JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

PT. PERUSAHAAN GAS NEGARA (Persero)
MINISTRY OF MINES AND ENERGY
DIRECTORATE GENERAL OF OIL AND GAS (MIGAS)
THE REPUBLIC OF INDONESIA

THE STUDY ON MASTER PLAN OF URBAN GAS DEVELOPMENT IN THE REPUBLIC OF INDONESIA

FINAL REPORT
SUMMARY VERSION

August 1997

Osaka Gas Co., Ltd.
The Institute of Energy Economics, Japan

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Acronyms and Abbreviations

Abs.	Absorption; absorption chiller(s)
AC	*air-conditioning, air-conditioner(s)*
ADB	the Asian Development Bank
AIC	average incremental cost
ANSI	American National Standards Institute
API	American Petroleum Institute
Bapedal	Board of Environment Effect Control, RI
BAPPENAS	the Bureau of National Development Planning, RI
bar	a pressure unit; 1 bar=100 kPa (kilo-Pascal)=0.987 atm=1.0197 kg/cm^2=10206 mmH_2O
bloe, (bbloe)	barrel(s) oil equivalent; 1 bl=0.159 kl, 1 bloe ≒ 0.147toe ≒ 5.836 mmBtu
BSD	Bumi Serpong Damai, (peaceful Serpong land), an estate in Tangerang
BOTABEK	Bogor-Tangerang-Bekasi
Btu	British thermal unit. 1 Btu is equivalent to 0.252 kcal or 1.0551 kJ; mmBtu = million Btu
C	Celsius; conversion: C=(F-32)*5/9
CFCs	*chloro-fluoro-carbons*
CNG	compressed natural gas
COP	coefficient of performance (virtual efficiency in air-conditioning)
deg, dg	*degree(s)*
DKI, D.K.I.	D.K.I. Jakarta; the capital district of Indonesia
DW	Durbin-Watson ratio; an index to test the independence of errors in a regression model including time-lag variables; *DW=2 meaning perfect independence.*
EHP	electric heat pump (compared to GHP)
EIB	the European Investment Bank
EIRR	economic internal rate of return
F	Fahrenheit; conversion: F=C*9/5+32
FIRR	financial internal rate of return
GAKINDO	the Association of Indonesia Motor Vehicle Industries
GDP	gross domestic product
GHP	gas (engine) heat pump
GOI	the Government of Indonesia
GRDP	gross regional and domestic product
GRP	gross regional product
GT	gas turbine
HCFC	hydro-chloro-fluoro-carbons
HR	house regulator
IRR	internal rate of return
IFC	International Finance Corporation (a subsidiary of the World Bank)
IMF	the International Monetary Fund
IPP	independent power producer
JEXIM	Japanese Export and Import Bank
JICA	the Japan International Cooperation Agency
JMDP	Jabotabek Metropolitan Development Plan
JABOTABEK	Jakarta-Bogor-Tangerang-Bekasi metropolitan area integrated
JATABEK	*Jakarta-Tangerang- Bekasi metropolitan area*
Kab.	Kabupaten, or prefecture
LHV, LCV	lower heating value, lower calorific value, =net heating value (cf. gross ...)
LNG	*liquefied natural gas*
LPG	liquefied petroleum gas, with main component of propane and/or butane
LRMC	long run marginal cost
Mcal	*Mega calories = million calories; 1 Mcal=1000 kcal=4.186 MJ*
MIGAS	General Directorate of Oil and Natural Gas of MME

Mikrolet	a mini-bus
MJ	Mega (10^6) Joule, an SI thermal unit. 1 MJ=238.9 kcal=947.8 Btu
MME	the Ministry of Mines and Energy, Directorate of Planning, RI
MMSCFD, mmscfd	million standard cubic feet per day; 1 mmscfd (60 deg. F) is equivalent to 10.75 million cubic meters (27 deg. C) per year. "MM" is million only in American units.
MRT	the Mass Rapid Transit system
MSCF, mscf	thousand standard cubic feet; 1 mscf of gas is equivalent to 28.3 m^3 at 15.5 deg. C and 29.43 m^3 at 27 deg. C; "M" or "m" is "thousand" in American units only.
MTN	medium term notes (promissory notes)
NGV	natural gas vehicle
NPV	net present value(s)
NSB	net social benefit
OECF	the Overseas Economic Cooperation Fund of Japan
O & M	operation and maintenance
Perum Perumnas	National Urban Development Corporation
PGN	PT. Perusahaan Gas Negara (Persero), i.e., National Gas Limited Company
PKLN	Pinjaman Komersial Luar Negeri or the National Foreign Debt Regulatory Board
PJP	National 25 Years Plan of RI; e.g., PJP II: the Second 25 Year Plan (1994-2018)
PLN	PT. Perusahaan Listrik Negara (Persero), i.e., National Electric Limited Company
P/S, PSC	production sharing, production sharing contractors
RI	the Republic of Indonesia
Repelita, REPELITA	National Five Year Plan; Repelita VI: the 6th Five-Year Plan (1994-1998)
ROE	return on equity
Rp	Rupiah; US$1.00=Rp 2350, JPYen 1= Rp 20 (January 1997)
R^2	the determination coefficient or square of the correlation coefficient used in regression analyses.
RT	refrigeration ton, a cold thermal flow unit. 1 RT=3024 kcal /h
SP	service pipe
t_i, t-value	Student's "t", for testing a regression coefficient of a (the i-th) variable.
toe	tons oil equivalent; 1 toe=10,000 kcal/kg x 1,000 kg/t=10^7 kcal
WB	The World Bank

THE STUDY ON THE MASTER PLAN OF URBAN GAS DEVELOPMENT IN THE REPUBLIC OF INDONESIA — FINAL REPORT

EXECUTIVE SUMMARY

1. Overview

Introduction:
This Final Report on the Study on the Master Plan of Urban Gas Development in the Republic of Indonesia ("the Study") focuses on the Jakarta area and consists of 4 parts. Part I describes our findings and analyses on current situations and sets forth most common assumptions for the Master Plan ("M/P") and Feasibility Studies ("F/S") to follow in Parts II and III respectively. Conclusions and recommendations are re-assembled in Part IV.

Formerly, the Government of Indonesia ("GOI") and the Japanese Government agreed that the Japan International Cooperation Agency ("JICA") conduct this Study with a stress on smaller customers in the Jakarta area than the currently served industrial customers and also consider applicability to other areas than the Jakarta area. The main text of this Study is in considerable detail in an expectation that the Counterpart, PT. Perusahaan Gas Negara (Persero), or "PGN", can apply the procedures and the results of this report to other regions that it originally requested to include in the study areas.

Background: Recent rapid economic and industrial growth in the Republic of Indonesia ("RI") has spurred the increase of domestic oil consumption with a forecast that the country will become a net oil importer early in the next century. Since the country's gas resource base is considerably large on the other hand, to promote domestic use of gas from appropriate gas fields has been a mandate.

Use of natural gas used to be limited in the areas close to gas fields and prioritized for large and strategically important industries, and mostly handled by Pertamina. PGN instead embarked on natural gas distribution two decades ago and has successfully expanded natural gas distribution in Jakarta, Bogor and Cirebon using gas from Pertamina's transmission lines, and also in Medan and Surabaya, mainly targeting large industrial customers. Total national domestic gas utilization either through Pertamina or PGN is increasing and approaching 50 % of the total national gas production.

Further domestic use of gas may involve more general industries, including smaller ones, and even commercial and residential customers. Market development activities are important in such smaller customer markets. Since new pipelines are planned to transport gas from Sumatra to Java, it is a high time to consider how to newly develop such smaller customer markets in a way that RI has never experienced.

Major Findings: This Study has found that the economic development in the Jakarta area is at a level that makes the area fully qualified for an urban gas system. It even will be necessary as a streamlined energy infrastructure in a modern capital area. This can be demonstrated by considerations on energy efficiency, urban energy transportation, traffic congestion, environment, safety, affordability and residents' desire for more convenience in the urban areas.

The urban gas network development, if feasible, is thus significant in two ways: to contribute to the national energy policy to promote the domestic use of non-oil energy to liberate as much oil for export and to modernize the urban energy infrastructure in the capital area of the country. The Study aims at clarifying the ways both in national policy and PGN's management strategies to accomplish such purposes.

Objectives: The objectives of the Study, in response to the foregoing, are to:

① formulate a master plan comprising the optimum development plan of an urban gas distribution system in the household (residential), commercial and industrial market sectors in the Jakarta area, and to conduct feasibility studies in the selected districts;

② propose appropriate plans for improving institutional and administrative systems of urban gas supply service; and

③ transfer the technical and administrative expertise to PGN, in the course of conducting the study.

Focus of Master Plan and Feasibility Studies:
The Study has defined a master plan of gas distribution to smaller customers, i.e., smaller than the current industrial customers, including residential, commercial, industrial and new technology gas market sectors. The Study focuses on the potential gas market in the east-west belt from Balaraja to Cikampek in PGN's Jakarta Branch service area as was initially agreed. It has also shown the result of feasibility studies on the two areas, Bumi Bekasi Baru and Bumi Serpong Damai as the selected candidate populated estates. The projection period both for the Master Plan and the Feasibility Studies is through 2020. It also discusses all policy and management issues to accomplish the plans. The Study Team held seminars for technical transfer during the study period.

2. Economic Scenarios

We have set national and regional economic development scenarios including three cases, i.e., base, high and low, as the base for demand projection after a considerable study (Table 1).

In this regard, the GDP projection in the 25 Year Plan of Indonesia was hired for our "high case" for the later years in our period through 2020. Looking at a separate report, JICA's Electricity Study of 1995 assumed a little lower growth rate through and beyond 2010; upon some modification for extrapolation, we took it as our "low case".

Table 1 GDP (National) Growth Assumptions %/y

year /case	till 2000	2000-2010	2010-2020
Base	6.5	6.4	6.7
High	6.9	7.1	8.7
Low	6.2	5.7	4.5

JICA Team

In the near term, both projections are close, with said JICA's slightly higher, while actual GDP growth these years surpasses the targeted GDP of both. The Repelita assumptions give the lowest figures and so are to become our "low case". JICA 1995's near term projections are accordingly our "high case". Smooth projections connecting those near-term and later year projections were considered as the mid-term projections. The averages of "high" and "low" are our "base case".

To study the Jakarta area, we rather need to project the local gross regional product (GRP) which is much higher than the national average. Its growth projections are determined as in Table 2.

Table 2 GRP (Jakarta) Growth Assumptions %/y

case / year	till 2000	2000-2010	2010-2020
Base	7.7	7.6	7.9
High	8.1	8.3	10.3
Low	7.3	6.7	5.3

JICA Team

The level of GRP per capita in Jakarta is also far higher than in other areas but its growth rate seems to be somewhat suppressed by a significantly higher population growth in the area. We recognize that GRP per capita in Jakarta is close to or over US$3,000 and consider that the area can now well afford to have urban gas distribution.

3. Gas Supply

Although the Study assumes sufficient gas supply in West Java in the future, we have recognized constraints having existed in the gas fields to supply Java and in existing pipelines presently and at least for the time being. PGN has secured a sizable amount of natural gas supply from the off-shore Jakarta North gas fields as of May 1997 and has been relieved from the supply problem for the near future. We will assume the Indonesia Integrated Transmission Pipelines which are being planned will solve the problem of quantity for the further future. We understand the supply capacity of 450 mmscfd is planned for West Java looking for market after completion of the Sumatra-Java pipeline in the near future.

The detail of gas supply is out of our scope of work. The development of upstream infrastructures, however, will affect the gas supply cost in real terms and we examined approximate costs to be used for our economic analyses by assuming the future gas production and transmission conditions.

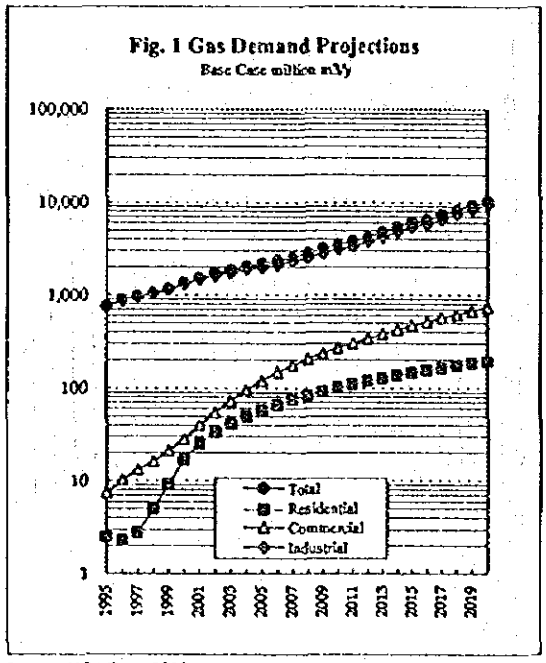
4. Master Plan

4.1 Master Plan Areas

We have defined the target area of the Master Plan as the high population density belt, with the width of about 10 km, along both the existing West Java Transmission lines and the already planned distribution mains, and the whole JATABEK area. Since the residential and commercial gas distribution requires especially careful cost and economic examination, it is better to begin from the areas which are very close to the existing lines with shorter additional distribution mains required.

4.2 Demand Projections in the Master Plan Areas

The Team laid out the gas demand projection in the Master Plan areas based on the economic scenarios and the field demand survey.



Source: JICA Team 1997

4.3 Demand Survey Results

The Team devoted major efforts to field demand survey work and the findings are briefed in each demand sector as in the following:

1) Residential: Average estimated gas consumption per month per family, or "per meter", in Indonesia is found to be rather large as compared to commonly expected levels for tropical countries, if considering certain income groups presumed suitable to have urban gas. The survey was conducted in two ways: collecting about 1200 questionnaire returns and actually visiting with more than 200 potential sample customers over wide income levels. The face to face discussions with sample customers revealed much preference for gas.

   Based on the larger than expected per-meters, economics of residential gas distribution seems feasible based on economic prices and costs, and is encouraging for future planning. The best customers are found in middle income groups. Current residential gas prices, however, are still too low before economic feasibility.

Also, we conducted "load pattern surveys" for selected existing gas customers using state of the art intelligent gas meters with a function to record gas flow signals showing the pattern of gas use within a day, which reflects the everyday life of Indonesian customers. The information is useful for correctly designing the distribution pipelines that must accommodate maximum, and not average, gas flows.

Residential energy demand mix is first projected to 2020 considering the trends of income level and size of family as well as their elasticity to energy consumption. Gas consumption was then determined approximately as a share in the residential energy mix, the shares being assumed as 5 to 9 %. The considerations on this share include the constraints by the closeness to the main pipelines being planned. This, however, gives still only a potential estimated consumption. The Team's real projection, defined as "possible demand" is determined after checking gas pipeline installation possibilities and the final projections are included in Fig. 1, together with other demand sectors.

2) Commercial: Combined with the gas cooling market, commercial gas distribution will be feasible for customers at current gas prices under certain presumptions. The Team conducted interview surveys with 60 plus customers. The data confirmed that experiences of the cooling market in Japan are applicable to Indonesia and economics are far better with gas cooling here because of more hours of operation due to climate reasons. Future economy will depend on electric prices in an upward trend, which we hope will be still favorable to gas.

3) Industrial: The Team's survey focused on the growth potential of new industrial estates since PGN already did detail work for industrial customers outside those estates and confirmed feasible. The Team made visits and analyses with 20 plus factories. Uncertainty exists in each estate and only long term plans will include gas distribution in those estates so that PGN may be ready to consider them when demands (and supply availability) come out closer.

4) New technology markets:

Gas air-conditioning, when applicable, is found to be technically and economically feasible in Indonesia. Detail results are in the main text and the gas development in this sector is encouraged for building the distribution infrastructure.

Marketing of high efficiency cogeneration may be difficult to generalize but seems to require higher electricity prices before becoming feasible. There is no doubt that the economics in cogeneration are favorable in the long term due to its high energy efficiency if there is certain amount of heat demand in customers' buildings, but the higher up-front cost sometimes discourages investors who are interested in a short period pay-back. Since electric prices have to rise based on the future cost of

facilities, the feasibility of cogeneration may be a matter of time.

District cooling has a possibility, too. The Team made a detail study on this for the BSD's commercial area. Large benefits such as convenience, cleanliness, space saving and prestige in commercial facilities give high premium values to a community and an economic analysis shows it beneficial. A high up-front cost, however, may inhibit it in situations, e.g., when they are not interested in longer term benefits or where facility build-up time is very long. From this view, this Study has taken a little pessimistic stance on the district cooling for the moment but does not mean no future.

NGV is found to be beneficial for the Indonesian urban environment with the costs for conversion much less than we initially expected. A bottleneck, however, will be the penetration of filling stations which have constraints in finding the sites in urban areas. The government's target to have 30,000 NGVs to be available in 2000 is tough and more time may be necessary.

5. Policy and Pricing Considerations

5.1 Policy

The policy for the gas distribution sector is not well defined yet. We are concerned with the inter-fuel price competition, distribution cost and gas pricing mechanism, business entry constraints, conditions to make financing available to both the gas distributor's and customer's sides, safety standards and regulatory framework. We recommend all policies be favorable to encouraging quick gas customer connection to maximize efficient gas use in the market.

The result of the ongoing consultant works for the gas regulatory framework to come out to MIGAS is being waited for. It has come to the Team's knowledge that some of relevant items in the draft of such works may appear to affect gas distribution business as follows:

- A bundled gas supply service on a local basis
- gas prices on negotiated basis for larger customers
- Any subsidy, if applicable, directly from Government and on a fixed sum
- No exclusivity in distribution territories
- prices to small customers to be under simple ceiling price control

We recommend to treat natural gas as an urban energy infrastructure with a high priority considering the energy resource situation in Indonesia, its particular suitability to urban areas and high efficiency in its direct use.

Smaller customer markets generally require an advance investment and longer term orderly planning. Investors in this sub-sector usually expect sure returns instead of high risky returns and the regulatory framework should consider this.

Natural gas to smaller urban customers may be a little expensive in thermal value terms in the future, but is a premium fuel to attract them in view of convenience, cleanliness, safety and efficiency as well as some pride even at a higher price.

5.2 Pricing

Gas prices have been improved by the recent revision for the first time since 5 years ago. It is welcomed as a beginning toward more rational gas pricing to assure investment in all the streams of natural gas as well as for the gas to remain competitive in the market. In view of the future smaller customer market, the price rise is clearly not yet enough and also we expect more strategic price structures to be worked out in the future when more market categories are explored.

A gas price, in principle, should be appropriately or strategically set in between the cost of distributed gas at customer's end and the net-back value which a targeted customer is willing to pay in view of competing fuels. To accurately determine such costs and values is not always easy, but approximate levels should always be recognized. The aggregate price should well cover all the costs of gas supply and attaining such price status is desired at least before inviting private sector financing. Long run marginal costs (LRMC) or average incremental costs (AIC) should be considered as an indication to minimum price for utility services accompanying future investment. Pricing proposals based on such mechanisms should be granted by the government.

A two-part tariff system should be studied especially for smaller customer markets. While considerations in the former paragraph give the concept of average gas costs and prices, how to allocate the costs into the tariff table is another problem, and the point is in how to quickly recover the rather high up-front costs. A tariff table should basically follow a principle of "the simpler the better" in view of accountability and transparency, but how to recover the cost by way of pricing is too important a topic. This may not necessarily apply to large customer markets because gas is currently competitive enough to be with economic rent in the sector. The situation, however, might be changed by other low cost fuels depending on the region and type of customers.

6. Utility Management

The organization of the utility, i.e., the gas company, will need to accommodate future changes and expansion of market sub-sectors or categories. A market is not simply there but is to be developed. Smaller customer markets may be explored by persistent

marketing activities by the personnel with engineering knowledge and by customer education, and there may not be a waiting list even if gas is preferred. Constant employee training may enable PGN to face this challenge with intensive training activities (and relevant facilities) with the current size of staff- and work-force of PGN for the time being.

7. Feasibility Studies

The concept of the urban gas expansion is to initially pick-up relatively larger customers even in the smaller customer market in the areas close to existing pipelines, or otherwise particularly low cost-of-supply customers, who are mainly commercial and high efficiency or premium use customers, as well as industrial and conveniently located residential customers, in order to develop the gas distribution infrastructure in an economical way. After that, eventually all potential customers in the area may be served with gas by extending pipes bit by bit to attain a core customer market. An existing residential area and a newly developing area, however, will require distinctive approaches. Also a dilemma exists in financing both PGN's and a customer's facilities. These will be discussed later.

For the Feasibility Study, the Steering Committee and the Team selected two areas in pursuant to the above concept: firstly the Perumnas Bekasi Baru, an existing detached residential housing estate operated by a governmental body, and secondly the Bumi Serpong Damai (BSD), a very large residential and commercial estate developed by private sector companies. While there were other candidates, too, those two estates are excellent comparative samples for the Study.

8. Conclusions

8.1 Energy and Economic Situations and Policies

(1) *Affordability:* The economic growth of the Jakarta area has been significant with the current average GRP per capita being about 3,000 US Dollars, a level perceived as sufficient to afford urban gas infrastructure. GRP per capita in other major metropolitan areas where gas is available are also growing fast and approaching the 1,000 US Dollar line. Perspective urban gas infrastructure in those areas will be worth consideration, too.

(2) *Gas Priority for Urban Use:* Urban gas priority is good enough to be built into the national energy policy at least in high growth metropolitan areas like Jakarta. Looking into the country's energy resource base available to domestic use and assuming abundance of natural gas in a long-term perspective, the gas could be best used for urban

energy infrastructure. This is because a modern urban area requires a streamlined energy distribution contributing to better traffic conditions, better environment, more convenience, safety and higher energy efficiency, and the direct use of gas can meet such requirements. Other energy resources are better used by larger customers and in more rural areas.

(3) *Competition with LPG:* Gas networks can compete well with LPG at economic price levels. Since urban gas can be available only through pipeline systems that require large up-front costs, economics have to be carefully examined in view of affordability by people and competition with LPG. The use of LPG is rapidly growing in suburban areas and it is also a clean energy suitable for household use with care. Due to safety issues and the nature of distribution system, however, the LPG is more suitable for rural areas. Natural gas is more suitable and preferred in urban areas.

(4) *Regulatory Framework and Policy:* There is almost no transparent framework yet to regulate urban gas distribution. Gas prices are set by the Government after discussions among PGN, Pertamina, MIGAS and political parties. By policy, the national one price system is applied so that the distributed gas has the same price throughout the nation if the use of gas is in a same category. While the constitution stipulates that gas and oil be marketed by a national company, whether or not it governs the delivery to the end use is unclear. GOI well recognizes this situation and the need to formulate a streamlined framework as a prerequisite in inviting investors, it is drafting one with the help of ADB and WB.

With recognition that economic prices work best in a market economy, it is desired that as long as the pricing is reasonable in view of affordability, the efficiency cost and competitiveness, price changes can be approved smoothly under transparent regulatory rules. Also in view of large up-front investments required, more favorable tariff systems like a two part tariff system is desired to be employed for smaller customers.

While PGN is authorized as the sole gas distributor to smaller customers, the approval of some variations in a flexible policy, like setting up a separate company for limited gas distribution, is desired, especially when a one price policy rule is too rigid, a different system is economically justified and residents select such a different system.

(5) *Importance of Market Development*: While when it is a mandate to develop the domestic use of natural gas, more attention is usually paid to upstream development, it should be recognized that market development is equally important. When only large industries are a target such burden is small, but as the gas is to be used by smaller but abundant number of customers, large development efforts and more intricate plans are necessary. Upstream and downstream have to be developed in parallel.

8.2 Assessment of Master Plan

(1) *Overall:* The Team concludes from the analysis of the Master Plan that the gas distribution to smaller customers is economically feasible and beneficial on the national economic basis. This is judged mainly from the overall EIRR (the economic internal rate of return) and NSB (the net social benefit) over the calculation period from 1997 and 2020. The IRR and the NSB values of cash flows are shown in Table 3.

Table 3 Economic Result of M/P

	IRR (%/y)	NSB (mil.Rp)
Base case	34.2	970,601
High case	40.2	1,353,508
Low case	28.1	653,777

Source: JICA Team

We set gas prices at a level competitive with alternative energies in calculating IRR rather than directly determining the economic gas distribution cost in each market sector. There is complexity in the gas market that includes residential, commercial, industrial and new technology sub-sectors which all use the same distribution network. Instead, the residential gas distribution cost is exemplified in a feasibility study that follows later.

The feasibility of the gas distribution to smaller customer markets is expected if:

- the price is set at a cost recoverable price;
- the price is at a level competitive with LPG;
- financing is available;
- all the effort to cut the cost is made; and
- large markets such as gas cooling is sought together.

(2) *Gas Purchase Price:* Before discussing gas sales prices, in our Study, the gas purchase price was set to gradually increase from the current price of 167 Rp/m3 in 1996 to 278 Rp/m3 in 2020, in real terms, reflecting future gas coming from farther gas fields with higher costs. We assume a reader knows that prices in real terms have to be inflated in the actual world according to the inflation rates in the future. The above price increase means an escalation over inflation. Also if the price is contracted in a fixed price, the real term price should be deflated.

(3) *Residential:* The residential gas price was set at 800 Rp/m3 in real terms (1997) in the above economic analysis. This is a level still low enough to compete with LPG and to recover the investment; thus is deemed as an economic price. The difference between the purchase price and 800 Rp/m3 represents the distribution cost which is based on efficient operations.

The set price of 800 Rp/m3 is far higher than the current residential gas price, but has to be realized for the independent feasibility of residential gas distribution. This level is both

economically competitive and affordable by many potential customers.

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

(4) *Separate Entity:* How to virtually raise the price is a political or corporate theme and we have proposed a concept of the "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, and it is presumed that a separate company may be allowed to apply a different but economically reasonable price to customers A similar scheme is already applied to apartment buildings, where a landowner charges a price to end customers, though the price is different from such a high level. 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. The estate operator may be rewarded with certain economic returns, keeping privileges and attractiveness to the property. By this scheme, the final price to the customer could be divided into a distribution charge and a gas price, the latter of which is still in line with the PGN gas tariff.

(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 implicit cross subsidy from more lucrative industrial sectors. The situation is shown in Table 4. Since the portion of the residential gas market in the whole PGN operation is small, a less economical element is well absorbed, except in the combined cases of current gas price and low demand. This can work as a back-stop element to PGN for venturing into new market sectors, but it is never desirable that the residential gas market 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.

Table 4 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	27.0	432,524	31.5	727,665	20.8	194,685
		Sep. U.	17.5	120,337	17.9	130,940	17.0	106,697
2	PGN operates. Price up in ten years		20.7	456,244	24.5	769,704	16.1	203,656
3	PGN operates. No price hike		16.6	259,105	21.2	574,686	10.4	8,837

Source: JICA Team 1997

(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. The estimated pay-back is 3 to 4 years. Assuming the electric prices will be raised in the future reflecting the clearly more expensive generation costs, absorption chillers will be feasible in the future, too.

(7) *Cogeneration:* High efficiency cogeneration may have some difficulty in attracting investors, who generally want a quick property investment return, due to high capital expenditure and generally low energy prices as well as an insufficient amount of heat demand depending on facilities. The pay-back for this is 5 to 6 years and the IRR may be in the range of 10 to 13 %/y in a 15 year project period. It is still economical to an investor with enough financial capability and long-term perspective of property investment. It is worth consideration to hotels and hospitals in urban areas. The gas cogeneration is challenged by another cogeneration using low priced oil products without environmental restrictions in urban areas.

(8) *NGV:* An NGV (natural gas vehicle) is simply beneficial for the environment in urban areas as long as economics allow it and the policy of the government to spread CNG (compressed natural gas) for taxis, buses and other fleet are appreciated if the price of a conversion kit is maintained at the current level and safety is ensured. There are still barriers of land prices in installing CNG filling stations in urban areas and so the economics are difficult to generalize. Certain density of the number of stations are required for NGVs to take off for a self sustaining market. It may be worth certain cross-subsidy in a transition period in view of the importance of urban environment.

(9) *Industrial Market:* There is a large potential in industrial gas markets in many industrial estates being developed in the east of Jakarta as well as in Serang. Uncertainty is also large in estimating the potential gas demand since many estates are in very early stage of development. The Team, nevertheless dared to approximate the potential. There are recently 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 Social Effect:* The Team conducted a detail environmental assessment for the Master Plan projections. As gas is good only compared to other fuels to damage the environment, it is essentially to assess how good natural gas is in urban areas. Gas considerably decreases SOx and NOx in urban areas by replacing oil for factories as well as greenhouse gases effective globally. Gas absorption chillers decreases ozone depleting CFCs. The gas is safer than LPG which has recently caused many large explosion incidents as well as more convenient. It is felt by people as having a premium value which, though, changes with income levels and hard to quantitatively determine.

8.3 Conclusions from Feasibility Studies

(1) The Team has confirmed the economic feasibility of the gas distribution to smaller customers under certain conditions in two estates: the Perum Perumnas Bumi Bekasi Baru and the Bumi Serpong Damai. The former is almost purely residential and the latter is the combination of large commercial centers and residential estates. Another distinction is that the former is a government sponsored estate while the latter is very large and purely a private sector estate. Table 5 shows the results of the assessment.

(2) *Bumi Bekasi*: The results on Bumi Bekasi Baru shows a typical genuine residential gas distribution which has proved rather tough economics. It is economically feasible if:

- the gas price is raised to 800 Rp/m3 from the beginning, and
- the operation cost is kept minimum by only the limited number of staff and workers.

(3) *Separate entity*: Assuming the difficulty in raising the gas price directly by PGN, the Team considers the case of a "separate entity" is the only possibility, in which a gas bill to a customer is broken down into gas charge and distribution service charge.

Table 5 Financial Results of Feasibility Studies

No.	Scenario		Bekasi		BSD			
					100% Progress		50% Progress	
			IRR %/y	NPV mil Rp	IRR %/y	NPV mil Rp	IRR %/y	NPV mil Rp
1	Operated by separate utility. Gas sold at 800 Rp, purchased at 315 Rp/m3	PGN	15.2	403	94.7	16,886	40.6	6,509
		S. Ut.	14.5	1,971	22.7	13,786	21.2	12,027
2	PGN operates. Up to 800 Rp in 10 yrs.		7.3	-1,722	17.4	10,203	8.6	-1,932
3	PGN operates. Price remains w/o hike.			-7,824	10.3	304		-11,832
4	PGN operates. Gov. help pipes; no price hike.			-4,613	38.0	11,701	8.5	777
5	PGN operates. Gov. help pipes; To 800 in 10 yrs.		13.6	1,489	52.5	21,600	24.1	9,122

Source: JICA Team

PGN has enough return by whole-selling the gas to a separate gas distributor at 315 Rp/m3 applying the current K2 tariff in line with the size of the demand from Bekasi. Based on our financial analysis on PGN's profitability, PGN will even be able to give a discount in the whole-sale price to such an entity or establish a new and lower tariff table, attracting more customers in the estate.

Responsibilities should be clearly defined in such a separate entity gas operation since it is matter of fact a joint distribution operation. Our analysis assumes PGN invest in all high pressure gas mains above 3 bars, all regulators from the main and a gas meter for the whole sale gas transfer. PGN also takes care of the patrolling along low pressure lines.

We assumed these be included in the wholesale price. Measure for gas leaks, if found, is a responsibility of the entity.

Safety is very important to assure the customers and for sustaining the business for long time and it is for this reason that PGN is expected to assume patrolling the low pressure pipelines since it is more experienced than a new entity which may be only financially interested in the residential gas distribution.

(4) *Responsibility of PGN:* By keeping the high pressure mains as PGN's property, PGN can expand its own service area through the estate to other larger customers, since PGN is basically given the right of a natural monopoly.

The price to existing residential gas customers will have to be gradually increased to eventually match the level at those estates. Since a tariff system more honest to the actual cost levels should be recognized as a fair system, we hope it will be accepted.

PGN should be able to invest in such a separate entity, but considering the regulation by PKLN which restricts the foreign investment in RI's governmental entities, PGN's share may be well restricted to a small level for quick implementation. Such consideration enables pipeline investment to be smoother.

(5) BSD: BSD is characterized by large commercial facilities as well as the residential districts and the overall economics of gas distribution will be much better than in Bekasi. The same discussions as in Bekasi can go for the residential part of the estate, but when the separate entity handles both commercial and residential districts in the estate as is expected, the performance of the entity of BSD will be more attractive due to a large demand for gas from air-conditioning if properly installed. Our Study has focused only on the eastern half of the estate divided by a river, which suggests that the study will be a good indication to the future development of the western half.

(6) *Gradual Development of Commercial Facilities:* The prospect of gas air conditioning market is heavily affected by the commercial facility build-up progress. Performance is best when all facilities are starting at the same time (defined as 100% Progress in Table 5) but such is unlikely. With a more conservative build-up progress (say, 50% in 5 years), however, the economics will still be attractive.

(7) *District Cooling:* District cooling has an economic possibility in BSD because of a sizable accumulation of cooling demand in a central area of commercial facilities. A more centralized energy system, it increases the energy efficiency, convenience, safety, smartness and privilege, and saves space in buildings. Premium values due to these factors, however, are felt differently according to the type people and income levels generally. Because of higher up-front costs of the system, than for decentralized systems, the decision will rest with the land developers on whether to take the long-term or short-term advantage. We have not necessarily been optimistic.

8.4 Utility Management

(1) Financial and market status: While PGN has successfully expanded gas distribution to industrial customers so far, further expansion of the entity is to involve enormous investment in high pressure and long haul transmission pipelines, drastically changing its financial status. Future projects are very large compared to the size of the current PGN and large borrowings are envisaged as well as inviting equity investors. Still the Debt/Equity ratio is expected to increase. When the ratio of Cost of Goods/ Total Sales and Profit/Total Sales are decreasing these years, each new project should be very carefully examined of the feasibility and maximum efforts must be devoted to securing the market and cutting the cost by further efficient operations.

Since these projects are national dream projects which are important for the national policy to promote the domestic gas use to replace oil, the government is expected to fully support the projects, subject to PGN's own effort as the major transmission and distribution company.

Market oriented approach will be more necessary in the future to secure the market, since without the market there will be no new pipelines and that means more efforts and expertise required. All possibility of the market especially in the Jakarta area will have to be explored and examined. For further expansion, the smaller customer markets will have to be explored, too, with more carefulness.

(2) Organization and human resource development: Restructuring of organization in PGN is actively going on to adapt to new business status for the future. PGN has successfully expanded the business without any large increase in the number of employees in the last decade. Further expansion, however, may require the involvement of more people in and out of the company with higher expertise because a more diversified gas market development is required. It will be necessary to involve and organize more outside contractors, to further develop own human resources for higher expertise and to cultivate more team-work among employees to exploit every employee for common targets.

Fort the Master Plan to be implemented, additional functions will have to be added to the organization, various gas sales promotion techniques have to be learned, safety standards have to be streamlined and more system developments will be necessary to handle more customers and to control gas networks more efficiently.

(3) Gas pricing: This Study finds that the current gas price level is insufficient to target smaller customer markets except for gas air-conditioning and any measures is desired to virtually increase the price within an economically justified range. It is also desired to restructure the tariff system to adapt to the new markets mainly to facilitate to more easily recover the investment costs by adopting a two-part tariff system or any other comparable system. To continuously study into the tariff system will be necessary as all

gas companies in the world do to cope with the changing world.

(4) Gas Networks: Through detail network analyses, the Study finds many bottlenecks existing in the gas distribution networks as PGN recognizes, too. Most problems will be solved by precisely locating those problems and by small additional investment. Some problems, however, appear to exist in between PGN and Pertamina, since the high pressure transmission line and distribution network is closely linked. In this regard, close talks and cooperation with Pertamina will be desired.

To cope with expanding gas networks, more technologies will have to be introduced without too much dependence on labor force in the future. The Study finds that personnel expenses are already becoming a heavier burden in the distribution costs with the increase of per-head income due to the economic growth and so personnel expenses.

(5) Marketing: Future marketing to target new smaller customer markets requires a more diversified approach to various potential customers, like land developers, building owners, architects and gas appliance sellers. New strategies to diversified markets will have to be gradually developed to implement the Master Plan

9. Recommendations

(1) Policy Level:

1) The government should recognize in its policy that the Jakarta area can already afford to have an urban gas infrastructure due to its economic strength while such development has been inhibited by low gas prices.

2) The government policy is recommended to put a high priority on urban gas for a streamlined urban energy infrastructure.

3) The policy should recognize that gas can have a competitive price with that of LPG, that gas is more suitable for urban residents and that LPG is an important fuel for more rural areas for the residential purpose.

4) Regulatory framework should allow the prices to be at a level to recover the justifiable costs for urban gas infrastructure. The two-part tariff system which is more appropriate in recovering the investment cost, should be considered. Efficient gas pricing based on economic costs and prices should be more easily approved in the approval process.

5) The policy makers should recognize that market development is important equally to

upstream development to promote domestic gas use.

(2) Master Plan:

1) It should be recognized that the gas distribution to smaller customer markets is feasible at economic prices under certain conditions including joint development of residential and commercial, and the gas cooling market. 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) 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 buildings and complexes.

4) NGVs are beneficial and recommended to be promoted in the 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.

(3) Feasibility Studies:

1) We recommend that a policy of a gas price increase or of establishing a separate utility for gas distribution, which is granted to apply separate tariffs, be established early especially for Bekasi. While gas distribution is economically feasible in Bekasi, subject to economic gas tariff of 800 Rp/m3, any lower price may inhibit development, since it is a purely residential estate, without commercial customers.

2) BSD is highly encouraging for gas distribution to the combination of residential and commercial customers and so we recommend that an agreement among relevant organizations be reached early.

(4) Gas Utility Management:

1) We recommend that human resource development in strategic areas for market development be effectively promoted.

2) PGN is recommended to lead an improved tariff system development to facilitate a quicker recovery of the investment cost.

3) We recommend to solve the bottlenecks of gas networks for future gas expansion.

4) More cooperation between Pertamina and PGN recommended to optimize the gas network operation.

5) More technology be introduced because the burden of personnel expense is rising as is seen in the analysis of the distribution costs in the Feasibility Studies.

10. Technology Transfer

Technology transfer is one of major items in this Study. The Team performed a technology seminar on October 10, 1996, and other small seminars in PGN. Also the second seminar was held on June 26, 1997 before the audience including potential investors and financiers. Some of these together with other relevant items are recorded in the Appendix.

11. Next Steps

11.1 Immediate Future:

This Study includes recommendations involving policy changes both at national and PGN levels which are a prerequisite for implementation of the Master Plan and other plans from feasibility studies. Establishing policies or a direction of policies on gas prices and PGN's policies for organizational and managerial improvement will be crucial for future steps from this Study.

All projections and analyses in this Study assume that such policy changes be made in 1997 and implementation begin in 1998. A delay of one year in policy formulations means a one year delay of all plans in this Study.

11.2 For Implementation:

There are still more steps to be followed until implementation, if implementation is decided.

a. Clearing government policies and regulations

b. Establish the direction for gas prices
c. Gas purchase arrangement
d. Acquiring supervising consultants
e. Establishing company policies
f. Establishing concrete rolling plans
g. Revised and finalized feasibility studies for financial institutions
h. Financing arrangement
i. Establishing work forces
j. Education and training for employees and contractors
k. Adjusting with gas appliance manufacturers and sellers
l. Procurement procedures

PART I

OVERVIEW AND CURRENT SITUATION

Chapter 1

Introduction

THE STUDY ON MASTER PLAN OF URBAN GAS DEVELOPMENT
IN THE REPUBLIC OF INDONESIA

FINAL REPORT

- SUMMARY VERSION -

PART I OVERVIEW AND CURRENT SITUATIONS

1. *Introduction*

1.1 Background and Objectives

(1) Overview

This is the Summary Version of the Final Report of the Study on the Master Plan of Urban Gas Development in the Republic of Indonesia ("the Study") that proposes the master plan of gas network development in the Jakarta area and describes the results of feasibility studies for selected areas. PART I describes our findings and analyses on current situations and sets forth most common assumptions for the Master Plan ("M/P") and Feasibility Studies ("F/S") to follow in PARTs II and III respectively. PART IV is for conclusions and recommendations. The Summary Version relatively focuses on assumptions and results.

(2) Background

A rapid economic and industrial growth has spurred the increase of domestic oil consumption in Indonesia, and the country is expected to become a net oil importer early next century. The country's gas resource base is large on the other hand. It has therefore been a mandate to promote domestic use of gas as a solution to conserving oil resources and for improving the environment and promoting benefits for the people.

The domestic use of natural gas used to be limited to areas close to gas fields and prioritized for strategically important industries like power generation, fertilizers, cement, steel, etc., and mostly handled by Pertamina. PGN, having more than 130 years in the history of gas distribution to urban customers, embarked on natural gas distribution two decades ago. It has successfully expanded natural gas distribution to industrial customers in Jakarta, Bogor and Cirebon as well as in Medan and Surabaya.

Looking at demand, the Study has found that economic development in the Jakarta area is at a level that qualifies it for an urban gas system. Urban gas will even be necessary as a streamlined energy infrastructure in the modern capital area of a gas rich country. This

can be demonstrated by considering the status of energy efficiency, energy transportation, traffic congestion, environment, safety, affordability and residents' desire for more convenience in the urban areas.

(3) Objectives

The objectives of the Study in response to the foregoing are to:

① formulate a master plan comprising the optimum development plan of an urban gas distribution system in the residential, commercial and industrial market sectors in the Jakarta area, and to conduct feasibility studies in the selected districts;

② propose appropriate plans for improving institutional and administrative systems of urban gas supply service; and

③ transfer the technical and administrative expertise to PGN, in the course of conducting the study.

1.2 Focus of the Study

The Study focuses on the potential gas market in the east-west belt from Balaraja to Cikampek in PGN's Jakarta Branch service area in West Java as was initially agreed.

The Study defines a proposed master plan ("Master Plan" or "M/P") of gas distribution to new public customers, generally smaller than the current large industrial customers. This also focuses on the new technology markets which include gas air-conditioning, cogeneration and natural gas vehicle (NGV) markets. District cooling is discussed in the chapter of Feasibility Studies (F/S).

The feasibility studies were conducted in two areas: Perumnas Bekasi Baru and Bumi Serpong Damai (BSD).

1.3 Work History of the Study

A team of JICA ("JICA Team") worked for this Study in 1996-1997. The Team[1] worked together with a Working Group established for this Study in PT. Perusahaan Gas Negara (Persero) ("PGN"). The Team from time to time consulted the "Counterpart Team"

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[1] The Team comprises 13 members: Hiroki Okimi (Team Leader, OG), Etsuo Shito (Sub-leader, OG), Yasuhiko Kaneda (Sub-leader, IEEJ), Kazuto Honda (PCI), Keii Chou (IEEJ), Fumio Omori (OG), Yoshiaki Shitaka (IEEJ), Takao Kondo (KRI), Tetsui Suetoshi (OG), Masayuki Inoue (OG), Hiroshi Sumitomo (OG), Tadashi Tsumura (OG) and Akihiko Nakaya (OG). Affiliations shown in the parentheses are: OG: Osaka Gas Co., Ltd.; IEEJ: The Institute of Energy Economics, Japan; KRI: The Kansai Research Institute; and PCI : Pacific Consultants International. On the Japanese side, the work was directly supported by the officials of JICA Headquarters, Messrs. Hiroshi Kato, Jiro Inamura, Minoru Yamada and Satoshi Nakamura of its Industrial Development Study Division, through frequent advice and discussions, and by the officials of JICA Indonesia Office.

comprising the officials from BAPPENAS, the Planning Dept. of MME, MIGAS, Pertamina and PGN, which was headed by Ir. Rohali Sani, Director of Development of PGN. The Study was overseen by the "Steering Committee" headed by Dr. Rachmat Sudibjo, Dierctor of Exploration and Production of MIGAS, and comprised ranking officials from BAPPENAS, MME, MIGAS and PGN.

Chapter 2

Economic, Energy and Social Situations and Scenarios

2. Economic, Energy and Social Situations and Scenarios

2.1 Macro-Economic Situations

(1) Overview

The Indonesian economic growth has been at a rate of 6 to 7 % per annum in real terms of GDP in recent years (Table 2-1) and this high growth is likely to continue in the coming 5 to 10 years. The average GDP per capita recently passed the $1000 line.

The growth on Java Island is especially high and the GRP per capita in the Jakarta area is now over 3,000 US dollars.

Table 2-1 Economic Growth of Indonesia

Year	GDP 1990P bil. Rp	Growth rate %/yr.
1983	132.8	8.8
1984	142.1	7.0
1985	145.6	2.5
1986	154.1	5.8
1987	161.7	4.9
1988	171.0	5.8
1989	183.8	7.5
1990	196.9	7.1
1991	209.9	6.6
1992	223.6	6.5
1993	238.1	6.5
1994	255.9	7.5
1995	276.7	8.1

Soure: IMF (except for 1995)

(2) Government Projections

The GOI in 1994 released the "Second 25 Year Plan (or PJPTII)" as well as the 6th Five Year Plan, or "Repelita VI", for the years starting in 1994. The Plan projects the GDP growth at 6.2 % per year with accelerated rates in later years and at 8.7 % per year in the five years between 2013 to 2018 (Repelita X) (Table 2-2).

On the other hand the national population growth is projected at 1.57 % in Repelita VI, gradually decreasing thereafter and at 0.88% per year in the Repelita X.

Table 2-2 GDP Growth Target by Sector in Second 25 Year Plan

		Repelita 5	Repelita 6	Repelita 7	Repelita 8	Repelita 9	Repelita 10
		Estimate ending in:		average over 5 years ending in:			
	unit	1993	1998	2003	2008	2013	2018
GDP total	% per year	6.6	6.2	6.6	7.1	7.8	8.7
1 Agriculture	% per year	2.4	3.4	3.5	3.5	3.5	3.5
2 Industry	% per year	10.0	9.4	9.4	9.4	9.1	8.7
of which non-oil a	% per year	11.0	10.3	10.2	10.0	9.5	9.0
3 Other	% per year	7.2	6.0	6.3	6.8	8.0	9.5

Source: Indonesian Government

2.2 JICA Team's Projections

(1) Principle

We consider that the Replita and the 25 Year Plan are an important target in Indonesia although there are other economic forecasts for Indonesia, at lower growth rates in the later years. The Repelita projection tends to give a steep growth line in the later years in the 25 year period.

Besides this Study, JICA has conducted several studies involving economic projections necessary as assumptions and we will also consider those projections. Those of JICA tend to give lower long term economic growth projections.

(2) Population

We use the national population projection in the 25 Year Plan for our base. It forecasts the growth at 1.57%/y from 1994 through 1998 and at 1.17 %/y thereafter through 2018. The Jakarta area has seen much higher population growth. The Team's common base for the growth of population is set out in a simple form in Table 2-3.

Table 2-3 Projection on Population

Growth rate %/yr.

	1996 - 2000	2000-2010	2010-2020	2000 - 2020 aggregate
National	1.52	1.28	0.94	1.11
Jakarta Area	5.0	2.5	2.5	2.5

Source: Restructured from Repelita by JICA Team

(3) National GDP

We have considered and combined the Repelita and the 1995 JICA study in formulating the Team's projections of GDP (Table 2-4)(Fig. 2-1):

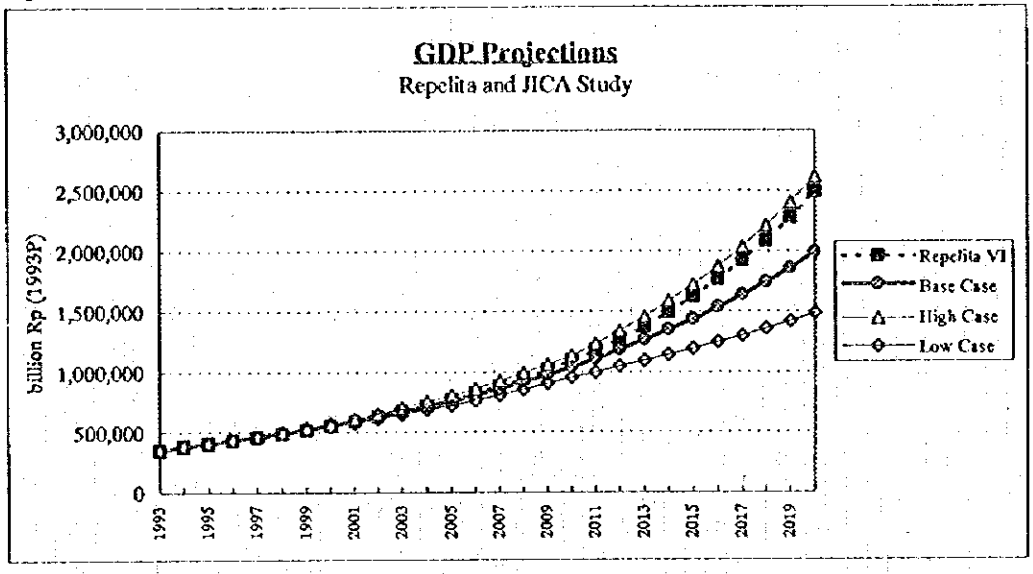
a. For the short period through 2000: the projection of the Repelita is set as the Lower Case and 1995 JICA projection is taken as the Higher Case.
b. For the long term perspective through 2010 and up to 2020, the Repelita will be used as the Higher Case. For the Lower Case we will assume a further 1.2%/y decrease in the growth rate in 2000-2010; thus 4.5 %/y.
c. For the middle period of 2000-2010, the Higher Case is taken from the Repelita and the Lower Case from the said JICA study.
d. The average of Higher and Lower will be our Base Case.

Table 2-4 National GDP Growth Rate - JICA Team Projection %/yr.

year	Base	High	Low
up to 2000	6.5	6.9	6.2
2000 - 2010	6.4	7.1	5.7
2010 - 2020	6.7	8.7	4.5

Source: JICA Team

Fig. 2-1 National GDP Scenario for the JICA Study



Source: Repelita VI and JICA 1996

(4) GRP - Gross Regional Product in the Jakarta Area

The GRDP of DKI Jakarta + West Java make up 30% of the national GDP. The growth rate is also high in the DKI+West Java area (Table2-7). The ratio of the GRP growth rate of DKI+West Java to that of national GDP (i.e., elasticity) is 1.18. The Team will use this ratio for general projection of GRDP in the area (Table 2-5, 2-7).

Table 2-5 GRP in Jakarta Area - JICA Projection

growth rate %/yr.

year	Base	High	Low
up to 2000	7.7	8.1	7.3
2000 - 2010	7.6	8.3	6.7
2010 - 2020	7.9	10.3	5.3

Source: JICA Team

(5) GRDP Per Capita

Per capita national GDP growth is currently at 6%/yr. The JICA Team has projected it by combining the GDP and population projections as follows (Table 2-6).

Table 2-6 National GDP per Capita Projection for JICA Study %/yr.

year	Base	High	Low
up to 2000	4.90	5.30	4.61
2000 - 2010	5.06	5.75	4.37
2010 - 2020	5.71	7.69	3.53

Source: JICA Team

The GDRP per capita in the Jakarta area is at a sky scraping level (6.2 million Rp. in 1994) compared to the national average (1.8 million Rp) (Fig.2-2, 2-3).

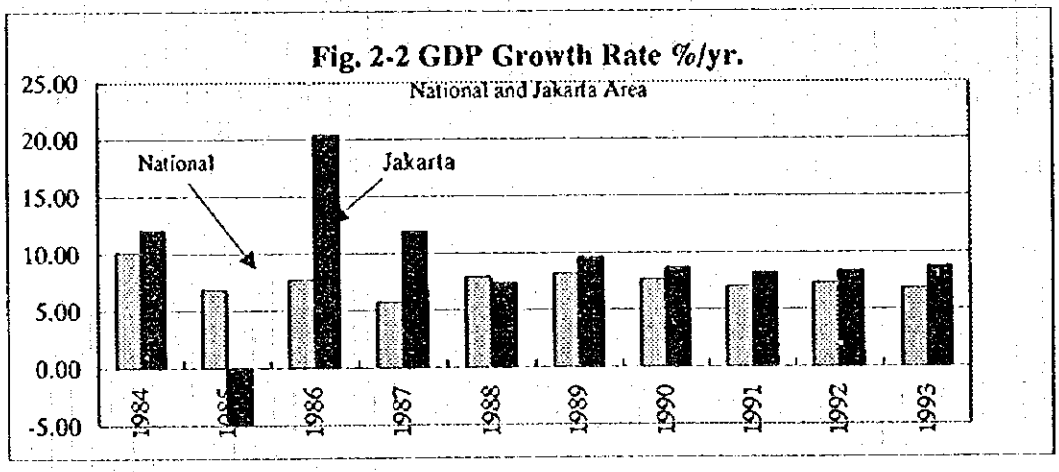
Table 2-7 GRP in Jakarta Area and Comparison to National

1983 Constant Prices in billion Rp

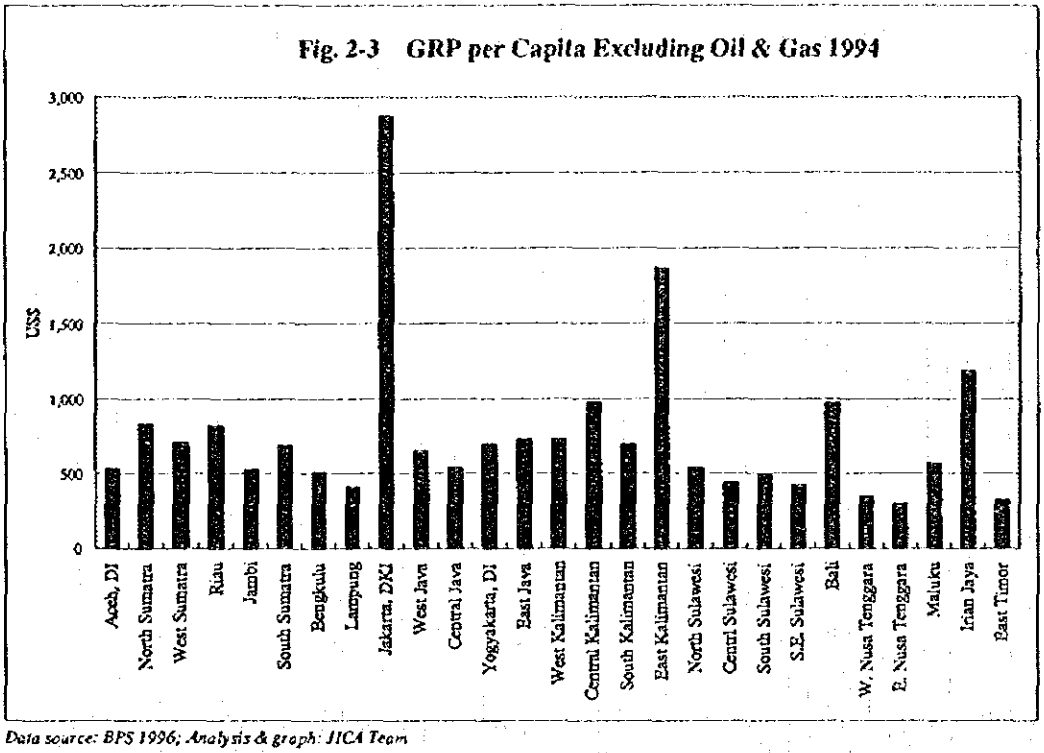
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	
DKI 5 districts	7,819	8,648	7,917	9,464	10,758	11,469	12,586	13,710	14,721	15,897	17,185	
Tangerang (Reg.)	583	673	762	877	914	1,041	1,145	1,168	1,278	1,380	1,513	Five year
Bekasi	307	389	471	619	636	712	778	809	910	1,052	1,221	average
Karawang	185	250	316	441	451	479	505	625	736	785	860	(1989-93
Area Total	8,893	9,961	9,467	11,401	12,759	13,702	15,013	16,312	17,645	19,114	20,778	
Growth rate %/yr.		12.00	-4.96	20.44	11.91	7.39	9.57	8.65	8.17	8.32	8.71	8.69
Ratio to National Total %	14.4	14.6	13.0	14.5	15.4	15.3	15.5	15.6	15.8	16.0	16.2	15.8
Elasticity to National		1.19	-0.73	2.65	2.07	0.93	1.17	1.13	1.16	1.14	1.28	1.18
Ratio to W. Java+Jakarta %	51.2	51.1	44.5	48.2	51.5	51.4	51.8	51.6	52.0	52.3	52.9	52.1
Elasticity to W. Java+Jkt		0.97	-0.55	1.81	2.51	0.99	1.08	0.95	1.12	1.08	1.15	1.08

Note) Data of 1983-1985 except for Jakarta are by retroactive extrapolation; Tangerang includes municipality.

Source: BPS and JICA Team



Source: BPS and JICA Team

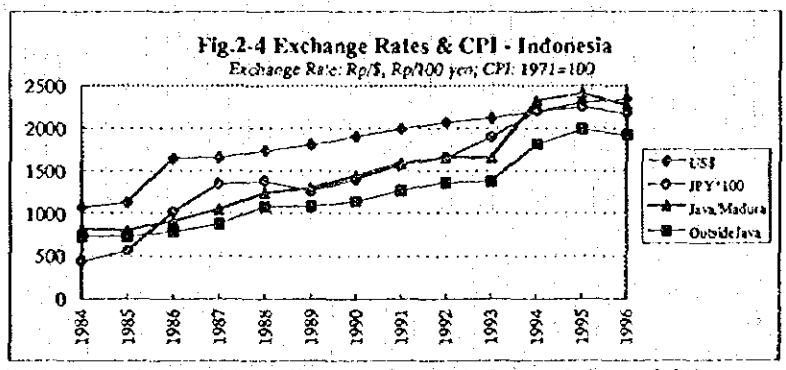


Data source: BPS 1996; Analysis & graph: JICA Team

(6) Inflation & Exchange Rates

Short-term studies and initial facility price adjustment will require the use of inflation rates.

The inflation rate for consumer prices (CPI) has been at 9.3 %/y on average from 1986 to 1996. (Fig. 2-4). Wholesale price indices are naturally lower and we assume them as about 6%/y.



Note) At each year end except 1996 being at end May. Data source: Indonesian Government Statistics; Graph JICA

Source: JICA Team/BPS 1996

Foreign currency exchange rates have been closely following the trend of inflation as also shown in Fig. 2-4. The floating of Thai Baht in July 1997 may affect Indonesian Rupiah in the future, but we assume the relation of the exchange rate and the inflation will basically continue in the long-term perspective.

(7) Interest Rates

The current rate in Indonesia comparable to a central bank discount rate is about 16.5%. The rate of loans from local commercial banks is about 20%. Considering the current inflation rate, the real interest rate is approximately 10%.

2.3 Energy Situation and Projections

(1) National Energy Resource Base

Table 2-8 shows that the RI is in fact a large coal country as well as a gas country. Most of natural gas reserves are located near the current LNG export areas, i.e., in East Kaklimantan, Aceh and North Sumatra as well as Natuna Island areas, the share of the reserves in these areas being about 82% of national proven reserves in 1993. Near term supply potential to Java may be from Java onshore and offshore, and South and Central Sumatra. The share of these areas of proven reserves was 16 % in 1993.

Table 2-8 Energy Resource Base of Indonesia

	Oil		Natural Gas		Coal		Hydro Potential		Geothermal
Resource category	proven reserves	potential reserves	proven reserves	potential reserves	Deposit of: Anthracite+ Bituminous	Subbituminous+ Lignite brown	Potential capacity	Annual potential production	Potential
units	million bbl		Tscf		million ton		MW	GWh	MW
Sumatra					782	23,893	15,587	84,110	9,562
Java						6,940	4,200	18,024	5,331
Kalimantan					4,560		21,581	107,202	
Other							33,608	192,290	4,765
Total	4979.7	4117.9	72.27	51.31	5,342	30,833	74,976	401,626	19,658
Proven + potential	9097.6		123.58		36175.0		mil. GJ/year	1,446	496
Proven + potential in common unit	million GJ		million GJ		million GJ		for 25 years:		
	55,950		134,331		908,535		mil.GJ/25y:	36,145	12,399

Note) JICA conversion:
1bbloe=6150 MJ, 1 Tscf(NG)=1.087*10^12 MJ, 1 ton-coal(6000kcal/kg)=25115 MJ
1GWh(hydro)=3600 GJ, for Geothermal in 80% load: 1 MW for a year=25,229 GJ/y

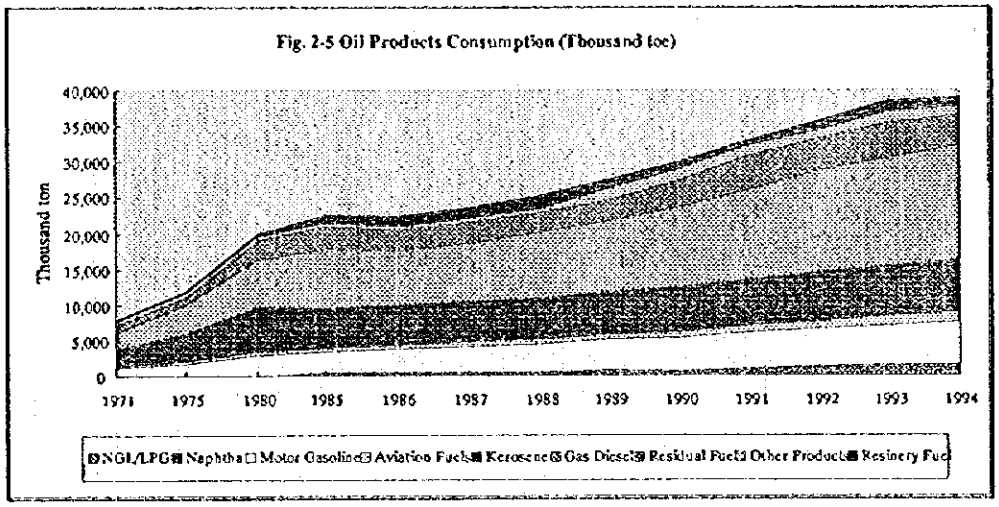
Source: MME 1996 and JICA Team

(2) Final Energy Consumption

Total final energy consumption in 1994 was 47.25 Mtoe. The GDP elasticity was 1.24 in 1985-90 and 1.30 in the 1990's indicating a further increase. Looking at energy consumption in 1994, petroleum products accounted for 72.04%, gas 16.88%, electric power 8.13%, and coal 2.95% (Fig. 2-5). The industrial sector accounted for 32.43% of the consumption, the transport 31.33%, the commercial and public 2.33%, the residential 21.18% and others 12.73% (1994).

(3) Natural Gas Status

Proven + potential natural gas reserves in Indonesia were 123.6 TCF in 1996, the reserves to production ratio being 41 years based on the 1995 production volume of 8,220 mmcfd. Certain reserves are already committed to the export of LNG and domestic sales in long term contracts and they expect own use and losses of about 27.5 % of reserves. Net available reserves are 65.9 TCF as shown in Table 2-9.



Source: IEA Energy Statistics and Balances of Non-OECD Countries 1985 to 1995

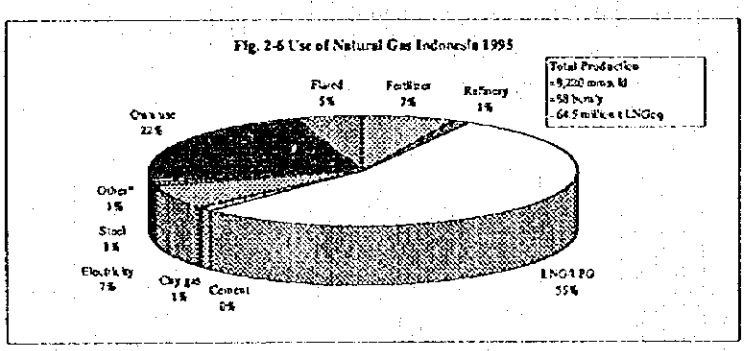
Table 2-9 Natural Gas Reserves Uncommitted

trillion cubic feet (TCF)

	Proven	Potential	Total
Reserves	72.3	51.3	123.6
Committed under contracts:			
LNG	16.7		16.7
Domestic distribution	7.0		7.0
Total	23.7	0	23.7
Own use or loss expected (27.5%)	19.9	14.1	34.0
Net uncommitted and available	28.7	37.2	65.9

Source: PGN 1996

Use of natural gas in 1995 is broken down into demand sectors in Fig. 2-6. Domestic use has grown year by year and is expected to match the amount of export in a few years.



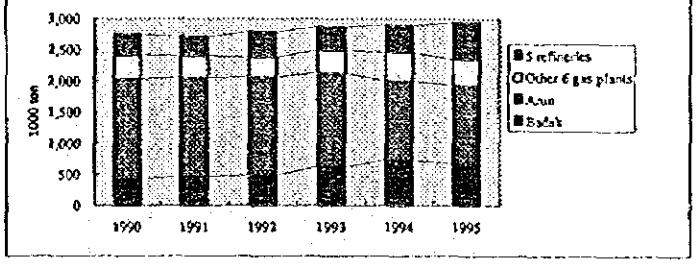
Data source: Pertamina 1995

(4) Status and Perspective of LPG

Recent LPG production is at the level of 2.7 to 2.9 million tons a year. Two thirds of Indonesian LPG is produced at LNG plants. More than 80 % of LPG produced in Indonesia is exported. Up to 1993, about 200,000 tons of LPG was used domestically of which 69% was for household use. Domestic consumption increased to 430,000 tons in 1995.

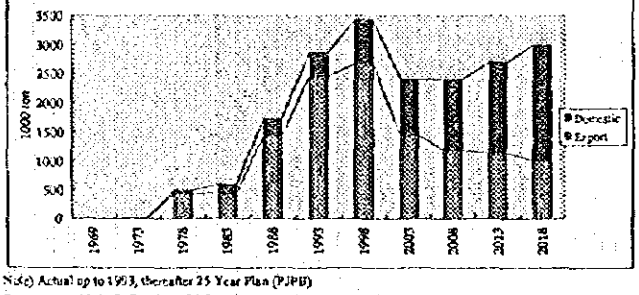
Future domestic use of LPG is expected to increase, too, as the current 25 Year Plan projects (Fig. 2-8). Domestic use of LPG in the country is forecast to reach 2.7 billion m3 per year in the Repelita X in terms of natural gas equivalent of 8,800 kcal/m3 (Fig. 2-9).

Fig. 2-7 LPG Production



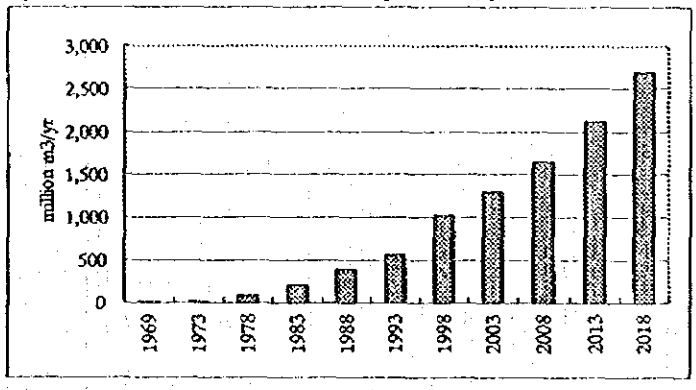
Source: MIGAS

Fig. 2-8 LPG Perspective by Use



Note) Actual up to 1993, thereafter 25 Year Plan (PJPII)
Data source: MIGAS; Graph: JICA Team

Fig. 2-9 Domestic LPG Use in Natural Gas Equivalence (8,800 kcal/m3)



Source: JICA Team based on RI's 25 Years Plan / actual through 1993

(5) Future Energy Outlook

For the future outlook of the energy mix, we will show the Repelita VI (Table 2-10), and refer to a forecast by Pertamina and a one from a recent separate JICA study in our hand.

Pertamina expects the long term primary energy as shown in Fig. 2-10. The energy use will grow from approximately 500 million bbloe in 1996 to 1,450 million bbloe in 2010. The average growth is equivalent to 7.9 %/y. Compared to our base case scenario of GDP growth, the elasticity will be 1.22 in the period of 1996 to 2010, which is an improvement.

Table 2-10 Primary Energy Supply Outlook in Repelita

million bbl oe

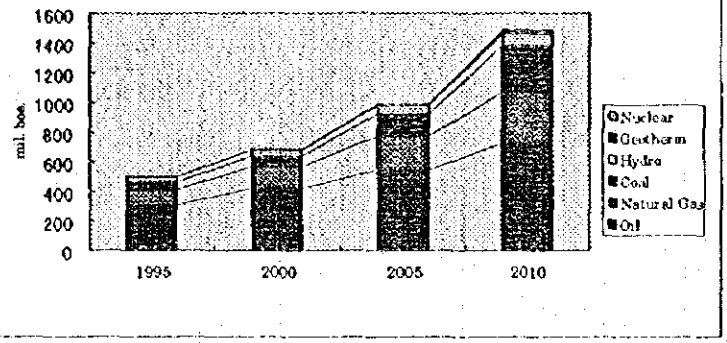
	Actual	REPELITA VI					Growth %/y	
	1992	1994	1995	1996	1997	1998	98/94	98/92
Oil	263.1	296	311.7	331.6	337.5	360	5.02	5.37
Natural gas	82.3	117.2	132.1	137.8	157.3	162.6	8.53	12.02
Coal	32.4	46.9	61.3	84.2	99.4	120	26.47	24.35
Geothermal	2	4.4	4.4	6.3	8.6	12	28.51	34.80
Hydro	26.2	29.1	29.4	29.9	31.3	33.6	3.66	4.23
Total	406	493.6	538.9	589.8	634.1	688.2	8.66	9.15

Shares %	1992	1994	1995	1996	1997	1998
Oil	64.8	60.0	57.8	56.2	53.2	52.3
Natural gas	20.3	23.7	24.5	23.4	24.8	23.6
Coal	8.0	9.5	11.4	14.3	15.7	17.4
Geothermal	0.5	0.9	0.8	1.1	1.4	1.7
Hydro	6.5	5.9	5.5	5.1	4.9	4.9
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: Indonesian Government

Another projection, from a JICA study of 1995, expects the total energy demand of Indonesia to reach 240.11 Mtoe in 2010 and 503.79 Mtoe in 2020 compared to 97.39 Mtoe consumed in 1995. The average growth rates will be 6.2% from 1995 to 2010 and 7.7 percent from 2010 to 2020. This outlook is from the Master Plan Study of Electric Power Development of Indonesia conducted by JICA (see Table 2-11).

Fig. 2-10 Projected Primary Energy Supply



Data source: Kaspan, Conference on Integrated Gas Transmission System in Indonesia 1995

Table 2-11 Forecasting Energy Demand by Sector

Mtoe

Year	1980	1985	1990	1995	2000	2005	2010	2015	2020
Industrial	7.32	9.04	21.04	28.72	39.85	55.5	79.37	116.91	177.36
Commercial	1.69	1.59	1.86	2.63	3.62	4.98	6.67	10.01	14.87
Public	0.26	0.14	0.19	0.32	0.45	0.64	0.91	1.31	1.84
Transport	6.34	7.5	12.47	17.04	23.02	31.69	44.66	65.02	98.67
Urban Households	5.68	5.78	7.12	10.96	13.95	17.15	21.44	26.26	32.33
Rural Households	16.03	16.99	18.84	20.7	21.58	21.41	21.85	22.26	22.37
Power Generation	2.26	4.01	8.36	17.42	29.24	42.89	65.98	103.2	158.74
Total	39.58	45.05	69.88	97.79	131.71	174.26	240.88	344.97	506.18

Note: M=million

Source : The Master Plan Study of Electric Power Development in the Republic of Indonesia by JICA 1995

2.4 Natural Gas Supply and Transmission Plans

The RI has many natural gas fields, and major gas fields and their production rates are shown in Table 2-12.

Among these gas fields, only Bontang, Ache and Natuna have more than 10 TSCF of gas reserves each. Reserves of most of other gas fields are less than 10 TSCF, which will be exploited mainly for domestic use.

PGN has a long term master plan called the "Indonesia Integrated Transmission Pipelines" shown in Table 2-13 and Fig. 2-13.

The main line of the Central

Table 2-12 Gas Production by Location in 1995 (mmscfd)

#	Location	Production	Utilization	Flared (F/P)
1	Aceh	3,234.4	3,233.9	1.3 (0.4%)
2	North Sumatra	137.9	122.4	15.5 (11.2%)
	Central Sumatra	107.7	86.0	21.7 (20.2%)
3	South Sumatra	500.8	364.7	136.2 (27.2%)
4	West Java	953.9	833.7	120.1 (12.6%)
5	East Java	317.9	309.6	8.3 (2.6%)
6	E.Kal - Bontang	2,660.3	2,639.4	21.0 (0.8%)
7	E.Kal - Bunyu	34.4	21.3	13.1 (38.1%)
8	Balikpapan/Smr	36.2	35.1	1.1 (2.9%)
9	South Sulawesi	0.0	0.0	0.0 (0.0%)
10	Irian Jaya	40.9	28.3	12.7 (31.0%)
11	Natuna	192.0	78.5	113.5 (59.1%)
	Total	8,217.1	7,752.7	464.3 (5.7%)

Note F/P = (Amount Flared) / (Amount Produced)

Source : Pertamina, 1996

Sumatra Project transmits gas from Gerisk to Duri and a branch line extends from Jambi to Batam Island. The Central Sumatra project is in the construction stage.

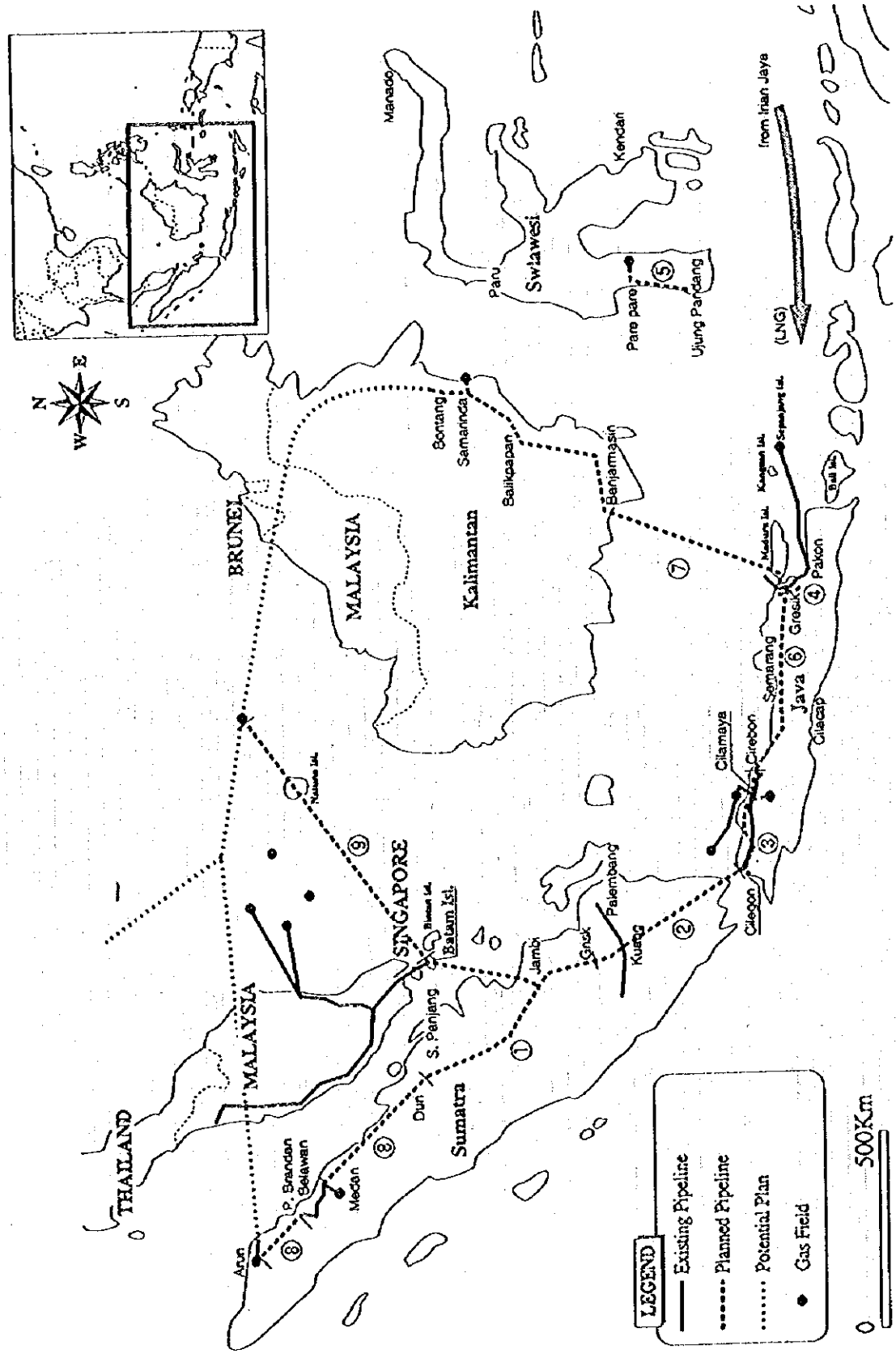
The South Sumatra Project aims at responding to the rapid gas demand increase in West Java. The operation of the transmission line is expected to start in November 2000. This South Sumatra Project is to be financially supported by The World Bank.

Table 2-13 Existing PGN Plan of Transmission Systems

Term	No.	From	To	Length (km)	Demand (MMFCD)	Cost US$M
Short	1	Asamera	Duri	524	220	530
		Jambi	Batam Is.	378	90	
	2	Palembang	Cilegon	500	250	500
	3	West Java		150	220	115
	4	East Java		227	240	110
	5	Sengkang	Ujung Pandang	270	51	84
Mid	6	East Java	West Java	300		300
	7	East Java	Kalimantan	600		600
	8	Duri	Medan	400		400
Long	9	Batam	Natuna	500		500
Total				3800		3800

Source : PGN, 1995

Fig. 2-13 Indonesia Integrated Gas Transmission Pipelines



Source: JICA Team

2.5 Team's Considerations on National Energy and Urban Gas

(1) Characteristics of Resources

Domestic use of smaller gas fields was limited to exploitation for nearby power stations, fertilizers and other large industries strategically important for the country. Now the policy has changed toward full domestic exploitation of gas by constructing the Integrated Indonesian Gas Transmission Pipelines. Coal is also targeted on for development. The use of coal, however, will be constrained in and around large cities due to environmental and infrastructural factors. Hydropower and other renewable energy sources are also receiving full attention for prompt development.

(2) Urban Gas Priority

The direct use of gas is the most efficient way of using natural gas for thermal purposes with the least conversion and transmission losses. It also will be a kind of final urban energy in the ultimate desirable energy mix in a long term perspective. In the future, oil may be already reliant on import. Coal energy may be supplied to cities only in the form of electricity from remote stations. The gas combined cycle power generation has high gas netback values and is good in locations comparatively near large cities but not fully ideal unless waste heat is properly utilized.

Full use of inherent energy in gas can be attained when gas is in the midst of a city. This is good time to review the captive market in the metropolitan area with a long term perspective when the support of the government and new transmission gas lines are envisaged.

(3) Urban Gas and LPG - Comparative Considerations

The urban gas distribution to be planned will face competition from LPG in most areas. Here are non-price and qualitative comparative issues.

i) Economics

- National and international economics: LPG is more easy for transportation than LNG, having more value for export and foreign revenue.
- Consumers: LPG is expensive in the domestic market, often sold at prices higher than the set prices. Natural gas thus contributes to bringing in the competition in the residential market.
- Transportation: LPG needs truck transportation and automotive fuels for this purpose.

ii) Environment

- Traffic: The truck transportation of LPG discharges pollutant emissions and adds to urban traffic load which in turn again increase pollution.
- Carbon dioxide (CO2): LPG emits more CO2 than natural gas, contributing to global warming. Based on the same thermal quantities consumed, propane (C3H8) emits 17% more CO2 than the natural gas of the Jakarta area.

iii) Safety

- LPG is heavier than air (C3H8: by 1.5 times) and easy to sink on the floor when leaked in the room.
- Systematic safety education of LPG dealers and customers may be insufficient since LPG is often handled by small enterprises.

2.6 Financial Conditions and Implication on Energy Financing

(1) General National Financial Conditions

i) Access to the overseas loan market

Changing Rupiah into foreign currencies is quite easy and the exchange rate is determined on the currency exchange market. Thus, together with Indonesian natural resources, the inexpensive labor force benefits and encourages foreign investment. It may not be very hard to find financial sponsors in terms of debt financing from overseas, if the project itself is feasible.

ii) Domestic financial market

There exists no market for long-term financing in Indonesia. Commercial banks mostly offer only short-term financing. Long term projects including the city gas development will need to obtain finance mostly from overseas.

iii) Governmental restriction on debt for public sectors

To prevent increase of the deficit of public sectors, any public sector borrowing from overseas needs permission from PKLN though there are exceptions if the amount of debt is reasonably small, say less than US$20 million.

(2) Availability of Financing for Gas Distribution and Utilization Projects

i) Debt financing

Whether a gas utilization project could be financed or not depends totally upon the economic feasibility of the project. An equivalent of project financing may not be suitable for an urban gas development project when gas customers are the mass public.
Consumer loans which are definitely recourse money to equity investors are available instead.

As found in later chapters, projects gas distribution to smaller customers, which take in thousands of new customers year by year for many years requires to continue to invest large amount of money every year for long time, requires special considerations in financing. This is different from many other typical types of financing. Strong links to bank financing may be necessary to facilitate a line of credit to insure continuous capital flows as well as self financing from rate revenues.

ii) Equity financing

Equity financing has the least hurdles in view of international debt restriction. The key is economic feasibility and viability which make the project attractive to investors. Pricing will be the most important given efficient operation is assured.

Equity investors must be those who could take commercial and country risks in Indonesia for 20 years and some assurances should be given in this regard. Domestic investors might be considered from construction or real estate companies for energy service projects. International financial institutions like IFC or OECF, etc., also accommodate limited shares of equity depending on conditions and equities from such institutions are treated like private sector equities in view of national international debt.

Chapter 3

Policies, Energy Costs and Prices

3. Policies, Energy Costs and Prices

3.1 Energy Policy and Regulatory Framework

The Team considers that to promote the smaller customer market, including residential and commercial, the possible necessity of regulatory changes may have to be investigated and implemented for PGN to go ahead to such markets.

There is no one consolidated law or regulation to specifically regulate the operation of gas distribution, but rather an aggregate of past laws and decrees of the related ministries jointly define the nature of the energy entities and the content of regulation. The most prominent law has been the Law No. 8 of 1971 that legislatively established P.N. Pertamina and Production Sharing (P/S) Contract schemes, and related regulations have been issued since to amend the content of P/S schemes. PGN has been directly under several regulations since 1984 mainly to define the form of the enterprise and basic functions.

Therefore, how their operations are regulated is not necessarily clear on a legal basis and are subject to national energy policies and governmental directions that are less transparent. As the domestic use of natural gas increases incurring various issues, the Government feels to need and has been studying more consolidated regulatory framework for the future gas industry as well as restructuring the industry toward privatization.

We recommend to treat natural gas as an urban energy infrastructure with public encouragement and endorsement. Regulations should allow to ensure profitability for a private utility, and investors, under efficient and safe operations. The smaller customer market generally requires more advance investment and longer term orderly planning. Investors in this sub-sector usually expect sure returns instead of high risky returns and the regulatory framework should consider this. Natural gas to smaller urban customers may be a little expensive in thermal value terms in the future but should be a premium fuel to attract them in view of convenience, cleanliness, safety and efficiency even at a bit higher price than competing fuels.

3.2 Energy Prices and Subsidy

Gas prices, fertilizers and steel plants have been low due to fixed price contracts and implied subsidy. In general, subsidy is used by the government to achieve particular purposes such as developing domestic industries and protecting weak industries. In principle, a price should be determined on economic basis. Subsidy distorts price structures and hampers economic efficiency. Therefore, subsidy has to be limited to the minimum. Even if the industries need continuous subsidy, it should be paid by the government directly, not by lowering energy prices.

3.3 Competing Fuel Market

Overview of Petroleum Product Prices

All fuel prices in the end use market are controlled by the government in Indonesia and a one-price policy basically goes throughout the country except in certain sectors. The table below shows the current set of prices of petroleum products.

Prices of petroleum products and LPG

	Btu/l	kcal/l	Rp/l 1993	Rp/ mmBtu	US$/ mmBtu	(reference) Rp/l 1990
PREMIUM	31,111	7,840	700	22,500	9.78	-
AVIGAS	33,532	8,450	420	12,525	5.45	330
AVTUR	33,532	8,450	420	12,525	5.45	330
IDO	36,786	9,270	360	9,786	4.25	235
ADO/IISD	35,964	9,063	380	10,566	4.59	245
FO	38,754	9,766	240	6,193	2.69	220
KEROSENE	35,079	8,840	280	7,982	3.47	190

note :valid from January 1993

	Btu/kg	KCAL/KG	Rp/kg 1995	Rp/ mmBtu	US$/ mmBtu	Rp/kg 1993
LPG	47,222	11,900	1000	22,500	9.78	750

note :valid from December 1995

source: PGN and JICA

Current Electric Prices

An electricity tariff has to be approved by the government. In 1994 a new tariff was set reflecting inflation and increase of fuel prices. It is characterized by its numerous tariff categories depending on usage and contracted capacity. It is composed of two parts, the demand charge and the energy charge. The demand charge is determined by contracted capacity in Rupiah per KW/ month. Energy charge is determined according to the consumption of electricity per month. This kind of tariff structure, a so called two-part tariff, contributes to stable recovering the fixed cost.

Economic Fuel Prices

Long-term planning and assessment are often better done by using economic prices

without distortion assuming that the distortion will be gradually eliminated or pointing to desirable pricing policy directions. Adopting the prices close to economic levels in businesses usually assures higher economic efficiency in a market economy and beneficial to consumers. Economic prices are not always easy to determine, but we will try at least to show what levels the prices should be in. The prices studied here will be used in economic analyses as assumptions in later chapters.

(1) Oil Products

While most economic prices of energy are determined in between the cost and a theoretical or an international market price, that of each oil product is never determined by the cost since various oil products come from one refinery plant at the same time. Judging from this limited information, an average cost of oil products in South East Asia may be in the range of US$ 3 ~ 4/bl fob above crude oil prices.

(2) LPG

LPG (priced at 1,000 Rp/kg in the end-use market) is the most competitive with gas in the suburban residential market. The price of LPG may be justified by two ways: domestic costs and international prices. The current LPG price of Rp1000/kg is in the range of economic prices derived either from international market prices or from domestic refinery costs.

(3) Coal

We consider that the standard coal for domestic power generation has the thermal value of 6600 kcal/kg. We will take the bench mark price as $38/ton FOB Kalimantan, consider a domestic premium due to abundance of coal as -$2.00, assume the freight of $5.00 within the archipelago based on smaller boats than for international trade and adjust the calorific value effect as "-$1.20/ton". For the future electric generation cost estimate, we assume the domestic coal price as around $40/ton CIF in Java area based on the situation stated above.

(4)Electricity

Since many facilities in PLN accounted for in price setting are based on past investments, this average price level has been able to accommodate PLN's operations so far, but is deemed not enough for the future due to large investments required for generation plants and transmission and distribution network expansion.

Therefore we suppose the rates will have to be increased sooner or later and the size of the increase may be U.S. 4 to 7 cents per kWh at present price in 2000 - 2010 when many new IPP plants are expected to surface.

Electricity Rate Assumption US cents/kWh

sub-sector	current average (1994/95 DKI)	future average (after 2000)
Residential	7.8	15.5
Commercial	10.8	14.5
Industrial	6.4	11.0
Average	7.8	13.5

Source: *JICA Team Assumption* *Assumed at 1997 prices*

3.4 Gas Supply and Purchase Cost Situation

Indonesian domestic gas prices to end users are set by the Government from the view point of national strategies. Most of these prices are US Dollar and fixed price contract based and have been unchanged for many years since once set for each customer; price ranges being as in the following table.

Domestic Gas Pricing

Rp/US$= 2350

		Rp		US$/mmBtu	
		min	max	min	max
1 Fuel					
	Fertilizer			1.00	1.50
	Steel Industries			2.00	2.00
	Electricity			2.45	3.00
	Cement Industries			3.00	3.00
	Paper			1.50	1.50
	Refinery			1.49	1.49
	Wood Industries			0.97	0.97
	City Gas*	2500	4150	2.16	2.16
2 Feedstock					
	Fertilizer			1.00	1.50
	Steel Industries			0.65	0.65
3 New Contracts					
	Based on economics of field development and transmission facilities				

*Price to PGN defined partly in Rp and partly in US$; is about 2 US$/mmBtu in 1997.

(Source: MME1996)

The pricing policy has been to prioritize nationally important industries; highest priorities are given to steel, fertilizer and wood industries to contribute to increased export. How economics and market principle are reflected and how city gas is positioned in this framework, however, are not clear to us.

Future Gas Supply Costs

How future gas prices to PGN will be determined is not clear but we consider that economic principle and costs will eventually rule them since privatization of oil and gas sector is on agenda. And the prices will have to reflect the gas supply costs in the upstream.

The following supply cost research is mostly conceptual as we have not had enough opportunities to access upstream information in detail this time:

A. West Java: Existing gas supply of 160 mmscfd. The price in the current arrangement is assumed fixed at $2.03/mmBtu as of 1997. Since future costs in our Study are all treated in 1997 real prices, this fixed price will be deflated by an inflation rate (6 % per annum is assumed for the wholesale price inflation) in our future gas purchase cost calculations.

B. Arco Gas: The gas of 60 mmscfd or more from Arco Jakarta North gas fields has recently been secured for supply to PGN after negotiations. The price is set at $3.40/mmBtu, which is unexpectedly high considering it is comparable to the current LNG prices c.i.f. in Japan. If this is a fixed price, however, the price will be deflated for our future considerations as in the foregoing paragraph. We have projected that the current price of $3.40 will be $0.82 in 2020 in the 1997 price.

C. Sumatra - West Java: The South Sumatra Gas project is for the length of 370 km from Pagar Dewa to Cilegon and targeted for operations beginning in 2001. The capacity is 350 mmscfd. The upstream gas price is considered at 1.8 to 2.2 dollars per million Btu at the gate station in South Sumatra. The present value transmission cost is calculated in a separate table in detail and estimated as about 0.95 $/mmBtu at 12% discount rate. This unit gas cost is a levelized one in real terms throughout the study period, and will not be inflated or deflated in our cost study. This concept applies to all other gases hereafter.

D. Grisik - Pagar Dewa Connection: This 180 km connection is to bring the gas from the Asamera-Duri area to the Jakarta area after 2008. The capacity is 175 mmscfd. The transmission cost is roughly calculated as 0.59 cents/mmBtu at the 12% discount rate. There may be argument that all this marginal cost may not fully apply to the Jakarta area service since the gas could be used for fertilizer

plants in Palembang area.

E. Natuna Gas: We conceptually assume that the Asamera - Batam Island Pipeline will be extended to Natuna and the cost of the portion of existing plan is covered by existing scheme customers. The extension is about 600 km offshore in concept and the total cost of this gas at Batam is estimated as $4.70/mmBtu, of which the transmission cost is $3.20/mmBtu. Again to apply the whole of this cost to the Jakarta area will not be practical as stated before. The marginal supply cost to Batam may be deemed as the cost to Jakarta.

F. LNG from Irian Jaya: If the 3000 km long LNG scheme from Irian Jaya to Java is materialized, the cost will have to be borne by the Java customers. A tentative estimate of the cost is $4.35/mmBtu (though we use $4.50/mmBtu with an allowance) at a receiving terminal outlet.

JICA Supply Cost Assumption

Without knowing detail gas reserve and availability positions in each relevant gas field, we will assume the weighted average gas supply cost tentatively as in the following table as an indication of economic costs at current constant price.

Table 3-4-2 Gas Supply Cost Assumption (weighted)

January 1997 Prices — Rp/US$= 2350

Case	A*	B*	C	D	E	F	JICA Assumption	
Gas Source	Existing Gas	Jkt North Arco Gas	S. Sumatra Gas	Asamera Gas	Natuna Gas	LNG from I. Jaya	Weighted average supply cost	
Transm'n			0.97	0.59	1.90			
Price('97)$/mmBtu	2.03	3.40	2.97	2.20	4.70	4.50		
Rp/8800kcal	167	279	243	181	386	369	$/mmBtu	Rp/m3
Shares (%)	Existing	Arco	S. Sumatra	Asamera	Natuna	LNG I.Jaya		
1997	100						2.030	167
1998	84	16					2.110	173
1999	82	18					2.012	165
2000	75	25					1.976	162
2001	55	17	28				2.159	177
2002	50	15	35				2.155	177
2003	44	16	40				2.176	179
2004	39	17	44				2.193	180
2005	37	16	48				2.192	180
2006	31	21	48				2.201	181
2007	32	19	49				2.153	177
2008	29	17	50	4			2.162	177
2009	26	16	50	8			2.172	178
2010	19	15	48	11		7	2.400	197
2011	9	13	49	13	6	11	2.758	226
2012		13	47	14	7	18	3.045	250
2013		12	44	16	12	17	3.106	255
2014		11	42	17	11	20	3.135	257
2015		10	43	19	10	18	3.089	253
2016		10	40	17	13	20	3.181	261
2017		9	37	17	17	20	3.268	268
2018		8	35	17	17	24	3.331	273
2019		7	32	17	19	24	3.385	278
2020		7	32	18	19	25	3.391	278

JICA Team 1997 Note* Real prices for A and B assumed to decline in general inflation (6%/yr).

3.5 Urban Gas Prices and Pricing Policy Considerations

Urban Gas Prices

New tariff table authorized in October 1996 by branch is as follows;

New Tariff Structure of PGN approved as of October 1996

❑ General Tariff

Branch	kcal	New Tariff (Rp/m^3)	Old Tariff (Rp/m^3)	Change
Medan	11,000	400	370	+ 8.1%
Jakarta	8,800	370	300	+23.3%
Bogor	8,800	370	300	+23.3%
Surabaya	9,100	335	300	+11.7%
Cirebon	7,000	300	225	+33.3%

❑ Contract Tariff

Branch	kcal	New Tariff (Rp/m^3)			Old Tariff (Rp/m^3)	Change (VS.K1)
		K1	K2	K3		
Medan	11,000	350	340	$Hn=Hd\times(1+g)^n$	320	+ 9.4%
Jakarta	8,800	330	315	$Hn=Hd\times(1+g)^n$	265	+24.5%
Bogor	8,800	330	315	$Hn=Hd\times(1+g)^n$	265	+24.5%
Surabaya	9,100	335	320	$Hn=Hd\times(1+g)^n$	265	+26.4%
Cirebon	7,000	Contract Tariff : 265 Rp/m^3 Small industry : 160 Rp/m^3			210	+26.2%

note: 1. K1 is applied to commercial and industrial customers which consumes from 1,000m^3 to 300,000m^3 per month.
2. K2 is applied to commercial and industrial customers which consumes from 300,000m^3/to 5,000,000m^3 per month.
3. K3 is applied to commercial and industrial customers which consumes more than 5,000,000m^3 per month.
4. In the formula of K3, "Hd" represents the basic price, "g" represents escalation rate set by negotiation,

The increase of general tariff, mainly applied to residential and small commercial and small industrial customers, ranges from 8% to 33%. In the residential gas market, natural gas will face with severe competition against LPG. As a result of tariff increase this time, price competitiveness of natural gas against LPG has weakened a little, but still has an advantage.

The contract tariff, mainly applied to large commercial and industrial customers, was split into 3 categories by consumption volume. Particularly, it is characteristic that K3, which can be set without authorization, was newly introduced in the tariff menu. PGN and customers can set the price by negotiation. Flexible pricing is required for large industrial customers, because the distribution cost to such kind of customers varies greatly depending on the usage conditions such as daily load factor, seasonal fluctuation etc., as well as netback values. K3 meets this needs. This enables PGN to acquire potential customers, which consumes more than 5 million cubic meters per month strategically.

Chapter 4

Corporate Situation of PGN

4. Corporate Situation of PGN

4.1 Corporate Status of PGN

The gas distribution business in Indonesia started in 1863. The legal status of the gas public corporation was converted to a state owned enterprise in 1958; to Perum Gas Negara in 1984; to a limited liability state owned company (PERSERO)in 1994.
PGN has been expanding natural gas sale to industrial market based on a feasibility study funded by the World Bank in 1984. On the other hand, the gas sale to residential and commercial market has not been active, because of the high cost of distribution so far.

Highlights of the PGN are shown below.

1) Business Territories: 8 Cities
(Java)Jakarta, Bogor, Bandung, Cirebon, Semarang, Surabaya
(Sumatra) Medan (Sulawesi) Ujung Pandang

2) Financial Data as of Fiscal Year 1996

Gas Sales Revenue	444,869 million Rupiah
Profit After Tax	91,160 million Rupiah
Paid up Capital	200 million Rupiah

3) Number of Customers and Sales Volume:

	No. of customers (as of March 1997)	Gas sales volume (as of 1995)	
		(MMSCFD)	(%)
Residential	42,805	1.7	1.5
Commercial	1,311	1.3	1.1
Industrial	600	117.0	97.4
Total	44,716	120.0	100.0

4) Pipeline Length(as of 1997): 1,629 km
5) Number of employees(as of 1995): 1,323 Persons

4.2 Financial and Budget Situation

From the view point of financial and budget situation of PGN, it is now rapidly changing company by aggressively capitalizing transmission pipelines. Recently PGN positively get financing from over sea.

This situation is clearly seen in the financial ratios based on 1993-1997 as shown in Table 4-1.

Table 4-1 Financial Ratios of PGN

	1993	1994	1995	1996	1997
ROE*1		23%	29%	32%	29%
Operating profit/total sales	40%	35%	30%	26%	25%
Cost of goods sold/total sales	40%	47%	53%	58%	61%
Operating expenses/total sales	20%	18%	17%	17%	13%
Profit before tax/total sales	40%	33%	30%	28%	23%
Profit after tax/total sales	25%	20%	21%	20%	17%
Annual sales growth rate		27%	41%	26%	38%
Sustainable growth rate*2		13%	21%	8%	39%
Debt/equity ratio	70%	80%	79%	117%	247%
Total assets turnover*3		132%	154%	154%	117%
Self-financing ratio*4	129%	79%	109%	48%	13%

*1 =After tax profit/average equity
*2=Growth rate of equity
*3=Total sales/average total assets
*4=Total cash from operation/total cash for investment

Estimated by JICA Team from the annual report 1995 and the budget 1997 of PGN
Source: PGN

When interests of loans that PGN borrowed these years (it will be capitalized in a few years) will be counted as cost, profitability may decline. Cost of gas per volume would be expected to keep growing to compensate the capital expenditures of transmission lines.

Again it is showing how important it is for PGN to secure the feasibility for the future demand increase of gas. It is also quite important for PGN to accelerate the development of new demand around the Jakarta area in the course of the development of new gas source to pay for the interests of loans PGN is financing now.

Table 4-2 Cash Flow Statements of PGN

Cash Flow Statement

	1993	1994	1995	Estimated 1996	Budget 1997
Cash flow from operational activities:					
Profit	48,813	49,603	73,611	91,160	102,494
Adjustment for:					
Depreciation & amortization	20,494	21,742	16,363	11,128	28,102
Long term expenditures paid					(37,824)
Others	(10,447)	(37,286)	(23,321)	(10,092)	885
Total cash from operating activities	58,861	34,058	66,653	92,196	93,657
Cash for investment:					
Additional for fixed assets	(27,543)	(32,624)	(53,673)	(176,875)	(685,469)
Others	(18,111)	(10,739)	(7,354)	(17,005)	(42,027)
Total cash for investment	(45,654)	(43,363)	(61,027)	(193,880)	(727,496)
Cash flow from fund activities:					
WB	9,462	22,097	24,753	29,552	24,283
ADB				31,662	219,105
EIB				5,611	123,560
JEXIM	(1,526)	(1,526)	(1,526)	29,369	210,042
MTN				0	124,000
PGN gas deposits	279	40	40		45
Payment for employees	(5,874)	(7,228)	(7,440)		(17,922)
Payment for small business fund	(2,109)	(2,441)	(2,480)		(2,735)
Payment for social fund	0	0	(3,000)		(10,493)
Payment for dividend					(5,565)
Payment for general reserves	(2,642)	(1,744)	0		0
Receiving government fund for project	8,438	13,388	10,755		32,944
Receive for donated capital	4,811	2,093	1,772		
Others		90		(40,173)	(9,317)
Total cash flow for fund activities	10,840	24,767	22,873	56,021	687,947
Additional cash for this year	24,047	15,462	28,498	(45,662)	56,568
Cash from other activities					2,460
Beginning cash of this year	82,594	106,641	122,103	150,601	104,939
Ending cash of this year	106,641	122,103	150,601	104,939	161,507

Source:PGN

4.3 Technology Status

Followings are the technology items which are lacking and are expected to be upgraded or introduced.

(1) Distribution area
1) Indoor piping materials (flexible pipes and fittings)
2) Pipe installation standards for high rise buildings
3) SCADA (Supervisory Control and Data Acquisition System)

(2) Gas utilization area
1) Sales know-how of residential and commercial gas appliances
2) Technologies for large commercial gas appliances (gas absorption chillers etc.)
3) Technologies for industrial gas appliances (cogeneration etc.)

(3) Gas safety area
1) Technical standards for installation of gas appliances and ducting flue gas
2) Intelligent gas meters
3) Safety standards for new gas appliances

Chapter 5

Current Urban Gas System Status

5. Current Urban Gas System Status

5.1 Urban Gas Network and Supply - Existing

5.1.1 Gas Supply in West Java

On Java Island, gas fields are located both on-shore and off-shore and are exploited for domestic use by Pertamina and PSCs (Product Sharing Contractors). Compared to offshore gas fields, the scale of onshore gas fields in West Java is small and more than 75% of natural gas is produced at offshore fields.

The gas production in the West Java area will increase until the year 2000 and after that will begin to decrease. If new gas fields are not found in West Java, it may be necessary to transport gas from other gas fields such as South Sumatra or East Java in order to respond to the rapidly increasing gas demand.

5.1.2 Gas Transmission in West Java

The West Java transmission system connects gas fields on the east side of Jakarta and in the demand areas in Jakarta and Cilegon. The main line of the system is 218 km long, 24 inches in diameter, with 3 compressor stations. The system was completed in 1976. The capacity of the main line is 250 MMSCFD. The operating pressure of the system is 10 to 26 bar although the design pressure of the pipeline is 40 bar.

Although the demand in this area is growing, supply and transmission capacity is insufficient. In order to rectify this situation, it will be necessary for onshore gas fields near demand areas to be developed as soon as possible. Also it is recommended that gas from South Sumatra be utilized efficiently.

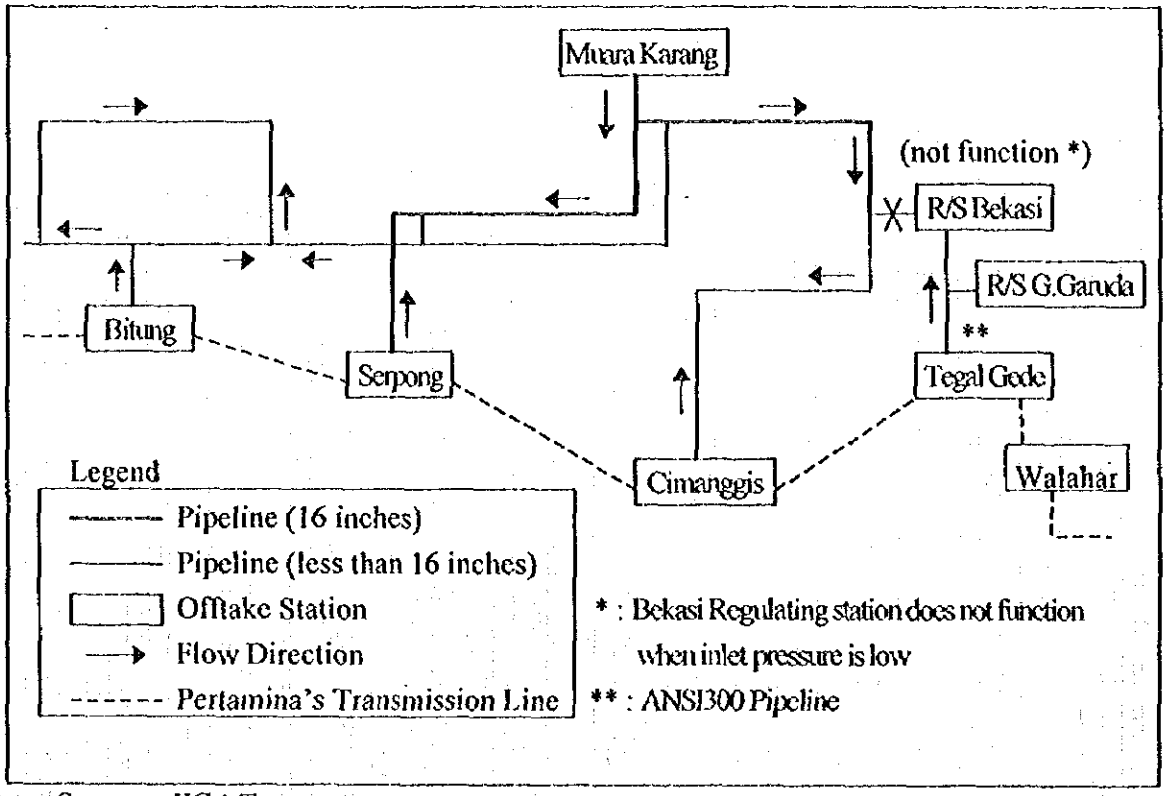
5.1.3 Gas Distribution Status

The distribution system in the PGN Jakarta Branch area consists of 3 networks :

(1) a high pressure network (design pressure 16 bar, partially 50 bar),
(2) a medium pressure network (design pressure 4 bar),
(3) a low pressure network (design pressure 300 mmH_2O).

The high pressure network is used for distributing gas to large industrial customers and regulators for the medium and low pressure networks. The network in PGN Jakarta Branch is shown in Fig. 5-1-1.

Fig. 5-1-1 High Pressure Network in PGN Jakarta Branch



Source : JICA Team

The high pressure network receives gas from 6 offtake stations ; Tegal Gede, Cimanggis, Serpong, Bitung, Muara Karang and Walahar. Since most of gas demand is for the industrial use and concentrates more in Kab. Tangerang and Kab. Bekasi than downtown Jakarta, the pipelines have more load at the east and west edge of the system than at the center of the system.

The medium and low pressure networks are located in downtown Jakarta and are used for distributing gas to residential and small commercial customers. Since PGN makes an effort mainly to develop industrial demand, the extension of medium or low pressure network is not large compared to the high pressure network. The low pressure network was established about 100 years ago and has problems with gas leakage. The system is currently under repair.

5.1.4 Facilities

The total length of the pipelines in PGN Jakarta Branch area is 451 km and the length of the high and medium pressure pipelines is more than 3 times longer than that of the low pressure pipeline. 68% of the pipes are made of welded steel and 20% are made of polyethylene. The remaining 12% are made of cast iron, ductile iron and threaded

steel which are the target of rehabilitation plans. Currently PGN uses only welded steel and polyethylene pipes for new pipeline construction.

5.1.5 Distribution Control and Facility Maintenance

In the case of the PGN Jakarta Branch, gas distribution is controlled by manually changing the outlet pressure at offtake stations in accordance with the fluctuation of demand. At PGN's offtake stations, staff are working 24 hours in order to record distribution data such as flow rate, pressure, and temperature and also to control the outlet pressure. However, the distribution pressures at places other than offtake stations are not monitored. It is recommended that pressure recorders be used for this purpose.

As for facility maintenance, the following items are important : leak detection surveillance, anti-corrosion control, preventive maintenance of regulators and valves, and the protection of facilities from third party activities. Although PGN administrates these items, the organization which controls third party activities should be strengthened in order to avoid accidents, as a subway system will be constructed in the near future.

5.2 Gas Load Fluctuations

5.2.1 Gas Flow Fluctuations

In order to investigate gas flow fluctuation, monthly, daily and hourly gas supplies from offtake stations were studied. Although we found small flow fluctuations, the gas flow does not fluctuate much. This is because the most of the customers in PGN Jakarta Branch are industrial and most of them use gas 24 hours constantly.

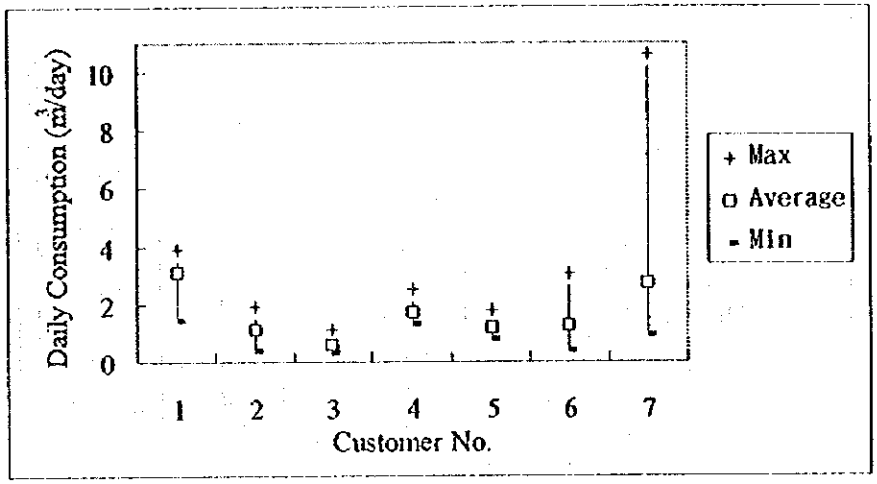
5.2.2 Demand Fluctuations in the Residential Sector

In order to clarify the actual gas usage in the residential sector of PGN quantitatively, load surveys were conducted during the second field work with the great cooperation of PGN staff. The actual gas usage of 7 customers were surveyed. The maximum, average and minimum of the daily gas consumption of these customers are shown in Fig. 5-2-1.

From the figure, we understand that average consumption is less than 4 m^3/day and the maximum is also less than 4 m^3/day except for customer No. 7 who sometimes cooked foods not only for their own use but also for selling.

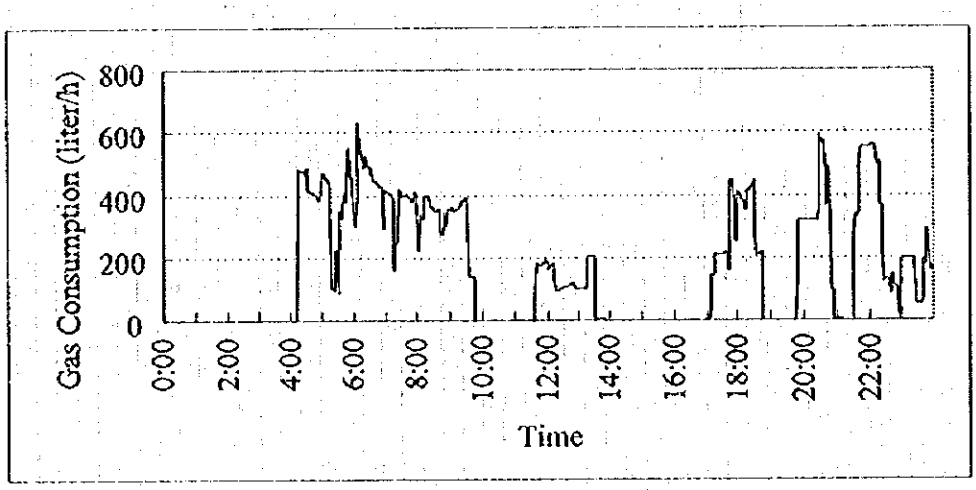
Fig. 5-2-2 shows the profiles of No. 7 customer's consumption on the day when the daily gas consumption was the maximum.

Fig. 5-2-1 Daily Gas Consumption of Each Customer



Source : JICA Team

Fig. 5-2-2 Profile of Daily Gas Consumption (Customer No. 1)



Source : JICA Team

From the analysis of the load survey data, we found the following characteristics :

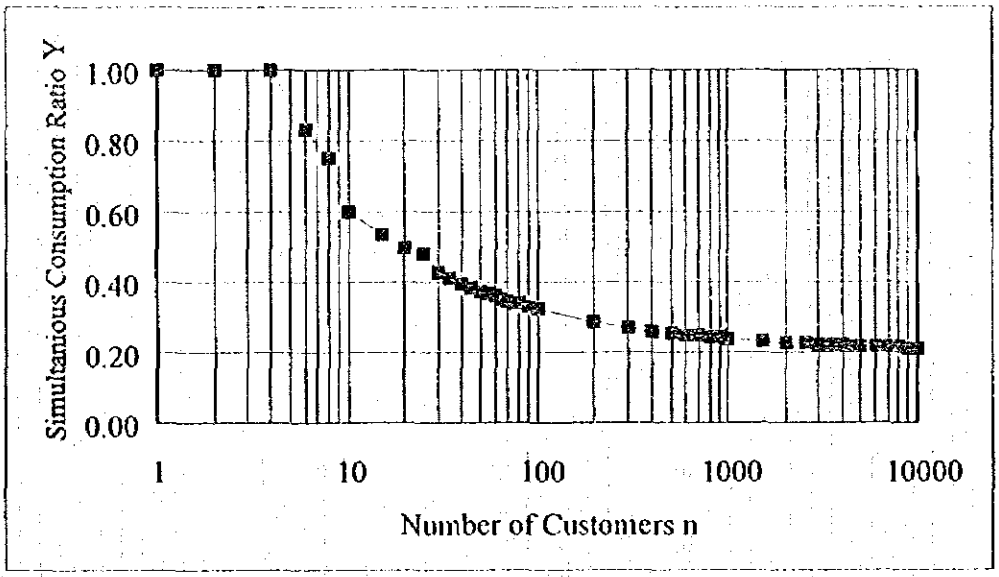
(1) Gas consumption patterns widely differ from customer to customer.
(2) 0.60 m^3/h is suitable as the design load of one residential customer who have only one table top cooker,
(3) The peak time of gas in the residential sector is early in the morning (5:45 - 6:45).

5.2.3 Simultaneous Consumption Ratio for Residential Customers

The simultaneous consumption ratio Y obtained from the load survey data is shown in

Fig. 5-2-3.

Fig. 5-2-3 Simultaneous Consumption Ratio for Residential Customers



Source : JICA Team

5.3 Gas Network Expansion Plan

PGN has the network expansion plan of both the transmission system and the distribution system. As for the transmission line, PGN is currently preparing 2 projects, Central Sumatra Project and South Sumatra Project. As for the distribution pipeline, PGN has been studying several options for developing industrial gas demand in West Java. This plan is synchronized with the construction of the transmission line from South Sumatra and gas demand development activities have already started.

5.4 Rehabilitation Status and Issues

In downtown Jakarta, PGN has old pipelines which have caused gas leakage. PGN began low pressure system rehabilitation in 1990 in order to reduce unaccounted-for gas and to maintain safety. In the rehabilitation program, isolated sectors are established by cutting off old pipelines from existing 'live' pipelines. According to the rehabilitation plan, more than 30 sectors have been prepared. Among these sectors, 29 sectors are already finished or are being worked on now. In 1996, 45 km of pipelines will be reconstructed. Next year 4 sectors are planned for rehabilitation.

5.5 Pipeline Costs

The unit price for construction work to be used for estimating the gas pipeline construction cost in the current development and investigation was calculated on the basis of

the amount which was given by PGN. Since the costs in different years were included in that data, it was corrected to the year of 1996 by the Team. Furthermore, the Team added certain business profits of the construction companies. Costs of construction work for special pipelines such as bridge pipes are estimated separately. Standard construction cost of indoor pipes was calculated from the quotation submitted to customers by the Jakarta Branch.

Chapter 6

Urban Development

6. Urban Development

(Note. Tables and Figures concerning this chapter are shown in the Appendix B.)

6.1. Administrative Hierarchy

The Republic of Indonesia has 6 levels of administrative hierarchy as follows:

1. D.I. Aceh, DKI Jakarta, D.I. Yogyakarta (Special Districts) and Propinsi (Province)
2. Wilayah/Kotamadya (Municipality) and Kabupaten (Regency)
3. Kecamatan (Subregency)
4. Kelurahan
5. Rukun Warga
6. Rukun Tengga

6.2 Present Urban Development Status

6.2.1 DKI Jakarta

Major residential estates are in the west and east part of DKI Jakarta(Fig. B-1). The existing land use and road/gas networks in DKI Jakarta are shown in the Appendix (B-2).

6.2.2 Kotamadya Tangerang

Kotamadya Tangerang is growing into an important area for transportation. Major residential estates are located between the toll road and provincial road. (shown in Fig. B-1 and B-3).

6.2.3 Kabupaten Tangerang

New estates are appearing after a toll road passing through the region is completed. Major industrial and residential estates are by toll road and in the south area of Tangerang. There are new towns already in Kecamatan Ciputat and Serpong. (shown in Fig.B-1 and Fig. B-3)

6.2.4 Kabupaten Bekasi

New industrial and residential estates are appearing after a toll road is constructed through the region. On the south side of the provincial road, there are many major residential estates. (shown in Fig. B-1 and Fig. B-4)

6.2.5 Kabupaten Karawang

Most of the residential/industrial areas are located near the provincial and Jakarta-Cikampek toll road. Many new industrial and residential estates are growing after a toll road passes through the region (shown in Fig. B-5).

6.3 Urban and Industrial Estate Development Plans

6.3.1 West Java

West Java Provincial Structure Plan : The prioritised industries selected by the official development strategies and the hierarchy of future strategic development area and cites in West Java Province are under planning (shown in B-6 and B-7).

6.3.2 Jabotabek

Jabotabek Metropolitan Development Plan Review (JMDPR) : JMDPR recommends the East - West liner City for urban development. The structural element of East - West liniar city are:

a) urban growth centers, including both new towns and expansion of existing centers;
b) the transportation system, including toll road, arterial road, suburban rail and mass rapid transit options; and
c) green space/wedges, reserves and low density semi-open areas.

In addition, JMDPR recommends the following:
a) Promotion of a polycentric urban structure
b) Promotion of mass rapid transit system
c) Nominating and defending green wedge
d) Adoption of well balanced mix use balance
e) Urban management

6.3.3 DKI Jakarta

DKI Jakarta Structure Plan 2005

DKI Jakarta is to publish the revised plan following the present plan in 1996, but it has 2 additional big projects (refer to Fig. B-9) as follows:

-The Jakarta Waterfront Project

-MRT (Mass Rapid Transit) system

The summary of the Present DKI Jakarta Structure Plan 2005 is described below.

The plan's target year is 2005.
The projection of population is 11,988,000 in 2005.

1) Development planning zone

DKI Jakarta is divided into 9 Development planning zones (refer to B-10) :

(2) District Plan

The structure and road network plan in DKI Jakarta are also defined (B-11).

6.3.4 Kotamadya Tangerang

Kotamadya Tangerang Urban Structure Plan: The plan is based on the following:

1. The forecasted population in 2010 will be about 3 million in Kotamadya Tangerang.

2. The grid road network system will be applied to the new road network.

3. The development will not include farming activities and Kotamadya Tangerang will promote the development of industrial/commercial/residential area.

The land use and road network plan is pubilished (B-12).

6.3.5 Kabupaten Tangerang

Kabupaten Tangerang Urban Structure Plan :The projection of Kabupaten Tangerang's population is projected at 5,793,000 in 2005.

Some of the main strategies of the plan are:

1. To motivate the development of three central business districts and three regents (Serpong, Balaraja and Teluknaga) by expanding and developing infrastructure such as roads, electricity, water and gas supply.

2. To expand road networks that connect three regents/central business districts with the commercial area and service areas.

3. To expand primary road networks that connect the three regents/central business

districts and also those between the three regents/central business districts and outer Tangerang .

4. The development of new commercial areas in housing estates should be controlled by the local government.

(The land use and road network plan is shown in B-13).

6.3.6 Kabupaten Bekasi

Kabupaten Bekasi Urban Structure Plan : Bekasi's population is projected at 4,590,000 in 2005.

The future land use and road network plan in Kabupaten Bekasi is also defined (B-14).

6.3.7 Kabupaten Karawang

Kabupaten Karawang Urban Structure Plan : Karawang's population is projected at 1,538,000 in 2000.

Some main points of the plan are:

1. The industrial area are located south of the provincial road and the Jakarta-Cikampek toll road. Infrastructures (such as roads, water and gas supply, electricity and telephone line) will be provided for the industrial area.
2. New area surrounding the primary roads and the Jakarta-Cikampek toll road will be developed intensively as urbanized land use areas.
3. To maintain existing farms and its irrigation system in the north of the provincial road.
4. To maintain the water resource, especially Citarum and Cilamaya rivers.
5. To conserve the forest in northern Kabupaten Karawang and in the southern Jatiluhur area.
6. To motivate and develop infrastructure including transportation facilities.

The land use and road network plan in Kabupaten Karawang is already defined (B-15).