply. Residential gas demand is projected on the assumption that PGN can construct all distribution pipelines and all indoor pipes necessary to realize such amount. Considering that the current number of households to which urban gas is supplied from the PGN Jakarta Branch is approximately 10,000, PGN will be subjected to broad innovation of its organization and business systems in the future in order to flexibly correspond to the number of customers increasing at the rate of dozens of thousands per year. The current sales of urban gas to residential customers will greatly depend on two factors; 1) Capacity of PGN's business management organization and 2) its capability of installing additional pipelines. Due to this reason, we defined the "possible demand" which has taken the above-mentioned restrictive conditions in addition to the projected potential demand in the residential market, and applied this newly defined value as the upper limit for the Master Plan demand.

Table 12-1-2 Gas Demand for Master Plan by Scenario

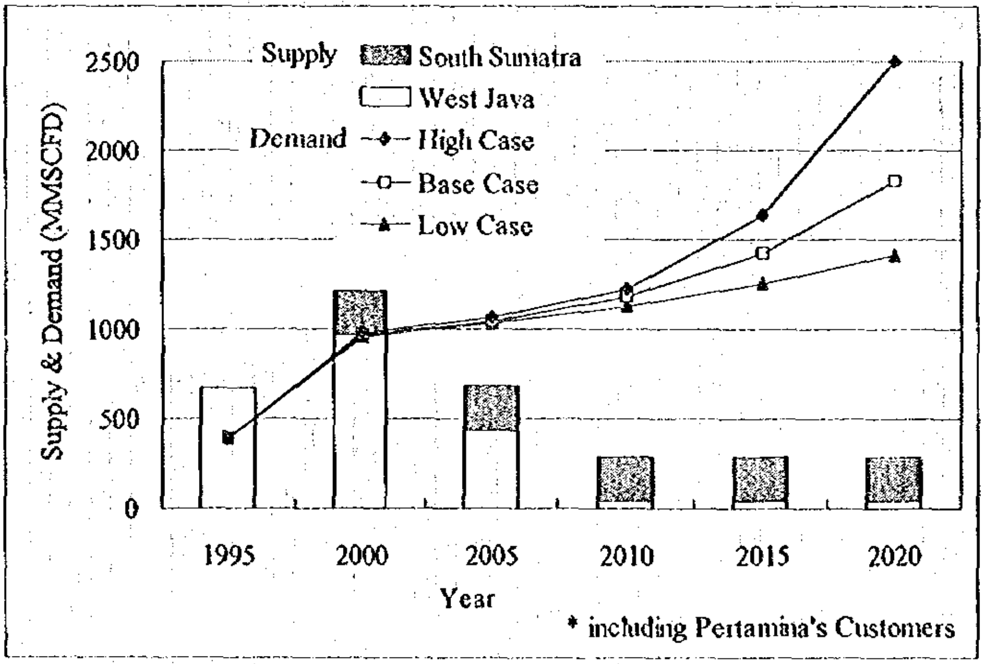
		1996	2000	2005	2010	2015	2020
Base Case		890	1,345	2,160	3,519	6,092	10,304
	Residential	2	17	57	101	146	192
	Commercial	10	28	120	270	469	737
	Industrial	878	1,300	1,982	3,149	5,477	9,376
High Case		890	1,430	2,397	4,037	8,282	17,160
	Residential	2	17	58	103	151	203
	Commercial	10	28	122	277	492	801
	Industrial	878	1,384	2,217	3,657	7,639	16,157
Low Case		890	1,259	1,975	2,994	4,301	5,946
	Residential	2	16	55	98	132	163
	Commercial	10	28	118	262	444	672
	Industrial	878	1,215	1,802	2,635	3,726	5,111

Source: JICA Team (Million m^3/Year)

12.2 Projected Supply and Demand for Urban Gas

Fig. 12-2-1 shows our supply and demand projection for natural gas in West Java. Gas production in West Java is predicted to decrease after year 2000 and the gas sources outside West Java and South Sumatra have to be exploited for the area after year 2005 even in the low case demand.

Fig. 12-2-1 Projected Supply and Demand for Natural Gas



Source : JICA Team

The amount of gas to be supplied from other than West Java and South Sumatra is 1,100 to 2,300 MMSCFD in 2020 and this amount is converted to 8 to 17 TSCF by reserve. Natuna, Sumatra and Irian Jaya are good candidates for gas supply. In order to transmit gas from these sources to West Java, construction of "Trans-Indonesia Pipeline" or LNG chain is necessary.

12.3 Design of Distribution Pipelines

Considering technical requirements and construction cost, we adopt welded steel pipes for the high pressure pipelines and polyethylene pipes for the medium and low pressure pipes. We choose the distribution system shown in Table 12-3-1 to customers in each sector from the view points of safety and required pressure at gas appliances.

Table 12-3-1 Basic Distribution System to Each Demand Sector

Demand Sector	Basic Distribution System
Residential	• Medium pressure with house regulator(HR) system • Low pressure system
Commercial	• Medium pressure for boilers, air conditioners & power generators. • Low pressure for cooking.
Industrial	• High pressure

Source : JICA Team

We will use the following "General Flow Equation" for deterring a pipe diameter which is usually used for gas network design world wide. The values of parameters are shown in Table 12-3-2.

Table 12-3-2 Values or Formula for General Flow Equation

Parameter	Value or Formula
Specific Gravity S	0.595 (air = 1.0)
Gas Temperature T	27℃
Compressibility Factor z	(High Pressure) AGA (Medium & Low Pressure) z = 1.00 (constant)
Transmission Factor $\sqrt{1/f}$	(High Pressure) Panhandle A (Medium Pressure) IGT (Low Pressure) Mueller

Source : JICA Team

Peak loads which are necessary for the network design are estimated by the way shown in Table 12-3-3.

Table 12-3-3 Peak Load Estimation

Demand Sector	Way of Peak Load Estimation
Residential	(1) Assume a peak load of one customer q = 0.60 [m^3/h] (2) Peak load of pipeline Q [m^3/h] is calculated by $Q = q \times n \times Y$ (n is No. of customers, Y is simultaneous consumption ratio.)
Commercial	- Calculate the peak load from the annual demand assuming that 1000 hours and 3000 hours of working time for cooking use and air conditioning use respectively.
Industrial	- Calculate the peak load from the demand assuming that 8760 hours of working time.

Source : JICA Team

12.4 Proposed Urban Gas Network

Using these base case peak time load, we conducted network analysis in order to confirm the capacity of transmission system. According to the results of network simulation conducted, the pipelines which increase the transmission capacity from Subang and Pasir Jadi gas fields to Pertamina's existing pipeline is necessary until year 1999. After the South Sumatra Line is connected to Pertamina's existing transmission line at Cilegon in year 2000, boosters at Tegal Gede and Bitung are no longer necessary to work to transmit gas to Cilegon since gas comes from Cilegon. This condition is predicted to continue until year 2015. After year 2015, another transmission lines are necessary to respond to the demand.

The Team listed up the target areas and customers in the residential, commercial and industrial sectors and showed their gas demand and the pipelines necessary from the existing pipeline to the entrance of the target in order to make the Master Plan more realistic. We recommend to develop these targets from those which are located near the existing pipeline to those which are far from the existing pipelines. In order to confirm the existing pipeline capacity, we conducted network analysis and found that the distribution capacity in the western part of the network is not sufficient for the total load. It is recommended to install the pipeline between Cikande where a new offtake station is planned and Balaraja at an early stage of the demand development.

Chapter 13

Business Plans for the Master Plan

13. Business Plans for the Master Plan

In the Master Plan, we consider PGN to expand pipeline network and develop residential market. To carry out the expansion of business, it is necessary for PGN to introduce necessary measures. This chapter will suggest such measures in the business plans for the Master Plan. In the section 13.1, we suggest the necessity to reform the tariff structure to be based on the cost and to introduce two-part tariff systems to make the recovery of costs more stable. In the section 13.2, we recommend to modify the organization to cope with the increase of residential customers. Section 13.3 will mention some measures to promote gas sales in each market. Section 13.4 emphasizes the necessity to reinforce the contractor's work capability and to reinforce the action system against pipeline incidents. In the section 13.5, we propose training programs for human resource development including contractors to promote gas sales and to reinforce piping works. We recommend in the section 13.6 that PGN establish new marketing offices in each region considering the increase and the density of the customers. The section 13.7 points out technical problems to realize the Master Plan.

13.1 Gas Tariff Systems

Energy prices should not be too much distorted for economics as the signal in the market, and at the same time, energy pricing has to be consistent with national energy policies. From the energy policy of Indonesia, gas pricing may be required to give incentives to end customers and to promote energy conversion from oil to natural gas by *keeping price advantages of natural gas against other fuels.*

Though PGN changed its status from Perum to Persero in May 1996, the business is meant to expand to public domain. PGN will be required of more supply stability and management stability as a public utility. To realize such stability in operations, the gas *tariff should be designed on the cost basis in principle.*

Currently, the difference between general and contract tariffs is just about 10 to 20%. However, if it is calculated by a cost based approach, the distribution cost to general tariff customers can be several times higher than that of contract tariff. It is necessary to find some measures to protect low income households from the standpoint of affordability, but a review of the tariff rebalance is needed from the cost allocation approach.

To realize more stable recovery of cost through tariff revenue, the introduction of two part tariff may be considered. The two part tariff is composed of standing charge and commodity charge. According to an economic theory, standing charge and commodity charge should collect the fixed cost and variable cost respectively. However, in reality, the range covered by the standing charge has to be limited considering the affordability *of small scale customers.*

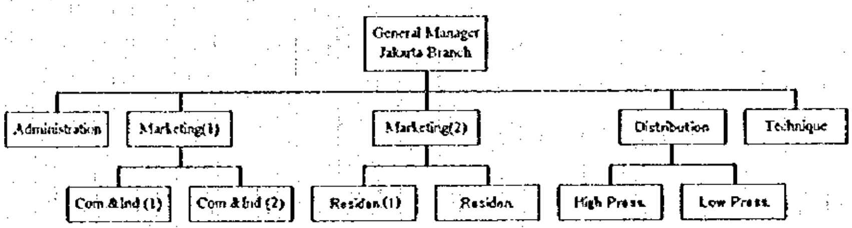
13.2 Organization and Employee Plan

Current marketing organization of PGN is oriented to industrial customers. In order to promote gas sale to residential and commercial market, restructuring of organization, strengthening of ability to make strategic plans to sell gas and increase of employees may be necessary.

To respond to increasing residential customers in more than twenty thousand per year, independent sections and additional work force for them may be necessary, for registration, meter reading and tariff collection. Also new offices near customer residences, as well as introducing office automation systems and setting up information network among offices may be required.

Figure below suggests an example of new organization. The benefit of this organization is that managers of residential marketing sections are able to modify their sections in response to rapidly increasing customers without influence of commercial and industrial sections.

Suggested Organization



Source: PGN modified by JICA team

13.3 Gas Sales Promotion Techniques

Residential Market

A key to successful development of the residential market is to quickly acquire a large number of customers near the new distribution grids. Bearing in mind that the main competitor is LPG, marketers should appeal to customers in the residential market:

- Lower running cost
- more safety
- convenience
- cleanliness.

With the increase of income and knowledge of new life styles and new use of gas like hot water showers, further increase of gas sales can be expected in the future. Hot showers are already installed in certain high income residences. Furthermore, it is recommended to appeal the effectiveness (e.g., comfort, healthy merit, etc.) of hot water to potential customers for development of new gas demand.

Kitchen utensils may also be more diversified from the current simple gas cookers, involving additional gas demand. Market developers should be kept abreast with the knowledge of new type of gas use and appliances, demanding for systematic education.

Commercial Market

Gas demand for commercial cooking will be put under such an environment that gas is readily accepted due to its superiority in economy and convenience.

The market development for boilers, air conditioners and co-generators is not to promote individual appliance sales but to promote gas systems. Two sales policies can be derived from this as follows:

- The first point is to educate sales engineers who are familiar with the total gas system.

- The second point is that sales activity should be deployed at an early stage of construction plan so that the gas equipment system is built in a building structure. For this purpose, it is indispensable to keep continued good relationship with project developers, design consultants, constructors, and equipment suppliers and, in addition, to promote the activity for collecting relevant information. It is recommended to hold presentation meetings, exhibition, etc., to disseminate information of gas systems for application to boilers, air conditioners, co-generators, etc., several times a year. One more efficient sales method is to deploy joint sales activity with equipment manufacturers and distributors/agents and to have the meeting for exchange of sales information.

Industrial Market

Consulting sales activities are desired to meet industrial customer's need and to develop new type of gas use. In this view, sales personnel will have to be trained so as to acquire "required sales mind" and "sense of engineering" to develop new market.

For developing new gas demand, advancing into new fields (chilling, power generation, etc.) other than heating application will be required in the future. By this approach, investment in pipelines can be utilized effectively toward a goal of maximizing gas development volume per customer.

Also, friendly relationship with developers of the industrial estates should be built up and, based on the good relationship, the pipeline should be installed in due time under close cooperation so the area customers can use urban gas as wanted, without delay.

13.4 Pipeline Construction Management

The present PE pipeline work capability of 17 contractors in the service area of PGN Jakarta Branch is approximately 40 km per year altogether, as detailed in Section 12. This capability may have to be widely reinforced up to 200 km per year to cope with this Master Plan in the future. It is not the best way, viewed from the efficiency, that a supervisor of the gas company always stays at work site to check work performance. The work control by a construction company at its responsibility is adopted world wide. The preconditions for adoption of this work control system are to review and improve work order specifications, work personnel qualification and certification system including training, the code of responsibility against accidents, etc. Though PGN already adopts the work personnel qualification and certification system, the system introducing relating to pipeline work will have to be reviewed from the viewpoint of newly distributing urban gas into several hundred thousands of unspecified customers (users) which are difficult to directly control.

13.5 Human Resource Development

In order to strengthen the organization to cope with increasing number of customers by twenty thousand per year, together with standardization and documentation, training and education are necessary for both new and existing employees. Training programs to be strengthened are on gas safety, market promotion and piping works. We suggest that a training center should be established and programs should be prepared not only for employees but for plumbers and contractors.

13.6 Business Facility Plans

The number of customers of PGN will increase substantially when PGN newly develops residential market. Currently, Jakarta Branch is located in central Jakarta and is in charge of broad area. When PGN develops new customers, we recommend that PGN establish new marketing offices to be effective in more remote areas considering the increase and the density of the customers. A new marketing office is expected to have a function of appliance sales, safety check, meter reading, bill collecting. It is expected for the marketing office to contribute to the improvement of service standards of PGN because it is possible to cope with customer needs much more quickly both in marketing and safety aspects. At the same time, rationalization of PGN operation can be expected because travel time from branch to customers can be shortened.

13.7 Other Technical Matters for Implementation

It is forecast that the conversion from LPG to natural gas cause a large change in gas input to appliances and, as a result, could cause complaints from customers due to input shortage if adjustment of the appliances delays. The work system for smooth conversion of gas appliances to the specifications for natural gas must be built up so as to ensure adjustment of the gas appliances in good time with supply of natural gas.

It is forecast that residential spaces which mostly have been of open-style will be modified into more airtight spaces in Indonesia in order to spread cooling system and to upgrade cooling efficiency with further improvement of the living standards. Furthermore, medium- and high-storied residences currently under construction in Jakarta City will be of more airtight structure due to great difference of building style from a single house. As a result, the environment of gas consumption will change from open style to high airtight style and this change is forecast to result in higher risk of explosion accidents which are caused by gas leak and flue gas. Under such a trend, the "standard for installation of gas equipment within medium- and high-storied buildings " and the " standard for installation of gas appliances at high airtight residences" must be improved in order to prevent recurrence of such accidents and to minimize damages even if any of them occurred. It will be an urgent subject for spread of city gas to families to create these standards that match the living situations of Indonesia.

Chapter 14

Economic and Financial Projections of the Master Plan

14. Economic and Financial Projections of the Master Plan

14.1 Alternatives for Smaller Market Viability

14.1.1 Five Pricing and Business Alternatives

We assume 5 alternative cases of gas pricing directions and business sponsors in developing new markets in the master plan and feasibility studies to find a feasible case to distribute gas to the residences as shown in the following table.

Table 14-1-1 Alternative Cases for Pricing & Business Unit

	Gas price	Investment	Operation
Case 1	Keep current price level	PGN	PGN
Case 2	Raise gas price gradually to an equivalence to competitive fuels	PGN	PGN
Case 3	Keep current price level	Government	PGN
Case 4	Raise gas price gradually to an equivalence to competitive fuels	Government	PGN
Case 5	Raise gas price immediately to equivalence to competitive fuels	third party (e.g.,a subsidiary)	third party (e.g., a subsidiary)

In Case 1, we assume the government keep a rigid gas pricing policy and give no support to initial investment for distribution pipelines.

In Case 2, we assume the government approves a gradual increase of a gas tariff to $800Rp/m^3$ in the residential sector in ten years which is equivalent to that of LPG.

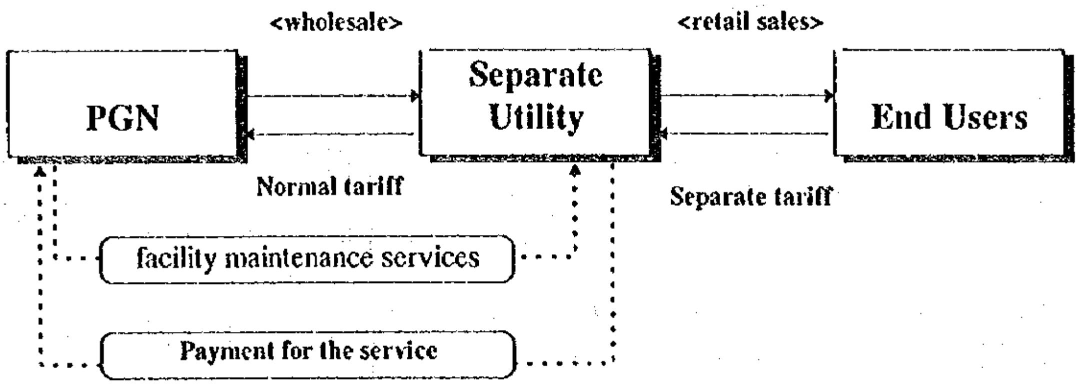
In Cases 3 and 4, we assume that residential distribution pipeline investment is borne by government as an urban infrastructure.

In Case 5, a separate utility established for commercial and residential sectors distributes gas. We assume immediate increase of gas tariff in commercial cooking and residential use up to 800Rp/m3, which competes with LPG.

14.1.2 Separate Utility Entity Concept

The separate utility entity concept is summarized in the figure below:

Fig 14-1-1 Separate Utility Entity Concept



For the financial projection, we assume PGN will invest in transmission lines, offtakers and meter stations, high pressure mains and "A" regulators. PGN will invest in those facilities strategically to meet future regional demand.

A separate utility will invest in regional mid or low pressure mains after "A" regulators and distribution lines together with "B" regulators.

The separate utility will be in charge of meter reading and billing/collections but facility maintenance work for safe distribution of gas will be contracted to PGN. We assume as labor costs for separate utilities two thirds of the average salary level of PGN.

14.2 Results and Assessment of the Master Plan

14.2.1 FIRR and NPV of a Project

The next table shows the cash flow analyses of master plan in base demand case, case 1. Detailed figures are shown in Appendices O. For case 5, we conducted financial analyses both of separate utility and PGN. For case 2, we conducted additional analysis when labor efficiency will be doubled in 20 years.

In each case, downside contingency (sensitivity) analysis with 2% sales volume and 10% of facility investment has been done.

In the financial projection, the difference in the cost of LPG bottle to be avoided and the installation of indoor pipelines is thus 200,000Rp per residential customer, which may discourage residential customers to accept urban gas. In that case the gas utility may need to pay for it even if the indoor pipes are owned by the customer. Financial assessment is also made for such a case.

Table 14-2-1 Financial Analysis

(Base Case, Case1)

				1997	2000	2005	2010	2015	2020	resid 2021
Sales	Residential		(mil Rp)	1,023	6,276	21,159	37,216	54,049	71,056	
	Commercial	Cooking	(mil Rp)	1,553	2,351	5,547	10,837	17,946	27,561	
	Commercial	Boiler+AC	(mil Rp)	2,807	6,943	34,172	78,194	136,810	215,519	
	Commercial	Total	(mil Rp)	4,360	9,294	39,719	89,031	154,756	243,080	
	Industrial		(mil Rp)	302,529	409,377	624,383	991,840	1,725,147	2,953,312	
Total			(mil Rp)	307,913	424,948	685,261	1,118,087	1,933,952	3,267,448	
Gas material cost			(mil Rp)	158,550	245,724	457,618	811,051	1,535,106	2,854,275	
Gross profit			(mil Rp)	149,363	179,224	227,643	307,036	398,845	413,173	
Gross profit (incremental,MMRp)			(mil Rp)	0	29,861	78,280	157,673	249,483	263,810	1,589,217
Property Tax			(mil Rp)	33	138	164	192	233	354	
Labor cost (incremental)		Staffs	(mil Rp)	1,183	6,211	7,789	6,254	4,323	2,615	
		Workers	(mil Rp)	1,540	8,779	13,553	14,244	13,366	11,193	
		Pensions	(mil Rp)	272	1,499	2,134	2,050	1,769	1,381	
		Total	(mil Rp)	2,995	16,489	23,477	22,548	19,458	15,188	91,496
Administrative expenses			(mil Rp)	898	4,947	7,043	6,764	5,837	4,557	27,449
Maintenance & other expenses			(mil Rp)	741	3,741	6,463	9,606	13,571	20,953	126,224
Total investment			(mil Rp)	37,356	54,087	28,756	30,743	34,363	-200	
Before tax cash flow		(financial)	(mil Rp)	-42,029	-49,541	12,377	87,820	176,020	222,958	1,344,048
IRR of before tax cash flow				16.6%						
NPV as of 10%		(financial)	(mil Rp)	259,105						
NPV as of 15%		(financial)	(mil Rp)	35,681						

Sources:JICA team, Appendices O

14.2.2 EIRR and NSB of a Project

As an example we show in the next table social benefit and loss analysis of base case of master plan (from case 1 to 4). Detailed analyses for each case are shown in Appendices O.

Table 14-2-2 Social Benefit and Loss Analysis (Base Case, Case 1 to 4)

			1997	2000	2005	2010	2015	2020	resid 2021
Social benefit for residential customers		(Rp/m3)	800	800	800	800	800	800	
Social benefit for commercial cooking		(Rp/m3)	800	800	800	800	800	800	
Social benefit for commercial AC		(Rp/m3)	528	528	528	528	528	528	
Social benefit for industrial customers		(Rp/m3)	308	308	308	308	308	308	
Social benefit for residential customers		(mil Rp)	2,213	13,571	45,750	80,467	116,862	153,634	
Social benefit for commercial cooking		(mil Rp)	3,765	5,700	13,447	26,271	43,506	66,815	
Social benefit for commercial AC		(mil Rp)	4,491	11,108	54,676	125,111	218,896	344,830	
Social Benefit for commercial total		(mil Rp)	8,256	16,808	68,122	151,382	262,402	411,645	
Social benefit for industrial customers		(mil Rp)	295,807	400,280	610,508	969,799	1,666,810	2,887,683	
Total social benefit from gas sales		(mil Rp)	306,275	430,659	724,380	1,201,648	2,066,074	3,452,962	
Social loss for gas supplied		(Rp/m3)	167	167	186	217	242	267	
Total social loss from gas supplied		(mil Rp)	163,057	224,571	401,707	763,639	1,474,190	2,751,233	
Gross social benefit		(mil Rp)	143,218	206,088	322,673	438,009	591,885	701,729	
Incremental gross social benefit		(mil Rp)	0	62,869	179,454	294,791	448,666	558,511	1,633,072
Total Investment		(mil Rp)	37,356	54,087	28,756	30,743	34,363	-200	
LPG bottle repurchase (residential)		(mil Rp)	1,186	4,244	4,114	4,000	4,000		
In house pipeline installation (residential)		(mil Rp)	2,371	8,488	8,229	8,000	8,000		
LPG bottle repurchase (cooking)		(mil Rp)	5	9	27	37	50		
In house pipeline installation (cooking)		(mil Rp)	94	164	475	649	891		
In house pipeline installation (AC)		(mil Rp)	94	344	897	1,211	1,647		
Turbo chiller		(1000$)	7,124	26,138	68,195	92,038	125,229		
		(mil Rp)	16,740	61,424	160,258	216,290	294,289		
Absorption chiller		(1000$)	7,636	28,018	73,101	98,659	134,238		
		(mil Rp)	17,945	65,843	171,786	231,849	315,460		
FO tank installation		(mil Rp)	1,141	2,532	2,262	3,395	4,593		
In house pipeline (industrial)		(mil Rp)	326	724	646	970	1,312		
Imported facilites (included)		(mil Rp)	3,937	12,631	20,387	26,665	35,487	0	
Imported tax		(mil Rp)	0	0	0	0	0	0	
Net social loss for facilities		(mil Rp)	39,114	61,440	44,128	49,701	58,741	-200	
Labor cost (incremental)	Staffs	(mil Rp)	1,183	6,211	7,789	6,254	4,323	2,615	0
	Workers	(mil Rp)	1,540	8,779	13,553	14,244	13,366	11,193	0
	Pensions	(mil Rp)	272	1,499	2,134	2,050	1,769	1,381	0
	Total	(mil Rp)	2,995	16,489	23,477	22,548	19,458	15,188	44,410
Income tax (included)		(mil Rp)	331	1,810	2,524	2,362	1,985	1,512	4,420
Administrative expenses		(mil Rp)	898	4,947	7,043	6,764	5,837	4,557	13,323
Maintenance & other Expenses		(mil Rp)	747	3,741	6,463	9,606	13,571	20,953	61,265
Value tax (included)		(mil Rp)	150	790	1,228	1,488	1,764	2,319	6,781
Net social benefit		(mil Rp)	-43,273	-21,148	102,095	210,022	354,809	521,843	1,525,273
EIRR			34.2%						
NSB as of 10%		(mil Rp)	970,601						
NSB as of 15%		(mil Rp)	435,187						

Sources:JICA team, Appendices O

14.2.3 Fair Financial Returns

In this financial projections we assume that the required financial internal rate of return or "FIRR" of total investment on the before tax basis and in real terms should be from 10% to 15% for a criterion of feasibility. This means that the average tariff per m3 of gas should be determined at a level at which the total investment would produce a return of 10% to 15% in the project period in real terms.

Minimum requirement for EIRR could be considered in accordance with fair return for FIRR.

14.2.4 Results of the Master Plan

The tables below shows results from projections of the Master Plan in each case. First three sections show the result of each demand case in five pricing and business alternative (case 1 to 5). The 4 section shows financial analysis of separate utility in case 5 in each demand case. The 5 section shows Case 2 analysis with labor efficiency doubled in 20 years.

Table 14-2-3 Results of the Master Plan

(%,mil Rp)

	Case 1	Case 2	Case 3	Case 4	Case 5
1) Base case demand projections					
FIRR	16.6%	20.7%	19.5%	24.0%	27.0%
NPV(10%)	259,105	456,244	326,238	523,084	432,524
NPV(15%)	35,681	136,540	88,928	189,690	175,268
(Downside contingency analysis)					
FIRR	13.3%	17.5%	16.1%	20.6%	22.8%
NPV(10%)	125,346	321,918	199,668	396,590	315,861
NPV(15%)	-38,289	61,664	20,429	120,498	112,860
(With in house pipeline installation)					
FIRR	15.7%	19.6%	18.4%	22.6%	25.0%
NPV(10%)	234,677	432,354	301,011	498,826	406,958
NPV(15%)	16,150	117,186	69,134	170,216	155,363
(Downside contingency with in house pipeline installation)					
FIRR	12.5%	16.6%	15.0%	19.5%	21.1%
NPV(10%)	101,086	297,379	175,019	371,238	289,529
NPV(15%)	-57,764	42,097	826	100,664	92,703
(Economic analysis)					
EIRR	34.2%	34.2%	34.2%	34.2%	36.0%
NSB(10%)	970,601	970,601	970,601	970,601	996,676
NSB(15%)	435,187	435,187	435,187	435,187	455,103

Table 14-2-3 Results of the Master Plan (Continue)

	Case 1	Case 2	Case 3	Case 4	Case 5
2) High case demand projections					
FIRR	21.2%	24.5%	24.3%	27.8%	31.5%
NPV(10%)	574,686	769,704	633,940	830,235	727,665
NPV(15%)	172,684	273,632	223,361	324,729	305,569
(Downside contingency analysis)					
FIRR	17.9%	21.2%	20.7%	24.3%	27.4%
NPV(10%)	400,115	593,559	468,263	662,301	570,842
NPV(15%)	80,235	179,930	136,947	236,837	224,914
(With in house pipeline installation)					
FIRR	20.3%	23.4%	23.0%	26.5%	29.7%
NPV(10%)	552,290	748,092	612,581	807,818	704,426
NPV(15%)	153,814	255,020	204,832	305,852	286,421
(Downside contingency with in house pipeline installation)					
FIRR	17.1%	20.3%	19.7%	23.1%	25.5%
NPV(10%)	377,556	570,836	445,143	639,777	548,514
NPV(15%)	61,311	160,952	117,839	217,925	206,067
(Economic analysis)					
EIRR	40.2%	40.2%	40.2%	40.2%	42.0%
NSB(10%)	1,353,508	1,353,508	1,353,508	1,353,508	1,378,804
NSB(15%)	622,282	622,282	622,282	622,282	642,015
3) Low case demand projections					
FIRR	10.4%	16.1%	13.3%	19.2%	20.8%
NPV(10%)	8,837	203,656	78,171	272,378	194,685
NPV(15%)	-77,793	20,803	-24,719	73,675	63,871
(Downside contingency analysis)					
FIRR	6.2%	13.1%	9.1%	16.1%	16.5%
NPV(10%)	-95,308	101,758	-19,267	177,882	107,422
NPV(15%)	-137,353	-38,707	-79,056	19,618	15,646
(With in house pipeline installation)					
FIRR	9.5%	15.1%	12.1%	17.9%	18.6%
NPV(10%)	-15,971	178,826	52,475	247,155	167,831
NPV(15%)	-97,117	1,471	-44,336	54,215	43,873
(Downside contingency with in house pipeline installation)					
FIRR	5.6%	12.2%	8.0%	15.0%	14.6%
NPV(10%)	-120,779	77,006	-45,269	152,184	79,390
NPV(15%)	-156,895	-58,013	-98,773	0	-4,739
(Economic analysis)					
EIRR	28.1%	28.1%	28.1%	28.1%	29.5%
NSB(10%)	653,777	653,777	653,777	653,777	680,837
NSB(15%)	272,395	272,395	272,395	272,395	292,281

Table 14-2-3 Results of the Master Plan (Continue)

4) Financial analysis of separate utility in case 5			
	(Base case)	(High case)	(Low case)
FIRR	17.5%	17.9%	17.0%
NPV(10%)	120,337	130,940	106,697
NPV(15%)	21,495	26,091	16,495
(Downside contingency analysis)			
FIRR	16.0%	16.5%	15.6%
NPV(10%)	103,655	113,644	90,454
NPV(15%)	9,244	13,604	4,582
(With in house pipeline installation)			
FIRR	15.1%	15.5%	14.6%
NPV(10%)	95,235	105,758	82,842
NPV(15%)	856	5,390	-3,371
(Downside contingency with in house pipeline installation)			
FIRR	14.0%	14.4%	13.5%
NPV(10%)	78,184	88,463	66,680
NPV(15%)	-11,517	-7,099	-15,258
5) Case 2 with labor efficiency doubled in 20 years			
	(Base case)	(High case)	(Low case)
FIRR	17.3%	21.6%	12.0%
NPV(10%)	319,033	637,341	64,891
NPV(15%)	56,721	195,305	-58,718
(Downside contingency analysis)			
FIRR	14.2%	18.4%	8.8%
NPV(10%)	183,282	460,097	-39,015
NPV(15%)	-18,662	101,203	-118,936
(With in house pipeline installation)			
FIRR	16.5%	20.7%	11.2%
NPV(10%)	294,391	615,479	40,354
NPV(15%)	37,120	176,611	-77,953
(Downside contingency with in house pipeline installation)			
FIRR	13.5%	17.6%	8.1%
NPV(10%)	158,678	438,080	-63,225
NPV(15%)	-38,250	82,458	-138,053
(Economic Analysis)			
EIRR	31.0%	37.1%	24.7%
NSB(10%)	846,771	1,231,681	533,662
NSB(15%)	363,457	551,119	202,611

(Source: JICA Team; detail in Appendix O, Master Plan)

14.2.5 Assessment of the Financial Projections

From Case 1 to 4, we see it will be inevitable to raise residential gas price in the long run. But Government have not necessarily to invest in residential distribution pipelines if PGN succeed to raise residential gas price.

In Case 5, we see high profitability of PGN and in each case FIRR will exceed 15%. Financial analyses of separate utilities as a whole show they will be financially feasible even in a low demand case with downside contingency.

Economic analyses show there are substantial social benefits for Indonesia to start developing gas demand in residential sector and commercial sector in Jakarta area in each demand case.

When we go to see Case 2 with labor efficiency doubled only in 20 years, we realize it will not be easy to sustain financial viability in a low demand case for the effect of labor expenses is rather large. For PGN, it is important to accelerate their demand development and raise labor efficiency even when they succeed raising residential gas price.

14.2.6 Per m3 Cost Analyses

As additional financial analyses of the master plan, we conducted per m3 cost analyses of each demand case. We did it in long term marginal cost bases.

We distributed NPV of each cost to each category of gas demand, residential, commercial cooking, commercial air conditioning, and industrial sectors and we get NPV cost of each sector (mil Rp). Dividing by NPV of gas sales volume of each sector, we get per m3 cost of each sector.

Next tables shows results.

Table 14-2-4 Per m3 Cost Analyses

NPV of Gas Demand

(1000m3)

	Residential	Cooking	AC	Industrial
Base case	293,727	80,070	626,449	7,241,758
High case	300,993	82,896	649,115	9,917,666
Low case	276,616	77,005	601,871	5,018,933

Distribution of NPV of Each Cost

(Base Case)

(mil Rp)

	Residential	Cooking	AC	Industrial	Total
Gas material	66,601	18,155	142,043	1,642,015	1,868,813
Labor	67,372	12,296	810	12,724	93,202
Pensions	6,737	1,230	81	1,272	9,320
Property tax	217	85	112	461	874
Administrative cost	22,233	4,058	267	4,199	30,757
Maintenance	8,280	3,232	4,265	17,621	33,398
Investment	61,891	24,156	31,883	131,710	249,639
Total	233,330	63,211	179,461	1,810,002	2,286,004
Cost per m3(Rp/m3)	794	789	286	250	277

(High Case)

(mil Rp)

	Residential	Cooking	AC	Industrial	Total
Gas material	67,988	18,724	146,621	2,243,103	2,476,436
Labor	67,166	12,406	811	13,107	93,491
Pensions	6,717	1,241	81	1,311	9,349
Property tax	215	85	112	536	948
Administrative cost	22,165	4,094	268	4,325	30,852
Maintenance	8,144	3,222	4,229	20,282	35,877
Investment	61,836	24,468	32,108	154,006	272,418
Total	234,231	64,241	184,228	2,436,671	2,919,371
Cost per m3(Rp/m3)	778	775	284	246	266

(Low Case)

(mil Rp)

	Residential	Cooking	AC	Industrial	Total
Gas material	63,228	17,602	137,574	1,149,620	1,368,023
Labor	66,923	12,157	809	10,812	90,701
Pensions	6,692	1,216	81	1,081	9,070
Property tax	211	84	113	393	800
Administrative cost	22,085	4,012	267	3,568	29,931
Maintenance	8,161	3,246	4,384	15,213	31,003
Investment	58,915	23,433	31,647	109,829	223,824
Total	226,214	61,749	174,874	1,290,516	1,753,353
Cost per m3(Rp/m3)	818	802	291	257	293

Sources: JICA team, Appendices O

Those results are showing it will be inevitable for PGN to increase sales price for residential and commercial cooking sectors in the long run.

Chapter 15

Environmental Assessment

15. Environmental Assessment

To evaluate the influence of the increased use of urban gas on the environment in the Study area, first of all, it is necessary to grasp the present situation of air pollution sources, across the whole of Indonesia to Java and around the Study area. Information of the fuel consumption in the areas has been collected and analyzed through the Study. In addition, the current situation of air pollutant emissions from fuel use in the area which is nearest to the Study Area, and the amount of reduction in air pollution by the growing use of urban gas in each sector has been projected until 2020.

Estimation of the environmental improvement in future due to urban gas use is calculated by using the emission factor of the fuel being substituted for urban gas in each sector. The degree of improvement in each is estimated by comparing with the case in which urban gas will not increase beyond the present quantity.

15.1 General Environment around the Study Area

15.1.1 Present and Future Environmental Issues in Indonesia

Environmental pollution accompanying economic growth in Indonesia began with water pollution caused by industrial waste water. Next, came air pollution which accompanied the rapid increase in energy consumption in the electric power sector and basic industries. Later, it expanded with the increase in traffic volume and population in the urban areas.

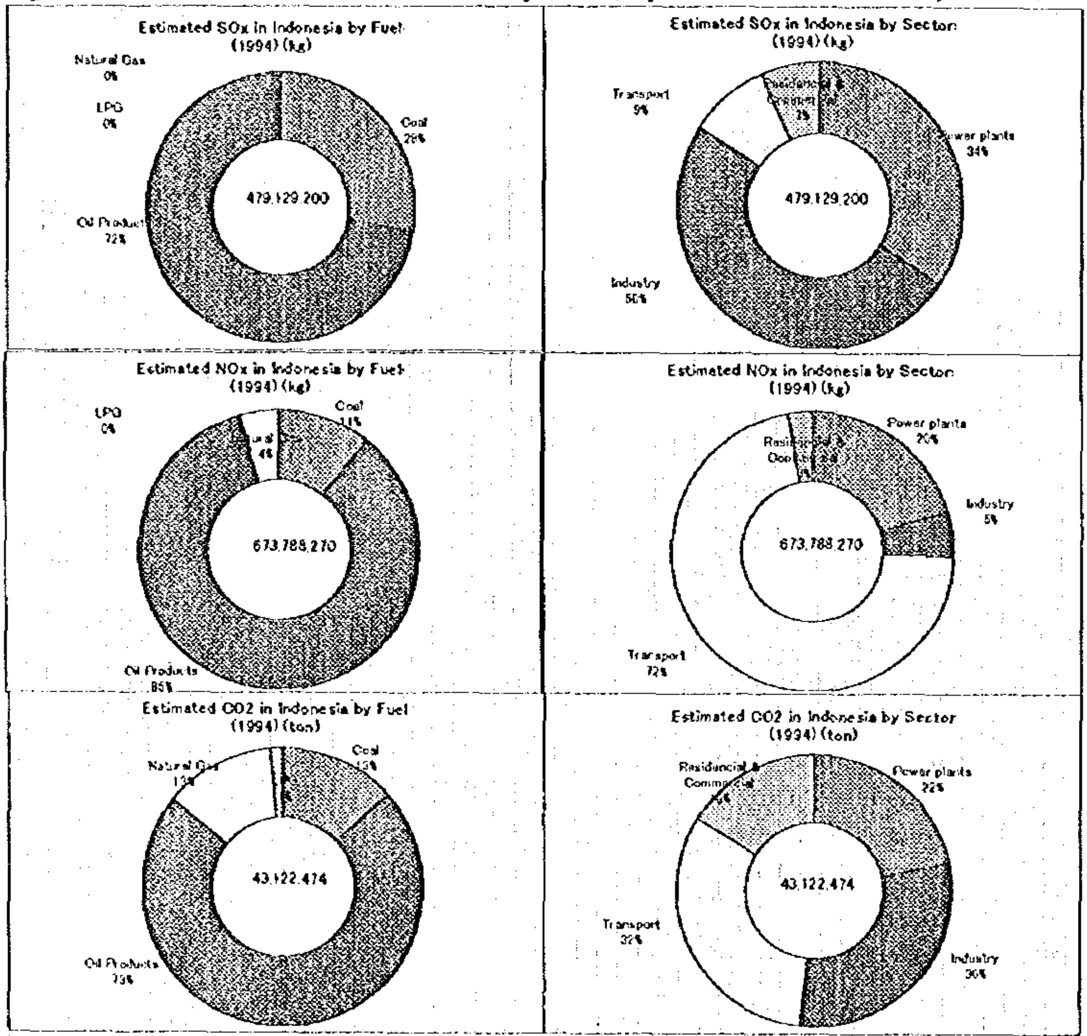
15.1.2 Current Situation of Air Pollution

In addition to the present situation of air pollution in Indonesia and in the Study area , we have evaluated the emission of each air pollutant from each type of fuel consumption, and determined the quantity of air pollutant when natural gas is used among all fuels.
This time, we have briefly evaluated the several data sources, we adopted the MME statistics for this estimation because of its suitability and consistency of each parameter which will be used in our environmental assessment.

The major source of air pollution in Indonesia, according to this estimation, is the use of oil products as fuels, followed by coal. The estimation reveals that more than 80% of the total pollution is caused by the industrial sector, including electric power, and the transportation sector. In particular, 65% of nitrogen oxide is from the transportation sector and 32% is from industries including the electric power sector.

Natural gas accounts for 13% of carbon dioxide, less than 4% nitrogen oxides and negligible share of sulfur oxides. (Figure 15.1.1)

Figure 15.1.1 Air Pollutant Emission by Fuels, by Sectors in Indonesia, 1994



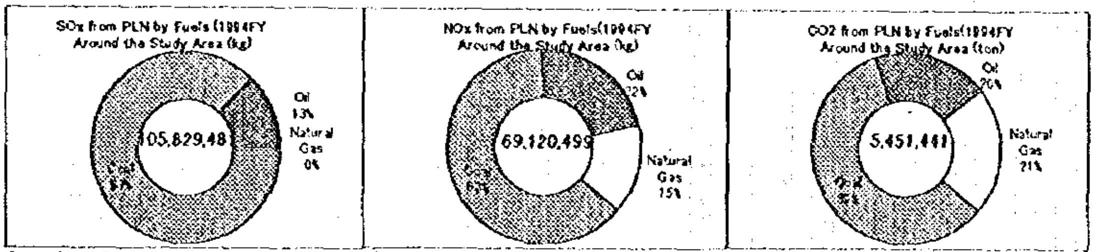
Source : Negara Energi Indonesia 1955-1994, by Biro Perencanaan MME 1995
A&Eng Estimation of Air Pollution by JICA Urban Gas Project, 1996

15.1.3 Air Pollution from the Electric Power Sector

To understand the discharge sources of air pollutants in the Study area, we have evaluated electric power which discharges large quantities of pollutants, based on the statistical data of PLN fuel consumption.

According to the results, most pollutant emissions come from the fuel use of coal in those power plants, and sulfur oxide emissions from natural gas use are quite small. But for nitrogen oxide, the emission by the use of natural gas has become much greater because of the recently growing use of gas combined cycle systems around the DKI area. (Figure 15.1.2)

Figure 15.1.2 Air Pollution by Fuels from Power Generation around the Study Area, 1994



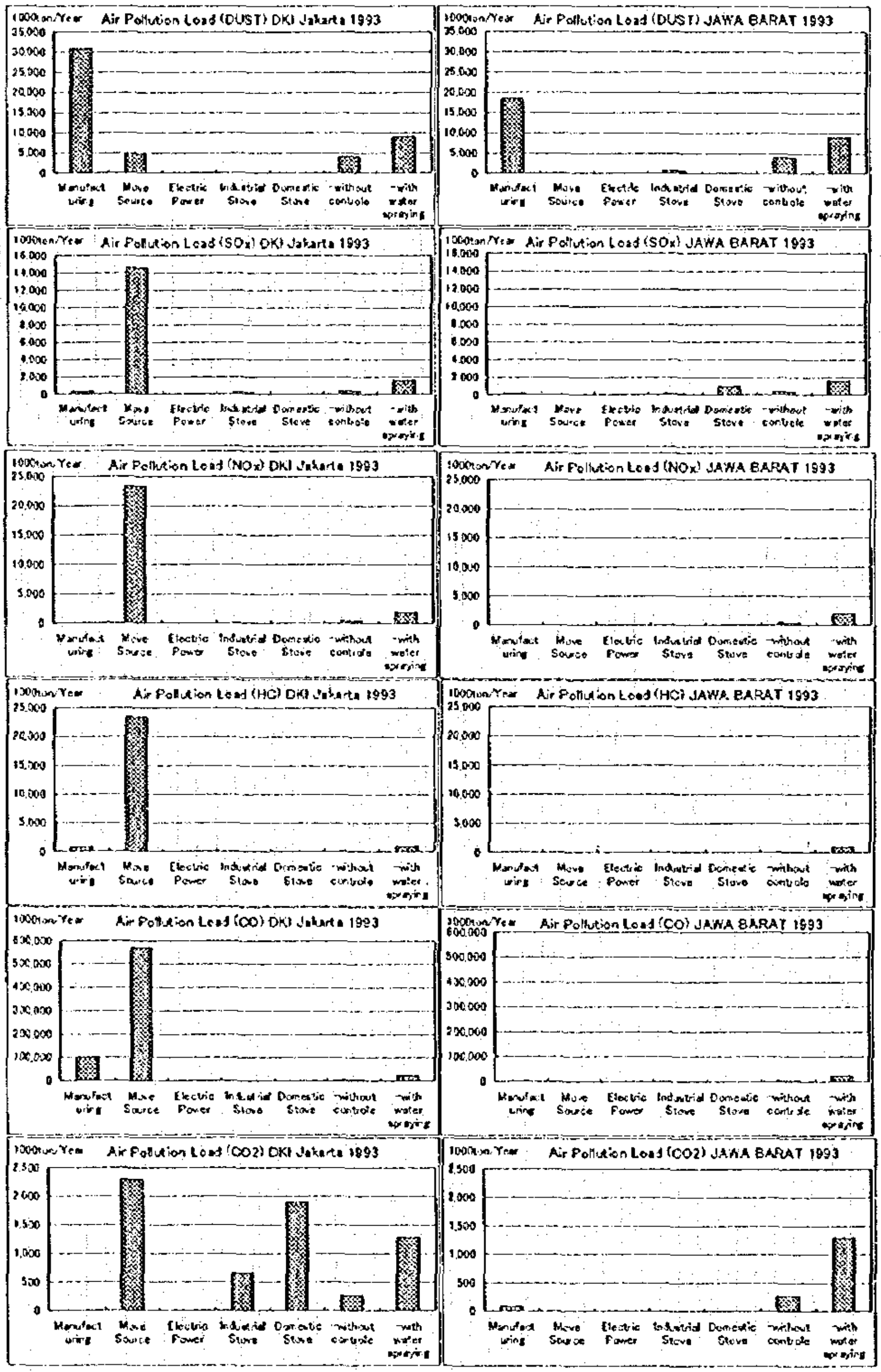
Source : Statistic Dan Informasi Ketenagalistrikan Dan Energi Tahun 1994 1995
Direktorat Jenderal Listrik Dan Pengembangan Energi JAKARTA, Maret 1995 (MME)
Adding Estimation of Air Pollution by JICA Urban Gas Project, 1996

15.1.4 Air pollution around the Study Area

The present situation of air pollution around the Study area is shown in Figure 15.1.3. This data is from statistics published by BPS. It does not include the data on fuel use in the electric power sector. So except for air pollution from electricity, air pollutants from the transportation sector are the major cause of environmental problems around the Study area. Dust is from industry, especially from cement factories in the DKI area, but the other air pollution mainly comes from emissions by moving sources (motor vehicles). And air pollution from the city incinerator is also significant.

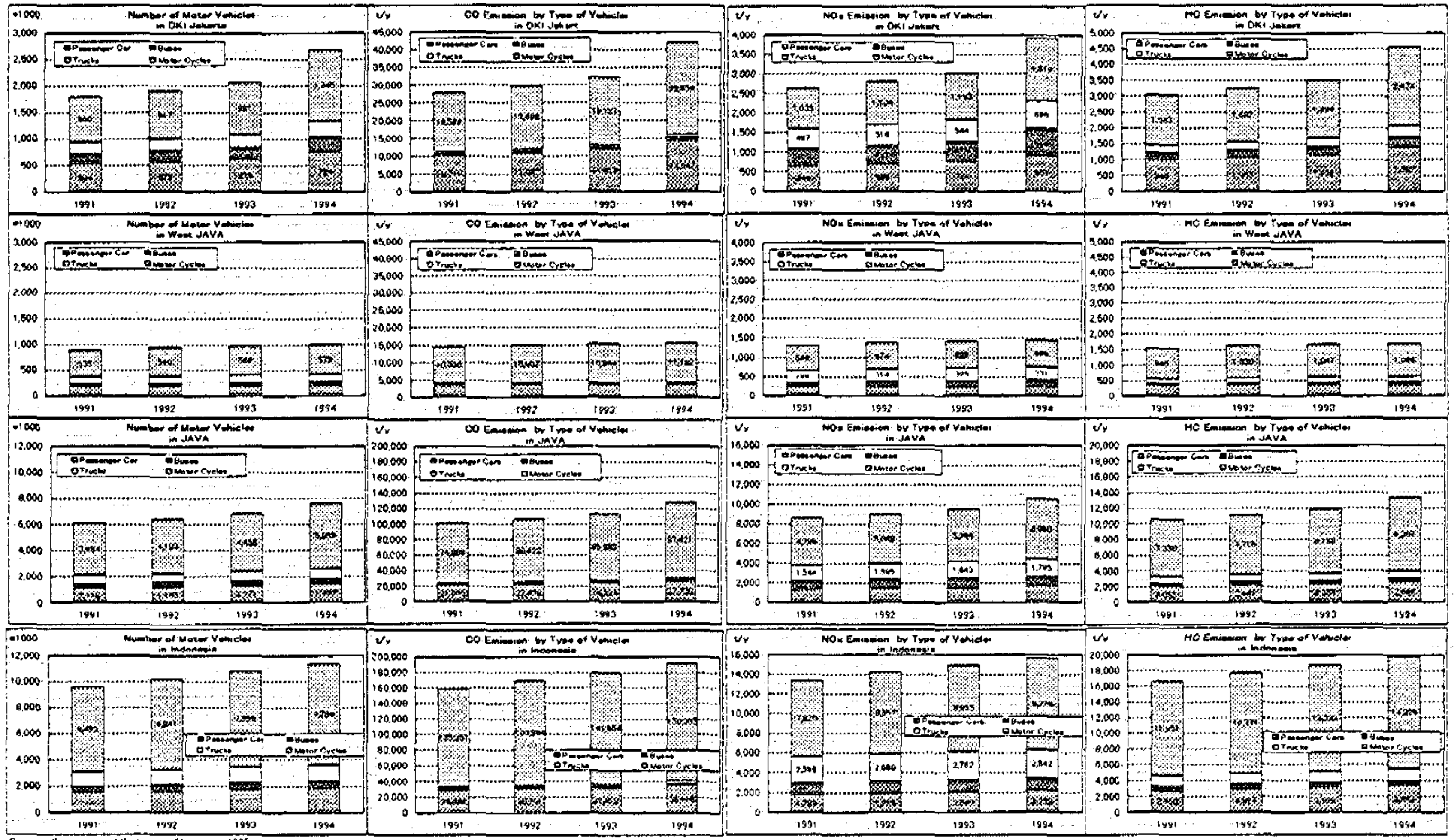
The current situation of air pollution caused by transportation is shown in Figure 15.1.4. This reveals much of the air pollution is from motorcycles around the DKI area, followed by passenger cars, and the amount of those pollutants has increased during the last two years. The Government of Indonesia has already recognized the necessity of countermeasures to reduce air pollution caused by the traffic.

Figure 15.1.3 Situation of Air Pollutant in West Java and DKI



Source :Environmental Statistic of Indonesia 1995, Regional Account of Quality environmental

Figure 15.1.4 Air Pollution by Transportation Sector in Each District of Indonesia



Source: Environmental Statistics of Indonesia 1995

15.2 Environmental Assessment for Demand Projection of Urban Gas Use

The Study estimates the amount of environmental improvement according to the projection of urban gas demand in each sector until 2020. Essential factors used in the estimation of pollutants were edited by the Science and Technology Agency of Japan. Also, the detailed emission factors by fuels and by sector which are included in the Interim Report of the JICA Environmental Investigation around the JABOTABEK area were used.

In the estimation, fuels to be replaced by increased urban gas use are shown below. For the residential sector, they are based on forecast fuel composition, for industry, they are based on actual fuel consumption. and for the commercial sector, respectively according to each facility, LPG for the kitchen, HSD for boilers and with the substitution fuel for air-conditioners being electric power. The quantites of improvement of the air pollutants is estimated and the Study's total estimated amounts of improvement are shown below.

Table 15.2.1

Improvement in Air Pollution by Urban Gas Use around the Study Area
(Based on 1995, Estimated for the Growth of Urban Gas Use since 1995)

Area	Item		1995	2000	2005	2010	2015	2020
Amount of Improvement								
Base Case	SOx	kg	0	29,670,084	47,438,483	73,813,187	128,448,102	219,333,916
	NOx	kg	0	7,115,788	11,575,523	18,197,845	31,672,680	53,931,023
	CO2	ton	0	331,947	529,914	820,753	1,424,737	2,430,298
High Case	SOx	kg	0	31,458,046	51,046,786	85,015,841	177,174,318	373,069,548
	NOx	kg	0	7,507,696	12,361,254	20,781,466	43,191,394	90,504,678
	CO2	ton	0	352,970	572,182	948,298	1,971,139	4,147,866
Low Case	SOx	kg	0	27,613,292	42,887,822	61,692,768	88,009,297	121,441,441
	NOx	kg	0	6,592,431	10,410,174	15,195,819	21,863,590	30,337,449
	CO2	ton	0	309,705	480,529	687,414	976,582	1,343,001
Rough Total of Air Pollution								
Base Case	SOx	kg	34,719,536	54,892,080	85,484,032	137,449,349	235,692,695	427,127,836
	NOx	kg	16,790,254	26,230,528	39,921,858	61,825,849	102,570,643	181,306,903
	CO2	kg	3,542,421	5,235,066	7,463,644	10,700,035	16,424,098	27,130,808
High Case	SOx	kg	34,794,293	56,045,624	90,774,984	155,569,559	317,441,707	715,199,917
	NOx	kg	16,820,389	26,527,276	41,899,249	68,989,697	135,628,508	298,218,386
	CO2	kg	3,546,242	5,295,933	7,768,719	11,706,873	20,793,431	42,262,660
Low Case	SOx	kg	34,619,211	53,661,721	79,653,987	118,891,761	170,755,808	249,305,167
	NOx	kg	16,824,623	25,650,898	37,482,095	54,231,207	76,190,579	109,155,282
	CO2	kg	3,544,481	5,153,736	7,115,234	9,654,765	12,927,992	17,721,614
Ratio of Improvement by Urban Gas Use (Base Case)								
Base Case	SOx			35.1%	35.7%	34.9%	35.3%	33.9%
	NOx			21.3%	22.5%	22.7%	23.6%	22.9%
	CO2			6.0%	6.6%	7.1%	8.0%	8.2%
High Case	SOx			36.0%	36.0%	35.3%	35.8%	34.3%
	NOx			22.1%	22.8%	23.1%	24.2%	23.3%
	CO2			6.2%	6.9%	7.5%	8.7%	8.9%
Low Case	SOx			34.0%	35.0%	34.2%	34.0%	32.8%
	NOx			20.4%	21.7%	21.9%	22.3%	21.7%
	CO2			5.7%	6.3%	6.6%	7.0%	7.0%

Source : Estimated Air Pollution by JICA Urban Gas Project, 1996

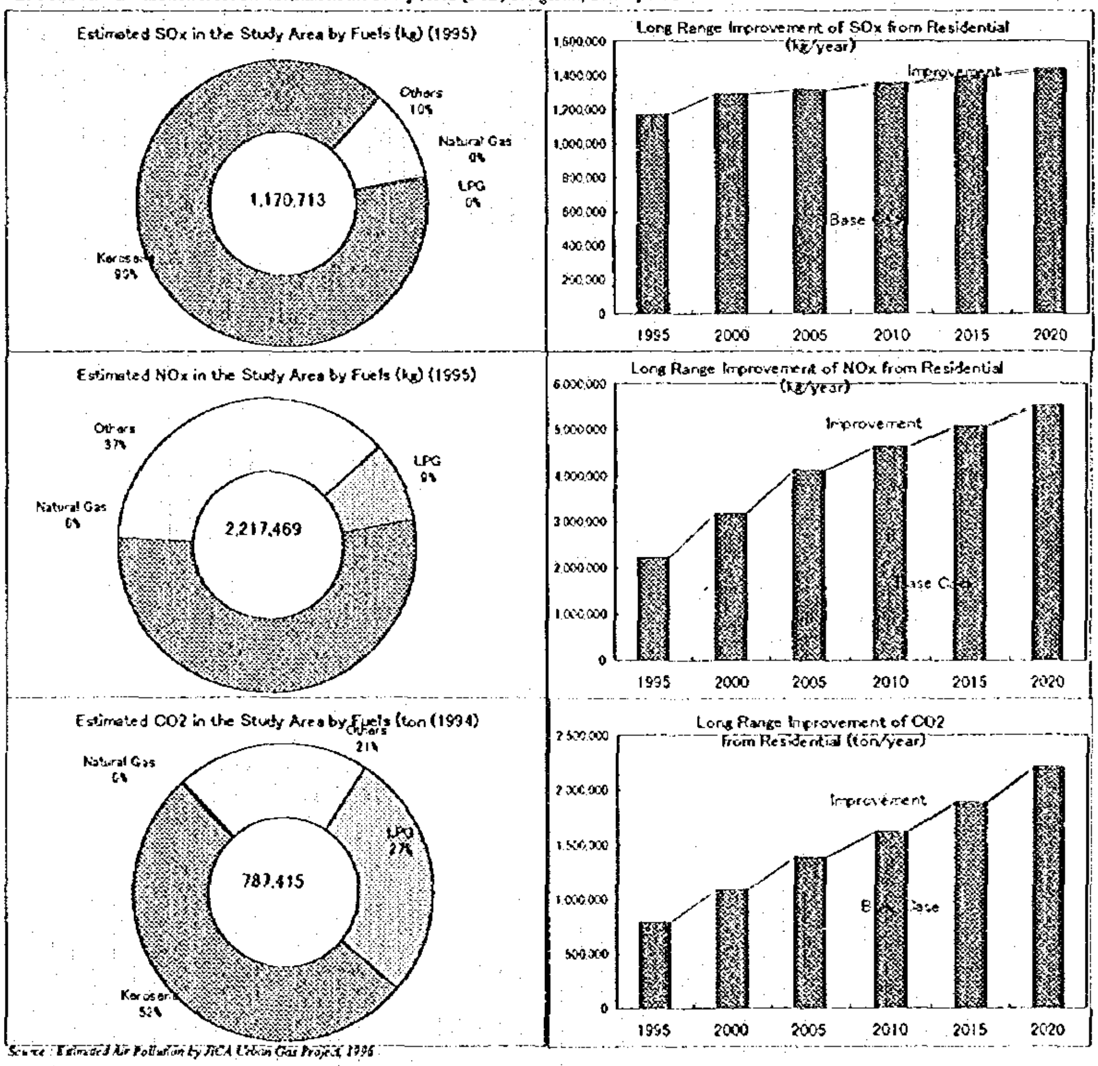
The improved quantity of air pollutants caused by urban gas use is estimated as well as air pollutants from other fuels that are to be replaced. Incidentally, in the commercial sector, the environment load in the power sector decreases, which accompanies the decrease of electricity due to electrical air-conditioners to be replaced by gas absorption air-conditioners.

15.2.1 Assessment of Urban Gas Use in the Residential Sector

In the residential sector, the amount of air pollutant improvement in DKI, Tangeran and Bekasi is estimated according to the urban gas demand in the residential sector forecast in the Study. Figure 15.2.1)

Figure 15.2.1

Air Pollutants Estimation from Residential in the Study Area (DKI, Tangeran, Bekasi) 1995



Source: Estimated Air Pollution by JICA Urban Gas Project, 1996

The share of the urban gas use in total fuel consumption in the residential sector is estimated to be 7% in 2020. In those years, the amount of kerosene and its share of the whole decreases gradually including other fuels, such as non-commercial fuels like fire wood, because of the growth of LPG use. So emission of sulfur oxide remains stable or rather decreases, including the conversion to LPG and urban gas, and the improvement is significant.

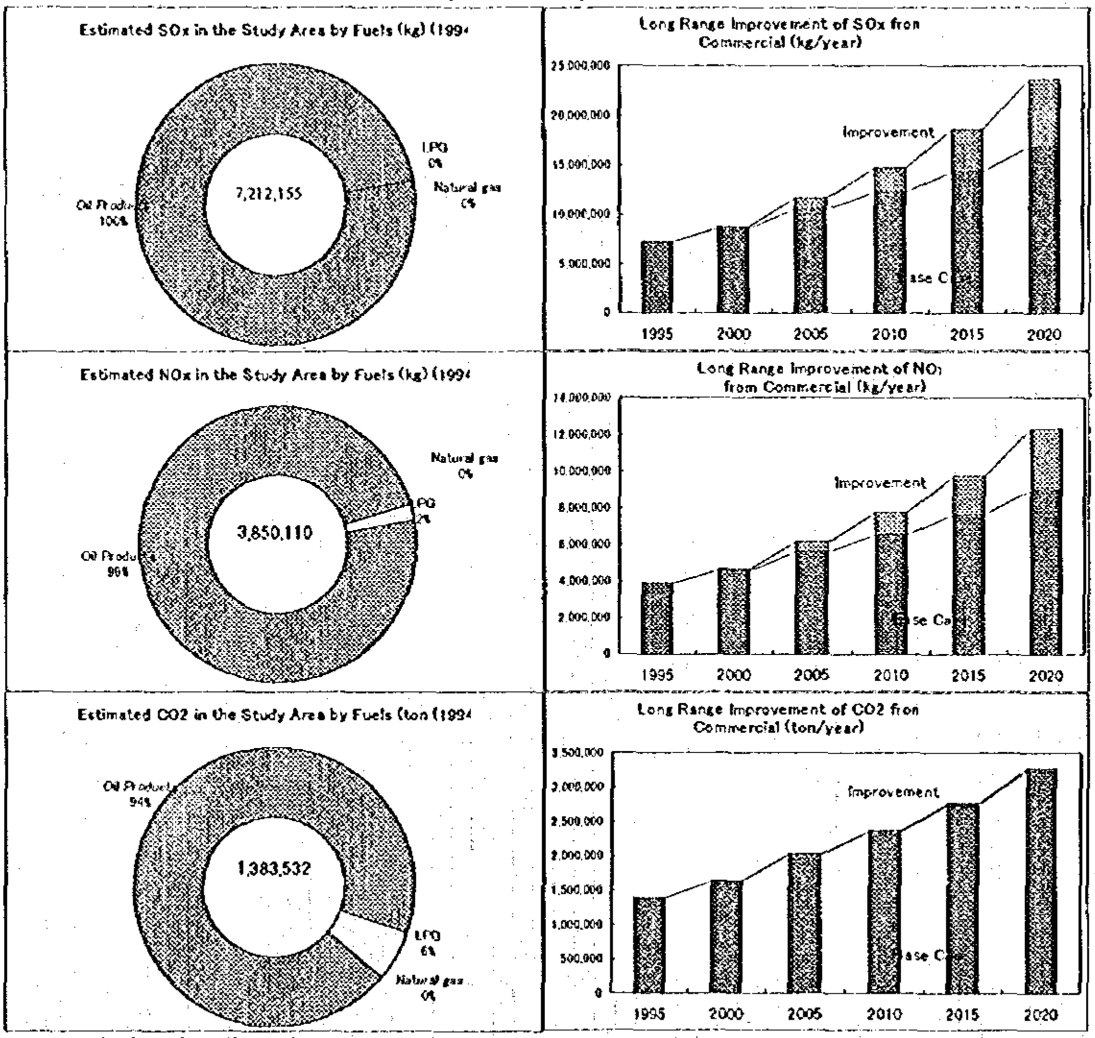
It is conspicuous that LPG consumption has increased mainly in the boomtown development areas like BSD, in recent years.

15.2.2 Assessment of Urban Gas Use in the Commercial Sector

As for the commercial sector, the substitution of urban gas for fuels is limited according to the usage. For cooking, LPG is at present the main fuel, so LPG will be substituted by urban gas.

Figure 15.2.2

Air Pollutants Estimation from Commercial Sector in the Study Area (DKI, Tangeran, Bekasi) 1994



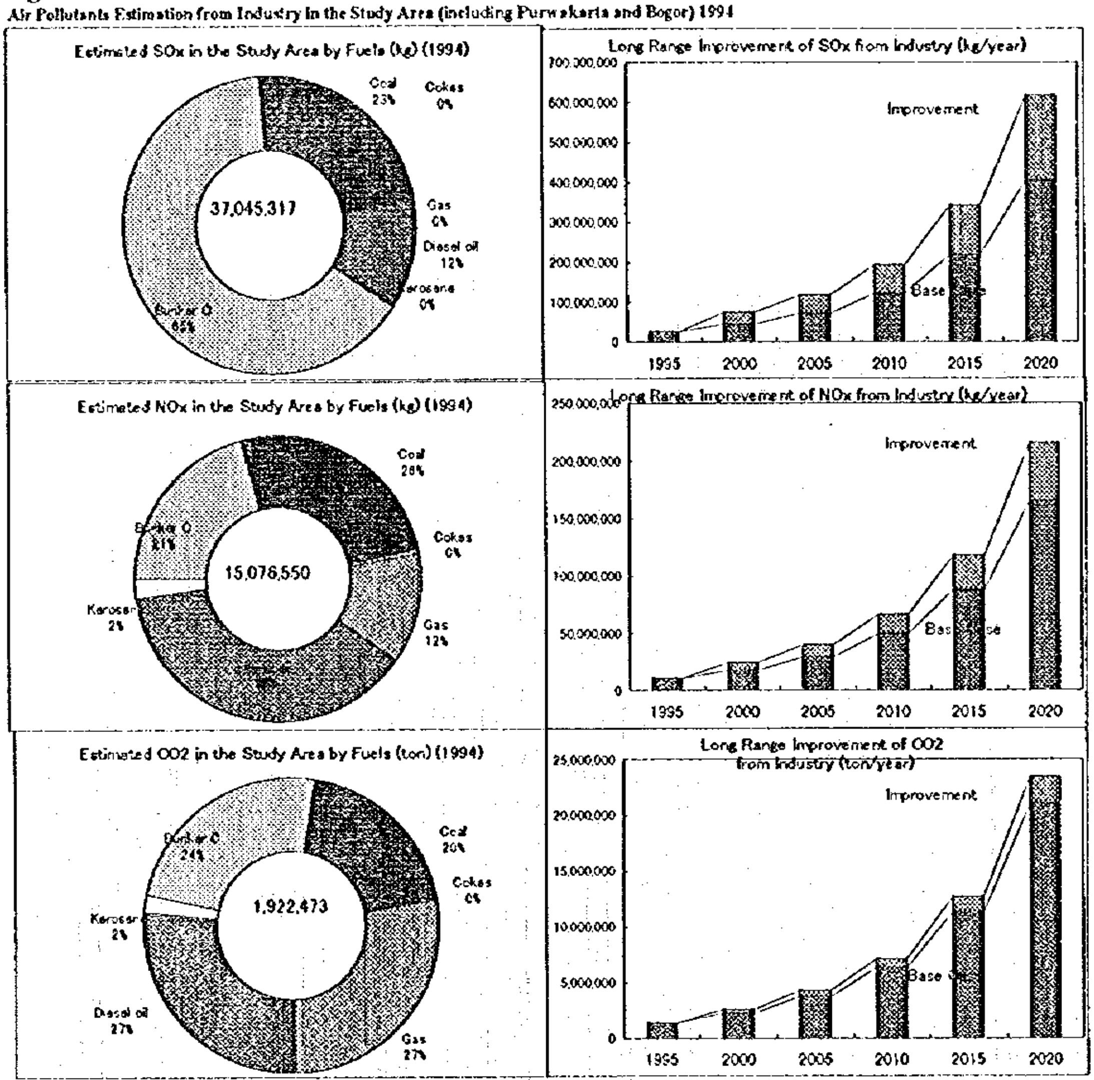
Source : Estimated Air Pollution by JICA Urban Gas Project, 1996

By this substitution of urban gas in the Base Case, present sulfur oxide will be decreased by 2.4% in 2000, 16.5% in 2010 and 28.8% in 2020. As for nitrogen oxide, it will be decreased by 2.2% in 2000, 15.4% in 2010 and 27%in 2020. Also, as for carbon dioxide it will be decreased by 0.1% in 2000, 0.6% in 2010 and 1.2% in 2020.

15.2.3 Assessment of Urban Gas Use in the Industrial Sector

For the fuels to be substituted with urban gas, we adopted the weighted average of actual oil product consumption around the Study area (from Purwakarta to Tangeran) in 1994, which was specially extracted from the BPS data base during the second Study mission.

Figure 15.2.3
Air Pollutants Estimation from Industry in the Study Area (including Purwakarta and Bogor) 1994



Source : Estimated Air Pollution by JICA Urban Gas Project, 1996

The improvement in air pollution is based on an estimate of the increment of urban gas use in future over the present quantity of gas use. As for nitrogen oxide, the emission factor of fuel use is originally different depending on the usage or facilities. But in this Study, we are not estimating the fuel consumption by each facility, but basically use the industrial average emission factor edited by the Science and Technology Agency of the Japanese government.

In the figure above, air pollutant emissions from the consumption of bunker C oil, which has been increasing rapidly in recent years, became a fairly large part of the air pollution load in 1994. On the other hand, major environmental improvement is expected by substituting urban gas for other fuels. The rate of improvement of sulfur oxide emissions, compared with the case in which urban gas use will not increase more than the present amount, is estimated to be improved by 40% in 2000, 37% in 2010, and 34% in 2020 as a

Base Case. As for nitrogen oxides, 28% of the whole is estimated to be improved in 2000, 26% in 2010 and 23% in 2020 in the Base Case. As for carbon dioxide, a 13% reduction is estimated in 2000, 11% in 2010 and 10% in 2020.

15.3. Environmental Influence of NGV

As for transportation, it is expected the environment will be improved by the use of NGV in future. During the third field survey, a newspaper reported that BAPEDAL has decided to switch all agency vehicles to NGV from now. PGN is also studying details for NGV use, but it seems difficult to create a scenario for introducing it because of the above reasons.

The target of NGV use will be taxis and Mikrolet (Mini Buses), and the air pollutants emitted by those will be 15% or 25% of the total emissions from transportation in the JABOTABEK area. As reported by the JICA Environmental Study in JABOTABEK, the improvement target of air pollution by using NGV will be expected within this range.

15.4 Conclusions

As for the total situation of the environmental issues in the Study area, the top priority problem is the securing of drinking water sources because of the river pollution caused by industrial waste water and residential drainage. Next, there is fear of farm product pollution coming from river pollution. Moreover, there is marine produce pollution which accompanies the coastal ocean pollution from the river water contamination. As for air pollution, because of the positive influence of the geographical situation in the Study area, in the pollution whole area pollution is not so obvious. It seems to occur with local air pollution, that is, the exhaust pollution from motor vehicles in the traffic congested areas and the air pollution in the areas near factories from which air pollutants such as PM are emitted. The source of this pollution is often able to be specified.

As for environmental counter measures in the industrial sector, for example, sulfur oxide emissions can be substantially improved by converting to a low sulfur fuel such as natural gas. On the other hand, if they have effective counter measures for air pollutant sources, other fuels can be used in the same air pollutant load as natural gas. Conversion to natural gas from other fuels is not always an indispensable item for air pollution improvement measures. Therefore, the attempt to increase the growth of gas fuel use will be done while making economic and environmental evaluations.

According to the improvement of the standard of living, as for the commercial sector, it is expected that the energy demand of shopping centers and office buildings will increase rapidly. In that situation especially, introducing the absorbing type of air-conditioning using gas in stead of the ordinary one using electricity will be effective from the view point of environmental evaluation. That is, first, electricity consumption (especially in the daytime peak load) growth will be suppressed and the emission quantity of air pollutants from the electric power sector will be reduced. Secondly, double environmental improvement can be expected because of changing the coolant from CFC gas to lithium bromide which is not said to be a green house gas.

As for the residential sector, they have been changing from non commercial fuels such as wood to kerosene and moreover from kerosene to LPG. Especially, in recent years, LPG growth is quite remarkable due to improvement of the standard of living. As a result, the environmental improvement concerning sulfur oxide is big, so it is also expected the quantity of sulfur oxide from households fuel use will be stable in future.

On the other hand, the danger of explosions will increase with the present type of LPG use. It will be necessary that the position of the LPG cylinder should be changed (from indoors to outdoors), or it will be better to change household fuel to urban gas.
Also, The World Bank reports that respiratory disease occurs with indoor pollution in such households so it is possible to expect that fuel conversion to LPG or urban gas can improve the environment in the residential sector.

From the view point of the environmental issue, evaluating the necessity of increase in the urban gas demand quantitatively is not always the first priority in the present situation of energy supply for urban areas. But it will become a problem in future. We can also say, it is important to investigate in future the problem of consuming energy and avoiding pollution by it in concentrated urban areas .

Chapter 16

Assessment and Recommendations on the Master Plan

16. Assessment and Recommendations on the Master Plan

16.1 Assessment of the Master Plan

(1) Overview

The Team concludes from the analysis of the Master Plan that the gas distribution to smaller customers will be economically feasible and beneficial on the national economic basis subject to conditions. This is judged mainly from the overall EIRR and NSB over the calculation period from 1997 to 2020.

The feasibility can be expected when:

a. The price is set at a cost recoverable price, and
b. is still at a level competitive with LPG,
c. financing is available,
d. all the effort to cut costs is made, and
e. a large market of gas cooling is sought together.

Table 16-1 Economic Results of M/P

	IRR (%/y)	NSB (mil. Rp)
Base case	34.2%	970,601
High case	40.2%	1,353,508
Low case	31.0%	653,777

Source: JICA Team 1997

(2) We assumed the gas purchase price to gradually increase from the current price of 167 Rp/m3 in 1996 to 268 Rp/m3 in 2020 in real terms.

(3) Residential gas price increase:

The residential gas price was set at 800 Rp/m3 in real terms in the above economic analysis. This is a level still low enough to compete with LPG and to recover the investment; thus deemed as an economic price.

A quick increase of the residential gas price to a level of 800 Rp/m3 is desired since a case of gradual increase over ten years proved not high enough a rate of return for inviting private sector investors.

(4) Concept of Separate Entity:

We have proposed a concept of "separate entity distribution operation".

In this concept PGN sells gas to a separate distribution entity, PGN's subsidiary or a third party company, at a wholesale price and the rest of the work of gas distribution is handled by such an entity which charges an 800 Rp/m3 level price to residential customers in a designated area.

This is because PGN is currently required by the Government to apply a unique gas price to residential customers in the country regardless of the region and actual cost differences.

To maintain the safety and common gas distribution standards, PGN may still act as a contractor for physical operations and patrols, not really feeling the loss of a market.

(5) Financial Analysis:

Whether to adopt the separate entity concept and how quickly to raise the price for residential customers affects the economics of the whole Master Plan mildly because of an inherent cross subsidy from more lucrative industrial sectors.

Table 20-2 Financial Analysis on the Master Plan

	Scenario		Base		High		Low	
			IRR %/y	NPV milRp	IRR %/y	NPV milRp	IRR %/y	NPV milRp
1	Managed by separate utility. Gas purchased at 315, sold at 800	PGN side	27	433,404	32	732,100	21	202,445
		Sep. U.	16	107,802	17	117,699	16	95,216
2	PGN operates. Price up in ten years		20	451,647	24	770,169	16	208,113
3	PGN operates. No price hike		16	253,449	21	576,379	10	12,813

Source: JICA Team 1997

It is never desirable that the residential gas market operation damage the financial picture of other sectors when PGN requires large investment in transmission lines. Thus an arrangement for self sustainability of the residential gas operation is necessary.

(6) Commercial Air-conditioning:

Gas absorption air-conditioning is mostly feasible in commercial facilities at the current gas and electric prices if the pipelines are located close to the customer facilities.

(7) Cogeneration:

High efficiency cogeneration may have some difficulty in attracting investors, who generally want a quick property investment return. It is still economical to an investor with enough financial capability and long-term perspective of property operation.

(8) Natural Gas Vehicles:

NGV is simply beneficial for the environment in urban areas as long as economics allows it.

A certain density of the number of stations is required for NGVs to take off in a self sustaining market. It may be worth certain cross-subsidy in a transition period.

(9) Industrial market:

There are recent challenges from low cost oil products, so PGN should feel competition and think in advance for possible demand areas.

The Team appreciates that PGN well knows the industrial gas sector from abundant experiences.

(10) Environmental and societal effect:

As gas is good only, it is essential to assess how good natural gas is in urban areas.

Gas absorption chillers decreases ozone depleting CFCs.

The gas is safer than LPG which has recently caused many large explosion incidents as well as is more convenient.

16.2 Recommendations

1) It should be recognized in energy policies that gas distribution to smaller customer markets is feasible at economic prices under certain conditions including joint development of residential, commercial, and gas cooling markets. Mid-income group residents can be better targeted for the residential gas market and so they can be a locomotive for building up the gas energy infrastructure.

2) It is recommended to consider a separate utility concept, if the policy of one gas price by one company continues in the country, since such policy seems to disregard market principles. When the distribution cost in a certain region is different from an other region and such a cost can still compete with other fuels, it is recommended to approve a mechanism to apply a different price through a separate entity establishment

3) The government is recommended to endorse the promotion of gas air-conditioning and cogeneration, when feasible, for commercial or industrial buildings and complexes.

4) NGVs are beneficial and recommended to be promoted in urban areas. More filling stations are necessary for sustainability.

5) It is recommended to continue to watch new industrial estate development, since industrial estates in West Java are growing and early pipeline planning is better for securing the gas market.

PART III

FEASIBILITY STUDIES

Chapter 17

Common Scheme and Assumptions

PART III FEASIBILITY STUDIES

17. Common Scheme and Assumptions

17.1 Overview

17.2 Area Selection

The major goal of this development plan is to increase gas use in the household sector, and therefore the candidate plans (1) and (2) were approved by the Steering Committee.

(1) Expansion of Residential Gas Use in Existing Areas: Bekasi Baru

(2) Gas Use in Multi-Functional Development Areas: BSD

(3) Utility Service Subsidiary in Newly Developed Industrial Complex: Purwakarta

(4) Rehabilitation Plans for Existing Gas Pipelines

17.3 Common Scheme and Assumptions

17.3.1 Common Scheme

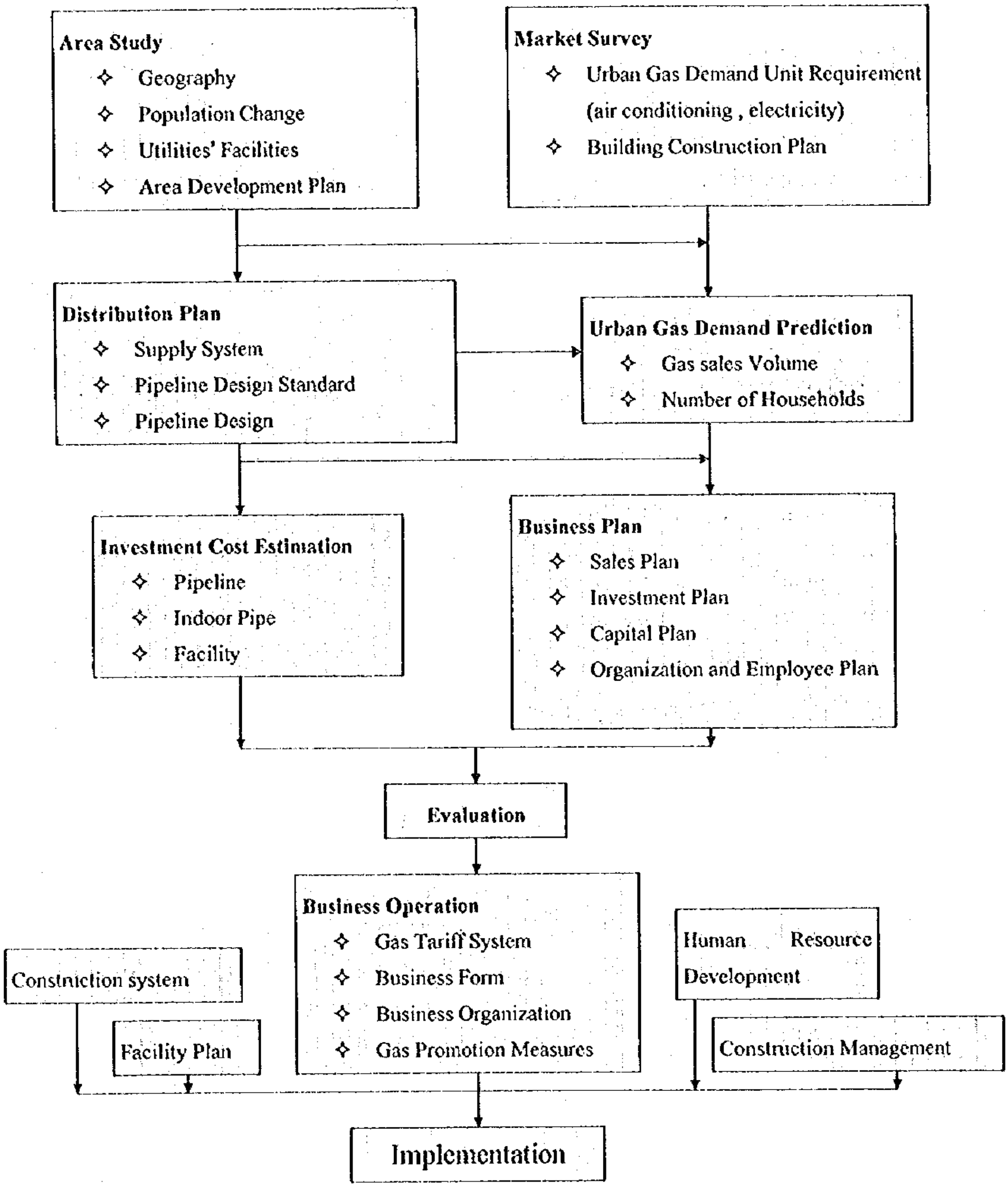
Figure 17-3-1 shows a rough works flow of the feasibility study.

17.3.2 Common Assumptions of the Feasibility Study (F/S)

Implementation of the two feasibility studies assumes the following preconditions:

- Proper gas price levels will be employed and the investment in gas pipelines described in the plan be implemented
- The infrastructure improvement plans and large-scale building plans will be implemented in the future as planned by developers.
- All-out cooperation to the gas project by the area developers be ensured.
- The work performance capability of contractors be sufficient to fulfill the related works.

Figure 17-3-1 Feasibility Study Plan



17.4 Gas Price Issues

17.4.1 Tariff levels competing other fuels

In setting tariff levels, it is important to consider the price levels of competing fuels. In the residential sector, we find the competing fuel is LPG, rather than kerosene. The price of LPG, which was set in 1995, is 1000Rp/kg, which is equal to a price of 784Rp/m^3 for natural gas. For thinking of competitiveness of natural gas, the tariff for the residential customers could be set at 700-800 Rp/m^3.

17.4.2 Allocation of the Distribution Cost to Each Customer Category

Allocation, ideally, should be done based on the actual cost of each category of customer, so that the tariff charged to each category will have fair cost allocation and there are no cross subsidy of costs between customers in an ideal case.

17.4.3 Two Part Tariff System

We recommend to introduce two part tariff system in the Feasibility Study areas.

17.5 The Case of an Alternative Business Unit

We assume 5 alternative cases of pricing and Business form in the analysis of the Feasibility Study as Table 17-5-1 shows. This assumption of case is exactly same as that of Master Plan.(see section 14.1.1)

Table 17-5-1 Alternative Cases for Pricing & Business Unit(reproduced)

	Gas Price	Investment	Operation
CASE 1	Keep current price level	PGN	PGN
CASE 2	Raise gas price gradually equivalence to competitive fuels	PGN	PGN
CASE 3	Keep current price level	Government	PGN
CASE 4	Raise gas price gradually equivalence to competitive fuels	Government	PGN
CASE 5	Raise gas price immediately equivalence to competitive fuels	third party (e.g., a subsidiaries of PGN)	third party (e.g., a subsidiaries of PGN)

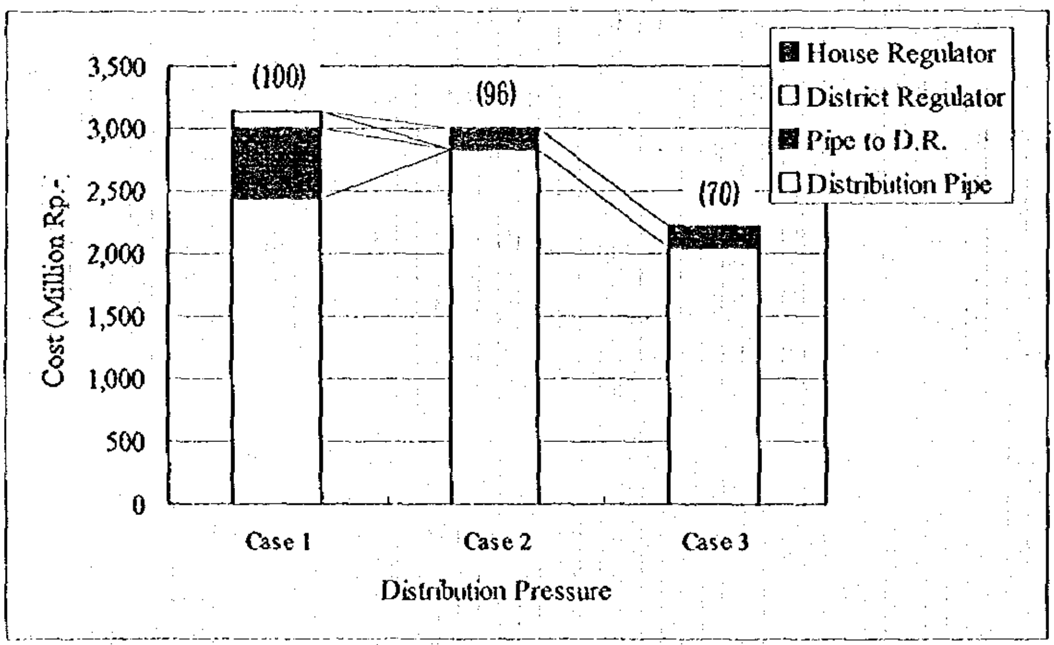
17.6 Distribution Pipeline System for Residential Customers

Table 17-6-1 Cases Compared for Finding the Best Distribution System

Case	System	Pressure Range	Minimum Diameter to be used
1	Low Pressure	180-230 mmH2O	PE 63 mm
2	Medium Pressure (1)	0.1 - 1.0 bar	PE 63 mm
3	Medium Pressure (2)	0.1 - 1.0 bar	PE 32 mm

Fig. 17-6-1 shows the cost comparison among 3 distribution systems defined in Table 17-6-1. From the graph, we will use the medium pressure distribution system that uses 32 mm pipes for distribution main as the standard distribution system in the Study.

Fig. 17-6-1 Construction Cost Comparison



Source : JICA Team