THE FEASIBILITY STUDY REPORT ON CITY GAS DISTRIBUTION SYSTEMS IN THE KLANG VALLEY AREA OF MALAYSIA

(SUMMARY)

MAY, 1987

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO, JAPAN

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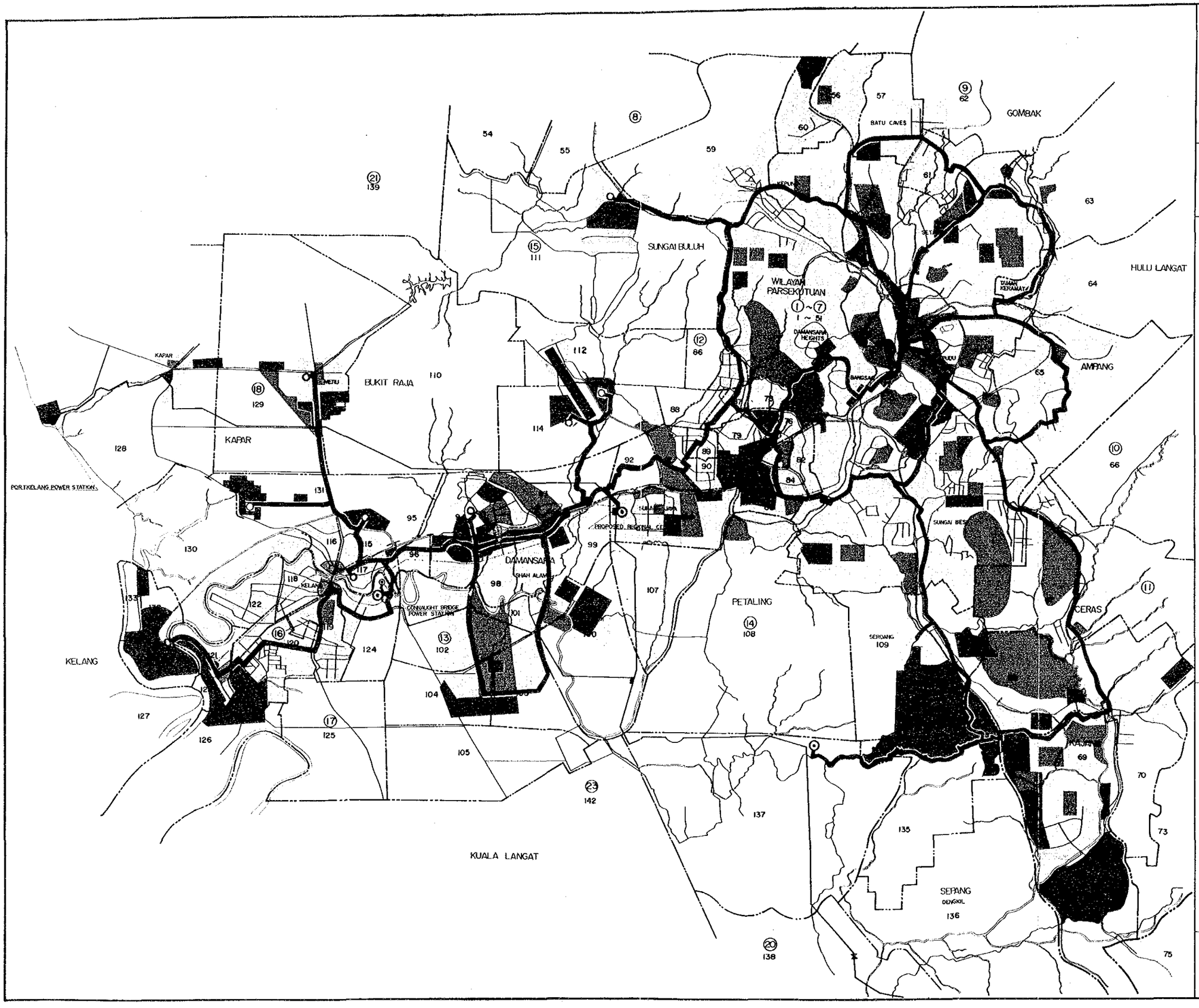
CITY GAS SUPPLY AREA AND TRANSMISSION PIPELINE ROUTE (in 2005)

FIGⅢ－1



CITY GAS SUPPLY AREA AND TRANSMISSION PIPELINE ROUTE (in 2005)

FIGIII－1

RESIDENTIAL
INDUSTRIAL
INSTITUTIONAL
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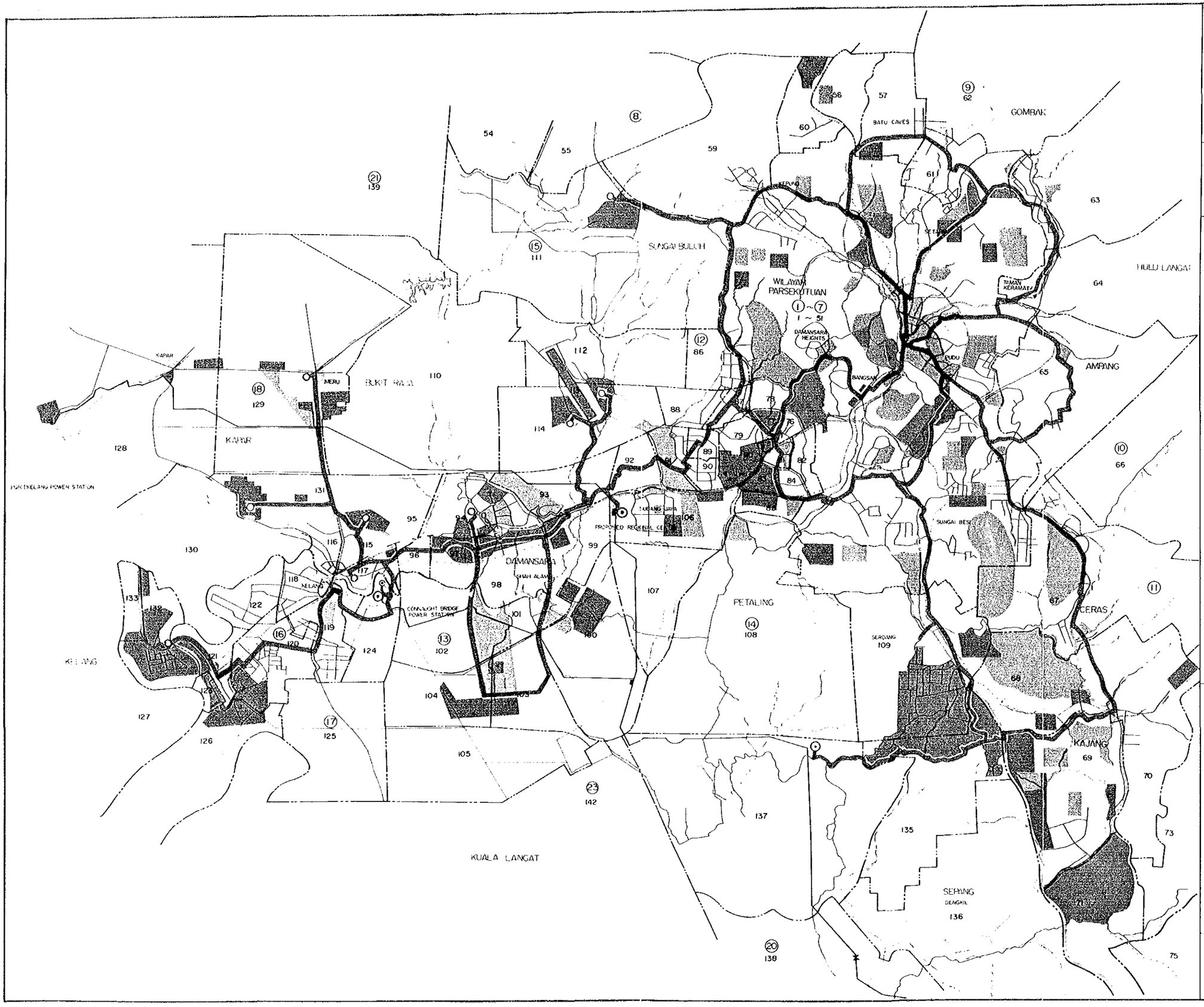
TRUNK LINE



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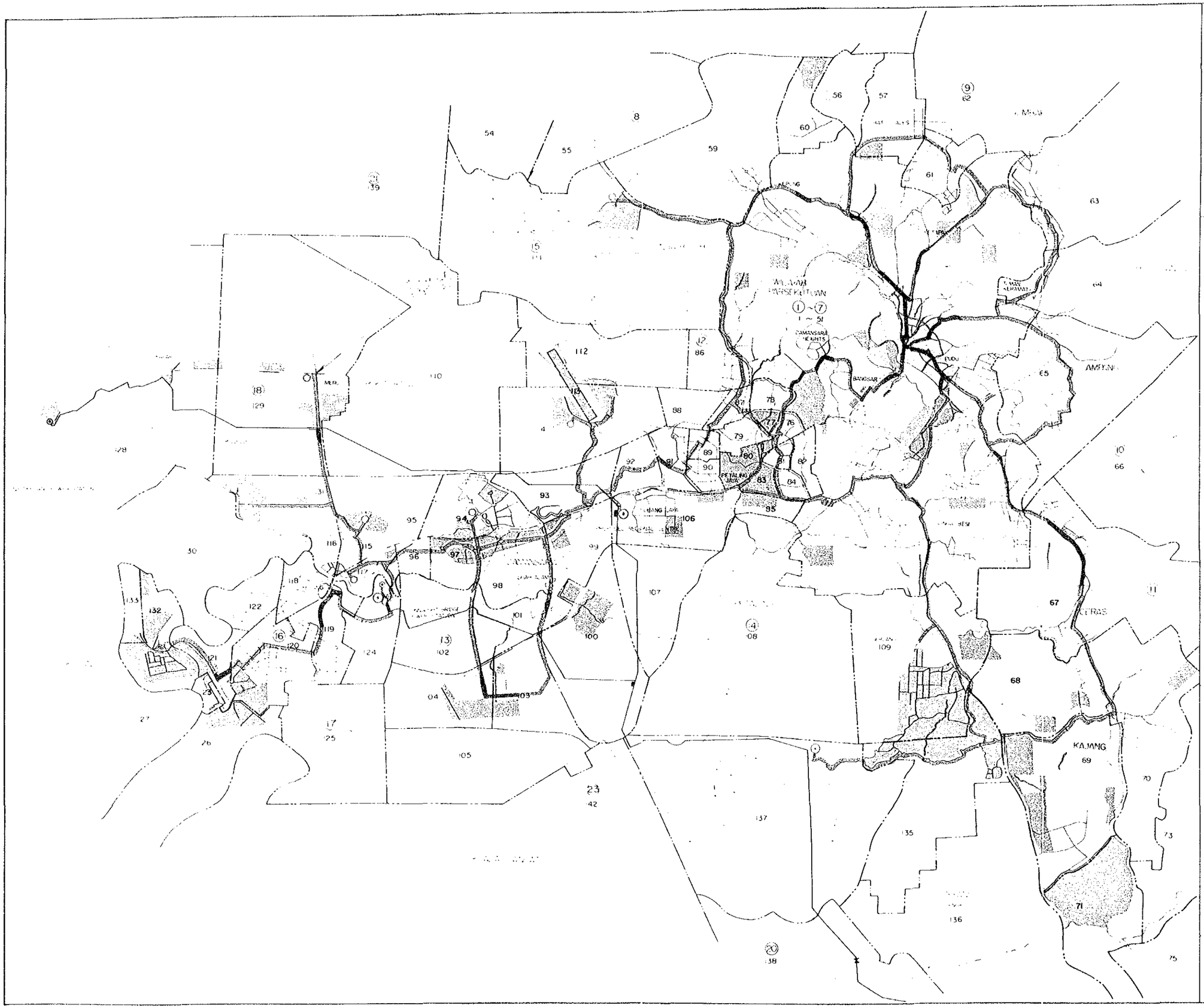

ABBREVIATION

Organization and Project

ADB	Asian Development Bank
ASEAN	Association of South East Asian Nations
BP	BP Malaysia Sdn Bhd
Consultant	Tokyo Gas Engineering, UNICO International Corporation
DID	Drainage and Irrigation Department
EPMI	Esso Production Malaysia Inc
EPU	Economic Planning Unit
EIA	Environmental Impact Assessment
ESSO	Esso Malaysia Bhd
FAO	Food and Agricultural Organization of the United Nations
FELCRA	Federal Land Consolidation and Rehabilitation Authority
FELDA	Federal Land Development Authority
F.T of K.L	Federal Territory of Kuara Lumpur
GDP	Gross Domestic Product
GDPC	Gross Domestic Originated from Commercial Sector
GDPM	Gross Domestic Originated from Manufacturing Sector
GDPR	Real Gross Domestic Products
GNP	Gross National Product
GNPR	Real Gross National Products
GRP	Gross Regional Product
GPS	Gas Pricing Study
HAM	Highway Authority Malaysia
HICOM	Heavy Industries Corporation of Malaysia
HPU	Highway Planning Unit
ICU	Implementation Coordination Unit
JACTIM	The Japan Chamber of Trade & Industry, Malaysia
JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
KL	Kuala Lumpur
KVPS	Klang Valley Planning Secretariate
KVRPC	Klang Valley Regional Planning Council
KVTS	Klang Valley Transportation Study

MA	Ministry of Agriculture
METP	Ministry of Energy, Telecommunication and Posts
MIDA	Malaysian Industrial development Authority
MFT	Ministry of Federal Territory
MHLG	Ministry of Housing and Local Government
MLRD	Ministry of Land and Regional Development
MPW	Ministry of Public Works and Public Utilities
MRA	Malayan Railway Administration
NEB	National Electricity Board
NUP	National Urbanization Policy
OECF	Overseas Economic Cooperation Fund, Japan
PERNAS	Perbadanan Nasional Berhad
PETRONAS	Petroliam Nasional Berhad
PDSB	PETRONAS Dagangan Sdn Bhd
PJ	Petaling Jaya
PGSB	PETRONAS Gas Sdn Bhd
PGUP	Peninsular Gas Utilization Project
PMD	Prime Minister's Department
Project	Overall project including planning, design, construction, operation, etc. related to the natural gas based city gas supply system to be located in the Klang Valley area of Malaysia
PWD	Public Works Department
SERU	The Social Economic Research Unit
SHELL	Shell Malaysia Berhad
SIRIM	Standards and Industrial Research Institute of Malaysia
SSB	Sarawak Shell Bhd
SSS	Selangar State Secretariate
SEPU	State Economic Planning Unit
S/W	"Scope of work" which is a written scope of feasibility study on the project contained in the agreement between EPU and JICA
TCD	Telecommunication Department, Malaysia
TPGPP	Trans Peninsular Gas Pipeline Project
UDA	Urban Development Authority
UNDP	United Nations Development Programme
WHO	World Health Organization

Unit and Conversion

mm	Millimeter
cm	Centimeter
m	Meter
km	Kilometer
in	Inch (1 in = 2.54cm)
ft	Foot (pl. feet)(1 ft = 0.305m)
cm^2	Square centimeter
m^2	Square meter
ha	Hectare (1 ha = 10,000m^2 = 2.471acres)
ft^2	Square foot (1 ft^2 = 0.0929m^2)
m^3	Cubic meter
Nm^3	Normal cubic meter at 0°C and 760 mm Hg
MMm^3	Million cubic meters
SCF, cu ft, cft	Standard cubic foot (1 ft^2 = 0.0283m^3)
MMSCF	Million standard cubic feet
l	Liter
kl	Kiloliter
gal	Gallon (1 British gallon = 4.546litters, 1 U.S. gallon = 3.785litters)
bbl	Barrel (1 barrel = 42 U.S. gallons)
g	Gram
kg	Kilogram
t, T, ton, Ton	Metric ton
lb	Pound (1 lb = 0.454kg)
LMT	Liquid metric ton (50% aques solution of caustic soda)
sec	Second
min	Minute
h, hr, Hr	Hour
d, D	Day
m, M	Month
y, Y	Year
°C	Degree centigrade
°F	Degree Fahrenheit
cal	Calorie
Kcal, K cal	Kilo calorie
BTU, Btu	British thermal unit (1 BTU = 0.252 K cal)

KBOE	Kilo barrel Oil Eqivalent
KTOE	KIlo ton Oil Equivalent
MMBTU, MMBtu	Million British thermal units
LHV	Low heating value
HHV	High heating value
PJ	Petajoule A Ampere
V	Volt
W	Watt
kW	Kilowatt
mW	Megawatt
kVA	Kilo-volt ampere
mVA	Mega-volt ampere
kWH, kWh	Kilowatt-hour
mWH, mWh	Megawatt-hour
HP	Horsepower
%	Percent
ppm	Parts per million
g/Nm^3	Gram per normal cubic meter
pH, PH	Hydrogen ion concentration
kg/cm^2	Kilogram per square centimeter
lb/in^2	pounds per square inch
mmAq	mm aqua (= water)
t/d, T/D	Metric tons per day
t/y, ton/y, MTA, MT/Y, T/Y	Metric tons per year
MMSCFD, MMscfd	Million standard cubic feet per day
BPCD	Barrels per calendar day
BPSD	Barrels per stream day
TPCD	Tons per calendar day
TPSD	Tons per stream day
MD	Man days
F/Ton, F/T	Freight tons

Technical Terms

ATF	Aviation Turbine Fuel
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
NG	Natural Gas
CNG	Compressed Natural Gas
BFW	Boiler Feed Water
CTW	Cooling Tower Water
FO	Fuel Oil
MFO	Medium Fuel Oil
MTBE	Methyl Tertiary Butyl Ether
E.P.C.	Engineering, Procurement and Construction
Flash Point (COC)	Flash Point (Cleveland Open Cup)
MM	Millions or Man-Months

Financial and Economic Terms

DCF	Discounted cash flow
IRR, IRROI	Internal rate of return on investment
EIRR, EIRROI	Economic internal rate of return on investment
FIRR, FIRROI	Financial internal rate of return on investment
IRROE	Internal rate of return on equity
C & F	Cost and freight
CIF	Cost, insurance and freight
FOB	Free on board
EMP	Energy Master Plan

Exchange Rate

M$, MD	Malaysian Ringgit (1 U.S. Dollar = M$2.65)
$, U.S.$	U.S. dollar
Yen	Japanese Yen (1 U.S. Dollar = 167 Yen)

ENERGY CONVERSION TABLE

Energy	Carolific Value in MMBTU	Carolific Value in kcal	Carolific Value as Natural Gas
LPG	47.23 MMBTU/Ton	11,902 kcal/kg	1 kg = 1.2051 Nm^3
Kerosene	43.97 MMBTU/Ton (S.G. 0.8)	8,864 kcal/liter	1 liter = 0.8975 Nm^3
Diesel	43.33 MMBTU/Ton (S.G. 0.85)	9,281 kcal/liter	1 liter = 0.9398 Nm^3
M.F.O.	41.03 MMBTU/Ton (S.G. 0.95)	9,823 kcal/liter	1 liter = 0.9946 Nm^3
Coal Bitumunous	11,000 BTU/lb	6,111 kcal/kg	1 kg = 0.6188 Nm^3
Wood		3,000 kcal/kg	1 kg = 0.3038 Nm^3
Charcoal		7,000 kcal/kg	1 kg = 0.7088 Nm^3
Electricity		860 kcal/kwh	1 kwh = 0.0871 Nm^3
Natural Gas	1,050 BTU/SCF	9,876 kcal/Nm^3	-

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1. PROJECT BACKGROUND AND RELEVANT CONDITIONS

1.1 Diversification of Energy away from Petroleum Products

Malaysia has oil and gas fields and is exporting crude oil and also gas in the form of LNG.

However, the volume of reserves of oil and gas are estimated as 2,350 million bbl and 48.5 TCFT. According to the British Petroleum, 1986 statistical review of world energy, proven oil and gas reserves in Malaysia are 19.5 years and over 100 years.

Due to this energy situation, the Malaysia Government has decided to reduce petroleum product consumption by diversification, whereby locally produced energy, like natural gas, coal and hydraulic power, would have a greater role than at present.

In keeping with this purpose, the Malaysia Government has decided to construct the Trans Peninsular Gas Pipeline to convey natural gas from East to West and South Malaysia to feed natural gas to electric power station and replace fuel oil.

Though the initial consumers to be supplied with natural gas would be the major power stations along the West Coast, gas would also be made available to industrial plants and other consumers along and in the vicinity of the pipeline route.

The construction of the pipeline is expected to be completed by 1989, therefore, natural gas for the city gas system will be available from 1990. The calorific value of natural gas is 1,050 BTU/SCF $\pm$ 10%.

1.2 Necessity for City Gas in the Klang Valley Area

The Klang Valley area consisting of F.T. of K.L. and four districts of Selangor (Gombak, Petaling, Klang and Hulu Langat) is the most developed area in Malaysia, with its 2.7 million inhabitants, vigorous commercial activities and highly technological industries. The energies supporting this city area, apart from electricity, are mainly cylinder-LPG, kerosene and charcoal, which are the fuels requiring human hands in the final stage of transportation.

As a city develops to be more concentrated and high-rising, as Klang Valley now does, other forms of energies more fitted to the urban structure in distribution efficiency and public safety is called for. City gas, energy delivered through conduits, has been the answer to this in most cases of large cities in the world and it will be so in Klang Valley, too, judging by the strong demand for the so-called reticulation system now being met by PETRONAS with bulk LPG.

So, in order to efficiently utilize the natural gas to be conveyed to the west coast of the peninsular, the Malaysian Government intended to study the feasibility of establishing, in the Klang Valley area, a gas distribution system to meet the general demand as referred in the above as well as the expected demand in industrial sector, and has requested the Japanese Government of a feasibility study. The latter agreed and the scope of the study has been finalized between the both governments as defined in Scope of Work also attached.

1.3 Economic Growth in the Klang Valley Area

The Study Team has estimated the GRP, population and employment in Klang Valley area based on the Fifth Five Year Plan and the Klang Valley Perspective Plan as the base case and has estimated the GRP and employment in the same area based on the medium and low growth rates of GDP of Malaysia proposed by EPU as alternative cases in Table 1.

Economic growth of Malaysia (GDP) was 7.8% per annum during 1970-1980 and 5.8% during 1981-85. It is estimated as 5.0% during 1986-90, by Fifth Five Year Plan. However, EPU proposed medium growth rate of 3% and low case of 1%.

The growth rate of GRP of F.T. of K.L. is higher than average and that of Selangor State is lower than average in Fifth Five Year Plan.

However, the economic growth rate in the four districts of the Klang Valley Area is estimated as higher than average, corresponding to the Klang Valley Perspective Plan.

GRP in Klang Valley Area was 15,511 million M$ in 1985 and is estimated as 48,842 million M$ in 2005 in 1978 constant prices for base case, 44,363 million M$ for medium case and 30,141 million M$ for the low case.

Annual rate of population growth during 1986-90 used in the Fifth Five Year Plan is expected as 2.5% for Malaysia, 3.4% for F.T. of K.L. and 3.4% for Selangor State in where growth rate is higher due to net internal migration. Population Klang Valley Area was 2,534,000 in 1985 and will be 5,450,000 in 2005.

Employment in Klang Valley Area was 950,000 in 1985 and will be 2,190,000 in 2005 for base and medium cases and 2,075,000 for the low case.

In order to achieve the best development of the Klang Valley Area, Klang Valley Secretariate and other organization, like F.T. of K.L. Selangor State, Klang, Shah Alam, Bangi and Gombak are at work and have announced several plans.

The Study Team has analyzed the above reports. The land use in the urban area in Klang Valley in 1985 and 2005, based on the above several plans by Klang Valley Transportation Study Team are shown in Figure 1 (1),(2).

The Klang Valley Area was divided into 133 zones by the Klang Valley Transportation Study Team which decided to apply the same zoning because there is the same base between both studies - Transportation and City gas - for market analysis.

Population, GRP and employment in Klang Valley Area are distributed to each zone, for estimating energy consumption in each zone.

2. PRICES OF NATURAL GAS AND CITY GAS

PETRONAS and the Study Team have agreed to use fuel oil price for a electric power station as the price of natural gas to be fed to the city gas system and price of fuels which will be replaced by city gas as city gas sales prices as LPG price in cylinder for households and restaurants and LPG price in bulk for hotel and manufacturing industries. However, the estimated economic value of natural gas by EPU is used for Economical Analysis. (Table 10)

Price of petroleum products (including fuel oil and LPG) fluctuate with the crude oil price which is forecast as mentioned in Figure 2 proposed by EPU.

FOB Singapore prices of petroleum products are estimated from the above crude oil price of the low scenario by using co-relation method and sales prices of petroleum products in Malaysia are estimated by adding the several charges to FOB Singapore prices. (Table 2) The effect of crude oil price difference on Economical Analysis will be analyzed by sensitivity analysis. However, LPG price based on FOB price of LPG at Arabian Gulf Coast estimated by EPU (Table 10) is used for economic analysis in consideration of that LPG supply will exceed than demand in Malaysia and LPG will be exported in future.

Table 2 shows the estimated sales price of petroleum product in Malaysia.

3. ENERGY CONSUMPTION IN EACH SECTOR

The team studied the actual energy consumption in the Household, Commercial and Industrial sectors by several measures including questionnaire survey, interview survey, telephone survey, and direct weight measurement of LPG cylinders besides data analysis.

The energy covered by the study was that for cooking and hot shower use in households and the energy excepting electricity in restaurants, hotels and manufacturing industries.

The estimated energy consumption in each sector in 1985 and 2005 equivalent natural gas volume is mentioned below. (See Table 3 for details)

(Unit: million Nm^3/year)

	1985 (A)	2005 (A')			2005/1985 (A')/(A)		
		Base	Medium	Low	Base	Medium	Low
Household	125.0	279.5	277.1	268.8	2.24	2.21	2.15
Restaurant	43.4	100.0	100.0	94.7	2.31	2.31	2.18
Hotel	7.5	19.0	19.0	19.0	2.54	2.54	2.54
Industrial	242.3	779.4	707.4	478.9	3.22	2.92	1.98
Total	418.2	1,177.9	1,103.5	861.4	2.82	2.64	2.06

4. POTENTIAL CITY GAS DEMAND

Based on the results of the actual energy consumption study, the energy to be reasonablly converted to city gas is considered to be the LPG used in all sectors, a part of the kerosene used for cooking in households (up to 60% in base case) and the energy to be consumed by 50% of new installation of hot showers in households. (See Table 4 for details)

(Unit: million Nm^3/year)

	1985(B)	2005 (B')			1985	2005 (B')/(A')		
		Base	Medium	Low	(B/A)	Base	Medium	Low
Household	73.0	209.0	197.1	182.3	58.4	75.0	71.1	67.8
Restaurant	33.3	76.9	76.9	72.9	76.9	76.9	76.9	76.9
Hotel	1.6	4.1	4.1	4.1	21.7	21.7	21.7	21.7
Industrial	15.0	48.2	43.7	29.6	6.2	6.2	6.2	6.2
Total	122.9	338.2	321.8	288.9	29.4	28.7	29.2	33.5

Furthermore, the demand for city gas by replacing fuel oil used in manufacturing industry, by using for cooling of buildings and CNG demand for automobiles were estimated for reference. The additional demands estimated for 2005 are mentioned below. (See Table 8 for details)

(Unit: million Nm^3/year)

Fuel oil in industry	High case	731.3	100% replaced
	Low case	365.7	50% replaced
Cooling of buildings	High case	66.2	50% of new buildings after 1996
	Low case	27.8	4 - 40% of new buildings after 1996
CNG for automobiles		154.7	PGSB estimated

5. DESIGN OF INTEGRATED GAS DISTRIBUTION SYSTEM

An integrated gas distribution system was designed based on the forecast potential city gas demand, by the following steps. The design procedures are roughly described in Figure 3.

As the basic supply facility system, a system comprising 10 kg/cm^2 transmission system, 3 kg/cm^2 distribution system for large-volume customers and 0.3 kg/cm^2 general distribution system were selected. This system fits a relatively sparsely distributed demand and possesses high adaptability for change in demand in future.

The boundary of the built-up area in 2005 was determined based on careful studies of the land use plans in the Klang Valley Perspective Plan and other official structure plans of the districts, with the help of detailed field surveys. This boundary was taken as the outer limit of the maximum city gas supply area.

A transmission pipeline route was designed to supply natural gas from the Trans Peninsular pipeline to as wide an area as possible within the supply area. This was done on an actual route survey basis, which means every section of the route was confirmed available for 10 kg/cm^2 pipeline installation. The designed transmission pipeline route is shown in Figure of top page with the supply area.

The potential city gas demand which can be converted to city gas and the rate of the conversion were assumed as shown in Figures 4. There, all the

population outside the built-up area and half of the population in the existing squatter area were assumed to remain intact.

The basic implementation schedule is mentioned in Figure 5. As the basic construction schedule, 5 years for the transmission pipeline and 4 years for the distribution system after the introduction of city gas to the area were assumed as mentioned in Figure 6. As for the transmission line construction schedule, there are two alternatives in the schedule of introducing city gas to K.L. and its contiguous area. One is a plan to supply city gas to the city center first then to the outer skirt of the city (Center Case) and the other is a plan with the reverse propagation direction (Circular Case).

There is no big difference between FIRR of both cases, and the latter was taken as the design base.

FIRR (Fixed Price)

	Before Tax (%)	After Tax (%)
Center Case	11.07	9.04
Circular Case	11.19	9.11

The load concentration factors necessary for design flow rate calculation was determined based on the loads survey carried out on the household demand in Klang Valley and the experience with similar demand in Japan. A 12% and 24% of concentration of the daily demand in the peak hour for household and commercial demand respectively and 1/2,000 concentration of the yearly demand on the same peak hour for industrial consumption were adopted as the design basis.

The route, diameters and construction schedule of the transmission pipeline are designed and determined based on the above conditions, and are shown in Figure 7.

For designing the distribution system, the result of the network designs for these areas were thoroughly studied and applied to all the area to obtain the construction cost of the distribution network.

The number of actual consumers and the sales volume of city gas as the final result of the conceptual design of the integrated gas distribution system are shown in Tables 5 and 6.

The annual sales volumes will attain to the amounts in the following table at the end of 2005 and is assumed to keep the same amounts in 2006 and after.

Of course, it is possible to meet the additional demand after 2006 by the additional investment.

(Unit: million Nm^3/year)

	2006 and after (C)			(C)/(B')			(C)/(A')		
	Base	Medium	Low	Base	Medium	Low	Base	Medium	Low
Household	165.8	153.3	141.8	79.3	77.8	77.8	59.3	55.3	52.8
Restaurant	69.3	68.5	64.9	90.2	89.1	89.1	69.4	68.6	68.5
Hotel	3.4	3.3	3.3	82.0	79.1	79.1	17.8	17.2	17.2
Industrial	33.3	28.0	17.2	69.1	64.0	58.3	4.3	4.0	3.6
Total	271.8	253.1	227.2	80.4	78.6	78.7	23.1	22.9	26.4

6. CONSTRUCTION COST

Results of the calculation of the construction cost for the designed integrated gas distribution system is shown by year and by cost item in Table 7.

The unit construction costs used in that calculation were obtained from the survey in Malaysia and the studies on the construction procedures.

7. FINANCIAL AND ECONOMICAL ANALYSIS

7.1 Outline of the Project Scheme

The project scheme is assumed as follows.

(1) Incorporation : Independent Sdn. Bhd.

(2) Organization : Self-supporting Organization

(3) Number of Employees:

	Base case	Medium/Low case
End of 1995 :	981	389
End of 2000 :	1,006	1,088
End of 2005 :	1,133	1,090

(4) Project Life Span :

	Base case	Medium/Low case
Start of investment :	1990	1993
End of life :	2025	2028
Total life span :	36 years	36 years

(5) Implementation schedule

The project implementation schedule is assumed to consist of the following phases of investment packages,

	Base case	Medium/Low case
Phase I	1990-1995	1993-1998
Phase II	1996-2000	1999-2005
Phase III	2001-2005	

Throughout the period, successive investments to complete the ultimate city gas distribution system will be made according to the demand increase, nevertheless, further investment to expand the system to meet increasing demand for after the year of 2006, will not be taken into account.

(6) Total capital requirement

Total capital requirement for the project is estimated as follows.

BASE CASE

(Unit: Million US$)

	Phase			Total
	I	II	III	
Land cost	0.2	-	-	0.2
Construction Cost	270.8	93.8	57.0	421.6
Preoperational Expenses	1.8	-	-	1.8
Interest during Construction	24.6	12.8	5.6	43.0
Working Capital	2.4	2.0	1.2	5.6
Total	299.8	108.6	63.8	472.2

MEDIUM CASE

(Unit: Million US$)

	Phase		Total
	I	II	
Land cost	0.2	-	0.2
Construction Cost	301.5	130.7	432.2
Preoperational Expenses	1.9	-	1.9
Interest During Construction	27.0	27.6	54.6
Working Capital	2.6	2.6	5.2
Total	333.2	160.9	494.1

LOW CASE

(Unit: Million US$)

	Phase		Total
	I	II	
Land cost	0.2	-	0.2
Construction Cost	300.0	129.2	429.2
Preoperational Expenses	1.9	-	1.9
Interest During Construction	26.9	27.3	54.2
Working Capital	2.5	2.3	4.8
Total	331.5	158.8	490.3

The capital requirement estimate above is on June, 1986 basis and not include price contingencies.

(7) Project cost financing plan

The total capital requirement will be financed by owner's equity (30%) and a long term foreign loan (70%) as base. For convenience, the long term foreign loan is assumed to be available at conditions as follows,

- Period : 25 years
- Interest : 5% p.a.
- Grace Period : 7 years

The effect of increase of interest to 10% on cash flow and foreign currency balance are studied.

(8) Infration rate

The following inflation rates are adopted by EPU suggestions.

	to 1990	1991 onwards (%)
Malaysia	1.4	3.5
Foreign	3.2	5.0

(9) Operating plan and sales volume

Commercial operation of the project will be commenced in 1992 for base case and in 1995 for medium and low case.

Sales volume of the city gas and the LPG by reticulation systems in 2005 are estimated 262.5 million Nm^3 and 5.5 million Nm^3 respectively for base case, 244.4 million Nm^3 and 5.0 million Nm^3 for medium case and 219.2 million N^3 and 4.7 million Nm^3 for low case as mentioned in Table 9.

It is assumed that the sales volume of the gases after 2006 through 2025 will be kept as the same level as at the end of 2005.

7.2 Financial and Economic Analysis

Based on the conditions and estimations mentioned above, financial and economic analysis were made.

The detailed information is attached in Annex, and financial and economic internal rate of return and net present value are as follows as mentioned in Table 9.

FIRR

(%)

	Fixed Price		Fixed Price with Modification 1/		Current Price	
	Bfr.Tax	Aft.tax	Bfr.tax	Aft.tax	Bfr.tax	Aft.tax
Base case	11.19	9.11	14.28	11.35	17.67	14.18
Medium case	10.60	8.74	14.02	11.19	16.91	13.69
Low case	9.52	7.96	12.81	10.33	15.67	12.76

EIRR

(%)

	Fixed Price	Fixed price with Modification 1/	Current Price
Base case	10.78	12.32	17.20
Medium case	10.21	11.92	16.66
Low case	9.20	10.85	15.52

1/ Fixed price excepting crude oil price which is taken from EPU estimation

Financial Net Present Value (Cut off Rate 15%)

(Unit: Million US$)

	Fixed Price		Fixed Price with Modification 1/		Current Price(%)	
	Bfr.Tax	Aft.tax	Bfr.tax	Aft.tax	Bfr.tax	Aft.tax
Base case	-57.8	-81.4	-11.6	-53.4	71.0	-19.1
Medium case	-70.2	-91.7	-16.7	-59.0	60.3	-36.4
Low case	-85.2	-100.9	-36.3	-70.5	20.3	-60.2

Economic Net Present Value (Cut off Rate 10%)

(Unit: Million US$)

	Fixed Price	Fixed price with Modification 1/	Current Price
Base case	20.3	58.8	334.0
Medium case	7.5	51.1	363.1
Low case	-16.2	23.3	290.9

1/ Fixed price excepting crude oil price which is taken from EPU estimation

The internal rate of return for all cases of financial and economic analysis at the fixed price base are about 10% and are not so big difference between for base case, medium case and low case, that means, the change of economic growth rate does not effect so big on the internal rate of return.

However, the fixed price base is based on the price level in June, 1986, when the crude oil price was bottom, therefore, the fixed price with modification by using crude oil price estimated by EPU is considered as more realistic. In the case of the fixed price with modification, the internal rate of return is improved.

In the case of fixed price with modification, EIRR is worse in comparison with FIRR, because of that the increase rate of price of LPG estimated by EPU based on the FOB price of LPG in Saudi is relatively low in

comparison with the price increase of crude oil as mentioned in Table 10, accordingly the price difference between LPG sales price based on LPG price and natural gas price based on fuel oil price becomes to low.

As present value, cut off rate is assumed for financial as 15% and for economic as 10%, therefore, in the case of financial present value at current price and before tax only become to plus, whereas, in the case of economic present value at fixed price of low case only becomes to minus.

The sensitivity analysis on FIRR for base case is mentioned in Table 11 and Figure 8, and the effect of each factors are as follows:

(1) The effect of crude oil price

In case of high scenario of crude oil price estimated by EPU, crude oil price is more than 20% higher than price in case of low scenario. In this case, FIRR in current term before tax becomes 18.7%.

(2) The effect of natural gas price

Even in the low price scenario, there is a possibility that natural gas price will become lower than fuel oil price calculated by crude oil price. If natural gas price is 20% lower than fuel oil price, FIRR becomes 20.15% at current price base for base case.

When natural gas price becomes lower than fuel oil price, the fuel oil and diesel oil used in manufacturing industry will be replaced by city gas. The amount replaced by town gas and the construction cost for this amount are estimated in Table 8. When natural gas price is lower than fuel oil price by 20%, the internal rate of return including the demand by replacing 50% of fuel oil used in manufacturing industry becomes to 20.64% which is higher than normal case of 20.15%.

(3) The effect of LPG price

If sales price of city gas is 20% higher or lower than LPG cylinder price, FIRR will be 15.3 - 21.0%. In the study, investment cost included whole cost including the cost of user, therefore, it is unneccessary to reduce sales price than LPG price.

(4) The effect of investment cost

If investment cost is 20% higher or lower than the estimated one, FIRR becomes to 15.3 - 21.0%.

In the study, as physical contingency, 20% of total construction cost is included.

To judge the soundness of cash flow, debt service ratio (D.S.R) is calculated. The result is mentioned below.

$$D.S.R = \frac{\text{Profit on after tax + Depreciation + Interest on L/T loan}}{\text{Repayment on L/T loan + Interest on L/T loan}}$$

	Base Case	Medium Case	Low Case
D.S.R (6 years after start of operation)	1.92	1.83	1.74
D.S.R (mean value)	5.09	4.86	4.45

6 years after start of operation is the first year of repayment and is the most tight year.

D.S.R even in the most tight year is over 1.5 which shows the soundness of cash flow.

If capital ratio in the investment is increased from 30% to 40% and 50%, D.S.R for base case is improved as follows.

	30%	40%	50%
D.S.R (6 years after start of operation)	1.92	2.21	2.63
D.S.R (mean value)	5.09	5.99	7.25

If annual interest rate on long term loan is increased from 5% to 10% in case of capital ratio of 30%, D.S.R for base case is decreased from 1.92 to 1.38 in the 6th year after the start of operation, after that, the cash flow keeps sound level.

In the first year of start of operation only, short term loan is necessary due to the low income against the high investment cost,

however, after first year, no shortage is occured.

Even in case of the annual interest rate at 10%, the cash flow is also no poblem.

The soundness of finance was obtained by the assumption of the good finance conditions.

The other financial indicators and cost analysis are illustrated in ANNEX and which show no problems.

8. CONCLUSION AND RECOMMENDATION

8.1 Viability of the Project

The difference due to change of economic growth rate and between financial and economic analysis is not so big as mentioned in Table 9.

Due to the difference of cut off rate, in principle, the present value of economic analysis is plus and of financial analysis is minus excepting before tax at current price base.

The required foreign currency for repayment, interest and maintenance can be covered by the foreign currency earning amount by LPG export replaced by city gas in each year and from before completion of repayment, foreign currency balance is surplus, therefore, the project can contribute to the improvement of foreign currency balance. (Table 12)

Also, this project has the merit of supplying clean and convenient energy to clients in the Klang Valley area and it will contribute to reducing pollution.

As mentioned above result, this project is recommendable as a national project.

Financial internal rate of return is 17.67% before tax at current price base in case of the low price scenario of crude oil for base case. This rate can

be considered as enough for a public project, however, it is not enough for private investment.

Even in case of the low price scenario of the crude oil, there is a possibility that the natural gas price will become lower than the price of fuel oil after 1995. In such a case, FIRR will be improved to be higher than 20%.

Futhermore, natural gas price will become much lower than the price of fuel oil, city gas demand will increase by replacement of diesel oil and fuel oil used by manufacturing industry.

As mentioned above, this project is profitable as a national project, however, though there is a possibility of improvement of FIRR by re-estimation of crude oil and natural gas, the risk is too big for a private company.

8.2 Cash Flow

In the first year of start of operation, short term loan is necessary to cover the shortage of fund, but after that no shortage will occure. For base case, even interest rate 10%, repayment of long term credit is also no problem due to the good financial conditions.

8.3 Organization

Because of high profitability as a national project but low profitability as a private project, it is desirable for this project to be realized by public investment. In case of public investment, the long term loan with low interest could be available from a foreign government and will be useful for this project.

As the base of this study, the company is suppossed to be as a not subscribed private company of which share capital is fully owned by PETRONAS and or its subsidiaries.

Now in Malaysia, there is a policy to promote privatization and the possibility of privatization of this project is also studied.

The merit of privatization is to introduce private capital, to activate the company and to prevent the excessive enlargement of the organization.

As mentioned in the Reference information-1, most of city gas companies in the world are private, however, this project is not so profitable for the private company, therefore, without any incentive, it will be very difficult to attract private investment.

To activate and/or to prevent the enlargement of the organization, some portion of the operation of the company can be entrusted to a private company.

There are several methods of entrustment of operation, for example, counting meter and collecting fee which require many staffs can be entrusted as in Japan and part of sales promotion and maintenance can be also entrusted.

8.4 The problems to be considered when this project is executed.

This project is considered as a good project to be promoted by the nation, and the following items should be taken into account when the project is realized.

(1) The forecast of natural gas price

In this study, the economical value of natural gas was given by EPU, however, the estimated value of natural gas for FIRR was not given and was estimated as the same price with fuel oil.

This project is to utilize the natural gas which will be conveyed through the Trans-Peninsula Pipeline, therefore, the viability of this project stands on the same ground as the Trans-Peninsula Pipeline. Therefore, if the natural gas price is forecasted in relation to crude oil price, it is desirable to re-calculate of FIRR.

(2) Promotion of reticulation system by LPG before construction of city gas system

The viability of a reticulation system (by LPG) is not so high as mentioned in Table 13 because the difference of price between LPG in bulk and in cylinders is not so big. In consideration that this project is useful as a national project, it is desirable to promote reticulation before installation of city gas system.

At that time, it is desirable that some portion of construction cost of reticulation is borne by the land developer because the cost of reticulation system is minor in comparison with the total cost of land development.

(3) Monopoly to be granted

Due to the high public character of this project and the high investment cost, a monopoly in the service area should be given. Therefore, reticulation is also recommendable for promotion by PETRONAS.

(4) Establishment of safe measure

City gas is more safe as a project in comparison with LPG distribution if the necessary safety measures are taken as mentioned in Reference information-3. In this study, at the stage of construction, transportation and utilization, the necessary cost for safety for installation, for training and for delegation of foreign experts are included for this reason.

(5) Preparation of law concerning city gas business

City gas business should be fitted to the existing various laws as mentioned in the reference information-2, however, as executed in Japan and other countries, one law such as the gas utility industry law of Japan attached in ANNEX can be considered as one of measure.

8.5 Preparatory works for the Project Implementation

For the implementation of this project, when it is approved to be proceeded, various preparatory works including those to settle the problems mentioned in the previous paragraphs are foreseen. They are categorized as follows.

(1) Setting-up of a project promoting body

(2) Establishment of the project scheme for implementation

(3) Preparations for authorization and control of city gas business in general

(4) Incorporation of operating companies

(5) Basic engineering for constructing facilities and operation systems

(6) Construction of facilities and operation systems

The details of each item of these preparatory works and the program for actualizing them are proposed in Table 14.

Table 1 ECONOMIC INDICATOR IN KLANG VALLEY AREA

	1980	1985	1990	1995	2005	Average Annual Growth Rate (%) 1985/95	1995/2005
Base Case							
GRP (M$ Million in 1978 prices)	11,099	15,511	20,564	28,274	48,842	6.2	5.6
Primary	249	307	330	341	348	1.0	0.2
Secondary	4,372	5,467	6,955	9,262	15,463	5.4	5.3
Tertiary	6,478	9,737	13,279	18,671	33,031	6.7	5.9
Population ('000)	2,020	2,534	3,283	3,940	5,450	4.5	3.2
Employment ('000)	760	950	1,245	1,514	2,190	4.7	3.8
Medium Case							
GRP (M$ Million in 1978 prices)	11,099	15,511	18,686	25,682	44,363	5.2	5.6
Employment ('000)	760	950	1,245	1,514	2,190	4.7	3.8
Low Case							
GRP (M$ Million in 1978 price)	11,099	15,511	16,941	21,149	30,141	3.1	3.6
Employment ('000)	760	950	1,172	1,449	2,075	4.3	3.7

Source: Klang Valley Transportation Study Team's Estimate

Table 2 PROJECTED PURCHASING AND RETAIL PRICES OF PETRO-PRODUCTS, KUALA LUMPUR
(1) US$/MMBTU

(Unit: US$/MMBtu)

Year	Fuel Oil		LPG/Cylinder	LPG/Bulk	Kerosene	Diesel Oil
	Excl. Duty	Incl. Duty				
1986*1	1.81	1.97	8.71	5.80	5.48	4.72
1990	4.30	4.46	12.76	9.64	7.57	6.96
1991	4.67	4.85	13.50	10.26	8.14	7.50
1992	5.10	5.28	14.31	10.96	8.78	8.10
1993	5.56	5.74	15.17	11.71	9.46	8.74
1994	6.05	6.24	16.09	12.50	10.20	9.43
1995	6.60	6.80	17.10	13.39	11.01	10.19
1996	7.04	7.24	17.96	14.12	11.68	10.82
1997	7.50	7.72	18.87	14.90	12.39	11.48
1998	8.00	8.22	19.83	15.72	13.14	12.19
1999	8.56	8.79	20.89	16.63	13.98	12.97
2000	9.13	9.36	21.96	17.56	14.83	13.77
2001	9.76	10.00	23.14	18.58	15.77	14.65
2002	10.40	10.65	24.34	19.62	16.72	15.55
2003	11.11	11.37	25.66	20.77	17.78	16.55
2004	11.87	12.14	27.05	22.00	18.91	17.61
2005	12.68	12.96	28.53	23.29	20.10	18.73
2006	13.54	13.83	30.09	24.67	21.38	19.92
2007	14.46	14.76	31.74	26.13	22.72	21.19
2008	15.48	15.79	33.55	27.74	24.22	22.60
2009	16.51	16.84	35.40	29.39	25.74	24.03
2010	17.64	17.98	37.39	31.17	27.39	25.58
2011	18.84	19.19	39.50	33.06	29.14	27.23
2012	20.15	20.51	41.77	35.11	31.04	29.02
2013	21.54	21.91	44.18	37.28	33.05	30.92
2014	23.02	23.40	46.72	39.59	35.19	32.94
2015	24.59	24.99	49.42	42.04	37.47	35.08
2016	26.33	26.74	52.37	44.73	39.97	37.45
2017	28.11	28.54	55.40	47.49	42.54	39.87
2018	30.08	30.52	58.72	50.53	45.37	42.54
2019	32.18	32.63	62.23	53.76	48.38	45.38
2020	34.41	34.88	65.96	57.19	51.58	48.40
2021	36.78	37.27	69.91	60.83	54.98	51.61
2022	39.31	39.81	74.10	64.70	58.59	55.02
2023	42.00	42.52	78.54	68.81	62.42	58.64
2024	44.96	45.50	83.38	73.32	66.63	62.62
2025	48.11	48.67	88.52	78.11	71.11	66.85
2026	51.46	52.04	93.98	83.19	75.87	71.35
2027	55.03	55.63	99.76	88.60	80.93	76.13
2028	58.82	59.44	105.90	94.35	86.31	81.22

Source: Table I.91

Table 2 PROJECTED PURCHASING AND RETAIL PRICES OF PETRO-PRODUCTS, KUALA LUMPUR
(2) AS NATURAL GAS EQUIVALENT

(Unit: US$/normal cubic meter of NG equivalent)

Year	Fuel Oil		LPG/Cylinder	LPG/Bulk	Kerosene	Diesel Oil
	Excl. Duty	Incl. Duty				
1986*1	0.071	0.077	0.341	0.227	0.215	0.185
1990	0.169	0.175	0.500	0.378	0.297	0.273
1991	0.183	0.190	0.529	0.402	0.319	0.294
1992	0.200	0.207	0.561	0.430	0.344	0.317
1993	0.218	0.225	0.594	0.459	0.371	0.343
1994	0.237	0.245	0.631	0.490	0.400	0.370
1995	0.259	0.266	0.670	0.525	0.431	0.399
1996	0.276	0.284	0.704	0.553	0.458	0.424
1997	0.294	0.303	0.739	0.584	0.486	0.450
1998	0.314	0.322	0.777	0.616	0.515	0.478
1999	0.335	0.344	0.819	0.652	0.548	0.508
2000	0.358	0.367	0.861	0.688	0.581	0.540
2001	0.382	0.392	0.907	0.728	0.618	0.574
2002	0.408	0.417	0.954	0.769	0.655	0.609
2003	0.435	0.446	1.006	0.814	0.697	0.649
2004	0.465	0.476	1.060	0.862	0.741	0.690
2005	0.497	0.508	1.118	0.913	0.788	0.734
2006	0.531	0.542	1.179	0.967	0.838	0.781
2007	0.567	0.578	1.244	1.024	0.890	0.830
2008	0.607	0.619	1.315	1.087	0.949	0.886
2009	0.647	0.660	1.387	1.152	1.009	0.942
2010	0.691	0.705	1.465	1.221	1.073	1.002
2011	0.738	0.752	1.548	1.296	1.142	1.067
2012	0.790	0.804	1.637	1.376	1.216	1.137
2013	0.844	0.859	1.731	1.461	1.295	1.212
2014	0.902	0.917	1.831	1.551	1.379	1.291
2015	0.964	0.979	1.937	1.647	1.468	1.375
2016	1.032	1.048	2.052	1.753	1.566	1.468
2017	1.102	1.118	2.171	1.861	1.667	1.562
2018	1.179	1.196	2.301	1.980	1.778	1.667
2019	1.261	1.279	2.439	2.107	1.896	1.778
2020	1.348	1.367	2.585	2.241	2.021	1.897
2021	1.441	1.461	2.740	2.384	2.155	2.022
2022	1.540	1.560	2.904	2.535	2.296	2.156
2023	1.646	1.666	3.078	2.697	2.446	2.298
2024	1.762	1.783	3.267	2.873	2.611	2.454
2025	1.885	1.907	3.469	3.061	2.787	2.620
2026	2.017	2.039	3.683	3.260	2.973	2.796
2027	2.157	2.180	3.909	3.472	3.171	2.983
2028	2.305	2.329	4.150	3.697	3.382	3.183

Note: Converted from Table 2 (1).
Heat value of natural gas: 9,876 kcal/normal cubic meter

Table 3(1) TOTAL ENERGY DEMAND IN THE CONSUMPTION FIELD RELATED TO CIGY GAS IN EQUIVALENT VOLUME OF NATURAL GAS (BASE CASE)

(1,000 Nm^3/Year)

Sector	Sub-sector	Use of Energy	Kind of Energy used at present	1985	1990	1995	2000	2005	Growth Rate 2005/1985
Household	All	Cooking	LPG, Kerosene Charcoal	109,723	142,155	170,603	206,109	235,983	2.15
		Hot shower	Electric power	15,268	21,366	27,448	35,703	43,531	2.85
Commercial	Restaurant	Cooking	LPG, Kerosene Charcoal	43,366	56,832	69,112	84,631	99,970	2.31
	Hotel	All heating	LPG, Fuel oil	7,470	9,516	12,675	15,828	18,988	2.54
Industrial	Manufacturing Industry	All heating	LPG, Fuel oil Kerosene Fuel Oil	242,349	327,189	448,898	614,185	779,471	3.22
Total				418,175	557,057	728,736	956,456	1,177,946	2.82

Table 3(2) TOTAL ENERGY DEMAND IN THE CONSUMPTION FIELD RELATED TO CIGY GAS IN EQUIVALENT VOLUME OF NATURAL GAS (MEDIUM CASE)

(1,000 Nm^3/Year)

Sector	Sub-sector	Use of Energy	Kind of Energy used at present	1985	1990	1995	2000	2005	Growth Rate 2005/1985
Household	All	Cooking	LPG, Kerosene Charcoal	109,723	142,155	170,603	206,109	235,986	2.15
		Hot shower	Electric power	15,268	20,396	25,182	33,294	41,072	2.69
Commercial	Restaurant	Cooking	LPG, Kerosene Charcoal	43,366	56,832	69,112	84,631	99,970	2.31
	Hotel	All heating	LPG, Fuel oil	7,470	9,516	12,675	15,825	18,988	2.54
Industrial	Manufacturing Industry	All heating	LPG, Fuel oil Kerosene Fuel Oil	242,349	295,664	407,992	557,723	707,455	2.92
	Total			418,176	524,563	685,564	897,582	1,103,471	2.64

Table 3(3) TOTAL ENERGY DEMAND IN THE CONSUMPTION FIELD RELATED TO CIGY GAS IN EQUIVALENT VOLUME OF NATURAL GAS (LOW CASE)

(1,000 Nm^3/Year)

Sector	Sub-sector	Use of Energy	Kind of Energy used at present	1985	1990	1995	2000	2005	Growth Rate 2005/1985
Household	All	Cooking	LPG, Kerosene Charcoal	109,723	142,155	170,603	206,109	235,986	2.15
		Hot shower	Electric power	15,268	19,780	23,739	28,679	32,837	2.15
Commercial	Restaurant	Cooking	LPG, Kerosene Charcoal	43,366	53,500	66,144	81,071	94,720	2.18
	Hotel	All heating	LPG, Fuel oil	7,470	9,516	12,675	15,825	18,989	2.54
Industrial	Manufacturing Industry	All heating	LPG, Fuel oil Kerosene Fuel Oil	242,349	266,334	336,451	407,695	478,880	1.98
	Total			418,176	491,285	609,612	739,379	861,412	2.06

Table 4(1) POTENTIAL CITY GAS DEMAND
(BASE CASE)

(1,000 Nm^3/Year)

Use	1985	1990	1995	2000	2005
Household cooking	65,330	86,658	111,866	149,462	187,236
Household hot shower	7,634	10,683	13,724	17,852	21,766
Sub-total	(72,964)	(97,341)	(125,590)	(167,314)	(209,002)
Restaurant	33,360	43,718	53,165	65,102	76,902
Hotel	1,621	2,065	2,751	3,435	4,121
Manufacturing Industry	14,997	20,221	27,742	37,957	48,171
Total	122,942	163,345	209,248	273,808	338,196

Table 4(2) POTENTIAL CITY GAS DEMAND
(MEDIUM CASE)

(1,000 Nm^3/Year)

Use	1985	1990	1995	2000	2005
Household cooking	65,330	85,419	103,410	139,749	176,529
Household hot shower	7,634	10,198	12,590	16,647	20,537
Sub-total	72,964	95,617	116,000	156,396	197,066
Restaurant	33,360	43,718	53,165	65,102	76,902
Hotel	1,621	2,065	2,751	3,435	4,121
Manufacturing Industry	14,997	18,272	25,214	34,467	43,721
Total	122,942	159,672	197,130	259,400	321,810

Table 4(3) POTENTIAL CITY GAS DEMAND
(LOW CASE)

(1,000 Nm^3/Year)

Use	1985	1990	1995	2000	2005
Household cooking	65,330	84,640	101,578	133,790	165,861
Household hot shower	7,634	9,891	11,870	14,339	16,419
Sub-total	72,964	94,531	113,448	148,129	182,280
Restaurant	33,360	41,154	50,882	62,364	72,863
Hotel	1,621	2,065	2,751	3,435	4,121
Manufacturing Industry	14,977	16,460	20,793	25,196	29,595
Total	122,922	155,210	187,874	239,124	288,859

Table 5(1) NUMBER OF ACTUAL CONSUMER (BASE CASE)

NO.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	#1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	#1991	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	#1992	229	28	257	257	68	7	75	75	533	46	579	579	4482	418	4900	4900
4	#1993	716	94	810	1067	141	18	159	234	274	70	344	923	2036	629	2665	7565
5	#1994	735	108	843	1911	162	22	183	417	5286	487	5773	6696	1889	817	2706	10270
6	#1995	489	119	608	2519	134	24	158	575	719	545	1264	7960	1205	1093	2298	12568
7	#1996	364	146	510	3028	84	34	118	693	181	553	734	8694	2334	1851	4186	16754
8	#1997	151	150	301	3330	45	34	79	772	0	555	555	9249	0	1852	1852	18606
9	#1998	49	149	199	3528	12	34	47	819	0	554	554	9803	0	1837	1837	20443
10	#1999	20	150	170	3698	5	34	39	858	0	553	553	10356	0	1835	1835	22278
11	#2000	0	149	149	3847	0	34	34	892	0	556	556	10912	0	1854	1854	24133
12	#2001	0	124	124	3972	0	34	34	926	0	557	557	11469	0	1832	1832	25965
13	#2002	0	123	123	4095	0	34	34	960	0	552	552	12021	0	1841	1841	27806
14	#2003	0	95	95	4190	0	33	33	993	0	555	555	12576	0	1829	1829	29635
15	#2004	0	152	152	4343	0	34	34	1027	0	554	554	13130	0	1835	1835	31469
16	#2005	0	124	124	4467	0	34	34	1060	0	558	558	13688	0	1828	1828	33298

COLUMN ELEMENT LABELS

1	POPULATION	EXS
2	(1,000)	NEW
3		E + N
4		ACCUMULATED
5	RESTAURANT	EXS
6	(1,000 SEAT)	NEW
7		E + N
8		ACCUMULATED
9	HOTEL	EXS
10	(ROOM)	NEW
11		E + N
12		ACCUMULATED
13	INDUSTRIAL	EXS
14	(1,000 NM3)	NEW
15		E + N
16		ACCUMULATED
17	RET POPULATION	ACCUMULATED
18	RET RESTAURANT	ACCUMULATED

NO.		17	18
1	#1990	0	0
2	#1991	0	0
3	#1992	73	11
4	#1993	50	9
5	#1994	48	11
6	#1995	35	11
7	#1996	7	7
8	#1997	17	10
9	#1998	28	12
10	#1999	38	15
11	#2000	48	17
12	#2001	59	19
13	#2002	70	22
14	#2003	81	24
15	#2004	92	27
16	#2005	103	29

Table 5(2) NUMBER OF ACTUAL CONSUMER (MEDIUM CASE)

NO.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	#1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	#1991	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	#1992	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	#1993	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	#1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	#1995	259	29	288	288	75	8	83	83	631	48	679	679	4644	409	5052	5052
7	#1996	814	81	895	1183	159	21	180	263	322	70	392	1071	2136	694	2830	7882
8	#1997	832	111	943	2126	179	26	205	468	6164	488	6652	7724	2010	917	2928	10810
9	#1998	553	128	681	2807	148	30	178	646	832	542	1374	9097	1561	1281	2842	13652
10	#1999	426	150	576	3383	96	34	130	776	207	553	760	9857	2709	1664	4372	18024
11	#2000	184	149	333	3717	52	34	86	862	0	556	556	10413	0	1678	1678	19702
12	#2001	60	124	184	3901	15	34	48	911	0	557	557	10970	0	1658	1658	21359
13	#2002	26	123	150	4050	7	34	40	951	0	552	552	11522	0	1668	1668	23028
14	#2003	0	95	95	4146	0	33	33	984	0	555	555	12077	0	1658	1658	24686
15	#2004	0	152	152	4298	0	34	34	1018	0	554	554	12631	0	1663	1663	26349
16	#2005	0	124	124	4422	0	34	34	1052	0	558	558	13189	0	1653	1653	28002

COLUMN ELEMENT LABELS

1	POPULATION	EXS
2	(1,000)	NEW
3		E + N
4		ACCUMULATED
5	RESTAURANT	EXS
6	(1,000 SEAT)	NEW
7		E + N
8		ACCUMULATED
9	HOTEL	EXS
10	(ROOM)	NEW
11		E + N
12		ACCUMULATED
13	INDUSTRIAL	EXS
14	(1,000 NM3)	NEW
15		E + N
16		ACCUMULATED
17	RET POPULATION	ACCUMULATED
18	RET RESTAURANT	ACCUMULATED

NO.		17	18
1	#1990	0	0
2	#1991	0	0
3	#1992	0	0
4	#1993	0	0
5	#1994	0	0
6	#1995	73	11
7	#1996	79	11
8	#1997	90	16
9	#1998	85	15
10	#1999	38	11
11	#2000	48	13
12	#2001	59	16
13	#2002	70	18
14	#2003	81	21
15	#2004	91	23
16	#2005	102	25

Table 5(3) NUMBER OF ACTUAL CONSUMER (LOW CASE)

NO.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	#1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	#1991	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	#1992	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	#1993	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	#1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	#1995	259	29	288	288	72	8	80	80	631	48	679	679	3899	191	4091	4091
7	#1996	814	81	895	1183	153	19	172	252	322	70	392	1071	1760	223	1983	6073
8	#1997	832	111	943	2126	171	25	196	448	6164	488	6652	7724	1635	313	1948	8021
9	#1998	553	128	681	2807	141	29	170	618	832	542	1374	9097	1204	563	1767	9788
10	#1999	426	150	576	3383	92	33	125	744	207	553	760	9857	2068	758	2826	12614
11	#2000	184	149	333	3717	50	32	82	826	0	556	556	10413	0	768	768	13381
12	#2001	60	124	184	3901	14	30	44	870	0	557	557	10970	0	776	776	14157
13	#2002	26	123	150	4050	6	30	36	906	0	552	552	11522	0	767	767	14925
14	#2003	0	95	95	4146	0	30	30	936	0	555	555	12077	0	768	768	15693
15	#2004	0	152	152	4298	0	30	30	966	0	554	554	12631	0	777	777	16470
16	#2005	0	124	124	4422	0	30	30	996	0	558	558	13189	0	774	774	17244

COLUMN ELEMENT LABELS

1	POPULATION	EXS
2	(1,000)	NEW
3		E + N
4		ACCUMULATED
5	RESTAURANT	EXS
6	(1,000 SEAT)	NEW
7		E + N
8		ACCUMULATED
9	HOTEL	EXS
10	(ROOM)	NEW
11		E + N
12		ACCUMULATED
13	INDUSTRIAL	EXS
14	(1,000 NM3)	NEW
15		E + N
16		ACCUMULATED
17	RET POPULATION	ACCUMULATED
18	RET RESTAURANT	ACCUMULATED

NO.		17	18
1	#1990	0	0
2	#1991	0	0
3	#1992	0	0
4	#1993	0	0
5	#1994	0	0
6	#1995	73	11
7	#1996	79	12
8	#1997	90	16
9	#1998	85	15
10	#1999	38	11
11	#2000	48	13
12	#2001	59	15
13	#2002	70	17
14	#2003	81	20
15	#2004	91	22
16	#2005	102	24

TABLE 6(1) SALES VOLUME OF CITY GAS BY SECTOR BY YEAR (BASE CASE)

SALES VOLUME BASE (1000NM3)

NO.		1	2	3	4	5	6	7	8	9
1	#1990	0	0	0	0	0	0	0	0	0
2	#1991	0	0	0	0	0	0	0	0	0
3	#1992	3475	2387	71	4900	10833	1090	339	1429	12262
4	#1993	18330	9827	185	7565	35907	1878	611	2489	38397
5	#1994	42082	20708	941	10270	74002	1523	637	2161	76163
6	#1995	64054	31566	1810	12568	109998	1320	708	2027	112025
7	#1996	82265	40358	2057	16754	141434	690	572	1262	142696
8	#1997	96695	46638	2216	18606	164155	412	539	951	165106
9	#1998	106907	50642	2353	20443	180345	767	695	1463	181807
10	#1999	115303	53370	2490	22278	193440	1135	850	1985	195426
11	#2000	123200	55702	2627	24133	205661	1517	1006	2523	208184
12	#2001	130533	57860	2764	25965	217122	1924	1162	3086	220208
13	#2002	137565	60008	2901	27806	228279	2356	1313	3669	231948
14	#2003	144194	62143	3038	29635	239009	2800	1464	4264	243273
15	#2004	151493	64276	3175	31469	250412	3257	1619	4875	255288
16	#2005	159506	66421	3312	33298	262536	3729	1773	5503	268039
17	#2006	161889	67489	3381	33298	266056	3938	1851	5789	271845

COLUMN ELEMENT LABELS

1	CITY GAS	HOUSEHOLD
2		RESTAURANT
3		HOTEL
4		INDUSTRY
5		SUB-TOTAL
6	RETICULATION	HOUSEHOLD
7		RESTAURANT
8		SUB-TOTAL
9	TOTAL	

TABLE 6(2) SALES VOLUME OF CITY GAS BY SECTOR BY YEAR (MEDIUM CASE)

SALES VOLUME MEDIUM (1000NM3)

NO.		1	2	3	4	5	6	7	8	9
1	#1990	0	0	0	0	0	0	0	0	0
2	#1991	0	0	0	0	0	0	0	0	0
3	#1992	0	0	0	0	0	0	0	0	0
4	#1993	0	0	0	0	0	0	0	0	0
5	#1994	0	0	0	0	0	0	0	0	0
6	#1995	3821	2648	84	5052	11606	1076	342	1418	13024
7	#1996	20006	11024	216	7882	39129	2291	707	2999	42128
8	#1997	46158	23273	1086	10810	81328	2604	885	3489	84817
9	#1998	70604	35454	2077	13652	121787	2761	1002	3764	125551
10	#1999	90887	45249	2341	18024	156501	1979	829	2808	159309
11	#2000	106894	52131	2503	19702	181230	1408	771	2179	183409
12	#2001	117533	56412	2641	21359	197946	1792	927	2719	200665
13	#2002	125636	59234	2778	23028	210675	2200	1078	3278	213954
14	#2003	132488	61577	2915	24686	221666	2621	1229	3850	225516
15	#2004	139571	63710	3052	26349	232682	3056	1383	4439	237121
16	#2005	147310	65856	3189	28002	244357	3506	1538	5044	249401
17	#2006	149557	66923	3258	28002	247741	3703	1615	5318	253059

COLUMN ELEMENT LABELS

1	CITY GAS	HOUSEHOLD
2		RESTAURANT
3		HOTEL
4		INDUSTRY
5		SUB-TOTAL
6	RETICULATION	HOUSEHOLD
7		RESTAURANT
8		SUB-TOTAL
9	TOTAL	

TABLE 6(3) SALES VOLUME OF CITY GAS BY SECTOR BY YEAR (LOW CASE)

SALES VOLUME LOW (1000NM3)

NO.		1	2	3	4	5	6	7	8	9
1	#1990	0	0	0	0	0	0	0	0	0
2	#1991	0	0	0	0	0	0	0	0	0
3	#1992	0	0	0	0	0	0	0	0	0
4	#1993	0	0	0	0	0	0	0	0	0
5	#1994	0	0	0	0	0	0	0	0	0
6	#1995	3752	2544	84	4091	10471	1052	360	1412	11883
7	#1996	19505	10556	216	6073	36351	2225	727	2952	39303
8	#1997	44687	22274	1086	8021	76068	2512	887	3398	79466
9	#1998	67886	33942	2077	9788	113694	2646	997	3643	117337
10	#1999	86828	43343	2341	12614	145126	1885	820	2705	147831
11	#2000	101503	49940	2503	13381	167328	1333	760	2094	169422
12	#2001	110960	53958	2641	14157	181716	1688	906	2594	184311
13	#2002	117952	56510	2778	14925	192164	2062	1045	3107	195271
14	#2003	123743	58613	2915	15693	200963	2445	1183	3629	204592
15	#2004	129732	60514	3052	16470	209768	2838	1322	4160	213928
16	#2005	136325	62410	3189	17244	219168	3243	1461	4703	223871
17	#2006	138404	63362	3258	17244	222267	3425	1531	4956	227223

COLUMN ELEMENT LABELS

1	CITY GAS	HOUSEHOLD
2		RESTAURANT
3		HOTEL
4		INDUSTRY
5		SUB-TOTAL
6	RETICULATION	HOUSEHOLD
7		RESTAURANT
8		SUB-TOTAL
9	TOTAL	

Table 7(1) CONSTRUCTION COST (BASE CASE)

CONSTRUCTION COST BASE

NO.		1	2	3	4	5	6	7	8	9	10	11	12
1	Y1990	0	0	0	0	0	0	0	0	0	0	0	0
2	Y1991	8340	0	0	0	0	0	8340	0	0	0	0	8340
3	Y1992	6094	12337	701	2866	4263	416	26677	169	1265	1793	3227	29904
4	Y1993	7159	29898	1962	7177	11915	1163	59272	62	479	665	1207	60479
5	Y1994	5607	32799	2132	7983	13045	1212	62779	38	300	414	752	63531
6	Y1995	4108	24069	1435	5694	9332	818	45455	24	201	272	497	45953
7	Y1996	0	16424	1025	4772	7554	608	30383	31	163	181	375	30758
8	Y1997	0	9655	516	2991	4786	252	18200	45	221	259	525	18725
9	Y1998	0	4773	207	2012	3132	81	10205	46	221	261	528	10733
10	Y1999	0	3589	122	1747	2682	33	8172	45	220	259	524	8696
11	Y2000	0	2756	63	1558	2357	0	6734	46	222	262	530	7264
12	Y2001	0	2322	54	1343	1982	0	5701	49	231	275	555	6256
13	Y2002	0	2319	54	1338	1978	0	5689	49	230	275	553	6242
14	Y2003	0	2259	53	1310	1932	0	5554	48	230	273	551	6105
15	Y2004	0	2813	64	1586	2403	0	6866	49	231	275	555	7422
16	Y2005	0	2326	54	1341	1985	0	5706	49	231	275	555	6262
17	TOTAL	31308	148339	8441	43716	69347	4582	305733	750	4446	5741	10937	316670

COLUMN ELEMENT LABELS

1	CITY GAS	TRANSMISSION
2	(1,000 US$)	DISTRIBUTION
3		SERVICE PIPE
4		GAS METER
5		INSTALLATION
6		CONVERSION
7		SUB-TOTAL
8	RETICULATION	PRODUCTION
9	(1,000 US$)	DISTRIBUTION
10		CUSTOMER
11		SUB-TOTAL
12	TOTAL	

Table 7(2) CONSTRUCTION COST (MEDIUM CASE)

CONSTRUCTION COST MEDIUM

NO.		1	2	3	4	5	6	7	8	9	10	11	12
1	Y1990	0	0	0	0	0	0	0	0	0	0	0	0
2	Y1991	0	0	0	0	0	0	0	0	0	0	0	0
3	Y1992	0	0	0	0	0	0	0	0	0	0	0	0
4	Y1993	0	0	0	0	0	0	0	0	0	0	0	0
5	Y1994	8340	0	0	0	0	0	8340	0	0	0	0	8340
6	Y1995	5947	13812	790	3165	4750	466	28930	170	1272	1803	3245	32176
7	Y1996	7042	33695	2237	7975	13252	1319	65522	145	998	1372	2515	68036
8	Y1997	5674	36464	2383	8850	14460	1369	69200	115	728	990	1833	71033
9	Y1998	4108	26576	1590	6314	10313	923	49824	92	563	753	1408	51233
10	Y1999	0	18095	1145	5194	8257	711	33403	45	220	259	524	33927
11	Y2000	0	11020	610	3269	5290	305	20493	46	222	262	530	21023
12	Y2001	0	4767	229	1882	2928	98	9904	49	231	275	555	10459
13	Y2002	0	3404	131	1568	2395	43	7541	49	230	275	553	8095
14	Y2003	0	2257	52	1296	1932	0	5537	48	230	273	551	6088
15	Y2004	0	2811	64	1571	2403	0	6849	49	231	275	555	7404
16	Y2005	0	2324	54	1326	1985	0	5689	49	231	275	555	6244
17	TOTAL	31111	155225	9286	42410	67966	5234	311232	855	5157	6813	12826	324058

COLUMN ELEMENT LABELS

1	CITY GAS	TRANSMISSION
2	(1,000 US$)	DISTRIBUTION
3		SERVICE PIPE
4		GAS METER
5		INSTALLATION
6		CONVERSION
7		SUB-TOTAL
8	RETICULATION	PRODUCTION
9	(1,000 US$)	DISTRIBUTION
10		CUSTOMER
11		SUB-TOTAL
12	TOTAL	

Table 7(3) CONSTRUCTION COST (LOW CASE)

CONSTRUCTION COST LOW

NO.		1	2	3	4	5	6	7	8	9	10	11	12
1	Y1990	0	0	0	0	0	0	0	0	0	0	0	0
2	Y1991	0	0	0	0	0	0	0	0	0	0	0	0
3	Y1992	0	0	0	0	0	0	0	0	0	0	0	0
4	Y1993	0	0	0	0	0	0	0	0	0	0	0	0
5	Y1994	8340	0	0	0	0	0	8340	0	0	0	0	8340
6	Y1995	5908	13753	785	3074	4713	459	28693	170	1274	1808	3252	31945
7	Y1996	7066	33630	2228	7879	13203	1312	65318	145	997	1370	2512	67831
8	Y1997	5560	36360	2373	8741	14411	1361	68807	115	727	989	1830	70637
9	Y1998	4011	26470	1582	6202	10268	917	49450	92	562	752	1406	50856
10	Y1999	0	18037	1139	5050	8217	704	33147	45	218	259	522	33670
11	Y2000	0	10966	606	3181	5271	303	20328	46	221	261	528	20856
12	Y2001	0	4736	227	1794	2910	97	9764	49	227	274	549	10313
13	Y2002	0	3368	129	1477	2375	43	7392	49	227	273	549	7940
14	Y2003	0	2234	51	1212	1918	0	5416	48	225	271	545	5960
15	Y2004	0	2779	62	1481	2385	0	6707	49	227	273	549	7256
16	Y2005	0	2289	52	1239	1969	0	5549	49	227	274	549	6098
17	TOTAL	30885	154622	9237	41331	67640	5196	308911	855	5132	6803	12790	321702

COLUMN ELEMENT LABELS

1	CITY GAS	TRANSMISSION
2	(1,000 US$)	DISTRIBUTION
3		SERVICE PIPE
4		GAS METER
5		INSTALLATION
6		CONVERSION
7		SUB-TOTAL
8	RETICULATION	PRODUCTION
9	(1,000 US$)	DISTRIBUTION
10		CUSTOMER
11		SUB-TOTAL
12	TOTAL	

Table 8 ADDITIONAL DEMAND STUDIES

-Potential demand
-Sales volume
-Construction cost, 1990-2005 total

	Fuel oil in Industry		Cooling of buildings		CNG for auto-mobile	Maximum case
	High (I)	Low (II)	High (III)	Low (IV)	(V)	(I+III+V)
Potential Demand (1,000 Nm^3/year)						
1985	227,372	113,686	0	0	0	227,372
1990	306,969	153,484	0	0	0	306,969
1995	421,156	210,578	0	0	19,621	440,777
2000	576,228	288,113	31,429	6,971	93,446	701,103
2005	731,330	365,650	66,206	27,810	154,661	952,197
Sales volume (1,000 Nm^3/year)						
1990	0	0	0	0	0	0
1995	190,799	95,400	0	0	19,621	210,420
2000	366,359	183,179	31,429	6,971	93,446	491,234
2005	505,500	252,750	66,206	27,810	154,661	726,367
2006-	505,500	252,750	69,707	30,610	61,437	736,643
Construction cost (US$ 1,000)						
Transmission	7,303	4,244	3,048	1,298	3,701	13,239
Distribution	6,706	3,354	47,708	20,949	-	54,414
Service Pipe	22	13	-	-	-	22
Gas meter	4,385	2,192	-	-	-	4,385
Internal pipe	593	296	-	-	-	593
Conversion	4,106	2,052	-	-	-	4,106
Total	23,115	12,151	50,756	22,247	3,701	76,759

Note: The Potential demand, sales volune and construction cost in the above are the amounts to be added to those in Base Case.

Table 9 RESULTS OF FINANCIAL AND ECONOMIC ANALYSIS

	Base Case			Medium Case			Low Case		
	1995	2000	2005	1995	2000	2005	1995	2000	2005
(1) Sales Volume ($10^3Nm^3/y$)									
Household	64,054	123,200	159,506	3,821	106,894	147,310	3,752	101,504	136,325
Commercial									
Restaurant	31,566	55,702	66,421	2,648	52,131	65,856	2,544	49,940	62,411
Hotel	1,810	2,627	3,312	84	2,503	3,189	84	2,503	3,189
Industry	12,568	24,133	33,298	5,053	19,702	28,002	4,091	13,381	17,244
(Total)	(109,998)	(205,661)	(262,537)	(11,606)	(181,230)	(244,357)	(10,471)	(167,328)	(219,168)
Reticulation	2,027	2,523	5,503	1,418	2,179	5,044	1,418	2,094	4,703
(2) Investment (10^3US)									
	Fixed Price	Current Price		Fixed Price	Current Price		Fixed Price	Current Price	
Construction Cost 1/	421,819	597,435		432,399	671,145		429,433	666,150	
Pre-operating Expense	1,790	1,986		1,889	2,324		1,889	2,324	
Initial Working Capital	5,630	13,082		5,265	12,222		4,798	11,097	
Interest Drg. Construction	43,023	59,615		54,626	84,696		54,233	83,953	
(Total)	472,262	672,118		494,179	770,387		490,353	763,524	
(3) Financial Analysis 2/									
FIRR (Before Tax, %)	11.19(14.28)	17.67		10.60(14.02)	16.91		9.52(12.81)	15.67	
FIRR (After Tax, %)	9.11(11.35)	14.18		8.74(11.19)	13.69		7.96(10.33)	12.76	
FNPV before tax(@15%, 10^6US)	-57.8(-11.6)	71.0		-70.2(-16.7)	60.3		-85.2(-36.3)	20.3	
FNPV after tax (@15%, 10^6US)	-81.4(-53.4)	-19.1		-91.7(-59.0)	-36.4		-100.9(-70.5)	-60.2	
(4) Economic Analysis 2/									
EIRR (%)	10.78(12.32)	17.20		10.21(11.92)	16.66		9.20(10.85)	15.52	
ENPV (at 10% discount, 10^6US)	20.3 (58.8)	334.0		7.5 (51.1)	363.1		-16.2 (23.3)	290.9	

Note: 1/ Including land, engineering service and computer
2/ Fixed price adjusted by crude oil price in a parethesis

Table 10 ENERGY PRICE PROJECTION BY EPU

(1) LIGHT ARABIAN CRUDE FOB MIDDLE EAST

(US$/Tonne in 1985 Constant Price)

	1985	1986	1990	1995	2000	2015	2010
Low Scenario	28	15	20	25	27.6	30.5	33.65
High Scenario	28	15	25	30	35.35	41.0	47.50

(2) LPG PRICES FOB MIDDLE EAST

(US$/Tonne in 1985 Constant Price)

	1985	1986	1990	1995	2000	2015	2010
LPG	213	127	136	150	166	186	207

(3) ECONOMIC VALUE OF NATURAL GAS AT WEST COAST

(M$/MMBTU in 1985 constant price)

	1990	1995	2000	2005	2010	2015
Low Fuel Scenario	3.5	3.9	4.4	5.2	6.4	7.2
High Fuel Scenario	3.6	4.1	4.8	5.8	7.4	8.6

Table 11 SENSITIVITY ANALYSIS ON RETURN ON INVESTMENT

- Base Case -

Variables		Current Price		Fixed Price	
		Before Tax(%)	After Tax(%)	Before Tax(%)	After Tax(%)
N.G. Price	20% down	20.15	16.02	11.99	9.67
	10% down	18.94	15.13	11.59	9.39
	0%	17.67	14.18	11.19	9.11
	10% up	16.33	13.16	10.79	8.81
	20% up	14.88	12.06	10.38	8.52
LPG Price	20% down	10.86	9.00	7.29	6.16
	10% down	14.54	11.84	9.31	7.72
	0%	17.67	14.18	11.19	9.11
	10% up	20.51	16.24	12.98	10.37
	20% up	23.17	18.13	14.69	11.57
Crude Oil Price	20% down	16.63	13.39	8.20	6.87
	10% down	17.16	13.79	9.73	8.04
	0%	17.67	14.18	* 11.19	9.11
	10% up	18.19	14.57	12.59	10.10
	20% up	18.67	14.93	13.95	11.05
Investment	20% down	20.97	16.56	14.02	11.11
	10% down	19.18	15.27	12.49	10.02
	0%	17.67	14.18	11.19	9.11
	10% up	16.39	13.24	10.09	8.30
	20% up	15.27	12.41	9.12	7.59

Note: * Assemed to be changed by natural gas price and LPG price at the same time

Table 12(1) CITY GAS SUPPLY PROJECT IN MALAYSIA
FOREIGN CURRENCY EARNING (IN CURRENT PRICE)
- BASE CASE - (US$ MILLION)

YEAR	(1) IN-FLOW FROM SALES	ACC. IN-FLOW	MAINTENACE COST	INTEREST ON L/T	REPAYMENT ON L/T	(2) TOTAL OUT-FLOW	ACC. OUT-FLOW	(3) NET IN-FLOW (1)-(2)	ACC.NET IN-FLOW
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	3.4	3.4	0.0	0.0	0.0	0.0	0.0	3.4	3.4
1993	13.0	16.3	0.0	0.0	0.0	0.0	0.0	13.0	16.3
1994	28.7	45.1	0.0	0.0	0.0	0.0	0.0	28.7	45.1
1995	45.4	90.4	0.0	0.0	0.0	0.0	0.0	45.4	90.4
1996	61.3	151.7	0.0	12.6	0.0	12.6	12.6	48.7	139.2
1997	75.3	227.0	0.0	12.6	14.0	26.5	39.1	48.8	187.9
1998	87.1	314.1	0.0	11.9	14.0	25.8	64.9	61.3	249.2
1999	98.5	412.6	0.0	11.2	14.0	25.1	90.0	73.3	322.6
2000	110.4	523.0	7.8	10.5	14.0	32.2	122.2	78.2	400.8
2001	122.9	645.9	8.5	15.6	14.0	38.0	160.2	84.9	485.7
2002	136.6	782.5	9.3	14.9	14.0	38.1	198.3	98.5	584.2
2003	151.1	933.6	10.2	14.2	20.4	44.7	243.0	106.4	690.6
2004	167.3	1100.9	11.2	13.2	20.4	44.8	287.8	122.5	813.1
2005	185.3	1286.3	12.4	12.1	20.4	44.9	332.7	140.4	953.6
2006	198.6	1484.8	13.0	15.5	20.4	48.9	381.6	149.7	1103.2
2007	209.7	1694.6	13.6	14.5	20.4	48.5	430.2	161.2	1264.4
2008	222.0	1916.5	14.3	13.5	25.3	53.1	483.3	168.8	1433.3
2009	235.5	2152.0	15.0	12.2	25.3	52.6	535.8	182.9	1616.2
2010	249.0	2401.1	15.8	11.0	25.3	52.1	587.9	197.0	1813.2
2011	263.3	2664.4	16.6	9.7	25.3	51.6	639.5	211.8	2025.0
2012	279.0	2943.4	17.4	8.4	25.3	51.1	690.6	227.9	2252.8
2013	295.9	3239.4	18.3	7.2	25.3	50.7	741.4	245.2	2498.0
2014	312.9	3552.3	19.2	5.9	25.3	50.4	791.7	262.5	2760.6
2015	331.7	3884.0	20.1	4.6	11.4	36.1	827.9	295.6	3056.2
2016	351.9	4235.9	21.1	4.1	11.4	36.6	864.4	315.3	3371.4
2017	373.0	4608.9	22.2	3.5	11.4	37.1	901.5	336.0	3707.4
2018	396.6	5005.5	23.3	2.9	11.4	37.6	939.1	359.0	4066.4
2019	420.6	5426.1	24.5	2.4	11.4	38.2	977.3	382.4	4448.8
2020	445.8	5871.9	25.7	1.8	11.4	38.9	1016.2	406.9	4855.7
2021	473.8	6345.7	27.0	1.2	4.9	33.1	1049.3	440.7	5296.4
2022	503.7	6849.4	28.3	1.0	4.9	34.2	1083.5	469.4	5765.9
2023	533.8	7383.2	29.8	0.7	4.9	35.4	1118.9	498.4	6264.3
2024	567.7	7950.9	31.2	0.5	4.9	36.6	1155.6	531.0	6795.3
2025	603.1	8554.0	32.8	0.2	4.9	38.0	1193.5	565.1	7360.4
	8553.9	94697.0	488.5	249.4	455.6	1193.5	17959.9	7360.4	76737.1

Table 12(2) CITY GAS SUPPLY PROJECT IN MALAYSIA
FOREIGN CURRENCY EARNING (IN CURRENT PRICE)
- INTEREST RATE; 10.0% - (US$ 1000)

YEAR	(1) IN-FLOW FROM SALES	ACC. IN-FLOW	MAINTENACE COST	INTEREST ON L/T	REPAYMENT ON L/T	(2) TOTAL OUT-FLOW	ACC. OUT-FLOW	(3) NET IN-FLOW (1)-(2)	ACC.NET IN-FLOW
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	3.4	3.4	0.0	0.0	0.0	0.0	0.0	3.4	3.4
1993	13.0	16.3	0.0	0.0	0.0	0.0	0.0	13.0	16.3
1994	28.7	45.1	0.0	0.0	0.0	0.0	0.0	28.7	45.1
1995	45.4	90.4	0.0	0.0	0.0	0.0	0.0	45.4	90.4
1996	61.3	151.7	0.0	27.8	0.0	27.8	27.8	33.5	124.0
1997	75.3	227.0	0.0	27.8	15.4	43.2	70.9	32.1	156.1
1998	87.1	314.1	0.0	26.2	15.4	41.6	112.6	45.5	201.6
1999	98.5	412.6	0.0	24.7	15.4	40.1	152.7	58.4	259.9
2000	110.4	523.0	7.8	23.1	15.4	46.3	199.0	64.1	324.0
2001	122.9	645.9	8.5	35.2	15.4	59.1	258.1	63.8	387.8
2002	136.6	782.5	9.3	33.6	15.4	58.3	316.4	78.3	466.1
2003	151.1	933.6	10.2	32.1	23.0	65.2	381.7	85.9	552.0
2004	167.3	1100.9	11.2	29.8	23.0	64.0	445.7	103.3	655.2
2005	185.3	1286.3	12.4	27.5	23.0	62.8	508.5	122.5	777.7
2006	198.6	1484.8	13.0	35.1	23.0	71.0	579.6	127.5	905.3
2007	209.7	1694.6	13.6	32.8	23.0	69.4	648.9	140.4	1045.7
2008	222.0	1916.5	14.3	30.5	28.4	73.2	722.2	148.7	1194.4
2009	235.5	2152.0	15.0	27.6	28.4	71.1	793.3	164.4	1358.8
2010	249.0	2401.1	15.8	24.8	28.4	69.0	862.3	180.0	1538.8
2011	263.3	2664.4	16.6	21.9	28.4	67.0	929.2	196.4	1735.2
2012	279.0	2943.4	17.4	19.1	28.4	64.9	994.2	214.1	1949.3
2013	295.9	3239.4	18.3	16.2	28.4	63.0	1057.1	233.0	2182.3
2014	312.9	3552.3	19.2	13.4	28.4	61.0	1118.1	251.9	2434.2
2015	331.7	3884.0	20.1	10.6	13.0	43.7	1161.9	288.0	2722.2
2016	351.9	4235.9	21.1	9.3	13.0	43.4	1205.3	308.4	3030.6
2017	373.0	4608.9	22.2	7.9	13.0	43.2	1248.5	329.9	3360.5
2018	396.6	5005.5	23.3	6.6	13.0	43.0	1291.5	353.6	3714.0
2019	420.6	5426.1	24.5	5.3	13.0	42.8	1334.3	377.8	4091.8
2020	445.8	5871.9	25.7	4.0	13.0	42.8	1377.1	403.0	4494.8
2021	473.8	6345.7	27.0	2.7	5.5	35.2	1412.3	438.6	4933.4
2022	503.7	6849.4	28.3	2.2	5.5	36.0	1448.3	467.7	5401.1
2023	533.8	7383.2	29.8	1.6	5.5	36.9	1485.1	497.0	5898.1
2024	567.7	7950.9	31.2	1.1	5.5	37.8	1522.9	529.9	6427.9
2025	603.1	8554.0	32.8	0.5	5.5	38.8	1561.8	564.3	6992.2
	8553.9	94697.0	488.5	561.2	512.1	1561.8	25227.0	6992.2	69470.1

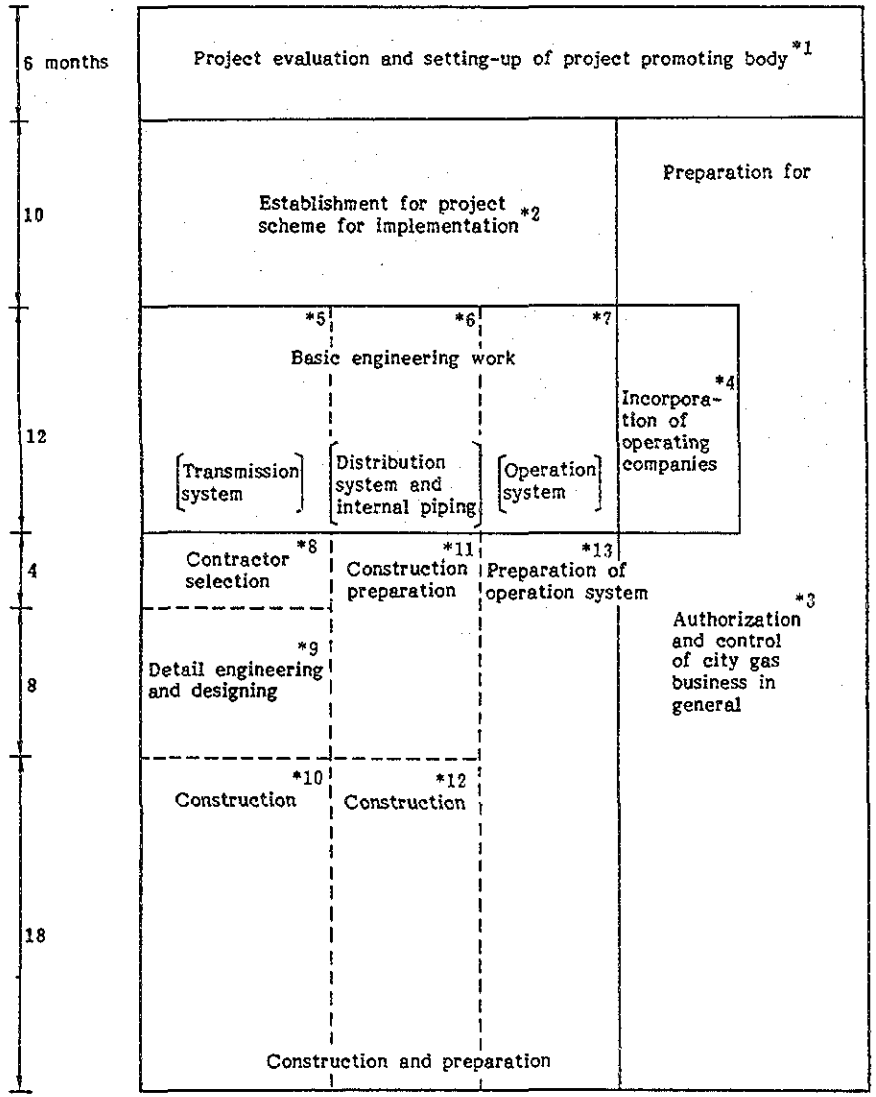
Table 13 FINANCIAL INTERNAL RATE OF RETURN OF RETICULATION IN FIXED PRICE BASE IN 1986

Conditions	
Number of Household	8,000
Construction per Household	230.4 US$
Table Construction Cost	1,843,200 US$
Construction Period	1 year
Sales volume per Household	160Nm^3/year
Raw Material (LPG Bulk) Cost	5.80 US$/MMBTU
Sales Price (LPG Cylinder Price)	8.71 US$/MMBTU
Total Raw Material Cost per Year	290,944 US$
Total Sales Amount per Year	436,864 US$
Labour Cost per Year	10,465 US$
The Project Life	35 years
Maintenance Cost	1% of Construction Cost
FIRR	
For Total Construction Cost	4.94%
For 70% 1/ of Construction Cost	7.82%
For 50% 1/ of Construction Cost	11.16%
For 30% 1/ of Construction Cost	17.92%

Note: 1/ The balance of construction cost is considered to be born by land developer

Table 14 SCHEDULE OF PREPARATORY WORKS TOWARD THE START-UP

Table 13 SCHEDULE OF PREPARATORY WORKS TOWARD THE START-UP



*1. Its purpose is (1) to establish the project scheme, (2) to promote legislative arrangement, (3) to set up operating company and (4) to manage basic engineering. It is agreeable that this body will take, or take part in the operation.

*2. To be defined are (1) purchase gas price, (2) target demand, (3) sales price, (4) time table and (5) way of operation. (1) is critical and to be fixed first.

*3. Main items are (1) legislation to establish city gas company, (2) approval to install piping under road and (3) technical standard for safety.

*4. Operation by public sector is primarily expected. But private sector is possible if certain measures are taken to improve the profitability.

*5. Internationally established engineering procedures for pipeline construction will be followed.

*6. Main items are (1) design/material standards, (2) qualification and approval system and (3) organization and training program.

*7. Main systems to be designed are for (1) construction/operation/maintenance, (2) billing/bill collection, (3) customer connection and (4) emergency handling.

*8. To be prepared with assistance by a consultant.

*9. Mainly by contractor.

*10. To be done by contractors selected by international bidding and under the construction management by consultant.

*11. Work forces are to be organized and trained under the management of the operating company.

*12. Mainly by domestic forces.

*13. Expert aided preparation is recommended.

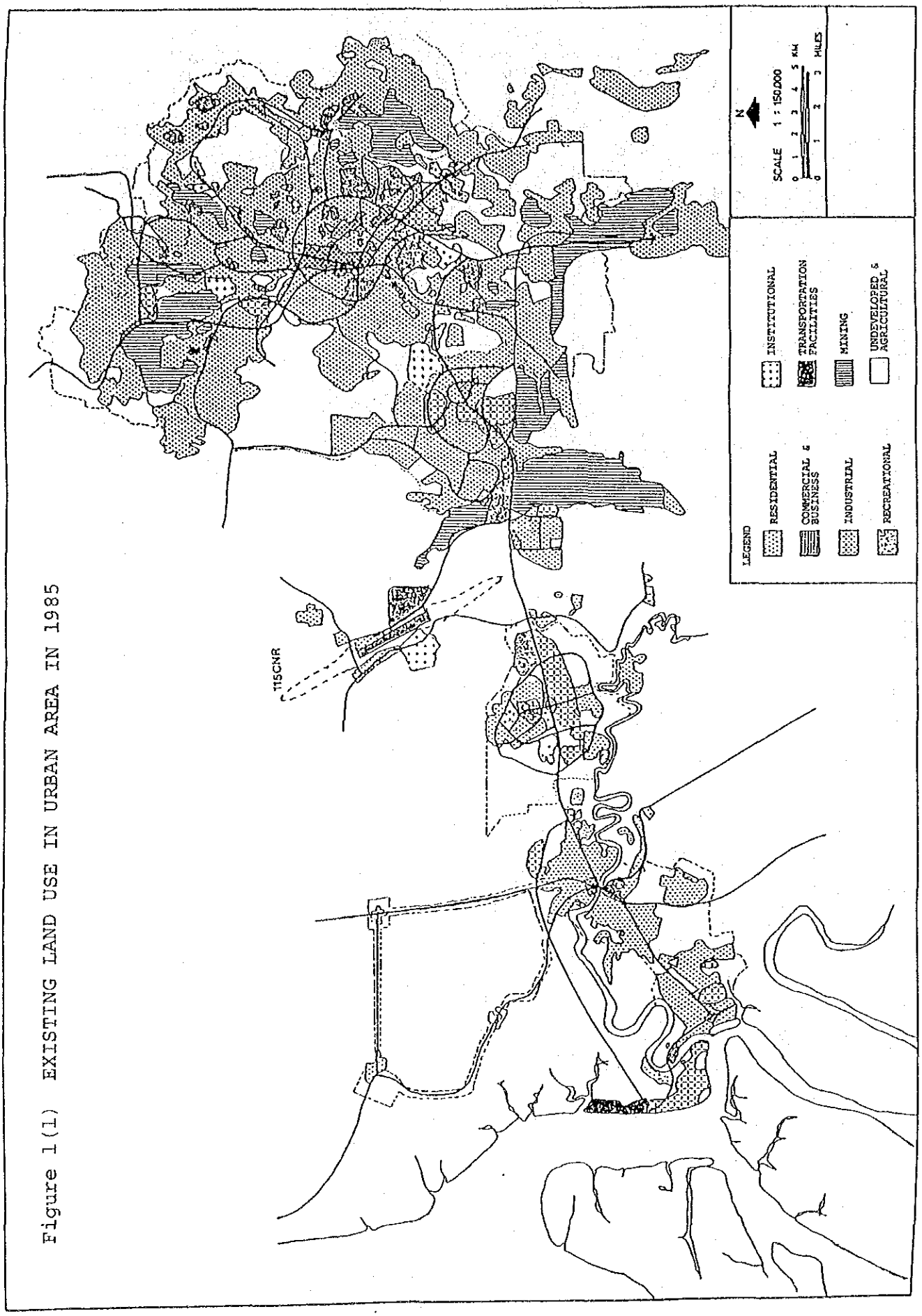


Figure 1(1) EXISTING LAND USE IN URBAN AREA IN 1985

Figure 1(2) LAND USE IN URBAN AREA IN 2005

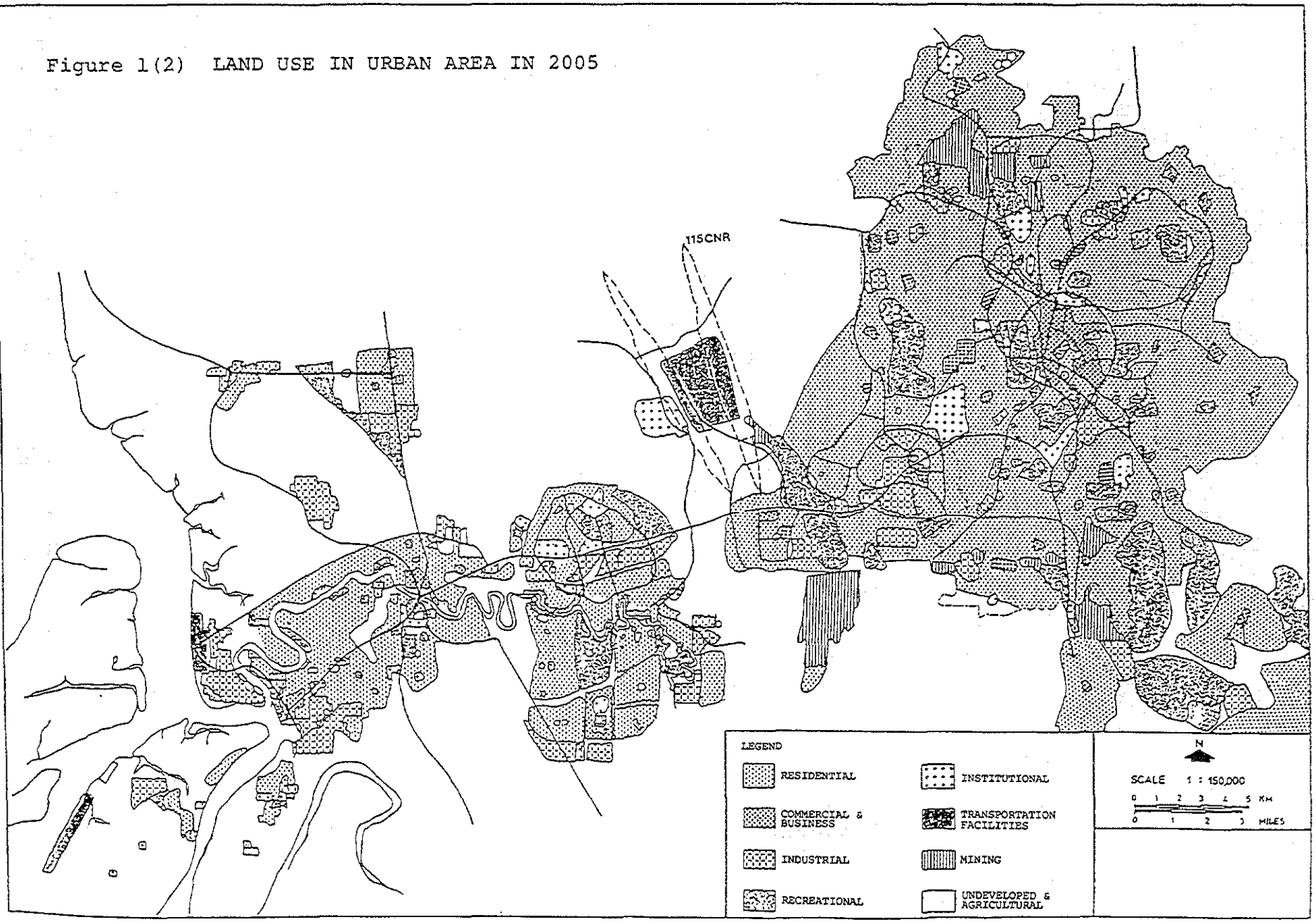


Figure 2 CRUDE OIL PRICE FORECAST

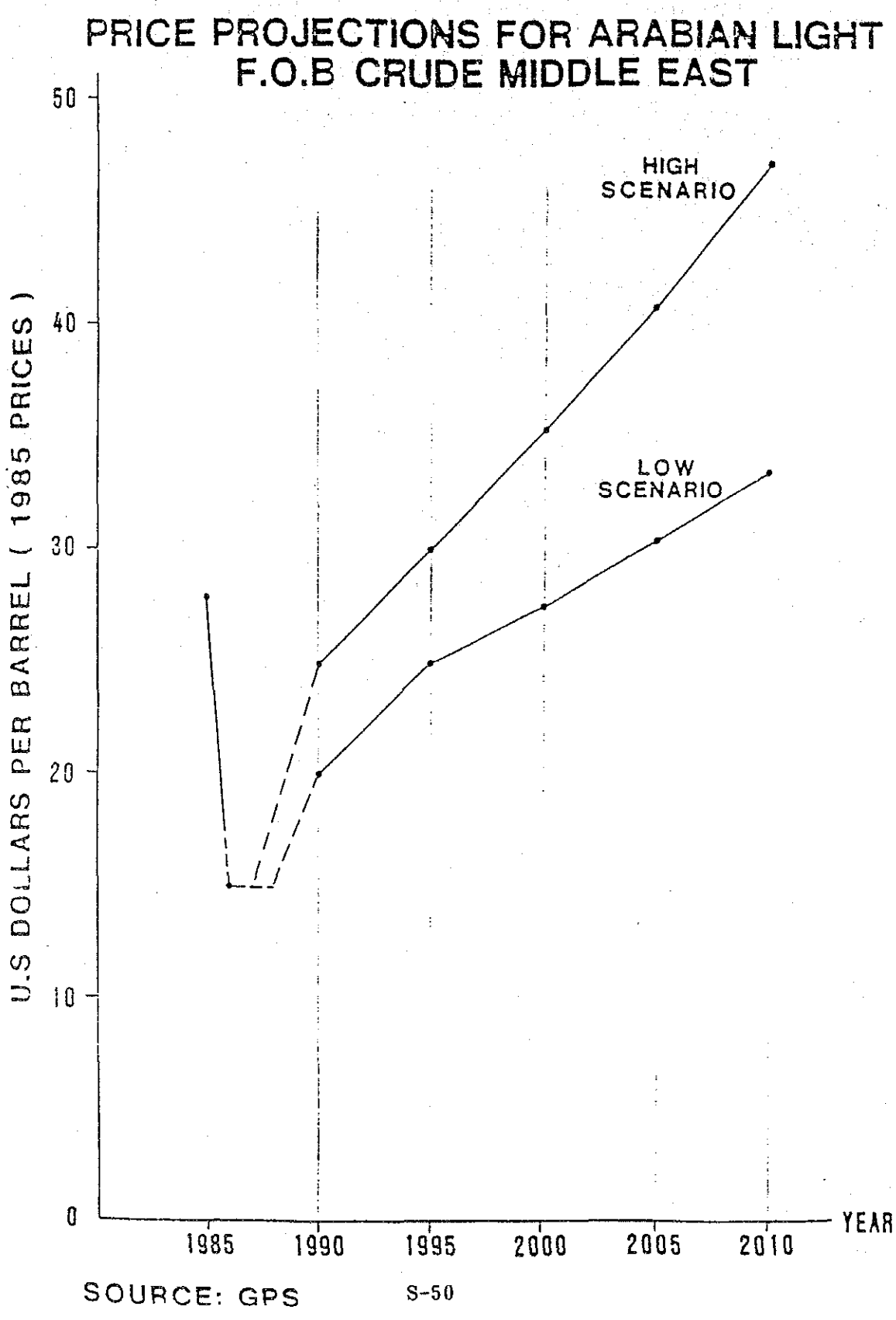


Figure 3 PROCEDURES OF CONCEPTIONAL DESIGN

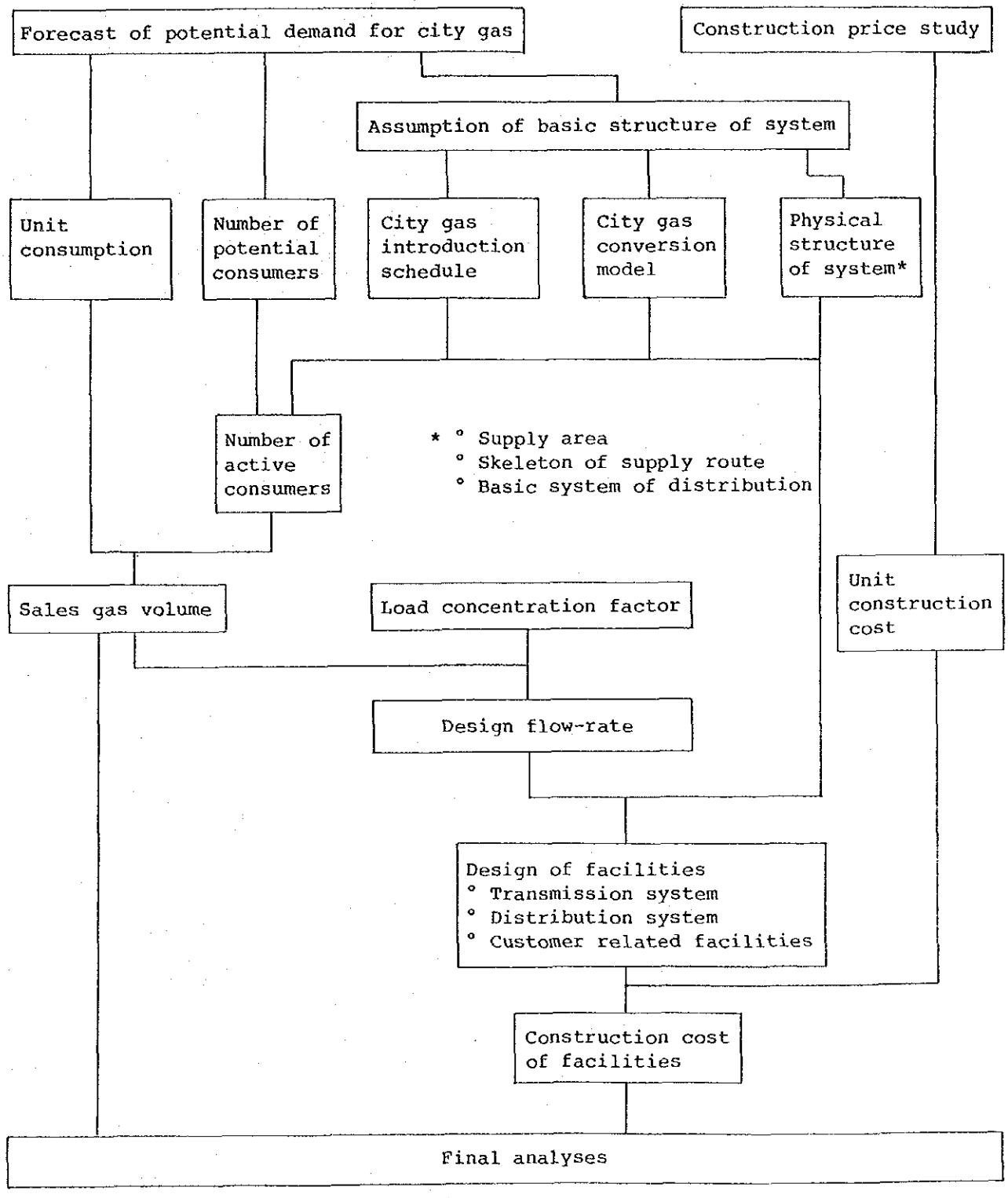
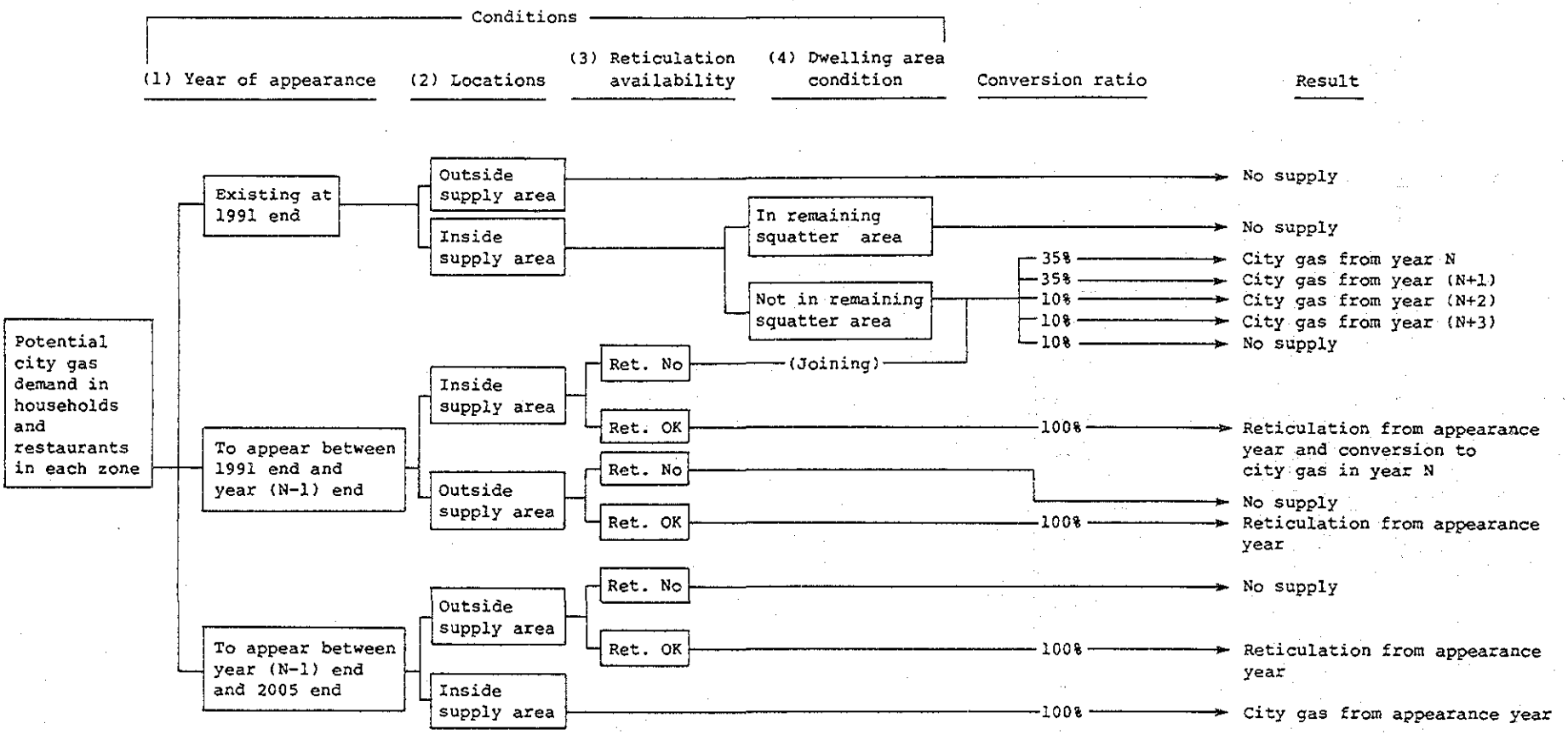


Figure 4 SUPPLY-SIDE CITY GAS CONVERSION MODEL FOR HOUSEHOLD AND RESTAURANT DEMANDS



Note: Year N is the year of beginning city gas supply to the zone. Transmission system is to be completed as far as to that zone just before year N.

Figure 5(1) BASIC IMPLEMENTATION SCHEDULE (BASE CASE)

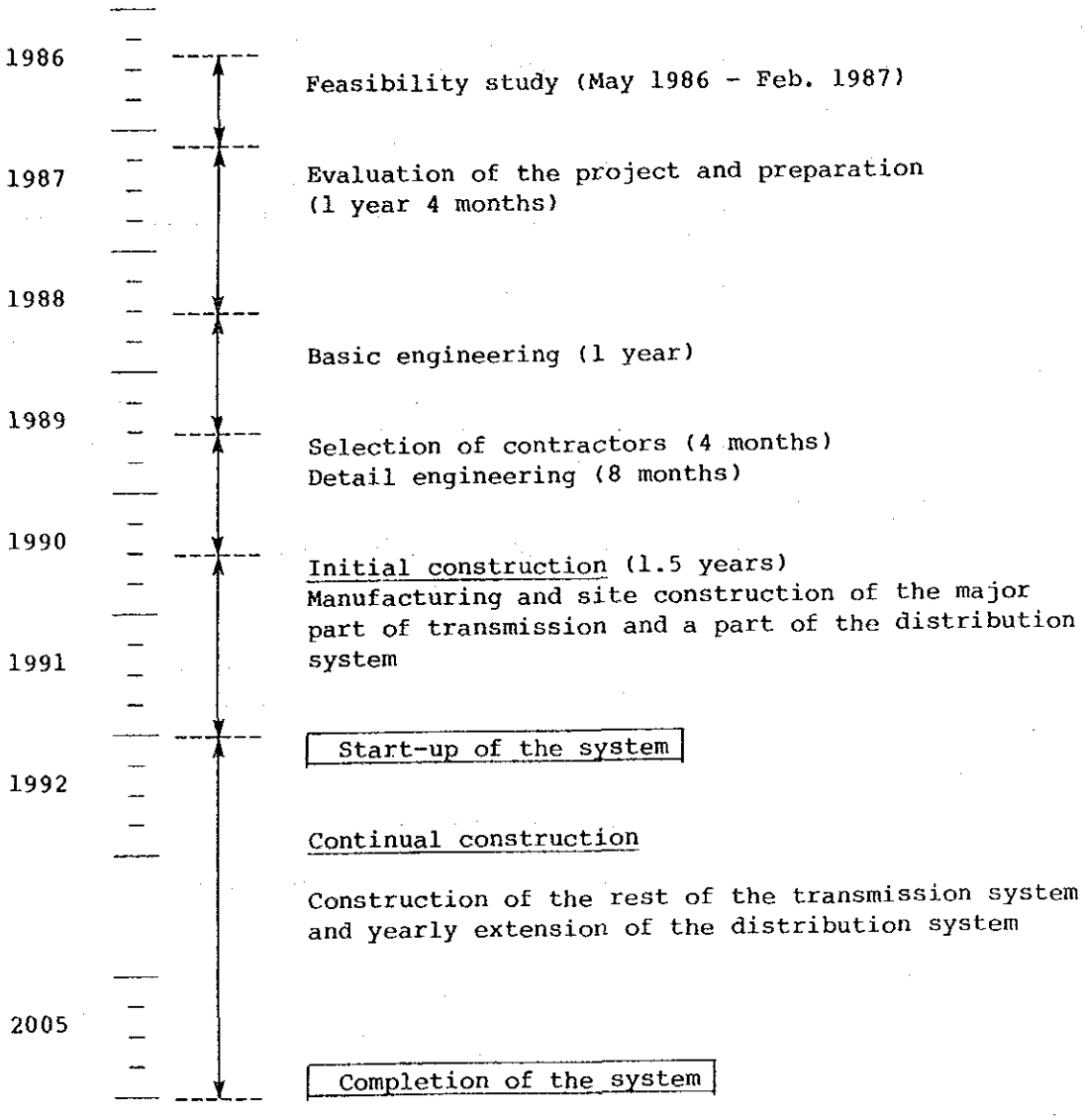


Figure 5(2) BASIC IMPLEMENTATION SCHEDULE (MEDIUM AND LOW CASES)

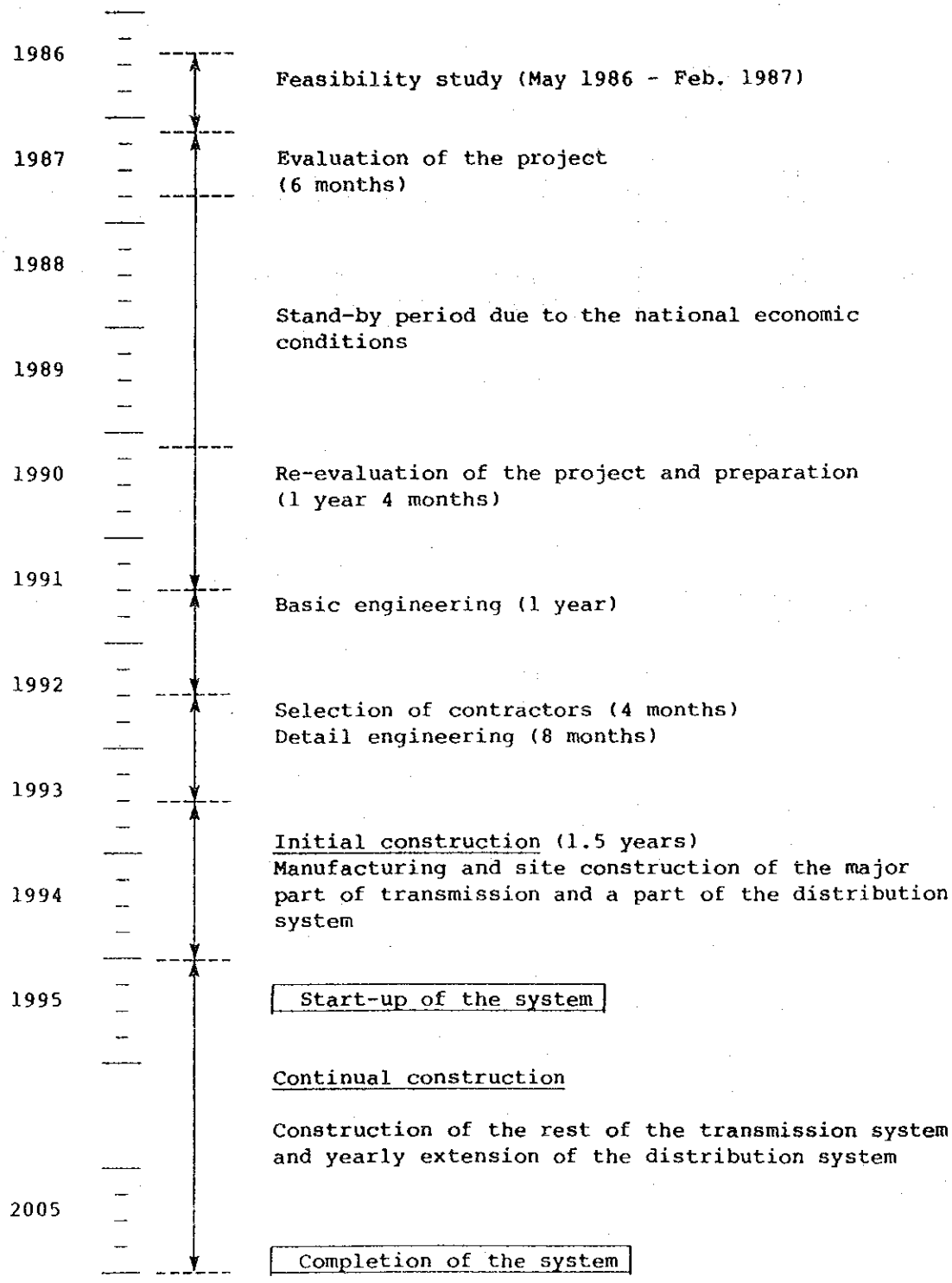
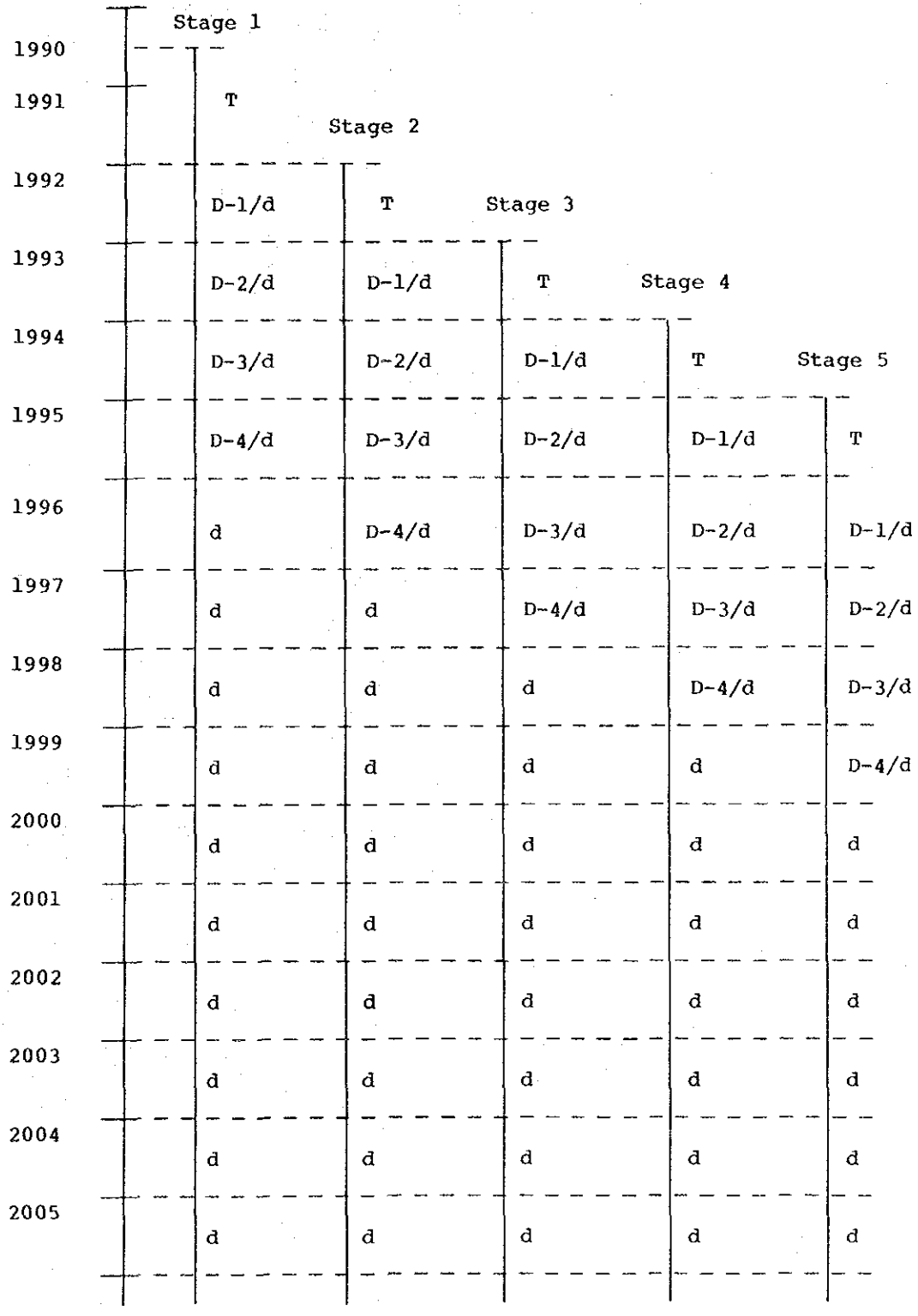


Figure 6 DEVELOPMENT PROGRAM OF TRANSMISSION AND DISTRIBUTION SYSTEM

T: Construction of transmission system
D-1,2,3,4: Construction of distribution network for existing demand
d: Construction of distribution network for new demand



DESIGN RESULT OF TRANSMISSION SYSTEM (BASE ROUTE 1)

PIPE SIZE	1PHESE	2PHESE	3PHESE	4PHESE	5PHESE	TOTAL
4 "	1.8	8.7	2.7	5.8	27.9	46.9
6 "	0	5.8	13.4	2.2	11.1	32.5
8 "	12.0	18.0	11.6	16.6	0	58.5
12 "	27.6	16.7	14.1	18.8	0	77.2
16 "	1.5	0	10.3	0	0	11.8
20 "	9.3	0	0	0	0	9.3
24 "	0	0	0	0	0	0
30 "	0	0	0	0	0	0
TOTAL	52.2	49.2	52.4	43.4	39.0	236.2
AVG.SIZE	12.3	8.4	9.9	9.1	4.6	9.1
VALVE	18	14	7	6	3	48

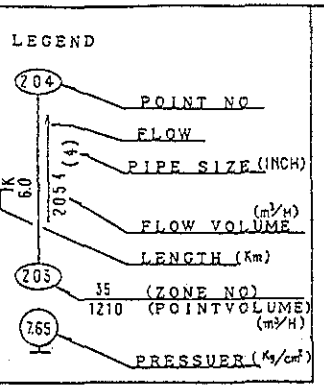
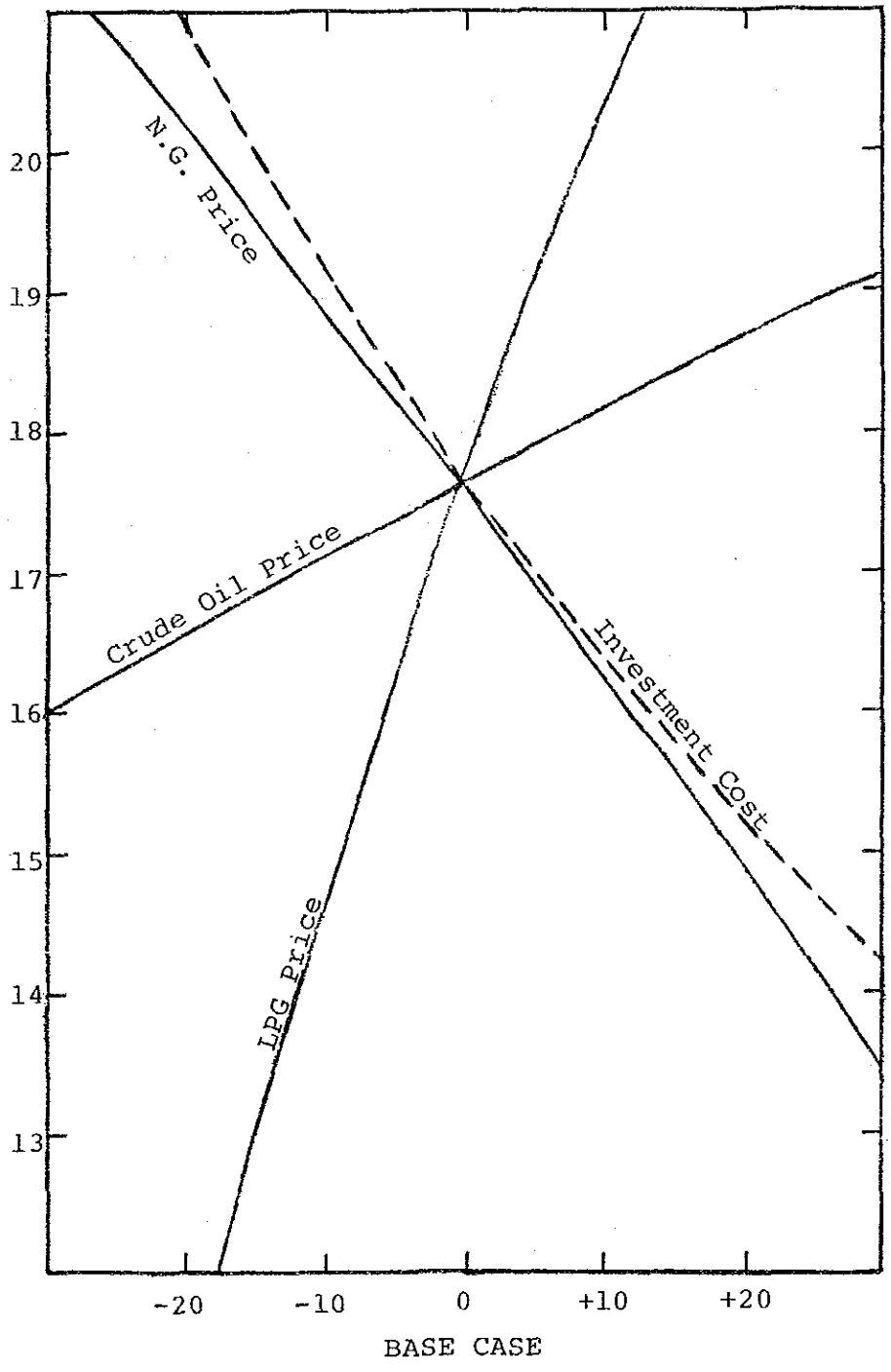


Figure 7 TRANSMISSION ROUTE, DIAMETERS AND CONSTRUCTION SCHEDULE

Figure 8 SENSITIVITY ANALYSIS OF RETURN ON INVESTMENT FOR BASE CASE

- CURRENT TERM (BEFORE TAX) -



SCOPE OF WORK

SCOPE OF WORK

FOR

THE FEASIBILITY STUDY ON CITY GAS DISTRIBUTION SYSTEMS IN THE KLANG VALLEY AREA OF MALAYSIA

AGREED UPON BETWEEN

THE ECONOMIC PLANNING UNIT OF THE

PRIME MINISTER'S DEPARTMENT

ON BEHALF OF

THE GOVERNMENT OF MALAYSIA

AND

THE JAPAN INTERNATIONAL COOPERATION AGENCY

KUALA LUMPUR, JANUARY 1986

(DATO SERI RADIN SOENARNO AL-HAJ)
DIRECTOR GENERAL
ECONOMIC PLANNING UNIT
PRIME MINISTER'S DEPARTMENT
ON BEHALF OF
THE GOVERNMENT OF MALAYSIA

(DR. KENJI TOMITA)
LEADER OF THE
PRELIMINARY SURVEY TEAM
ON BEHALF OF
THE JAPAN INTERNATIONAL
COOPERATION AGENCY

I. INTRODUCTION

In response to the request of the Government of Malaysia, the Government of Japan has decided to conduct a Feasibility Study on City Gas Distribution Systems in the Klang Valley Area (hereinafter referred to as "the Study"), and in accordance with the relevant laws and regulations in force in Japan, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programmes of the Government of Japan, will undertake the Study in close cooperation with the authorities of Malaysia.

The present document sets forth the Scope of Work with regard to the Study.

II. OBJECTIVE OF THE STUDY

The objective of the Study is to examine the technical, economic and financial feasibility of city gas distribution systems utilizing the natural gas to be introduced into the Klang Valley Area by 1990. The Study shall cover the period of 5 years from 1990.

The Study area covers the Federal Territory of Kuala Lumpur and the other growth centres of Petaling Jaya, Shah Alam, Klang, Bandar Baru Selayang, Bangi and other conurbation areas in the Klang Valley.

III. SCOPE OF THE STUDY

In order to achieve the above objective, the Study shall cover the following items:

1. The background and relevant conditions :
   (1) General economic situation of Malaysia.
   (2) Present situation and policies on the Peninsular Gas Utilization Project.
   (3) Relevant laws and regulations.

2. Demand forecast for city gas :
   (1) Survey of the current energy consumption.
   (2) Forecast of the growth in energy consumption.

(3) Estimation of the share of city gas in the total energy consumption.

(4) Revision of the demand for city gas based on the effect of introducing city gas.

3. Conceptional design of the basic structure of the integrated gas distribution system.

(1) Design of the basic route and the gas transmission system.

(2) Selection of gas distribution system.

(3) Study on other facilities of gas supply system.

4. Study of the construction schedule of the city gas distribution system.

(1) Preparation of the outlined schedule of introducing the city gas system.

(2) Preparation of the outlined schedule of constructing the transmission pipeline and its major auxiliary facilities.

(3) Introduction of distribution system using LPG and other forms of gas as an initial step towards final conversion to natural gas.

5. Estimation of the construction cost

(1) Number of facilities to be constructed.

(2) Unit cost of construction items.

(3) Total construction cost.

6. Financial analysis

(1) Overall investment costs (local and foreign).

(2) Expenditure schedule of investment costs.

(3) Financing scheme.

(4) Production cost.

(5) Estimation of capital contribution and gas price structure.

(6) Projected balance sheet.

(7) Projected income statement.

(8) Projected cash flow statement.

(9) Financial internal rate of return.

(10) Sensitivity analysis.

7. Organization and management aspects

8. Environment and safety

9. Economic and social evaluation

10. Conclusion and recommendation

IV. STUDY SCHEDULE

The whole work will be conducted in accordance with the attached tentative schedule.

V. REPORTS

JICA shall prepare and submit the following reports in English to the Government of Malaysia.

1. Inception Report

   30 copies

   At the beginning of the Study in Malaysia

2. Progress Report

   30 copies

   At the end of field work

3. Interim Report

30 copies

Within 7 (seven) months after the commencement of the Study

4. Draft Final Report

30 copies

Within 10 (ten) months after the commencement of the Study

The Government of Malaysia will provide JICA with its comments within 1 (one) month after the receipt of the Draft Final Report

5. Final Report

50 copies

Within 2.5 (two and half) months after the receipt of the Government of Malaysia's comments on the Draft Final Report

The Study team should ensure that all data, information, maps, materials and findings connected with the Study are kept confidential and not disposed of or revealed to any third party except with the prior written consent of the Government of Malaysia. Such maps and aerial photographs are to be returned to the Government of Malaysia immediately upon completion of the Study. All reports when finalized and submitted to the Government of Malaysia shall remain the property of the Government of Malaysia.

VI. UNDERTAKINGS OF THE GOVERNMENT OF MALAYSIA

To facilitate the smooth conduct of the Study, the Government of Malaysia shall take the following necessary measures:

1. To inform the members of the Study team of any existing risk in the Study area and to take any measures deemed necessary to secure the safety of the Study team.

2. To secure the necessary entry permits for the Study team to conduct field surveys in Malaysia and exempt them from consular fees.

3. To exempt the members of the Study team from taxes and duties, as normally accorded under the provision of Malaysian General Circular No. 1 of 1979, on equipment, machinery and other materials brought into and out of Malaysia for the conduct of the Study.

4. To exempt the members of the Study team from Malaysian income tax on their official emoluments in respect of their period of assignment in Malaysia in connection with the conduct of the Study but the Government of Malaysia shall retain the right to take such emoluments into account for the purpose of assessing the amount to be applied to income from other sources.

5. To provide the necessary facilities to the Study team for remittance as well as utilization of funds introduced into Malaysia from Japan in connection with the conduct of the Study.

6. To secure permission for entry into private properties or restricted areas for the conduct of the Study.

7. To provide the Study team with medical services when needed but the expenses will be chargeable to the members of the Study team.

8. To make arrangements for the Study team to take back to Japan the data, maps and materials connected with the Study, subject to the approval of the Government of Malaysia, in order to prepare the reports.

9. To provide the Study team with available data, maps and information necessary for the execution of the Study.

10. To appoint counterpart personnel to the Study team during the Study period.

11. To provide the Study team with suitable office space with clerical service and necessary office equipment in Kuala Lumpur.

12. To provide the Study team with adequate means of local transport for official travel only.

13. To indemnify any member of the Study team in respect of damages arising from any legal action against him in relation to

any act performed or omissions made in undertaking the Study except when the two Governments agree that such a member is guilty of gross negligence or wilful misconduct.

14. To nominate PETRONAS Dagangan Sdn. Bhd. to act as counterpart agency for the Study and the Economic Planning Unit as the main coordinating body in relation to other relevant Governmental and non-Governmental organizations.

VII. UNDERTAKINGS OF JICA

In order to conduct the Study, JICA shall take the following measures:-

1. To despatch, at its own expense, the Study team to Malaysia.

2. To pursue technology transfer to the Malaysian counterpart personnel in the course of the Study.

VIII. CONSULTATION

JICA and the Government of Malaysia shall consult each other in respect of any matter that is not agreed upon in this document and which may arise from or in connection with the Study.

APPENDIX

TENTATIVE SCHEDULE OF THE STUDY

Item \ Year & Month	1986									1987				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Preparatory Office Work	▭													
Inception Report		△												
Field Work		▨	▨	▨										
Progress Report				△										
Home Office Work				▭	▭	▭								
Interim Report							△							
Supplementary Field Work							▨	▨						
Home Office Work								▭	▭					
Draft Final Report										△				
Discussion of the Results											▨			
Supplementary Office Work											▭	▭	▭	
Final Report														△

▨ in Malaysia ▭ in Japan