E. Industrial Demand Projection

Gas Demand Projection of Industrial Sector of PGN Jakarta Branch(Base Case)

District Name	Categories & Industrial Estate	Potential Gas Demand (thousand M3/year)	Pipeline Construction Condition		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
					Gas Demand (thousand M3/year)									
			Main Pipe	Distribution Pipe	750,734	877,599	960411	1,033,000	1,135,000	1,300,000	1,462,000	1,622,000	1,746,000	1,883,000
					Yearly Increase of Gas Demand (thousand m3/year)									
						126,865	82,812	72,589	102,000	165,000	162,000	160,000	126,000	135,000
Tangerang	Existing Factories Potential	137,000	Constructed					20,000	20,000	20,000	20,000	20,000	20,000	17,000
	Future	93,000												
DKI Jakarta	Existing Factories Potential	77,000	Constructed					10,000	10,000	10,000	10,000	10,000	10,000	10,000
	Future	100,000												
Bekasi	Existing Factories Potential	146,000	Planning						20,000	20,000	20,000	20,000	20,000	20,000
	Future	64,000												
	New Industrial Estate													
	EJIP	46,340	Constructed	Constructed				10,000	10,000	10,000	10,000	5,340		
	Hyundai	44,000	Constructed	Constructed				14,000	15,000	15,000				
	Delta	34,600											8,700	8,700
	Newton	11,200												2,800
	Diamond	2,900												
	Boston	2,600												
	MM2100 phase1,2	61,000	Constructed					12,000	12,000	12,000	12,000	13,000		
	phase 3	68,000												
	Jababeka phase 1,2	94,280	Constructed	Constructed				20,000	20,000	20,000	20,000	14,280		
	phase 3,4	69,200											12000	12,000
	NOIP	72,000	Constructed	Constructed				5,000	5,000	5,000	5,000	2,000		
Karawang	Existing Factories Potential	180,000	Planning											
	Future	195,200												
	New Industrial Estate													
	KIIC phase 1	53,900	Constructed							18,000	18,000	17,900		
	phase 2	107,600												
	Surya Cipta phase 1	57,000	Constructed						15,000	15,000	15,000	12,000		
	phase 2	92,700												12000
	phase 3	121,000												
	Mitra I, P. phase 1	44,000	Planning									14,000	15,000	15,000
	phase 2	66,000												
	Peryni	110,000	Planning											
Purwakarta	Existing Factories	0												
	New Industrial Estate													
	Bukit Indah phase 1	264,000	Planning							53,000	53,000	53,000	53,000	52,000
	phase 2	770,000												
	Indotaisei phase 1	44,000	Planning								11,000	11,000	11,000	11,000
	phase 2	44,000												
	Pupuk Kujang													
	Timor	46,200	Planning							8,000	8,000	8,000	8,000	8,000
Total Gas Demand in Master Plan Area		3,277,220			Yearly Amount of Target Demand (thousand M3/year)									
						126,900	82,800	91,000	127,000	206,000	202,000	200,520	157,700	168,500
Serang	Existing Factories(Cireqon)	159,310												
	Existing Factories(Serang)	527,200												

Gas Demand Projection of Industrial Sector of PGN Jakarta Branch(High Case)

District Name	Categories & Industrial Estate	Potential Gas Demand (thousand M3/year)	Pipeline Construction Condition		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
					Gas Demand (thousand M3/year)									
			Main Pipe	Distribution Pipe	750,734	877,599	960411	1,051,000	1,178,000	1,384,000	1,586,000	1,787,000	1,945,000	2,114,000
					Yearly Increase of Gas Demand (thousand m3/year)									
						126,865	82,812	90,589	127,000	206,000	202,000	201,000	158,000	169,000
Tangerang	Existing Factories Potential	137,000	Constructed					20,000	20,000	20,000	20,000	20,000	20,000	17,000
	Future	93,000												
DKI Jakarta	Existing Factories Potential	77,000	Constructed					10,000	10,000	10,000	10,000	10,000	10,000	10,000
	Future	100,000												
Bekasi	Existing Factories Potential	145,000	Planning						20,000	20,000	20,000	20,000	20,000	20,000
	Future	84,000												
	New Industrial Estate													
	EJIP	45,340	Constructed	Constructed				10,000	10,000	10,000	10,000	5,340		
	Hyundai	44,000	Constructed	Constructed				14,000	15,000	15,000				
	Delta	34,800											8,700	8,700
	Newton	11,200												2,800
	Diamond	2,900												
	Goyton	2,600												
	MM2100 phase1,2	61,000	Constructed					12,000	12,000	12,000	12,000	13,000		
	phase 3	66,000												
	Jababeka phase 1,2	94,280	Constructed	Constructed				20,000	20,000	20,000	20,000	14,280		
	phase 3,4	69,200											12000	12,000
	NGIP	22,000	Constructed	Constructed				5,000	5,000	5,000	5,000	2,000		
Karawang	Existing Factories Potential	160,000	Planning											
	Future	195,200												
	New Industrial Estate													
	KIIC phase 1	53,900	Constructed							16,000	16,000	17,900		
	phase 2	107,600												
	Surya Cipta phase 1	57,000	Constructed						15,000	15,000	15,000	12,000		
	phase 2	62,700												12000
	phase 3	121,000												
	Mitra I.P. phase 1	44,000	Planning									14,000	15,000	15,000
	phase 2	66,000												
	Perum	110,000	Planning											
Purwakarta	Existing Factories	0												
	New Industrial Estate													
	Bukit Indah phase 1	264,000	Planning							53,000	53,000	53,000	53,000	52,000
	phase 2	770,000												
	Indotaisei phase 1	44,000	Planning								11,000	11,000	11,000	11,000
	phase 2	44,000												
	Pupuk Kujang									8,000	8,000	8,000	8,000	8,000
	Timor	46,200	Planning											
Total Gas Demand in Master Plan Area		3,277,220			Yearly Amount of Target Demand (thousand M3/year)									
						126,900	82,800	91,000	127,000	206,000	202,000	200,520	157,700	168,500
Serang	Existing Factories(Cirogom)	159,310												
	Existing Factories(Serang)	527,200												

Gas Demand Projection of Industrial Sector of PGN Jakarta Branch(low Case)

District Name	Categories & Industrial Estate	Potential Gas Demand (thousand M3/year)	Pipeline Construction Condition		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
			Main Pipe	Distribution Pipe	Gas Demand (thousand M3/year)									
					750,734	877,599	960411	1,015,000	1,091,000	1,215,000	1,336,000	1,456,000	1,551,000	1,652,000
					Yearly Increase of Gas Demand (thousand m3/year)									
						126,865	82,812	54,589	76,000	124,000	121,000	120,000	95,000	101,000
Tangerang	Existing Factories Potential	137,000	Constructed					20,000	20,000	20,000	20,000	20,000	20,000	17,000
	Future	92,000												
DKI Jakarta	Existing Factories Potential	77,000	Constructed					10,000	10,000	10,000	10,000	10,000	10,000	10,000
	Future	100,000												
Bekasi	Existing Factories Potential	145,000	Planning						20,000	20,000	20,000	20,000	20,000	20,000
	Future	84,000												
	New Industrial Estate													
	EJIP	45,240	Constructed	Constructed				10,000	10,000	10,000	10,000	5,240		
	Hyundai	44,000	Constructed	Constructed				14,000	15,000	15,000				
	Delta	34,800											8,700	8,700
	Newton	11,200												2,800
	Diamond	2,900												
	Boston	2,600												
	MM2100 phase1,2	61,000	Constructed					12,000	12,000	12,000	12,000	13,000		
	phase 3	66,000												
	Jabebeka phase 1,2	94,280	Constructed	Constructed				20,000	20,000	20,000	20,000	14,280		
	phase 3,4	89,200											12000	12,000
	NCIP	22,000	Constructed	Constructed				5,000	5,000	5,000	5,000	2,000		
Karawang	Existing Factories Potential	180,000	Planning											
	Future	195,200												
	New Industrial Estate													
	KIIC phase 1	53,900	Constructed							18,000	18,000	17,900		
	phase 2	107,800												
	Surya Cipta phase 1	57,000	Constructed						15,000	15,000	15,000	12,000		
	phase 2	92,700												12000
	phase 3	121,000												
	Mitra I. P. phase 1	44,000	Planning									14,000	15,000	15,000
	phase 2	66,000												
	Peruri	110,000	Planning											
Purwakarta	Existing Factories	0												
	New Industrial Estate													
	Bukit Indah phase 1	264,000	Planning							53,000	53,000	53,000	53,000	52,000
	phase 2	770,000												
	Indotaisei phase 1	44,000	Planning								11,000	11,000	11,000	11,000
	phase 2	44,000												
	Pupuk Kujang													
	Timor	46,200	Planning							8,000	8,000	8,000	8,000	8,000
Total Gas Demand in Master Plan Area		3,277,220			Yearly Amount of Target Demand (thousand M3/year)									
						126,900	82,500	91,000	127,000	206,000	202,000	200,520	157,700	168,500
Serang	Existing Factories(Ciregon)	159,310												
	Existing Factories(Serang)	527,200												

LIST OF EXISTING CUSTOMERS

No.	District	Name	Status	Soctor	Business	Appliance	Hour	Day	LPG Kg/Mont	FO Ltr/Mont	HSD Ltr/Mont	IDO Ltr/Mont	KERO Ltr/Mont	COAL Kg/Mont	WOOD Kg/Mont	ELEC Kwh/M	NAT.GAS M3/Mont.
1	Bekasi	GUNUNG GARUDA	E	I	B.METAL	Furnace	24	365									2,869,000
2	Bekasi	CIKARANG INDAH TILE	E	I	CERAMIC		24	365									268,000
3	Bekasi	DAINN AMPUH	E	I	CERAMIC		16	240									5,000
4	Bekasi	FERRO MAS DINAMIKA	E	I	CERAMIC		24	365									287,000
5	Bekasi	MULIA GLASS KERAMIK	E	I	CERAMIC	Lehr/Dryer	24	365									2,008,000
6	Bekasi	SUPER BATA.	E	I	CERAMIC		8	240									81,000
7	Bekasi	TERRA KOTA	E	I	CERAMIC		24	330									287,000
8	Bekasi	FAJAR SURYA WISESA	E	I	PAPER	Boiler	24	365									2,869,000
9	Bekasi	KERTAS BEKASI TEGUH	E	I	PAPER	Boiler	24	330									1,434,000
10	Bekasi	SANDANG MUTIARA ERA MULYA	E	I	TEXTIL		16	240									26,000
																	-
	Total																10,133,000
																	-
1	Jakarta West	BINTANG FULLS	E	I	CERAMIC	Blander	24	240									153,000
2	Jakarta West	HIKARI	E	I	CERAMIC	Mesin Bohlam	16	288									43,000
3	Jakarta West	KEDAUNG GROUP	E	I	CERAMIC	Furnace	24	330									768,000
4	Jakarta West	PASIR SARI RAYA	E	I	CERAMIC	Kiln	24	365									1,263,000
5	Jakarta West	SERINCO JAYA	E	I	CERAMIC	Kiln	24	365									1,912,000
6	Jakarta West	DUTA FORT INDONESIA	E	I	CHEMICAL	Oven/Boiler	24	330									239,000
7	Jakarta West	KEDAUNG RAYA	E	I	FOOD	Boiler	24	330									143,000
8	Jakarta West	PALKO SARI EKA (SUMBER DERAS)	E	I	FOOD	Boiler	24	288									104,000
9	Jakarta West	SAYANG HEULANG/BIMOLI	E	I	FOOD	Boiler	24	365									688,000
10	Jakarta West	WIDICO STANTINA	E	I	FOOD	Waber Stick	14	240									67,000
11	Jakarta West	PELITA ENAMEL WARE	E	I	METAL	Oven	24	330									115,000
12	Jakarta West	SUPREME ALOURUDIN	E	I	METAL	Furnace	24	330									239,000
13	Jakarta West	TEMBAGA MULIA SEMANAN	E	I	METAL	Furnace	24	330									252,000
14	Jakarta West	TIMUR KENCANA	E	I	METAL	Dapur	24	330									124,000
15	Jakarta West	UNITED CAN COMPANY	E	I	METAL	Oven	24	365									326,000
16	Jakarta West	MAXFOS PRIMA	E	I	PAPER		24	330									143,000
17	Jakarta West	PELITA CENGKARENG	E	I	PAPER	Boiler	24	365									1,589,000
18	Jakarta West	HISOTEX	E	I	TEXTIL	Boiler	24	330									335,000
19	Jakarta West	METRO LAUNDRI	E	I	TEXTILE	Boiler	14	240									17,000
																	-
	Total																8,522,000
																	-
1	Jakarta East	ALKARINDO	E	I	B.METAL	Dapur	24	330									335,000
2	Jakarta East	BUMI KAYA STEEL	E	I	B.METAL	Boiler	8	240									6,000
3	Jakarta East	LOGAM MULIA	E	I	B.METAL		8	240									17,000
4	Jakarta East	THE MASTER STEEL	E	I	B.METAL	Burner RM	24	365									1,759,000
5	Jakarta East	WIRA MUSTIKA I	E	I	B.METAL	Furnace	24	330									177,000

No.	District	Name	Status	Sector	Business	Appliance	Hour	Day	LPG Kg/Mont	FO Ltr/Mont	HSD Ltr/Mont	IDO Ltr/Mont	KERO Ltr/Mont	COAL Kg/Mont	WOOD Kg/Mont	ELEC Kwh/M	NAT.GAS M3/Mont.
6	Jakarta East	F.N.G.	E	I	CERAMIC		24	365									636,000
7	Jakarta East	K.C.I.	E	I	CERAMIC		24	365									287,000
8	Jakarta East	UNION KERAMIK	E	I	CERAMIC		24	365									239,000
9	Jakarta East	IGAR JAYA	E	I	CHEMICAL	Annealing/Pemb	24	240									57,000
10	Jakarta East	INTIRUB	E	I	CHEMICAL		24	330									330,000
11	Jakarta East	NELLCO PHARMA	E	I	CHEMICAL		8	240									3,000
12	Jakarta East	CIPTA RASA PRIMA TAMA	E	I	FOOD		8	240									5,000
13	Jakarta East	HASIL KESATUAN	E	I	FOOD	Boiler	24	330									115,000
14	Jakarta East	MONDE BISCUIT	E	I	FOOD		16	240									11,000
15	Jakarta East	BUMI KAYA STEEL II	E	I	METAL		8	240									1,000
16	Jakarta East	EDICO UTAMA	E	I	METAL		16	240									57,000
17	Jakarta East	NAPOLEON LIGHT	E	I	METAL	Die Casting	8	240									6,000
18	Jakarta East	NATIONAL GOBEL	E	I	METAL	Boiler/Painting	8	240									32,000
19	Jakarta East	NEW RED & WHITE	E	I	METAL	Oven/Mesin C	8	240									11,000
20	Jakarta East	PABRIK PIPA INDONESIA	E	I	METAL		8	240									19,000
21	Jakarta East	RHEEM INDONESIA	E	I	METAL		8	240									10,000
22	Jakarta East	KAYABA INDONESIA	E	I	MMETAL		8	240									5,000
23	Jakarta East	DAINIPPON PRINTING IND.	E	I	PAPER		8	240									30,000
24	Jakarta East	GOLDEN WEB	E	I	PAPER		8	240									1,000
25	Jakarta East	MATAHARI ALKA/AMMO DIASO	E	I	PAPER	Diazo Paper	8	240									18,000
26	Jakarta East	APTERYX	E	I	TEXTIL		24	365									143,000
																	-
	Total																4,311,000
																	-
1	Jakarta North	PABRIK GELAS ELOK/SIBALEXS	E	I	CERAMIC	Furnace	24	330									913,000
2	Jakarta North	DELTA JAKARTA	E	I	FOOD	Boiler	24	330									96,000
																	-
	Total																1,009,000
																	-
1	Tangerang	ANGSA DAYA II/PORSELAIN WARE	E	I	CERAMIC	Kiln/Dryer	24	365									1,278,000
2	Tangerang	ANGSA DAYA(IKAD I)	E	I	CERAMIC	Kiln/Dryer	24	365									1,097,000
3	Tangerang	BATA API SURYA	E	I	CERAMIC	Dapur/Oven	8	240									19,000
4	Tangerang	DANTO TILE INDONESIA	E	I	CERAMIC	Kiln	24	365									181,000
5	Tangerang	HANKOOK KERAMIK	E	I	CERAMIC		24	330									57,000
6	Tangerang	INDO CERAMIK INTI	E	I	CERAMIC	Kiln	24	365									138,000
7	Tangerang	INDOPOTERINA	E	I	CERAMIC		8	240									46,000
8	Tangerang	INTI KERAMIK ALAM SARI	E	I	CERAMIC		24	330									382,000
9	Tangerang	K O P I N	E	I	CERAMIC	Kiln/Dryer	24	365									593,000
10	Tangerang	LUCKY INDAH KERAMIK	E	I	CERAMIC	Furnace	24	365									889,000
11	Tangerang	MASTERINA	E	I	CERAMIC	Kiln	24	365									1,243,000
12	Tangerang	OPAL INDAH GLASS INDUSTRI	E	I	CERAMIC	Furnace/Anelli	24	330									409,000
13	Tangerang	PROSMO	E	I	CERAMIC	Kiln	24	365									287,000

No.	District	Name	Status	Sector	Business	Appliance	Hour	Day	LPG Kg/Mont	FO Ltr/Mont	HSD Ltr/Mont	IDO Ltr/Mont	KERO Ltr/Mont	COAL Kg/Mon	WOOD Kg/Mont	ELEC Kwh/M	NAT.GAS M3/Mont.
14	Tangerang	SATYARAYA KERAMINDO INDAH	E	I	CERAMIC	Kiln	24	330									1,156,000
15	Tangerang	SINAR DUNIA KRISTAL	E	I	CERAMIC	Oven/Anelling	24	365									239,000
16	Tangerang	SUPRA KRISTALINDO	E	I	CERAMIC		24	365									-
17	Tangerang	SURYA TOTO IND II	E	I	CERAMIC	Kiln	24	330									143,000
18	Tangerang	SURYA TOTO INDONESIA	E	I	CERAMIC	Kiln/Heater	24	365									311,000
19	Tangerang	TIGER HEAD	E	I	CERAMIC	Blowing Mach	24	365									104,000
20	Tangerang	UNION MULTI POWER	E	I	CERAMIC		8	240									1,000
21	Tangerang	BILLBOARDIND	E	I	CHEMICAL	Pemanas	8	240									-
22	Tangerang	CISADANE RAYA CHEMICAL	E	I	CHEMICAL		24	365									574,000
23	Tangerang	GAJAH TUNGGAL	E	I	CHEMICAL	Boiler	24	365									2,486,000
24	Tangerang	GRAHA EXEL	E	I	CHEMICAL		8	240									6,000
25	Tangerang	LATEX INDO LESTARI	E	I	CHEMICAL	Burner	8	240									-
26	Tangerang	NUSA DIPA PERDANA	E	I	CHEMICAL	Burner	8	240									-
27	Tangerang	PESTAGRA	E	I	CHEMICAL		8	240									1,000
28	Tangerang	TATA RUBBERINDO INDUSTRIES	E	I	CHEMICAL	Pemanas	8	240									48,000
29	Tangerang	TIRTASUCI LATEX INDUS.	E	I	CHEMICAL	Pemanas	8	240									-
30	Tangerang	TRIHASTA LOKA	E	I	CHEMICAL	Burner	16	240									15,000
31	Tangerang	BESTARI INDOPRIMA	E	I	FOOD		8	288									18,000
32	Tangerang	INBISCO	E	I	FOOD	Oven	8	288									6,000
33	Tangerang	KADU MANIS MURNI	E	I	FOOD	Penggorengan	8	240									57,000
34	Tangerang	MULTI BINTANG INDONESIA	E	I	FOOD	Boiler	24	330									207,000
35	Tangerang	MULTI SARANA RASA AGUNG	E	I	FOOD		8	240									3,000
36	Tangerang	S.W.W INDUSTRI	E	I	FOOD	Boiler	24	365									222,000
37	Tangerang	UNITED BRANINDO	E	I	FOOD	Oven/Pemanas	16	240									153,000
38	Tangerang	WIHADIL CHEMICAL	E	I	FOOD		24	330									120,000
39	Tangerang	EUROSTATIC UNGGUL	E	I	METAL		8	288									12,000
40	Tangerang	FURUKAWA BATTERY	E	I	METAL		8	288									12,000
41	Tangerang	GANDA GUNA INDUSTRI	E	I	METAL		8	240									57,000
42	Tangerang	IKI KABEL	E	I	METAL		24	330									298,000
43	Tangerang	LIPPO TSK	E	I	METAL		8	288									3,000
44	Tangerang	NON FERINDO UTAMA	E	I	METAL		24	330									96,000
45	Tangerang	PELANGI INDAH CANINDO	E	I	METAL		16	240									27,000
46	Tangerang	SUPEREX RAYA	E	I	METAL		8	240									29,000
47	Tangerang	TOYO ASAHI BICYCLE INDUSTRIES	E	I	METAL		8	240									9,000
48	Tangerang	UNI TUMBUH UTAMA	E	I	METAL		8	288									1,000
49	Tangerang	YKK ALUMICO	E	I	METAL	Furnace	24	365									222,000
50	Tangerang	UNIVERSAL RESPATI	E	I	OTHERS	Turbine	8	240									3,000
51	Tangerang	TUNAS ALFIN	E	I	PAPER	Burner	16	240									34,000
52	Tangerang	FAJAR KEMENANGAN	E	I	TEXTIL		24	240									96,000
53	Tangerang	INDO TORAY SINTETYS	E	I	TEXTIL		24	330									143,000
54	Tangerang	JABATEX	E	I	TEXTIL	Boiler	24	330									143,000
55	Tangerang	PAN BROTHER TEX	E	I	TEXTIL	Boiler	24	240									57,000

No.	District	Name	Status	Sector	Business	Appliance	Hour	Day	LPO Kg/Mont	FO Ltr/Mont	HSD Ltr/Mont	IDO Ltr/Mont	KERO Ltr/Mont	COAL Kg/Mont	WOOD Kg/Mont	ELEC Kwh/M	NAT.GAS M3/Mont.
56	Tangerang	PELANGI PRIMA DIRGANTARA	E	I	TEXTIL	Boiler	24	240						-			44,000
57	Tangerang	ARGO PANTES	E	I	TEXTILE	Boiler	24	365									13,000
58	Tangerang	INDO TAICHIN TEXTILE	E	I	TEXTILE		24	240				-					76,000
59	Tangerang	JABATEX II	E	I	TEXTILE	Boiler	24	365						-			593,000
60	Tangerang	RASICO	E	I	TEXTILE	Oven	16	288									47,000
61	Tangerang	UNINDO PERKASA NUSANTARA	E	I	TEXTILE		16	288									7,000
62	Tangerang	JABAR UTAMA WOOD	E	I	WOOD	Boiler	24	330									67,000
																	-
	Total																14,683,000
																	-
	Groud Total																38,657,000

LIST OF POTENTIAL CUSTOMERS

No	District	Name	Status	Sector	Business	Appliance	Hour	Day	LPG Kg/Mont	FO Ltr/Mont	MSO Ltr/Mont	IDO Ltr/Mont	KERO Ltr/Mont	COAL Kg/Mont	WOOD Kg/Mont	ELEC Kwh/Mont	NAT. GAS M3/Mont
1	Bekasi	LAWANG KEMCANA UTAMA	P	I	B. METAL	BURNER GENSET		364	40.000								0 52.000
2	Bekasi	SUDIN TEGELINDO	P	I	CERAMIC	DRYER MESIN PRESS		364	2.000.000		-						2.630.000
3	Bekasi	ONGBON KERRASA	P	I	CERAMIC	KILN		364	600.000								791.000
4	Bekasi	KERRASA PRIMA RINDO	P	I	CERAMIC	GENSET SPRY DRYER PAST DRYER KILN	24	364	60.000		27.200						121.000
5	Bekasi	MADIAN CERAMICA INDAH	P	I	CERAMIC	KILN SPRY DRYER		364	350.000								461.000
6	Bekasi	BRIDGESTONE TIRE	P	I	CHEMICAL	BOILER		364			300.000						339.000
7	Bekasi	GALIC ARTHA BAHARI	P	I	CHEMICAL	BOILER		364			200.000						226.000
8	Bekasi	MULTI KIMIA INTI PELANGI	P	I	CHEMICAL	SPRY DRYER, BOILER, GENERATOR	24	364			100.000						113.000
9	Bekasi	SUMILINDO	P	I	CHEMICAL	BOILER 3,6 T/JAM	24	312		75.000							83.000
10	Bekasi	SWASTI PARAMA MULYA	P	I	CHEMICAL	BOILER 4 T/JAM GENSET 550 KVA	24	364			150.000						169.000
11	Bekasi	BINA KARYA PRIMA	P	I	FOOD	BOILER		364		160.000	94.000						253.000
12	Bekasi	KARTIKA SASANA BOGA	P	I	FOOD	RICE PILLOW MACHINE (2)		364			35.000						40.000
13	Bekasi	YKK BEKASI	P	I	METAL	BOILER, GENSET		364			120.000						136.000
14	Bekasi	ZIPCO INDONESIA	P	I	METAL	BOILER, GENSET (3)		364			48.000						54.000
15	Bekasi	TOKAI YKKPRINT INDONESIA	P	I	PAPER	P L N		364	350.000								481.000
16	Bekasi	P O L I U X	P	I	TEXTIL	FINISHING BLEASHING	14	312	3.000	0	135.000		0		145.840	0	209.000
17	Bekasi	MUSASA BUANA	P	I	TEXTIL	BOILER		364			250.000						282.000
18	Bekasi	YKK ZIPPER	P	I	TEXTIL	GENSET 1200 KVA (2), GENSET 1500 KVA (3)	24	364	98		486.000						549.000
	Total																0 7.978.000
																	0 0
1	Cilegon	C.P.W.I.	P	I	B. METAL	OVEN	24	336		1.740.000							1.955.000
2	Cilegon	KRAKATAU PRIMA DHARMA SENTANA	P	I	B. METAL	FURNACE	24	312			200.000						226.000
3	Cilegon	SIEMENS	P	I	B. METAL		16	312	500								1.000
4	Cilegon	KAPURINDO SENTANA PT.	P	I	CERAMIC	BURNER	24	365				300.000	120.000				444.000
5	Cilegon	ASAMINAS SUBENTRA PT.	P	I	CHEMICAL	BOILER	24	365	900.000			160.000					1.226.000
6	Cilegon	BAKRIE KASEI	P	I	CHEMICAL	MESIN DIESEL	24	365			1.200.000	1.400.000				10.5 MW	3.842.000
7	Cilegon	DAROID INDONESIA PT.	P	I	CHEMICAL	GENSET	16	365			96.000						108.000
8	Cilegon	DONG JIN INDONESIA PT.	P	I	CHEMICAL	BOILER	24	365	1.250	240.000							275.000
9	Cilegon	DOWEK INDONESIA	P	I	CHEMICAL	BOILER/KOMPOR	24	336	90		54.180					5.704	73.000
10	Cilegon	GEMA POLYTAMA KIMIA	P	I	CHEMICAL	BOILER/GENSET	24	240	4.100		50.000					192.000	62.000
11	Cilegon	HOECHST CILEGON KIMIA	P	I	CHEMICAL	BURNER	24	312			92.000					172.000	104.000
12	Cilegon	LAUTAN OTSUKA CHEMICAL PT.	P	I	CHEMICAL	BOILER	24	365			300.000						339.000
13	Cilegon	PASIPIC INDOMAS PLASTIC INDONESIA	P	I	CHEMICAL	BOILER/OIL HEATER	24	336	50		300.000						339.000
14	Cilegon	PETROKIMIA NUSANTARA INT PT.	P	I	CHEMICAL	BOILER	24	365	54.990	56.511							137.000
15	Cilegon	STANDART TOYO POLIMER	P	I	CHEMICAL	GENSET BOILER	24	365			730.000					1.154.250	975.000
16	Cilegon	TRIPOLYTA INDONESIA PT.	P	I	CHEMICAL	BOILER	24	365	150.000		539.476						799.000
17	Cilegon	UNGGUL INDAH CORP.	P	I	CHEMICAL	HEATER GENSET	24	365	100		1.200.000					2.800.000	1.356.000
18	Cilegon	DANATA INDONESIA	P	I	METAL	GENSET	8	260			16.000						18.000
19	Cilegon	CATUR YASA	P	I	METAL	GENSET	8	240			30.000					69.000	34.000
20	Cilegon	CIGADING MASBAK CENTRE	P	I	METAL	OVEN/GENSET	16	240	80.000		16.000					128.000	128.000
21	Cilegon	GOLDEN HANTWARE PT.	P	I	METAL												0
22	Cilegon	KHI PIPE INDUSTRIES	P	I	METAL		8	260	50		10.000						11.000
23	Cilegon	KRATAMA GELINDO INTERNATIONAL	P	I	METAL	KETEL	16	260			48.000						54.000
24	Cilegon	PELAT TIMAH NUSANTARA	P	I	METAL	BOILER FURNACE	24	365	60	134.000						173.114	151.000
25	Cilegon	SEAMLES PIPA INDONESIA JAYA	P	I	METAL	GENSET/MESIN ROLL	16	240			800.000					128.000	904.000
26	Cilegon	SURINAGME UTAMA	P	I	METAL	GENSET	24	240			30.000					200	34.000
27	Cilegon	TIKSIMA YASA	P	I	OTHERS	GENSET	8	312			26.000						29.000
	Total																0 15.276.000
																	0
1	Jakarta West	UNILEVER INDONESIA	P	I	CHEMICAL	BOILER/GENSET	24	336				865.000				2.000.000	924.000
2	Jakarta West	ABC CENTRAL FOOD	P	I	FOOD	BOILER	9	288				100.000					107.000
3	Jakarta West	PERTAMI	P	I	TEXTIL	BOILER/GENSET	24	336				180.000					192.000
4	Jakarta West	VINITEX	P	I	TEXTIL	BOILER/GENSET	24	336			200.000						226.000
	Total																0 1.449.000
																	0

Source: PGN

No	District	Name	Status	Sector	Business	Appliance	Hour	Day	LPG Kg/Mont	FO Ltr/Mont	MSD Ltr/Mont	IDO Ltr/Mont	KERO Ltr/Mont	COAL Kg/Mont	WOOD Kg/Mont	ELEC Kwh/Mont	NAT. GAS M3/Mont
1	Jakarta East	ALEXINDO	P	1	B. METAL	BOILER		364	200.000								264.000
2	Jakarta East	JAKARTA PRIMA STEEL	P	1	B. METAL	DAPUR		364	1.000.000								1.318.000
3	Jakarta East	KABELINDO MURNI	P	1	B. METAL	BURNER		364			40.000						45.000
4	Jakarta East	Pnorsha DHARMA	P	1	B. METAL	BURNER		364			70.000						72.000
5	Jakarta East	TAIYO SINAR MAYA TRIN.	P	1	B. METAL	HEAT LEADER		364			190.000						202.000
6	Jakarta East	TOSU INDONESIA	P	1	B. METAL	BURNER		364			300.000						339.000
7	Jakarta East	WIRA MUSTIKA II	P	1	B. METAL	DAPUR (4), BOILER (3)		364			400.000						452.000
8	Jakarta East	GLAS FIBINDO INDAH	P	1	CERAMIC	MOULDING PREHEATING	24	312	320.000								422.000
9	Jakarta East	TRI BINTANG CHEMICAL	P	1	CERAMIC	MESIN CETAK		364			45.000						51.000
10	Jakarta East	VITALIA	P	1	CERAMIC	KILN, SPRY DRYER		364	77.000								102.000
11	Jakarta East	GARUDA MAS	P	1	CHEMICAL	BOILER		364			60.000						68.000
12	Jakarta East	MAHKOTA INDONESIA	P	1	CHEMICAL	MELTING FURNACE, BOILER		364		120.000						950	136.000
13	Jakarta East	PALEMAD INDONESIA CHEMICAL	P	1	CHEMICAL	DAPUR, BOILER, SPRY DRYER, GENSET	24	364	360		170.000						192.000
14	Jakarta East	TUNGGAL FARMASI	P	1	CHEMICAL	BOILER, DAPUR	24	312			500.000						876.000
15	Jakarta East	PABRIK TAHU	P	1	FOOD	BOILER	24	364			40.000						45.000
16	Jakarta East	ARYA JATI MULYA	P	1	METAL	OVEN, LAS, DAPUR PERANAS	7	312	500		10.000		30.000				43.000
17	Jakarta East	BUMI AGUNG PERKASA INDAH	P	1	METAL	OVEN 10 T/JAM, DAPUR (1)	24	312			30.000						34.000
18	Jakarta East	SAHANA KEMAS UTAMA	P	1	PAPER	BOILER 8 T/JAM	24	312			100.000						113.000
19	Jakarta East	LUCKY PRINT	P	1	TEXTIL	BOILER		364			170.000						192.000
20	Jakarta East	PABRIK KAOS ASLI	P	1	TEXTIL	BOILER		364			30.000						34.000
21	Jakarta East	PUNCAK GUNUNG MAS	P	1	TEXTIL	BOILER		364			60.000						68.000
22	Jakarta East	SANINDO PRIMA DAYA	P	1	TEXTIL	GENSET 625 KVA, BOILER 2.5 T/JAM	24	364			200.000						220.000
23	Jakarta East	SHINTA NYLON UTAMA	P	1	TEXTIL	GENSET(3), BOILER(3), DORMAN(2)	24	312			643.500						727.000
																	0
	Total																5.825.000
																	0
1	Jakarta North	SANMARU FOOD MANUFACTURING	P	1	FOOD	BOILER/GENSET	24	288				750.000				850.000	801.000
2	Jakarta North	HONDA PEGENAL	P	1	METAL	BOILER/MELTING P	24	288	6.500		60.500						77.000
3	Jakarta North	SILONA MURNI GLASS	P	1	CERAMIC	MELTIN P/GENSET	16	288			125.000						141.000
4	Jakarta North	ANCOL IRON FACTORY	P	1	METAL	FURNACE	12	240	150			36.000				180.000	39.000
5	Jakarta North	ELITE PERMAI METAL WORK	P	1	METAL	OVEN	14	288			48.000						54.000
																	0
	Total																1.117.000
																	0
1	Karawang	BHINNEKA KARYA WANUNGGAL	P	1	TEXTIL	GENSET 500 KVA (8), BOILER	24	364		520.000	500.000						1.152.000
2	Karawang	PINDO DELI	P	1	PAPER												0
3	Karawang	SURYA KARYA PRATAMA	P	1	TEXTIL	GENSET 1250 KVA, BOILER 5 T/JAM	24	364		850.512	817.800						1.994.000
4	Karawang	TRIGUNA PRATAMA ABADI	P	1	PAPER	GENSET(3), BOILER (3)	24	312		38.200	15.000		20.000				81.000
5	Karawang	TRITUNGGAL DUTA PERKASA	P	1	TEXTIL	GENSET, BOILER	24	364		333.840	321.000						740.000
6	Karawang	BUKIT MURIA JAYA	P	1	PAPER	GENSET, BOILER	24	364		353.600	340.000						783.000
7	Karawang	GOLDEN ADI SHOES	P	1	TEXTIL	MERCEDES BENZ(4 BUAH), WANSON (2)	24	312		189.280	192.000						419.000
8	Karawang	INDOMASTIKA PASIFIK TEXTIL MILLS	P	1	TEXTIL	GENSET 500 KVA	24	364		106.000	100.000						240.000
9	Karawang	INDOKRIJAYA	P	1	METAL		24	364	1.000.000	1.400.000							2.900.000
10	Karawang	PLASTIK NUSALINDO	P	1	CHEMICAL	GENSET 500 KVA	24	312	9.000	272.360	144.000						487.000
11	Karawang	SAMSTAR	P	1	TEXTIL	GENSET 600 KVA, BOILER 2 T/JAM	14	312		208.000	200.000						454.000
12	Karawang	INNI PIONER	P	1	FOOD	BOILER 100 KG/JAM	8	312	77.000	120.280	12.000						251.000
13	Karawang	SANTOMAS UTAMA	P	1	CHEMICAL	GENSET 100 KVA, 65 KVA	12	312	49.000	52.785	1.716						120.000
14	Karawang	KAIROM METAL PRIMA	P	1	METAL	GENSET 625 KVA	9	260		20.800	20.000						40.000
15	Karawang	KAYARIT METAL INDUSTRIES	P	1	B. METAL	BENDER MILL, MESIN COR	14	312	12.000	186.300			150.000				300.000
16	Karawang	PAKAN SANTERA JAYA	P	1	FOOD	BOILER 2,5 T/JAM	14	312		31.200	30.000						69.000
17	Karawang	KHAKISWA BUSANA INDAH	P	1	TEXTIL	GENSET 500 KVA	8	312		33.280	32.000						74.000
18	Karawang	BUANA MARIMAS TEXTIL	P	1	TEXTIL	GENSET 625 KVA, BOILER 1 T/JAM	24	312		72.800	70.000						161.000
19	Karawang	ANTOMTEX INDUSTRI	P	1	TEXTIL	DIESEL 910 KVA, BOILER 2,5 TON	24	364		156.000	150.000						346.000
20	Karawang	MALIGI SPINING MILL	P	1	TEXTIL		24	364	456	104.639	100.000						232.000
21	Karawang	PRESIDENT FEED INDONESIA	P	1	FOOD	BOILER 6 T/JAM	8	312		27.040	26.000						60.000
22	Karawang	WANUNGGAL ADI CEMERLANG	P	1	CHEMICAL	GENSET 3000 KVA, BOILER 3 T/JAM	22	312		224.640	216.000						498.000
23	Karawang	SARIMAS SENTOSA	P	1	PAPER	BOILER, GENSET 500 KVA	7	312		9.490	91.000						113.000
24	Karawang	DHARMALA TOMEI INDUSTRIAL	P	1	METAL	GENSET 200 KVA	12	312		16.640	16.000						37.000
25	Karawang	AFA SAMPOO GEMILANG	P	1	TEXTIL	BOILER 3 T/JAM, GENSET 300 KVA	24	312		172.640	166.000						383.000
26	Karawang	MITRA SETIA KHA PERWIRA	P	1	TEXTIL	BOILER, GENSET 500 KVA	16	364		26.730	25.950		500				59.000
27	Karawang	SEDIMA JOANAN KOOT WEAR	P	1	TEXTIL	GENSET 100 KVA, BOILER 2 T/JAM	24	312		31.200	30.000						69.000
28	Karawang	POLYSTAR PANCA MITRA INDUSTRI	P	1	TEXTIL	BOILER 26 T/JAM, GENSET 6000 KVA	24	312		1.768.483	1.700.464						3.918.000

Source: PGN

No	District	Name	Status	Sector	Business	Appliance	Hour	Day	LPG Kg/Mont	FO Ltr/Mont	HSD Ltr/Mont	IDO Ltr/Mont	KERO Ltr/Mont	COAL Kg/Mont	WOOD Kg/Mont	ELEC Kwh/Mont	NAT. GAS M3/Mont
29	Karawang	NOMOKEN SURYA	P	I	CHEMICAL	BOILER 5 T/JAM, HOT BOILER, GENSET 220 KV	24	364			180,000						203,000
																	0
Total																	16,767,000
																	0
1	Serang	CITRA BUANA UNGGUL	P	I	B. METAL	GENSET	6	312			18,000	-					18,000
2	Serang	COLOUR INDO ANEKA CHEMICAL	P	I	CHEMICAL	GENSET & BOILER	24	312			250,000	192,000					442,000
3	Serang	CONTINENTAL CARBON	P	I	CHEMICAL	GENSET	24	365			200,000						276,000
4	Serang	GOLDEN KEY GROUP	P	I	CHEMICAL	BOILER	24	365		4,297,020							4,834,000
5	Serang	INDOCHLOR KHARSA INDUSTRIES	P	I	CHEMICAL	BOILER/GENSET	24	336			60,000					268,800	98,000
6	Serang	INTI CELLULOSA UTAMA INDONESIA	P	I	CHEMICAL	BOILER/ GENSET	24	336			150,000					268,800	169,000
7	Serang	MULTISIDA AGRILINDO	P	I	CHEMICAL	BOILER	24	365			75,000						85,000
8	Serang	MARIGI LAJU SAKTI	P	I	CHEMICAL	BOILER	8	260			50,000						56,000
9	Serang	MARIGI LAJU SEJATI	P	I	CHEMICAL	BOILER	8	240			50,000					64,000	56,000
10	Serang	POLYCHEM LINDO INC	P	I	CHEMICAL	HEATER BOILER GENSET	24	365	45,000	110,000						280,000	184,000
11	Serang	SRIWIJAYA PERKASA SEJATI PT.	P	I	CHEMICAL	BOILER	24	312			35,000						40,000
12	Serang	SST	P	I	CHEMICAL	GENSET & BOILER	6	312			5,280						6,000
13	Serang	STYRINDOMO INDONESIA (SMI)	P	I	CHEMICAL	GASTURBINE	24	336	20,000,000		1,280,000						27,809,000
14	Serang	SULFINDO ADHI USAHA	P	I	CHEMICAL	BOILER/BENSET	24	336			50,000					268,800	56,000
15	Serang	TOYO LAMO	P	I	CHEMICAL	GENSET	24	336			70,000					268,800	79,000
16	Serang	TUNAS SUMBER IDEA KREASI KIMIA	P	I	CHEMICAL	GENSET, OIL HEATER	16	312			50,000						56,000
17	Serang	YASA GANESHA PURA PT	P	I	CHEMICAL	GENSET, BOILER	24	365			2,380,952	1,190,000					3,951,000
18	Serang	DASARIA UTAMA	P	I	METAL	BRANDWIR	8	312	1,500		16,000						20,000
19	Serang	JAKIMDO PERDANA	P	I	METAL	GENSET	7	312			1,900						2,000
20	Serang	CITRA MUTIARA PERMAI	P	I	OTHERS	GENSET	8	260			16,000						18,000
21	Serang	DUTA EMATAMA	P	I	OTHERS	GENSET	24	312			25,000						28,000
22	Serang	ELTRI INDO FOOT REDLY	P	I	OTHERS	BOILER	24	312			24,000						27,000
23	Serang	LUNG CHEONG BROTHERS	P	I	OTHERS	GENSET	12	312			112,000						127,000
24	Serang	PRIMA TIORAMA ASIA	P	I	OTHERS	GENSET	7	365			2,800		180			200	3,000
25	Serang	RAWA SHINTA CITRA KREASI	P	I	OTHERS	GENSET	8	260			8,000						9,000
26	Serang	CIPTA PAPERIA	P	I	PAPER	BOILER	24	365									0
27	Serang	OWAMO PAPER UTAMA	P	I	PAPER	BOILER/GENSET	24	365			300,000	210,000					583,000
28	Serang	SERAYAN MAJU PERSAT	P	I	PAPER	GENSET	24	312									0
29	Serang	KRAMS PRoritaTEX	P	I	TEXTIL	BOILER/GENSET	24	336			300,000					268,800	339,000
30	Serang	MULIA SPINDO MILLS	P	I	TEXTIL	GENSET	16	240			150,000					128,000	169,000
31	Serang	PANCA CITRA WIRA BROTHERS	P	I	TEXTIL	GENSET	24	336			800,000					268,800	904,000
32	Serang	PANCA PLAZA INDO TEXTILE	P	I	TEXTIL	BOILER/DYING/GENSET	24	288	15,000		350,000					230,400	426,000
33	Serang	PINTALAN WAS INTERNUSA	P	I	TEXTIL	GENSET	24	336			959,000						1,082,000
34	Serang	SAGIN BROTHERS	P	I	TEXTIL	GENSET	24	336			400,000					268,800	452,000
35	Serang	SUNG HWA DUNIA	P	I	TEXTIL	BOILER/GENSET	24	336			60,000					268,800	68,000
36	Serang	CITRA SELARAS BUSANINDO	P	I	TEXTILE		8	312			1,300						1,000
37	Serang	KRAMS PNoritaTEX PT.	P	I	TEXTILE	BOILER	24	365			300,000						339,000
38	Serang	MULIA SPINDO MILLS	P	I	TEXTILE	GENSET	24	365			324,000					6,840	366,000
39	Serang	PANCA PLAZAINDO TEXTIL	P	I	TEXTILE	BOILER	24	312	60		14,500	345,000					385,000
40	Serang	SINGLONG BROTHERS	P	I	TEXTILE	GENSET	16	312			24,000	18,000					40,000
41	Serang	SUGIN BROTHERS	P	I	TEXTILE	GENSET	24	365			171,429						194,000
42	Serang	SATYA MAYA INDAH WOODBASE IND PT.	P	I	WOOD	GENSET	22	312			70,000						79,000
43	Serang	SUKSES INSH BUMINDO	P	I	WOOD	GENSET	24	365			65,000						73,000
																	0
Total																	43,934,000
																	0
1	Tangerang	TAIYO ARYA NUGRAHA	P	I	B. METAL	BOILER GENSET	8	312			28,862						30,000
2	Tangerang	MULIA KURNIA ABADI	P	I	CERAMIC	OVEN	7	288	125,000							97,200	155,000
3	Tangerang	PEARLAND	P	I	CERAMIC	KILN	12	365	36,000								47,000
4	Tangerang	ASTRA OOGYANG INTERNATIONAL	P	I	CHEMICAL	BOILER GENSET	8	312			48,000						54,000
5	Tangerang	CHAROEN POKPHAND	P	I	CHEMICAL	GENSET	24	365			55,000						73,000
6	Tangerang	EJO LONDON CHEMICAL	P	I	CHEMICAL	WASIN PRES	7	312	4,500								5,000
7	Tangerang	ETERNAL BUANA CHEMICAL	P	I	CHEMICAL	BOILER GENSET	24	365	250		1,785						2,000
8	Tangerang	PARDIC JAYA CHEMICAL	P	I	CHEMICAL	BOILER GENSET	24	365	18,000		80,000						114,000
9	Tangerang	POLARIS CHEMICAL COY.	P	I	CHEMICAL	BOILER BURNER	24	365			240,000						271,000
10	Tangerang	POLY UNGGUL	P	I	CHEMICAL	OIL HEATER	24	365			200,000						226,000
11	Tangerang	SINAR BOLA TAMA	P	I	CHEMICAL	GENSET	7	312			12,500						13,000
12	Tangerang	SINGA TERBANG DUNIA	P	I	CHEMICAL	GENSET	8	312								630	0

Source: PGN

No	District	Name	Status	Sector	Business	Appliance	Hour	Day	LPG Kg/Mont	FO Ltr/Mont	HSD Ltr/Mont	IDO Ltr/Mont	KERO Ltr/Mont	COAL Kg/Mont	WOOD Kg/Mont	ELEC Kwh/Mont	NAT. GAS M3/Mont
13	Tangerang	SUNYA WILANI PLASTIK UTAMA	P	I	CHEMICAL	OVEN/GENSET	24	288	1.750		22.700						31.000
14	Tangerang	YOYOYOR	P	I	CHEMICAL	BOILER	16	312				28.000					27.000
15	Tangerang	YUASA BATTERY	P	I	CHEMICAL	LEAD PWDR.	24	365	36.612								48.000
16	Tangerang	GLOMIA INDUSTRI PANGAN	P	I	FOOD	BOILER	18	312				60.000					94.000
17	Tangerang	SARINI ASLI JAYA	P	I	FOOD	BOILER/GENSET	20	288			507.500	-				192.000	573.000
18	Tangerang	SENUA MEKANIKA	P	I	METAL	GENSET	7	312			9.000						5.000
19	Tangerang	DHARMA POLY METAL	P	I	METAL	GENSET	8	260	4.000		8.000						14.000
20	Tangerang	INTER FERRO MANGAMDO INDONESIA	P	I	METAL	REHEATING	24	336			94.787						107.000
21	Tangerang	JEMBO CABEL COMPANY	P	I	METAL	BOILER/REHEATING	16	288				120.000					128.000
22	Tangerang	KUSUMA JAYA PRATAMA	P	I	METAL	GENSET	14	312			16.000						18.000
23	Tangerang	KUMBANG CONTAINER IND.	P	I	METAL	BOILER GENSET	8	312			83.333						94.000
24	Tangerang	MITRA TONGYANG WOOSAN	P	I	METAL	GENSET, FURNACE	15	260			116.667						132.000
25	Tangerang	MUARA PLUIT INDAH STEEL	P	I	METAL	REHEATING	24	288				120.000					128.000
26	Tangerang	YUASA BATERY INDONESIA	P	I	METAL	CASTING/ DRYNG	24	288	25.000								32.000
27	Tangerang	ARTOIS PRIMA	P	I	OTHERS	BOILER, KOMPOR	8	312	200		1.000						1.000
28	Tangerang	ASTRA CIPTA UNDRELLA	P	I	OTHERS	GENSET	8	312			1.000						1.000
29	Tangerang	CENTER PLUS	P	I	OTHERS	FURNACE, MESIN CETAK	12	312			9.000					6	10.000
30	Tangerang	EDS MANUFACTURING	P	I	OTHERS	GENSET	8	312			5.000						6.000
31	Tangerang	JEMBO CABLE COMPANY	P	I	OTHERS		24	312			120.000						136.000
32	Tangerang	IS PRIMA KONNESIA	P	I	OTHERS	GENSET	10	312			3.500						4.000
33	Tangerang	KOUKA JAYA RUBBER IND.	P	I	OTHERS	BOILER	14	312			5.000						6.000
34	Tangerang	MITRA SEMMING IND	P	I	OTHERS	GENSET	9	312			50.000						56.000
35	Tangerang	MITRA TOYO TAKA IND.	P	I	OTHERS	GENSET	8	260			14.000						16.000
36	Tangerang	RAPINDO PASIFIC MAS	P	I	OTHERS	BOILER	8	312	1.000		4.800					329	7.000
37	Tangerang	SPONINDO MAKMUR	P	I	OTHERS	BOILER	16	312				20.000					21.000
38	Tangerang	SUNYA WILANI PLASTIK UTAMA	P	I	OTHERS	BOILER GENSET	24	312	3.750		22.500						29.000
39	Tangerang	TIP TOP (VANIA TOYS IND.)	P	I	OTHERS	GENSET	16	312			16.000						18.000
40	Tangerang	TUGU PAKULONAN	P	I	OTHERS	BOILER	12	312		9.000							10.000
41	Tangerang	GUMMING JAYA AGUNG	P	I	PAPER	BOILER GENSET	24	312				300.000					320.000
42	Tangerang	INDO PAPER PRIMA RAYA	P	I	PAPER	BOILER	16	312				40.000					42.000
43	Tangerang	INPAK AGUNG	P	I	PAPER	BOILER	16	312			60.000						88.000
44	Tangerang	KATI KARTIKA MEGAH	P	I	PAPER	BOILER GENSET	24	312			130.000						169.000
45	Tangerang	MULTI BOX INDAH	P	I	PAPER	BOILER/GENSET	16	288			70.000					153.600	79.000
46	Tangerang	SUMBER TUGU SERIBU	P	I	PAPER	BOILER	24	365		45.000							51.000
47	Tangerang	UNIPA JAYA, PT	P	I	PAPER	BOILER	24	365			478.000						540.000
48	Tangerang	ACTEX	P	I	TEXTILE	BOILER	24	336			299.000						329.000
49	Tangerang	DIONI TEXTINDO	P	I	TEXTILE	KOMPOR	24	365					1.700				1.900
50	Tangerang	GOLDEN TAIEK INDONESIA	P	I	TEXTILE	GENSET	24	365			300.000						339.000
51	Tangerang	GUNAWAN TEXTINDO	P	I	TEXTILE	KOMPOR	24	365	138				1.000				1.000
52	Tangerang	HINGS SUBUR	P	I	TEXTILE	BOILER	8	312			40.000						45.000
53	Tangerang	HINGS SUBUR	P	I	TEXTILE	BOILER	8	288				40.000					43.000
54	Tangerang	INDO YONGTEX JAYA	P	I	TEXTILE	BOILER	12	365			6.210						7.000
55	Tangerang	JAWA MAJU IND.	P	I	TEXTILE	KOMPOR, DIESEL	8	312	48		5.000						6.000
56	Tangerang	JAYA SUNLI SUBUR MAKMUR POLYESTER PT	P	I	TEXTILE	BOILER	24	365			180.000						203.000
57	Tangerang	KOLN KARYA WISESA	P	I	TEXTILE	GENSET	8	260			8.000						9.000
58	Tangerang	KUNAFINDO	P	I	TEXTILE	BOILER, GENSET	24	365	500		1.011.904	488.095					1.865.000
59	Tangerang	KUNATEX	P	I	TEXTILE	BOILER	24	365				400.000					427.000
60	Tangerang	SARASA NITRATAMA	P	I	TEXTILE	GENSET	7	312	150		30.000						34.000
61	Tangerang	SHINTA INDAH JAYA	P	I	TEXTILE	BOILER	24	336			300.000						329.000
62	Tangerang	TAEHWA INDONESIA	P	I	TEXTILE		24	312		8.000	132.000						158.000
63	Tangerang	TERMINAL GAYA SUGANA	P	I	TEXTILE	BOILER	8	312			12.000						14.000
64	Tangerang	TONIKITEX	P	I	TEXTILE	BOILER	8	288			40.000						45.000
65	Tangerang	ANEKA INDOWOOD INDUSTRI	P	I	WOOD	GENSET	24	336							500.000		176.000
66	Tangerang	ANTEX	P	I	WOOD	GENSET	8	260			5.000						6.000
67	Tangerang	TONGGO MITRA JAYA	P	I	WOOD	GENSET	14	312			8.333						9.000
68	Tangerang	OKASA INDAH PT	P	I	WOOD	DIESEL	14	365			16.000						18.000
																	0
	Total																7.771.000

Source: PGN

LIST OF POTENTIAL CUSTOMERS IN FUTURE

No	District	Name	Status	Sector	Business	Appliance	Hours	Day	LPG Kg/Mont	FO Ltr/Mont	HSD Ltr/Mont	IDO Ltr/Mont	KERO Ltr/Mont	COAL Kg/Mont	WOOD Kg/Mont	ELEC Kwh/Mont	NAT.GAS M3/Mont
1	Bekasi	INDOALLOY UTAMUSA	F	1	8. METAL		24	365									2,400,000
2	Bekasi	TUNNAK MAS INTI	F	1	8. METAL		24	365									175,000
3	Bekasi	GLASS PYRINDO	F	1	CERAMIC		24	365									300,000
4	Bekasi	INDO PORLEN	F	1	CERAMIC		24	365									250,000
5	Bekasi	KING HIKARIKO	F	1	CERAMIC		8	240									35,000
6	Bekasi	OROBAN PERKASA	F	1	CERAMIC		24	365									1,000,000
7	Bekasi	PERKASA PRIMA	F	1	CERAMIC		24	330	100000								0
8	Bekasi	RADIAN KERAMIK INDAH	F	1	CERAMIC		24	365									450,000
9	Bekasi	WAHYUNUSA WAHANA	F	1	CERAMIC		24	365									750,000
10	Bekasi	BRITGSTONES	F	1	CHEMICAL		24	365									350,000
11	Bekasi	DARMA ARDA YARMA	F	1	CHEMICAL		8	240									10,000
12	Bekasi	PURIN INDUSTRI	F	1	CHEMICAL		8	330									50,000
13	Bekasi	GALYK ARTHA BAHARI	F	1	CHEMICAL		16	330									25,000
14	Bekasi	INDOFARMA	F	1	CHEMICAL		8	240									550,000
15	Bekasi	METALINDO MOLEK	F	1	CHEMICAL		8	240									20,000
16	Bekasi	MULTI KIMIA	F	1	CHEMICAL		8	240									100,000
17	Bekasi	POLEKAO INDONESIA	F	1	CHEMICAL		8	330									180,000
18	Bekasi	RUCIKA PLASTIC	F	1	CHEMICAL		16	240									90,000
19	Bekasi	SUMI ASIH PT	E	1	CHEMICAL	Boiler	24	330			46080		648000				0
20	Bekasi	SWASTIKA PARANAMULYA	F	1	CHEMICAL		8	330									150,000
21	Bekasi	TAKEDA INDONESIA	F	1	CHEMICAL		8	330									10,000
22	Bekasi	BUKIT MANIKAM SAKTI	F	1	FOOD		24	365									22,000
23	Bekasi	KARTIKA SASANA BOGA	F	1	FOOD		8	330									35,000
24	Bekasi	PRISCO	F	1	FOOD		24	330									180,000
25	Bekasi	SAN MIGUEL	F	1	FOOD	Boiler	24	330									40,000
26	Bekasi	SANTA KENT	F	1	FOOD		8	240									10,000
27	Bekasi	SINAR SOSRO	E	1	FOOD		24	365									350,000
28	Bekasi	ALEXINDO	F	1	METAL	Furnace/Oven	24	365									4,000,000
29	Bekasi	BRIPINDO UTAMA	F	1	METAL		8	240									25,000
30	Bekasi	GERBANG SAKAN BAJA	F	1	METAL		8	330									12,000
31	Bekasi	INDO ALUM	F	1	METAL	Furnace	24	365									900,000
32	Bekasi	INKOMOSIL	F	1	METAL		8	330									40,000
33	Bekasi	INDUSTRI NON WOVEN	F	1	METAL		24	365									60,000
34	Bekasi	INTER ALUMINDO	F	1	METAL		8	330									100,000
35	Bekasi	KATO BUKI ELECTRONIC	F	1	METAL		8	330									40,000
36	Bekasi	MENARA TERUS MAKMUR	F	1	METAL		8	240									15,000
37	Bekasi	SONNY ELECTRIC	F	1	METAL		8	330									10,000
38	Bekasi	T M S	E	1	METAL		8	365	60000		75000						0
39	Bekasi	TANDAN REJEKI MULYA	F	1	METAL		8	330									120,000
40	Bekasi	TOYOGIRI	F	1	METAL	Furnace	24	365									1,500,000
41	Bekasi	TRI DARMA WISESA	F	1	METAL		8	240									80,000
42	Bekasi	WIRADIAN	F	1	METAL			330									200,000
43	Bekasi	ZIPPO INDONESIA	F	1	METAL		16	330									50,000
44	Bekasi	SAMPURNA PERCETAKAN	F	1	PAPER		24	365									32,000
45	Bekasi	SARANA KEMAS UTAMA	F	1	PAPER		8	330									100,000
46	Bekasi	GLORIA CIPTA AGUNG	F	1	TEXTILE		8	330									12,000
47	Bekasi	INUMAS	F	1	TEXTILE			330									60,000
48	Bekasi	PANCA MEGA	F	1	TEXTILE	Boiler	8	240									700,000
49	Bekasi	POLLUX	F	1	TEXTILE		8	330									160,000
50	Bekasi	SHINTA NYLON UTAMA	F	1	TEXTILE		8	330									700,000
51	Bekasi	SHINTA SULINDAMICS	F	1	TEXTILE		8	330									250,000
52	Bekasi	SHINTA TOPAN PRINTING	F	1	TEXTILE		8	330									200,000
53	Bekasi	TORAY TEXPRINT	F	1	TEXTILE		8	330									800,000

Source:PGN

No	District	Name	Status	Sector	Business	Appliance	Hours	Day	LPG Kg/Mont	FO Ltr/Mont	HSD Ltr/Mont	IDO Ltr/Mont	KERO Ltr/Mont	COAL Kg/Mont	WOOD Kg/Mont	ELEC Kwh/Mont	NAT. GAS M3/Mont
54	Bekasi	Y K K	F	I	TEXTIL		24	330									500,000
																	0
	Total																15,198,000
																	0
1	Jakarta West	CITRA LAND	F	K	OTHERS		10	365									70,000
2	Jakarta West	ROXY PLAZA	F	K	OTHERS		10	365									100,000
3	Jakarta West	SINAR JOPAN PERKASA	F	K	OTHERS		24	365									400,000
																	0
	Total																570,000
																	0
1	Jakarta Center	DAICHI HOTEL	F	K	OTHERS			365									50,000
2	Jakarta Center	INDOKISAR HOTEL	F	K	OTHERS		10	365									100,000
3	Jakarta Center	SHANGRILA HOTEL	F	K	OTHERS			365									70,000
																	0
	Total																220,000
																	0
1	Jakarta East	JAKARTA KYUI STEEL	F	I	B. METAL		24	365									600,000
2	Jakarta East	ARTISTIKA	F	I	CERAMIC		24	365									360,000
3	Jakarta East	P N C	F	I	CERAMIC		8	240									175,000
4	Jakarta East	BAYER	F	I	CHEMICAL		8	330									10,000
5	Jakarta East	CIBA	F	I	CHEMICAL		8	240									12,000
6	Jakarta East	DUMEX	F	I	CHEMICAL		8	330									24,000
7	Jakarta East	I. C. I	F	I	CHEMICAL		24	365									250,000
8	Jakarta East	MUSTIKA RATU	F	I	CHEMICAL		8	240									9,000
9	Jakarta East	SARAPAX	F	I	CHEMICAL		8	240									10,000
10	Jakarta East	TIRTA MENING MULYA	F	I	CHEMICAL		24	365									360,000
11	Jakarta East	WIRLOCK WARDEN	F	I	CHEMICAL		8	240									18,000
12	Jakarta East	BINA SUCI	F	I	FOOD		8	240									25,000
13	Jakarta East	FORMOS	F	I	FOOD		24	365									24,000
14	Jakarta East	FRISIEN FLAG	F	I	FOOD		24	365									600,000
15	Jakarta East	INDOMILK	C	I	FOOD		24	330	36000	107360							0
16	Jakarta East	KHONG GUAN	C	I	FOOD		16	330									75,000
17	Jakarta East	MERAPI	F	I	FOOD		8	240									20,000
18	Jakarta East	PABRIK ROTI CIRACAS	F	I	FOOD		8	330									480,000
19	Jakarta East	WINA SATWA	F	I	FOOD		8	240									20,000
20	Jakarta East	ALKAN	F	I	METAL		24	330									25,000
21	Jakarta East	CIPTA PIRANTI TEKNIK	F	I	METAL		8	240									10,000
22	Jakarta East	DENDRIT	F	I	METAL		24	365									200,000
23	Jakarta East	FEDERAL DAYA MUSTIKA	F	I	METAL		8	240									100,000
24	Jakarta East	FEDERAL NUSA METAL	F	I	METAL		8	240									15,000
25	Jakarta East	G. K. D GROUP	F	I	METAL		8	330									35,000
26	Jakarta East	HITACHI	F	I	METAL		8	240									30,000
27	Jakarta East	LOGAM SARI BIRMINDO	F	I	METAL		8	240									10,000
28	Jakarta East	METALINDO YOSAN	F	I	METAL			330									30,000
29	Jakarta East	NEW CROWN	F	I	METAL		8	240									45,000
30	Jakarta East	SAMBO METAL	F	I	METAL		8	240									240,000
31	Jakarta East	TOSHIBA	F	I	METAL		8	240									30,000
32	Jakarta East	WARNA CANGGIH	F	I	METAL		8	240									2,000,000
33	Jakarta East	YASONTA	F	I	METAL		8	330									55,000
34	Jakarta East	GURU INDONESIA	F	I	PAPER		24	330									700,000
35	Jakarta East	PUPAK	F	I	PAPER		24	365									101,000
36	Jakarta East	CENTEX	F	I	TEXTIL		24	365									10,000
37	Jakarta East	LASANO	F	I	TEXTIL		8	240									90,000
38	Jakarta East	PUNCAK GUNUNG WAS	F	I	TEXTIL		8	330									70,000

Source: PGN

No	District	Name	Status	Sector	Business	Appliance	Hours	Day	LPG Kg/Mont	FO Ltr/Mont	HSD Ltr/Mont	IDO Ltr/Mont	KERO Ltr/Mont	COAL Kg/Mont	WOOD Kg/Mont	ELEC Kwh/Mont	NAT. GAS M3/Mont
																	950,000
39	Jakarta East	S C Y I	F	I	TEXTIL		24	365									250,000
40	Jakarta East	SAMPURNA	F	I	TEXTIL	Oven/Boiler	8	330									10,000
41	Jakarta East	KAYU PERKATA	F	I	WOOD		8	240									25,000
42	Jakarta East	PEJALINDO	F	I	WOOD		8	240									0
																	0
	Total																3,461,000
																	0
1	Jakarta North	SINAR ANCOL	F	I	CHEMICAL			330									300,000
2	Jakarta North	ANCOL TERANG	F	I	METAL			330									40,000
3	Jakarta North	FATA METAL	F	I	METAL			10	312								5,000
4	Jakarta North	KRIKRAS	F	I	METAL			330									25,000
																	0
	Total																370,000
																	0
1	Karawang	TEXMACO PERKASA ENG.	F	I	CHEMICAL	GAS TURBINE	24	365									15,000,000
																	0
1	Tangerang	ALWIN	F	I	METAL			330									220,000
2	Tangerang	GARAMA DHARMA JAYA	F	I	METAL			330									750,000
3	Tangerang	GLASSINDO MITRA	F	I	CERAMIC	FURNACE	24	365	16200		90000						0
4	Tangerang	GUNUNG SEWU KENCANA	F	I	CERAMIC			330									1,250,000
5	Tangerang	INDAH JAYA	F	I	TEXTIL		24	288			120000						0
6	Tangerang	INDAH KIAT	F	I	PAPER	BOILER/GENSET	24	336			1500000					230400	0
7	Tangerang	INDO TAICHEN TEXTILE IN.	F	I	TEXTIL	BOILER	24	365				666640					0
8	Tangerang	INTAI ELEKTRIC PRIMA	F	I	CERAMIC	HEATING CUTTER	12	288	100000								0
9	Tangerang	INTER WORLD STEEL MILLS INDONESIA	F	I	METAL	CUTTING, MELTING FURNACE	24	365	1500	65000							0
10	Tangerang	ISTEM	F	I	TEXTIL	BOILER	24	312									65,000
11	Tangerang	JAYACO MURNI ABADI	F	I	METAL		24	312									4,160,000
12	Tangerang	MAXIFERO STEEL INDUSTRY	F	I	METAL	CUTTING, ROLLING	24	365	5000				200000				0
13	Tangerang	NEW RED & WHITE	F	I	METAL		14	312									40,000
14	Tangerang	NON FERINDO UTAMA	F	I	METAL			330									50,000
15	Tangerang	PACINECTA CHEMICAL	F	I	METAL		24	312									96,000
16	Tangerang	SATYA STEEL	F	I	METAL			330									500,000
17	Tangerang	SULYNDAPIN GROUP, PT	F	I	CHEMICAL	BOILER, DIESEL	24	365			1800000	750000					0
18	Tangerang	SUPER TATA RAYA STEEL	F	I	METAL	REHEATING FURNACE	24	365			240000						0
19	Tangerang	TIFICO	F	I	TEXTIL	Boiler	24	365									1,800,000
20	Tangerang	TRI MARGA JAYA HUTAMA	F	I	CERAMIC		8	330									50,000
21	Tangerang	TULUS REJEKI MURNI	F	I	FOOD	GENSET	10	365	5000		3000						0
22	Tangerang	WARGA LANEX	F	I	CHEMICAL	SPRAY DRYER	24	312									67,000
23	Tangerang	WIDTCO	F	I	TEXTIL		16	312									258,000
24	Tangerang	YASINTA POLY	F	I	TEXTIL		24	365									1,100,000
																	0
	Total																16,606,000
	Ground Total																56,442,000

Source: PGN

Table Fuel Consumption in the Industrial Sector in Serang

		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Gasoline	(kl)	272	552	316	375	393	718	736	989	895	1,265
Diesel fuel	(kl)	7,434	8,230	12,383	21,147	23,370	35,274	47,179	33,124	46,995	62,727
Diesel oil	(kl)	76,178	15,545	10,854	17,881	12,591	13,316	14,042	10,125	38,114	52,463
Bunker C Fuel	(kl)	0	0	0	0	0	0	0	0	8	399,368
Kerosene	(kl)	184	222	213	472	498	931	1,520	1,049	1,329	871
Coal	(t)	0	0	0	0	0	0	0	0	0	0
Coke	(t)	0	509	1,110	5,484	1,814	1,814	1,814	1,180	1,180	1,479
Gas	(10^3m^3)	186,159	236,000	286,239	282,504	431,458	376,556	321,654	333,581	580,900	458,004

Table Fuel Consumption (calolie equivalent) in the Industrial Sector in Serang

		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
(A)Transportation											
Gasoline	(10^3kcal)	2,132,480	4,237,680	2,477,440	2,940,000	3,081,120	5,629,120	5,770,240	7,753,760	7,016,800	9,917,600
Diesel fuel	(10^3kcal)	67,374,342	74,588,490	112,227,129	191,655,261	211,802,310	319,688,262	427,583,277	300,202,812	425,915,985	568,494,801
Subtotal	(10^3kcal)	69,506,822	78,916,170	114,704,569	194,595,261	214,883,430	325,317,382	433,353,517	307,956,572	432,932,485	578,412,401
(B)Factory	(10^3kcal)										
Gas	(10^3kcal)	1,645,645,560	2,086,240,000	2,530,352,760	2,497,335,360	3,814,088,720	3,328,755,040	2,843,421,360	2,948,856,040	5,135,156,000	4,048,755,360
Diesel oil	(10^3kcal)	690,401,214	140,884,335	98,369,802	162,055,503	114,112,233	120,682,908	127,262,646	91,762,875	345,427,182	745,472,169
Kerosene	(10^3kcal)	1,626,560	1,962,480	1,882,920	4,172,480	4,402,320	8,230,040	13,436,800	9,273,160	11,748,360	7,699,640
Bunker C Fuel	(10^3kcal)	0	0	0	0	0	0	0	0	78,128	3,900,227,888
Coal	(10^3kcal)	0	0	0	0	0	0	0	0	0	0
Coke	(10^3kcal)	0	3,664,800	7,992,800	39,484,800	1,306,800	13,060,800	13,060,800	8,496,000	8,496,000	10,648,800
Subtotal	(10^3kcal)	2,337,673,334	2,232,751,615	2,638,597,482	2,703,048,143	3,945,664,073	3,470,728,788	2,997,181,606	3,058,388,075	550,905,670	8,442,803,857
Total	(10^3kcal)	2,407,180,156	2,311,667,785	2,753,302,051	2,897,643,404	4,160,547,503	3,796,046,170	3,430,535,123	3,366,344,647	5,933,838,155	9,021,216,258

Remarks: diesel fuel means transportation use (truck, passenger car) in factories.
diesel oil means net factory use (process heating, boiler, power generation)

Sourse: BPS

Table Fuel Consumption in the Industrial Sector in Tangerang

		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Gasoline	(kl)	2,271	3,508	7,114	5,983	5,517	9,182	35,474	11,890	7,988	8,796
Diesel fuel	(kl)	138,903	124,065	154,758	167,167	193,912	216,415	238,917	404,020	390,292	420,866
Diesel oil	(kl)	42,744	62,056	49,149	52,083	68,332	72,039	98,742	125,641	137,454	153,170
Bunker C Fuel	(kl)	0		0	0	0	0	0	0	885	3,961
Kerosene	(kl)	8,171	6,541	9,630	9,424	11,173	18,633	14,509	19,915	22,551	2,711
Coal	(t)	133	79	44	52	37	219	61	42	152	2,659
Coke	(t)	1	61	78	106	133	110	13	111	94	413
Gas	(10^3m^3)	3,962	10,227	8,778	13,547	34,940	64,675	104,563	104,838	114,424	150,458

Table Fuel Consumption (calorie equivalent) in the Industrial Sector in Tangerang

		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
(A)Transportation											
Gasoline	(10^3kcal)	17,804,640	27,502,720	55,773,760	46,906,720	43,253,280	71,986,880	278,116,160	93,217,600	62,625,920	68,960,640
Diesel fuel	(10^3kcal)	1,258,877,889	1,124,401,095	1,402,571,754	1,515,034,521	175,424,456	1,961,369,145	2,165,304,771	3,661,633,260	3,537,216,396	3,814,308,558
Subtotal	(10^3kcal)	1,276,682,529	1,151,903,815	1,458,345,514	1,561,941,241	1,800,677,736	2,033,356,025	2,443,420,931	3,754,850,860	3,599,842,316	3,883,269,198
(B) Factory	(10^3kcal)										
Gas	(10^3kcal)	35,024,080	90,848,680	77,597,520	119,755,480		571,727,000	924,336,920	926,767,920	1,011,508,160	1,330,048,720
Diesel oil	(10^3kcal)	387,388,872	566,491,878	445,437,387	472,028,229	619,292,916	652,889,457	894,336,920	1,138,684,383	1,245,745,602	1,338,179,710
Kerosene	(10^3kcal)	72,231,640	57,822,440	85,129,200	83,308,160	308,869,600	164,715,720	128,259,560	176,048,600	199,350,840	23,965,240
Bunker C Fuel	(10^3kcal)	0	0	0	0	0	0	0	0	8,642,910	38,683,126
Coal	(10^3kcal)	931,000	553,000	308,000	364,000	259,000	1,533,000	427,000	294,000	1,064,000	18,613,000
Coke	(10^3kcal)	7,200	439,200	561,600	763,200	957,600	792,000	93,600	799,200	676,800	27,973,600
Subtotal	(10^3kcal)	495,582,792	716,155,198	609,033,707	676,219,069	1,028,148,436	1,391,657,177	1,948,015,826	2,242,594,103	2,466,988,312	2,802,463,396
Total	(10^3kcal)	1,772,265,321	1,868,059,013	2,067,379,221	2,238,160,310	2,828,826,172	3,425,013,202	4,391,436,757	5,997,444,963	6,066,830,628	6,685,732,594

Remarks: diesel fuel means transportation use (truck, passenger car)in factories,
diesel oil means net factory use (process heating , boiler, power generation)

Soueee: BPS

Table Fuel Consumption in the Industrial Sector in DKI Jakarta

		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Gasoline	(kl)	14,000	14,701	15,762	16,574	21,069	23,434	22,519	26,432	24,657	26,397
Diesel fuel	(kl)	192,107	213,131	234,712	224,373	243,361	345,216	213,117	266,352	289,366	291,749
Diesel oil	(kl)	122,856	116,793	110,453	118,181	106,295	92,320	60,110	67,423	93,393	115,722
Bunker C Fuel	(kl)	0	0	0	0	0	0	0	0	81,392	86,071
Kerosene	(kl)	26,562	17,992	20,769	30,854	24,007	39,285	31,019	43,134	21,648	25,492
Coal	(t)	207	102	169	73	56	4	15	12	7,264	7,269
Coke	(t)	1,894	1,940	2,228	3,172	2,472	1,653	1,767	596	13,127	2,937
Gas	(10^3m^3)	33,069	32,041	47,744	52,823	63,080	87,948	81,353	102,677	90,858	153,932

Table Fuel Consumption (calorie equivalent) in the Industrial Sector in DKI Jakarta

		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
(A)Transportation											
Gasoline	(10^3kcal)	109,760,000	115,255,840	123,574,080	129,940,160	165,180,960	183,722,560	176,548,960	207,226,880	193,310,880	206,952,480
Diesel fuel	(10^3kcal)	1,741,065,741	1,931,606,253	2,127,194,856	2,033,492,499	2,205,580,743	3,128,692,608	1,931,479,371	2,413,948,176	2,622,524,058	2,644,121,187
Subtotal	(10^3kcal)	1,850,825,741	2,046,862,093	2,250,768,936	2,163,432,659	2,370,761,703	3,312,415,168	2,108,028,331	2,621,175,056	2,815,834,938	2,851,073,667
(B)Factory											
Gas	(10^3kcal)	292,329,960	283,242,440	422,056,960	466,955,320	557,627,200	777,460,320	719,160,520	907,664,680	803,184,720	1,360,758,880
Diesel oil	(10^3kcal)	1,113,443,928	1,058,494,959	1,001,035,539	1,071,074,403	963,351,585	836,696,160	544,776,930	611,054,649	846,420,759	1,048,788,486
Kerosene	(10^3kcal)	234,808,080	159,049,280	183,597,960	272,749,360	212,221,880	347,279,400	274,207,960	381,304,560	191,368,320	225,349,280
Bunker C Fuel	(10^3kcal)	0	0	0	0	0	0	0	0	794,874,272	840,569,386
Coal	(10^3kcal)	1,449,000	714,000	1,183,000	511,000	392,000	28,000	105,000	84,000	50,848,000	50,883,000
Coke	(10^3kcal)	13,636,800	13,968,000	16,041,600	22,838,400	17,798,400	11,901,600	12,722,400	4,291,200	94,514,400	21,146,400
Subtotal	(10^3kcal)	1,655,667,768	1,515,468,679	1,623,915,059	1,834,128,483	1,751,391,065	1,973,365,480	1,550,972,810	1,904,399,089	2,781,210,471	3,547,495,432
Total	(10^3kcal)	3,506,493,509	3,562,330,772	3,874,683,995	3,997,561,142	4,122,152,768	5,285,780,648	3,659,001,141	4,525,574,145	5,597,045,409	6,398,569,099

Remarks: diesel fuel means transportation use (truck, passenger car) in factories.
diesel oil means net factory use (process heating, boiler, power generation).

Sourse: *BPS*

Table Fuel Consumption in the Industrial Sector in Bekasi

		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Gasoline	(kl)	827	912	1,165	1,116	1,333	1,895	3,115	3,985	5,708	5,898
Diesel fuel	(kl)	20,482	20,834	23,831	26,205	32,596	264,563	49,454	76,141	94,727	123,667
Diesel oil	(kl)	13,963	12,227	11,679	12,584	15,834	15,798	38,040	37,179	35,039	25,708
Bunker C Fuel	(kl)	0	0	0	0	0	0	0	0	20,712	30,522
Kerosene	(kl)	533	782	1,505	2,554	3,023	3,985	16,350	25,044	14,501	12,905
Coal	(t)	0	0	0	3	6	19	8,900	322	1	2,420
Coke	(t)	19	0	23	0	410	532	420	16	15	2,753
Gas	(10^3m^3)	45	80	74	73	287	5,406	18,173	17,728	17,861	53,888

Table Fuel Consumption (calorie equivalent) in the Industrial Sector in Bekasi

		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
(A)Transportation											
Gasoline	(10^3kcal)	6,483,680	7,150,080	9,133,600	8,749,440	10,450,720	14,856,800	24,421,600	31,242,400	44,750,720	46,240,320
Diesel fuel	(10^3kcal)	185,628,366	188,818,542	215,980,353	237,495,815	295,417,548	2,397,734,469	448,201,602	690,065,883	858,510,801	1,120,794,021
Subtotal	(10^3kcal)	192,112,046	195,968,622	225,113,953	246,245,355	305,868,268	2,412,591,269	472,623,202	721,308,283	903,261,521	1,167,034,341
(B)Factory											
Gas	(10^3kcal)	397,800	707,200	654,160	645,320	2,537,080	47,789,040	160,649,320	156,715,520	157,891,240	476,369,920
Diesel oil	(10^3kcal)	126,546,669	110,813,301	105,846,777	114,048,792	143,503,542	143,177,274	344,756,520	336,953,277	317,558,457	232,991,604
Kerosene	(10^3kcal)	4,711,720	6,912,880	13,304,200	22,577,360	26,723,320	35,227,400	144,534,000	221,388,960	128,188,840	114,080,200
Bunker C Fuel	(10^3kcal)	0	0	0	0	0	0	0	0	202,273,392	298,077,852
Coal	(10^3kcal)	0	0	0	21,000	42,000	133,000	62,300,000	2,254,000	7,000	16,940,000
Coke	(10^3kcal)	136,800	0	165,600	0	2,952,000	3,830,400	3,024,000	115,200	108,000	19,821,600
Subtotal	(10^3kcal)	131,792,989	118,433,381	119,970,737	137,292,472	175,757,942	230,157,114	715,263,840	717,426,957	806,026,929	1,158,281,176
Total	(10^3kcal)	323,905,035	314,402,003	345,084,690	383,537,827	481,626,210	2,642,748,383	1,187,887,042	1,438,735,240	1,709,288,450	2,325,315,517

Remarks: diesel fuel means transportation use (truck, passenger car) in factories.
diesel oil means net factory use (process heating, boiler, power generation).

Sourse: *BPS*

Table Fuel Consumption in the Industrial Sector in Karawang

		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Gasoline	(kl)	538	495	534	552	179	298	1,260	1,890	3,858	703
Diesel fuel	(kl)	10,270	9,857	9,689	9,827	9,944	13,260	23,885	36,927	49,621	68,542
Diesel oil	(kl)	9,164	10,137	10,928	9,221	6,399	8,053	14,234	32,791	54,154	40,625
Bunker C Fuel	(kl)	0	0	0	0	0	0	0	0	7	4,949
Kerosene	(kl)	176	257	109	209	207	130	2,169	342	337	433
Coal	(t)	0	0	0	0	0	0	0	0	0	0
Coke	(t)	0	0	0	0	0	0	0	0	0	0
Gas	(10^3m^3)	0	0	0	11	16	17	16	75	65	11,923

Table Fuel Consumption (calorie equivalent) in the Industrial Sector in Karawang

		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
(A)Transportation											
Gasoline	(10^3kcal)	4,217,920	3,880,800	4,186,560	4,327,680	1,403,360	2,336,320	9,878,400	14,817,600	30,246,720	5,511,520
Diesel fuel	(10^3kcal)	93,077,010	89,333,991	87,811,407	89,062,101	90,122,472	120,175,380	216,469,755	334,669,401	449,715,123	621,196,146
Subtotal	(10^3kcal)	97,294,930	93,214,791	91,997,967	93,389,781	91,525,832	122,511,700	226,348,155	349,487,001	479,961,843	626,707,666
(B)Factory											
Gas	(10^3kcal)	0	0	0	97,240	141,440	150,280	141,440	663,000	574,600	105,399,320
Diesel oil	(10^3kcal)	83,053,332	91,871,631	99,040,464	83,569,923	57,994,137	72,984,339	129,002,742	297,184,833	490,797,702	368,184,375
Kerosene	(10^3kcal)	1,555,840	2,271,880	963,560	1,847,560	1,829,880	1,149,200	19,173,960	3,023,280	2,979,080	3,827,720
Bunker C Fuel	(10^3kcal)	0	0	0	0	0	0	0	0	68,362	48,331,934
Coal	(10^3kcal)	0	0	0	0	0	0	0	0	0	0
Coke	(10^3kcal)	0	0	0	0	0	0	0	0	0	0
Subtotal	(10^3kcal)	84,609,172	94,143,511	100,004,024	85,514,723	59,965,457	74,283,819	148,318,142	300,871,113	494,419,744	525,743,349
Total	(10^3kcal)	181,904,102	187,358,302	192,001,991	178,904,504	151,491,289	196,795,519	374,666,297	650,358,114	974,381,587	1,152,451,015

Remarks: diesel fuel means transportation use (truck, passenger car) in factories.
diesel oil means net factory use (process heating, boiler, power generation).

Sourse: *BPS*

Table Fuel Consumption in the Industrial Sector in Purwakarta

		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Gasoline	(kl)	6,866	6,858	196	183	186	189	220	552	996	312
Diesel fuel	(kl)	7,842	8,158	7,650	9,122	14,000	19,000	24,134	66,756	34,639	43,762
Diesel oil	(kl)	1,557	3,650	4,157	4,071	3,681	2,496	2,035	7,730	2,206	6,390
Bunker C Fuel	(kl)	0	0	0	0	0	0	0	0	60,507	39,765
Kerosene	(kl)	2,746	151	170	364	261	799	740	1,096	1,332	1,078
Coal	(t)	27	0	0	0	3	3	0	0	0	0
Coke	(t)	14	0	0	0	0	0	0	0	0	0
Gas	(10^3m^3)	2	0	0	0	0	0	0	2	1	951

Table Fuel Consumption (calorie equivalent) in the Industrial sector in Purwakarta

		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
(A)Transportation											
Gasoline	(10^3kcal)	53,829,440	53,766,720	1,566,640	1,434,720	1,458,240	1,481,760	1,724,800	4,327,680	5,456,640	2,446,080
Diesel fuel	(10^3kcal)	71,072,046	73,935,954	69,331,950	82,672,686	126,882,000	172,197,000	218,726,442	605,009,628	313,933,257	396,615,006
Subtotal	(10^3kcal)	124,901,486	127,702,674	70,868,590	84,107,406	128,340,240	173,678,760	220,451,242	609,337,308	319,389,897	399,061,086
(B)Factory											
Gas	(10^3kcal)	17,680	0	0	0	0	0	0	17,680	8,840	8,406,840
Diesel oil	(10^3kcal)	14,111,091	33,079,950	37,674,891	36,895,473	33,360,903	22,621,248	18,443,205	70,056,990	19,992,978	57,912,570
Kerosene	(10^3kcal)	24,274,640	1,334,840	1,502,800	3,217,760	2,307,240	7,063,160	6,541,600	9,688,640	11,774,880	9,529,520
Bunker C Fuel	(10^3kcal)	0	0	0	0	0	0	0	0	590,911,362	388,344,990
Coal	(10^3kcal)	189,000	0	0	0	21,000	21,000	0	0	0	0
Coke	(10^3kcal)	100,800	0	0	0	0	0	0	0	0	0
Subtotal	(10^3kcal)	38,693,211	34,414,790	39,177,691	40,113,233	35,689,143	29,705,408	24,984,805	79,763,310	622,688,060	464,193,920
Total	(10^3kcal)	163,594,697	162,117,464	110,046,281	124,220,639	164,029,383	203,384,168	245,436,047	689,100,618	942,077,957	863,255,006

Remarks: diesel fuel means transportation use (truck, passenger car) in factories.
diesel oil means net factory use (process heating, boiler, power generation).

Sourse: *BPS*

Table Fuel Consumption in the Industrial Sector in Bogor

		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Gasoline	(kl)	9,035	561	4,827	4,803	4,747	6,150	8,964	8,420	7,877	9,105
Diesel fuel	(kl)	115,405	118,799	13,630	92,781	99,078	108,405	117,732	146,512	189,071	172,546
Diesel oil	(kl)	218,805	402,508	342,119	450,184	480,349	488,604	504,968	308,519	348,924	123,720
Bunker C Fuel	(kl)	0	0	0	0	0	0	0	0	3,106	3,446
Kerosene	(kl)	2,170	1,720	1,721	6,139	6,227	6,629	7,359	8,476	3,493	6,309
Coal	(t)	1,264	1,724	13,789	7,322	8,087	8,087	164,376	229,913	508,356	2,031
Coke	(t)	163	944	217	240	1,988	1,988	237	821	2,799	513
Gas	(10^3m^3)	208,174	76,055	14,179	11,070	40,921	40,921	54,541	97,132	107,233	115,000

Table Fuel Consumption (caloric equivalent) in the Industrial Sector in Bogor

		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
(A)Transportation											
Gasoline	(10^3kcal)	70,834,400	4,398,240	37,843,680	37,655,520	37,216,480	48,216,000	70,277,760	66,012,800	61,755,680	71,383,200
Diesel fuel	(10^3kcal)	1,116,749,915	1,076,675,337	123,528,690	840,874,203	897,943,914	982,474,515	1,067,005,116	1,327,838,256	1,713,550,473	1,563,784,398
Subtotal	(10^3kcal)	1,116,749,915	1,081,073,577	161,372,370	878,529,723	935,160,394	1,030,690,515	1,137,282,876	1,393,851,056	1,775,306,153	1,635,167,598
(B)Factory											
Gas	(10^3kcal)	1,840,258,160	672,326,200	125,342,360	97,858,800	361,741,640	361,741,640	482,142,440	858,646,880	947,939,720	1,016,600,000
Diesel oil	(10^3kcal)	1,983,029,715	3,647,930,004	3,100,624,497	4,080,017,592	4,353,402,987	4,428,218,052	4,576,524,984	2,796,107,697	3,162,298,212	1,121,274,360
kerosene	(10^3kcal)	19,182,800	15,204,800	15,213,640	54,268,760	55,046,680	58,600,360	65,053,560	74,927,840	30,878,120	55,771,560
Bunker C Fuel	(10^3kcal)	0	0	0	0	0	0	0	0	30,333,196	33,653,636
Coal	(10^3kcal)	8,848,000	12,068,000	96,523,000	51,254,000	56,609,000	56,609,000	1,150,632,000	1,609,391,000	3,558,492,000	14,217,000
Coke	(10^3kcal)	1,173,600	6,796,800	1,562,400	1,728,000	14,313,600	14,313,600	1,706,400	5,911,200	20,152,800	3,693,600
Subtotal	(10^3kcal)	3,852,492,275	4,354,325,804	3,339,265,897	4,285,127,152	4,841,113,907	4,919,482,652	6,276,059,384	5,344,984,617	7,750,094,048	2,245,210,156
Total	(10^3kcal)	4,969,242,190	5,435,399,381	3,500,638,267	5,163,656,875	5,776,274,301	5,950,173,167	12,552,118,768	10,689,969,234	9,525,400,201	3,880,377,754

Remarks: diesel fuel means transportation use (truck, passenger car) in factories.
diesel oil means net factory use (process heating, boiler, power generation, etc).

Sourse: *BPS*

F. Integrated Potential Demand

Gas Demand Projection for Master Plan(Base)

			1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total			790,097	890,107	970,369	1,065,140	1,166,709	1,293,890	1,527,295	1,711,000	1,893,924	2,028,930	2,152,104	2,241,899	2,366,014	2,626,752	3,184,547	3,572,748	3,793,666	4,262,511	4,270,995	5,295,195	6,006,798	6,446,877	7,299,719	8,274,454	9,270,963	10,312,450
	Residential		2,490	2,274	2,706	3,701	10,157	17,424	25,209	39,184	41,179	49,256	57,414	65,801	74,310	82,943	91,700	100,584	109,466	118,456	127,554	136,781	146,078	156,909	164,837	174,769	184,000	193,734
	Commercial		7,490	10,234	13,212	16,536	21,739	28,815	40,818	56,199	74,966	97,099	122,012	149,592	178,000	208,073	239,851	273,465	309,093	346,779	386,751	428,124	474,054	521,704	572,247	625,886	682,257	743,125
		Gasvine		4,564	4,705	5,548	6,780	7,720	8,449	10,041	12,007	14,348	17,093	19,937	22,979	25,196	29,808	33,221	37,054	41,122	46,440	49,074	54,892	60,081	62,551	71,382	77,578	84,195
		Bar-Air		5,670	8,508	10,988	15,348	21,363	32,369	46,158	62,959	82,751	105,919	129,655	155,021	191,875	210,249	240,245	272,039	305,657	341,311	379,100	419,162	461,623	508,695	554,865	605,161	658,920
	Industrial		780,234	877,599	960,411	1,033,211	1,134,811	1,248,611	1,461,211	1,621,922	1,747,787	1,882,587	1,982,197	2,126,546	2,314,298	2,547,736	2,872,996	3,148,699	3,365,336	3,797,277	4,255,790	4,829,280	5,419,936	5,769,799	6,561,679	7,474,221	8,454,177	9,375,594
Tangerang					223,150	241,864	262,670	285,094	309,106	333,172	457,235	478,933	498,491	525,037	564,647	606,776	650,265	698,325	732,472	784,498	840,504	889,203	951,524	1,004,597	1,072,004	1,145,092	1,222,000	1,304,248
	Residential				150	525	1,477	2,852	4,918	8,900	7,097	9,712	11,228	13,210	15,422	17,562	19,272	21,933	24,137	29,388	28,923	30,810	32,222	35,529	37,661	40,240	42,940	45,869
	Commercial	Gasvine			0	825	1,250	1,875	2,501	3,126	3,751	4,376	5,001	5,626	6,251	6,877	7,502	8,127	8,752	9,377	10,002	10,628	11,253	11,878	12,503	13,128	13,753	14,378
		Bar-Air			0	1,734	9,842	9,227	15,187	21,047	29,907	37,767	39,927	44,487	50,247	56,207	62,067	67,927	73,787	79,647	85,507	91,367	97,227	103,087	108,947	114,807	120,667	126,527
	Industrial				222,000	239,000	255,000	271,000	287,000	293,000	419,000	427,000	442,825	461,600	492,925	525,732	561,084	600,366	625,796	669,506	718,596	766,596	819,822	854,000	913,650	977,499	1,045,742	1,118,784
DKI Jakarta					279,679	290,567	297,457	310,084	329,277	345,984	369,907	395,344	429,072	478,811	532,200	588,533	651,100	717,666	786,674	831,521	912,228	999,177	1,092,828	1,144,529	1,248,978	1,291,344	1,442,252	1,612,342
	Residential				2,019	2,741	5,048	8,995	12,509	16,070	19,967	23,300	26,574	29,944	33,364	36,833	40,352	43,922	47,488	51,098	54,751	58,447	62,188	65,972	69,717	73,542	77,407	81,314
	Commercial	Gasvine		4,564	4,705	5,548	6,780	7,720	8,449	9,542	7,804	9,349	11,465	12,939	15,990	18,500	21,211	24,124	27,257	30,825	34,243	38,128	42,290	46,705	51,556	56,897	62,781	68,990
		Bar-Air		5,670	8,508	8,988	9,018	10,996	15,116	22,232	32,432	40,582	61,782	79,104	97,972	118,199	139,929	163,287	188,417	215,431	244,451	275,606	309,004	344,880	383,299	424,453	469,918	515,971
	Industrial				261,000	268,000	277,000	283,000	292,000	301,000	309,000	317,000	329,273	356,005	384,884	416,014	449,012	486,355	493,517	534,277	578,784	629,977	679,311	649,982	744,407	806,663	874,149	947,298
Bekasi					291,000	341,259	409,299	478,111	535,204	582,021	618,551	657,309	671,006	720,495	820,228	920,528	1,032,581	1,191,979	1,222,555	1,327,124	1,523,218	1,719,194	1,928,928	2,078,514	2,221,107	2,506,755	2,819,411	3,172,530
	Residential				0	1,175	3,027	5,597	8,242	11,114	13,815	16,744	19,902	22,941	25,522	28,648	31,917	34,790	37,841	40,991	44,178	47,404	50,668	53,936	57,239	60,578	63,952	67,362
	Commercial	Gasvine			0	75	149	224	299	373	448	522	597	672	746	821	896	970	1,045	1,120	1,194	1,268	1,343	1,418	1,493	1,567	1,642	1,717
		Bar-Air			0	756	996	1,290	2,064	2,838	3,612	4,389	5,166	5,934	6,709	7,482	8,257	9,021	9,805	10,579	11,353	12,127	12,901	13,676	14,450	15,224	15,998	16,772
	Industrial				291,000	339,000	404,400	471,000	524,000	568,296	600,850	635,849	645,046	691,946	787,251	882,070	991,912	1,146,860	1,176,864	1,274,434	1,466,492	1,657,344	1,860,015	1,910,485	2,153,925	2,426,309	2,707,819	3,088,082
Karawang					65,411	65,411	97,411	122,811	150,211	185,731	197,331	218,931	229,535	240,676	249,676	290,316	337,304	393,489	441,187	515,452	602,277	700,749	822,218	880,799	1,029,201	1,207,810	1,405,227	1,642,005
	Residential																											
	Commercial																											
	Industrial				65,411	65,411	97,411	122,811	150,211	185,731	197,331	218,931	229,535	240,676	249,676	290,316	337,304	393,489	441,187	515,452	602,277	700,749	822,218	880,799	1,029,201	1,207,810	1,405,227	1,642,005
Purwakarta					0	0	0	46,600	108,400	164,000	221,800	276,400	334,049	368,684	399,658	431,995	493,097	551,609	629,977	763,506	901,568	1,078,694	1,291,191	1,437,500	1,720,443	2,059,093	2,341,190	2,560,825
	Residential																											
	Commercial																											
	Industrial						0	0	46,600	108,400	164,000	221,800	276,400	334,049	368,684	399,658	431,995	493,097	551,609	629,977	763,506	901,568	1,078,694	1,291,191	1,437,500	1,720,443	2,059,093	2,341,190	2,560,825

Gas Demand Projection for Master Plan(High Case)

			1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total			790,097	890,107	970,369	1,072,281	1,210,064	1,420,097	1,657,329	1,870,923	2,081,911	2,281,329	2,399,307	2,611,790	2,846,707	3,144,213	3,540,715	4,040,726	4,459,443	5,182,798	6,000,899	7,064,172	8,207,077	9,081,196	10,278,695	12,096,559	14,025,081	17,100,950
	Residential		2,490	2,274	2,706	5,412	10,215	17,472	25,395	39,455	41,875	49,938	58,282	67,070	75,834	84,798	93,918	103,292	112,992	121,860	131,528	141,270	151,148	161,196	171,267	181,352	192,293	202,932
	Commercial		7,490	10,234	13,212	16,536	21,738	28,819	40,823	56,547	75,955	98,250	124,357	152,995	181,311	212,000	245,264	280,382	317,883	356,972	401,208	447,507	497,222	550,029	606,020	666,719	730,048	797,391
		Gasvine		4,564	4,705	5,548	6,390	7,220	8,449	10,079	12,064	14,477	17,257	20,209	23,244	26,575	30,210	33,965	38,000	42,374	47,049	52,082	57,490	63,298	69,517	76,243	83,484	91,280
		Bar-Air		5,670	8,508	10,988	15,348	21,582	32,471	46,907	63,571	83,792	107,100	131,796	157,967	185,714	215,145	246,376	279,634	315,098	354,159	395,444	439,732	487,351	538,503	593,470	652,564	716,111
	Industrial		780,234	877,599	960,411	1,051,411	1,178,411	1,394,411	1,586,411	1,775,921	1,964,031	2,113,121	2,216,670	2,392,701	2,589,562	2,847,127	3,201,433	3,657,101	4,019,118	4,702,764	5,468,150	6,475,394	7,558,707	8,379,241	9,249,479	11,045,094	12,899,751	16,150,633
Tangerang					223,150	245,687	270,560	297,091	325,129	453,223	481,342	509,497	522,047	552,401	598,919	644,107	691,158	758,517	808,831	861,458	958,979	1,044,740	1,126,520	1,207,341	1,312,352	1,426,172	1,549,477	1,683,252
	Residential				150	526	1,487	2,859	4,442	9,050	7,684	9,344	11,494	13,572	16,749	17,965	20,220	22,518	24,870	27,150	29,524	31,845	34,292	36,881	39,408	41,973	44,576	47,221
	Commercial	Gasvine			0	825	1,250	1,875	2,501	3,126	3,751	4,376	5,001	5,626	6,251	6,877	7,502	8,127	8,752	9,377	10,002	10,628	11,253	11,878	12,503	13,128	13,753	14,378
		Bar-Air			0	1,734	6,843	9,227	15,187	21,047	29,907	37,767	39,927	44,487	50,247	56,207	62,067	67,927	73,787	79,647	85,507	91,367	97,227	103,087	108,947	114,807	120,667	126,527
	Industrial				372,000	243,000	262,000	282,000	302,000	422,000	440,000	460,000	466,625	488,718	524,672	563,056	604,368	659,947	701,477	743,781	824,877	910,810	993,849	1,055,495	1,151,494	1,256,224	1,370,429	1,495,125
DKI Jakarta					279,628	288,596	301,460	319,089	334,446	356,244	381,807	410,810	444,880	498,724	556,880	619,899	687,526	764,092	812,758	905,467	1,007,014	1,118,145	1,242,741	1,314,497	1,442,877	1,570,388	1,707,500	1,852,995
	Residential				2,019	3,750	5,072	9,002	12,565	16,188	19,805	23,600	26,998	30,477	34,019	37,624	41,292	45,027	48,791	52,562	56,412	60,278	64,290	68,334	72,439	76,584	80,817	85,105
	Commercial	Gasvine		4,564	4,705	5,548	6,780	7,720	8,449	9,542	7,804	9,349	11,465	12,939	15,990	18,500	21,211	24,124	27,257	30,825	34,243	38,128	42,290	46,705	51,556	56,897	62,781	68,990
		Bar-Air		5,670	8,508	8,988	9,018	10,996	15,116	22,232	32,432	40,629	62,312	81,275	100,911	122,024	144,821	169,418	195,242	226,472	257,206	291,950	329,033	370,509	415,109	463,479	515,899	572,812
	Industrial				261,000	271,000	281,000	291,000	301,000	311,000	321,000	331,000	342,882	372,992	406,909	441,071	479,902	524,746	540,517	585,556	657,446	720,700	802,946	830,563	919,727	1,016,906	1,128,996	1,250,594
Bekasi					291,000	362,467	427,893	523,125	593,751	652,041	695,457	742,718	787,847	866,582	938,885	1,031,999	1,158,309	1,350,063	1,467,515	1,707,666	1,903,800	2,274,724	2,648,940	2,811,109	3,273,821	3,812,191	4,442,009	5,175,309
	Residential				0	1,174	3,055	5,612	8,388	11,210	14,077	16,998	19,949	22,980	26,000	29,208	32,405	35,656	38,919	42,229	45,589	48,999	52,491	55,987	59,526	63,185	66,966	70,907
	Commercial	Gasvine			0	75	149	224	299	373	448	522	597	672	746	821	896	970	1,045	1,120	1,194	1,269	1,343	1,418	1,493	1,567	1,642	1,717
		Bar-Air			0	756	996	1,290	2,064	2,838	3,612	4,389	5,166	5,934	6,709	7,482	8,257	9,021	9,805	10,579	11,353	12,127	12,901	13,676	14,450	15,224	15,998	16,772
	Industrial				291,000	360,542	423,693	516,000	583,000	637,620	676,320	721,620	772,141	836,980	905,354	993,588	1,116,748	1,304,423	1,417,746	1,653,741	1,845,470	2,212,708	2,582,275	2,740,080	3,194,322	3,730,185	4,327,495	5,056,211
Karawang					65,411	65,411	100,411	122,411	166,411	210,211	225,211	252,211	266,805	273,008	287,008	326,009	367,954	461,219	539,471	658,823	806,095	984,023	1,202,781	1,342,250	1,640,800	2,000,908	2,481,327	2,999,590
	Residential																											
	Commercial																											
	Industrial				65,411	65,411	100,411	122,411	166,411	210,211	225,211	252,211	266,805	273,008	287,008	326,009	367,954	461,219	539,471	658,823	806,095	984,023	1,202,781	1,342,250	1,640,800	2,000,908	2,481,327	2,999,590
Purwakarta					0	0	0	61,000	133,000	205,000	277,000	348,000	377,748	420,993	465,931	511,406	592,750	666,624	819,912	1,029,370	1,296,291	1,631,521	2,056,055	2,410,510	3,039,046	3,831,272	4,566,563	5,378,114
	Residential																											
	Commercial																											
	Industrial						0	0	61,000	133,000	205,000	277,000	348,000	377,748	420,993	465,931	511,406	592,750	666,624	819,912	1,029,370	1,296,291	1,631,521	2,056,055	2,410,510	3,039,046	3,831,272	4,566,563	5,378,114

Gas Demand Prospekan for Master Plan(Low Case)

			1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total			760,990	880,107	978,299	1,008,529	1,121,979	1,291,021	1,491,848	1,655,077	1,665,880	1,799,471	1,879,116	2,116,098	2,294,161	2,507,208	2,700,219	2,882,187	3,099,717	3,371,819	3,645,973	3,902,982	4,207,506	4,391,049	4,770,560	5,184,269	5,575,575	5,967,390
	Residential		2,490	2,274	2,799	4,095	9,028	17,299	23,154	27,951	40,789	48,007	56,260	62,750	66,843	75,903	80,280	92,046	99,000	106,544	114,631	123,333	132,700	140,991	149,101	158,047	167,220	177,642
	Commercial		7,469	19,234	13,212	18,536	21,738	28,814	50,882	55,797	74,160	93,781	120,910	148,733	174,200	209,009	233,500	285,501	298,970	333,981	370,994	406,913	448,867	490,907	534,757	580,624	628,699	678,779
		Gasbura		4,564	4,709	5,548	9,809	12,238	8,435	9,996	11,919	14,200	18,941	19,924	22,559	25,846	28,904	32,938	39,935	39,702	43,850	47,784	52,119	56,947	61,995	69,367	71,572	77,027
		Bontang		5,670	8,503	12,988	11,929	16,576	42,447	45,801	62,239	79,581	101,969	128,809	151,641	183,163	204,596	252,563	259,035	294,279	326,934	361,130	396,748	434,960	472,762	511,257	557,127	601,752
	Industrial		750,724	827,599	960,411	1,015,011	1,081,211	1,214,411	1,326,011	1,456,223	1,550,943	1,652,052	1,801,922	1,908,575	2,051,015	2,278,207	2,440,236	2,634,938	2,701,717	2,931,294	3,160,708	3,432,736	3,725,819	3,759,151	4,096,722	4,445,588	4,782,449	5,111,969
Tangerang					327,150	337,820	354,207	373,042	392,085	412,128	432,189	461,440	471,781	492,571	522,204	562,477	599,500	631,765	650,810	684,815	720,154	756,962	795,109	810,294	856,278	897,852	941,087	986,081
	Residential				150	467	1,274	2,842	4,299	5,955	7,877	9,097	11,070	12,867	14,372	16,041	17,931	20,090	21,922	23,700	25,710	27,859	30,182	32,149	34,246	36,461	38,803	41,280
	Commercial	Gasbura			0	926	1,259	1,875	2,921	3,128	3,751	4,276	5,001	5,926	6,261	6,877	7,502	8,127	8,752	9,377	10,002	10,626	11,253	11,878	12,503	13,128	13,753	14,378
		Bontang			0	1,704	4,843	9,227	15,187	21,047	29,907	32,767	38,927	44,467	50,247	58,207	62,087	67,927	72,787	78,647	83,507	91,387	97,227	102,967	108,947	114,807	120,887	129,927
	Industrial				327,000	335,000	347,000	359,000	371,000	383,000	395,000	409,200	417,087	429,770	459,204	483,352	513,000	535,671	546,446	572,069	599,934	627,009	650,492	668,181	700,587	730,467	767,874	803,998
DKI Jakarta					278,628	284,413	297,992	304,000	318,092	326,281	355,932	379,742	419,068	464,810	501,699	551,979	605,900	651,844	699,509	747,203	807,610	871,960	938,531	998,149	1,040,468	1,116,731	1,195,104	1,279,839
	Residential				2,516	3,567	5,184	8,899	12,439	15,997	19,464	23,008	26,211	28,579	30,999	33,091	36,722	40,200	42,999	46,000	49,240	52,759	56,544	59,700	63,117	66,717	70,240	74,699
	Commercial	Gasbura		4,564	4,709	4,999	4,901	5,133	5,925	6,497	7,719	9,291	11,243	13,226	15,656	17,949	20,509	23,241	26,106	28,209	32,457	36,987	39,517	43,351	47,399	51,871	56,177	60,927
		Bontang		5,670	8,503	8,997	9,817	10,995	14,998	21,910	31,719	44,406	59,981	78,087	94,592	113,783	134,275	159,205	179,443	204,952	230,992	267,836	288,746	312,498	348,985	384,229	420,262	456,558
	Industrial				261,000	267,000	278,000	279,000	285,000	291,000	297,000	300,000	312,422	326,227	350,598	386,579	414,369	447,199	449,929	466,005	490,022	525,202	555,724	548,170	580,007	613,117	646,025	684,654
Bekasi					291,000	226,864	280,205	430,080	470,801	613,213	641,229	570,932	807,181	552,098	722,348	893,058	896,922	907,269	983,858	1,097,505	1,138,074	1,224,170	1,328,791	1,324,354	1,436,137	1,555,174	1,685,247	1,820,205
	Residential				0	951	2,598	5,562	8,299	11,029	13,774	16,572	19,200	21,472	23,892	26,071	28,720	31,766	34,209	36,841	39,573	42,716	46,094	48,783	51,739	54,999	58,197	61,704
	Commercial	Gasbura			0	75	149	224	299	373	448	522	597	672	746	821	896	970	1,046	1,120	1,195	1,269	1,343	1,418	1,492	1,567	1,642	1,717
		Bontang			0	258	669	1,290	2,084	2,838	3,612	4,386	5,160	5,934	6,708	7,483	8,257	9,031	9,805	10,579	11,353	12,127	12,901	13,676	14,450	15,224	15,998	16,772
	Industrial				291,000	272,000	276,800	420,000	460,200	598,972	572,982	549,492	582,110	524,018	691,231	765,083	838,150	925,007	939,800	1,018,965	1,082,859	1,170,056	1,272,052	1,260,478	1,367,406	1,463,512	1,569,420	1,748,912
Karawang					85,411	85,411	94,411	114,211	124,011	180,251	169,261	185,551	200,880	207,005	211,077	241,057	275,294	308,400	310,090	351,579	380,873	424,500	482,979	490,177	544,859	605,842	673,204	748,204
	Residential																											
	Commercial																											
	Industrial				85,411	85,411	94,411	114,211	124,011	180,251	169,261	185,551	200,880	207,005	211,077	241,057	275,294	308,400	310,090	351,579	380,873	424,500	482,979	490,177	544,859	605,842	673,204	748,204
Purwakarta					0	0	0	29,000	79,800	123,000	166,200	208,800	286,608	310,555	331,836	351,840	393,488	422,792	459,451	570,056	589,054	695,979	752,001	791,076	893,817	1,009,869	1,083,922	1,127,946
	Residential																											
	Commercial																											
	Industrial						0	29,000	79,800	123,000	166,200	208,800	286,608	310,555	331,836	351,840	393,488	422,792	459,451	570,056	589,054	695,979	752,001	791,076	893,817	1,009,869	1,083,922	1,127,946

G. Organization

G. Organization

Allocation of Work Force in a Japanese gas utility

As a reference, an allocation of employees in a Japanese gas utility is shown in a table below . According to the table, about one third of employees work for registration, meter reading and tariff collection. Another third of them work at marketing area for gas sales promotion. The others work at construction and distribution area for supervising construction of pipeline and indoor piping, maintaining distribution pipeline. In Japan sales promotion is very important, because the gas market is well matured. However, in Indonesia pipeline construction and distribution are important because gas demand is high and the gas market is growing rapidly. The allocation of work force is depend on the situation of each country.

Table : Allocation of Work Force in a Japanese gas utility

Name		No. employee	No. contractor	Total	Region	Total
Head Office	staff div.	2,192	136	2,328		22%
	line div.	883	6	889		9%
	subtotal	3,075	142	3,217		31%
Region Branch						
General Managers		15	0	15	0%	
Living Sales Dept.		2,250	1,136	3,386	54%	
Industrial Sales Dept.		823	3	826	13%	
Distribution Dept.		1,116	13	1,129	18%	
Safety & Distribution Control Center		611	1	612	10%	
Planning Dept.		246	4	250	4%	
Subtotal		5,061	1,157	6,218	100%	
Offices		616	97	713		
Others		265	2	267		
Subtotal		5,942	1,256	7,198		69%
Total		9,017	1,398	10,415		100%

*No. contractor: Number of contractor who are regularly hired

*Living Sales Dept.: Numbers include registration, meter reading, tariff collection, and gas sales for residential customers

Source: JICA Team

H. Human Resource Development Program

H. Human Resource Development

An Example of Human Resource Development Program in a Japanese Gas Company

PGN already has good training facilities in some operation areas. The training programs are very wide and diversified, and include marketing, technical training, economical training, computer training, management, audit, legal matters, logistics and English, as well as study abroad. Participants are currently limited to PGN employees. As a reference, the human resource development program of a Japanese company is shown below.

An Example of a Human Resource Development Program in a Japanese Gas Company

1. Training program for each level employees

For new graduates

1) 1st year for 1--2 months
2) 2nd year for 1 week
3) 3rd year presentation of research result

For high school graduates

1) 1st year (1--2 months)
2) 2nd year (1 day)
3) 3rd year including TOEIC English test(2 days)

For candidates of job promotion(including human assessment test)

Group discussion, presentation, decision making test (2-- 3 days)

For newly assigned group leaders and section chiefs

Management (4 days)

For middle age(45--49 years old) employee

Refreshment and revitalization(3 days)

2. Voluntary Training Program

- Management courses(human relation, presentation, leadership etc.)

3. Specialty Training Courses

- Business skill, computer program,
- Scholarship for study abroad
- Personnel exchange program with foreign companies

4. Subsidy (100~50%)

- Qualification tests(Gas engineer, TOEIC)
- Specified Lessons(Business related correspondence study, English)

5. Specialty Training Courses for Distribution and Utilization Area

<Distribution Area>

For new comers

- Gas Safety Inspection (5 months)
- Basic Course for main pipeline(20 days) and gas equipment(4 days)

<Marketing Area>

For manager level

- Accounting(2 days), Legal(1 day), Marketing control(2 days), Finance(2 days), Administration(2 days)

For Sales Promotion Staff for Residential Customers

- Sales promotion ability (2 days),
  Grade up promotion of appliances(2 days),
  Sales promotion of gas cooling(2 days),
  Sales promotion of gas ranges (3 days)

For Sales and Maintenance Staff for Industrial and Commercial Customers

(See an attached figure.)

6. Courses for staffs of franchised gas shops

- Qualifications (appliances installation, piping and maintenance)

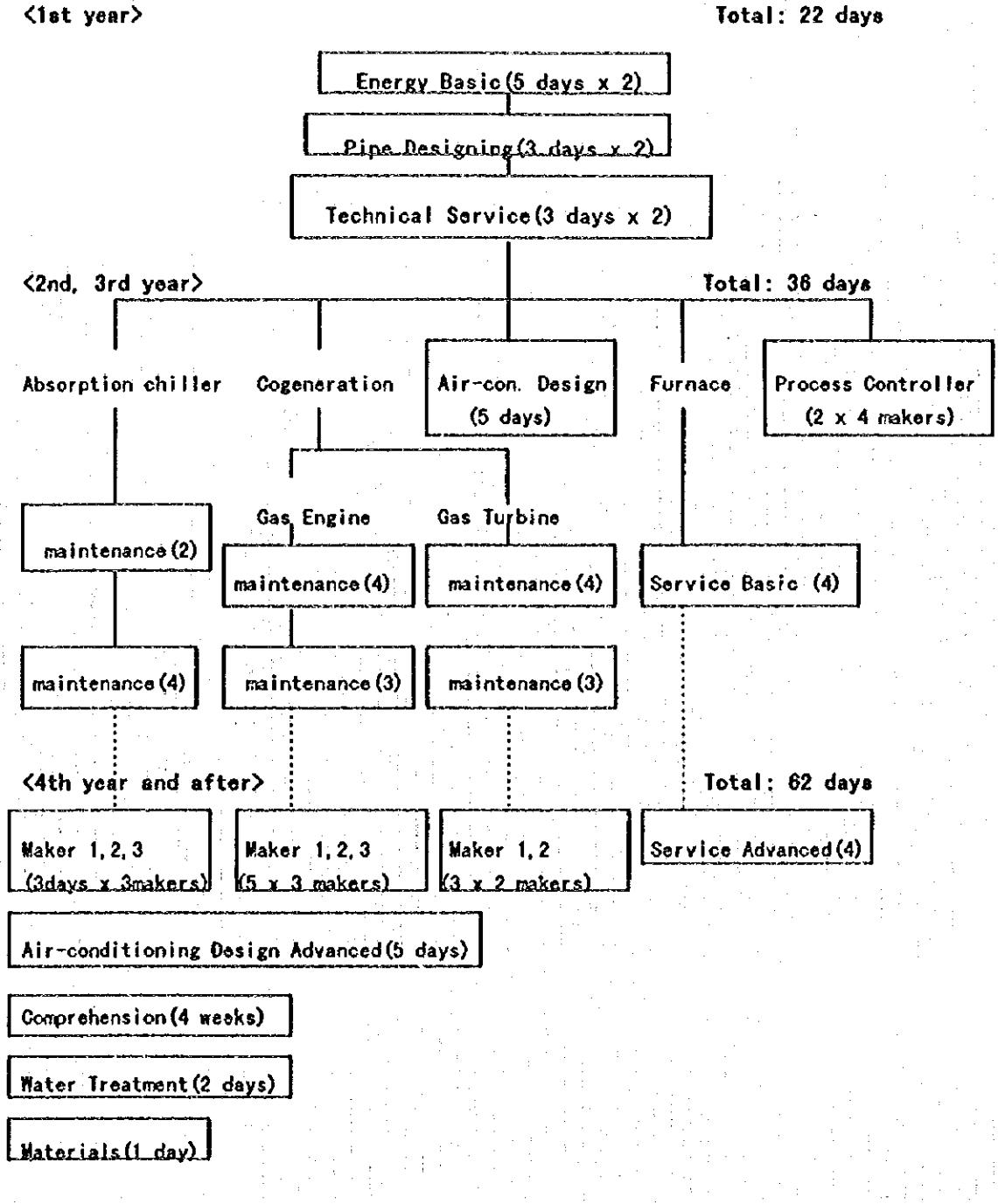
7. Courses for indoor- pipe contractors

- Qualifications (plumber, designer, supervisor)

8. Courses for Gas Main Contractors

- Qualifications (Supervisor, Maintenance, Gas work)

A Training Program for Sales & Maintenance Service Men for Commercial and Industrial Customers



I. Gas Network Cost

Appendix Gas network Cost

1.1 Distribution Pipe Construction Cost

Table 1 PIPE CONSTRUCTION COST

Max. pressure	Materials	Size	Note	Construction Cost(rp/m)			
				Total Cost unit	Material	Construction	Supervising
more than 10bar	steel	16 inch		426,000	185,000	170,000	71,000
		12 inch		317,000	115,000	149,000	53,000
		10 inch		268,000	92,000	131,000	45,000
		8 inch		221,000	66,000	118,000	37,000
		6 inch		184,000	50,000	103,000	31,000
		4 inch		149,000	30,000	94,000	25,000
4-10 bar	steel	16 inch		355,000	148,000	136,000	71,000
		12 inch		264,200	92,000	119,200	53,000
		10 inch		223,400	73,600	104,800	45,000
		8 inch		184,200	52,800	94,400	37,000
		6 inch		153,400	40,000	82,400	31,000
		4 inch		124,200	24,000	75,200	25,000
-4 bar	polyethylene	180 mm		191,000	48,000	93,000	50,000
		125 mm		136,000	24,000	79,000	33,000
		90 mm		101,000	14,000	64,000	23,000
		63 mm		84,000	8,000	58,000	18,000
		32 mm		24,000	4,000	15,000	5,000
		20 mm		21,000	3,000	14,000	4,000
	EF socket	180 mm		65,000	65,000	0	
		125 mm		33,000	33,000	0	
		90 mm		23,000	23,000	0	
		63 mm		11,000	11,000	0	
		32 mm		8,000	8,000	0	
		20 mm		7,000	7,000	0	
	EF elbow	180 mm		117,000	117,000	0	
		125 mm		67,000	67,000	0	
		90 mm		37,000	37,000	0	
		63 mm		25,000	25,000	0	
	EF saddle	180 mm	32mm	33,000	33,000	0	
		180 mm	63mm	61,000	61,000	0	
		125 mm	32mm	32,000	32,000	0	
		125 mm	63mm	57,000	57,000	0	
		90 mm	32mm	32,000	32,000	0	
		90 mm	63mm	58,000	58,000	0	
		63 mm		32,000	32,000	0	
	(Branching)	180mm	90mm	160,000	160,000	0	
		125mm	90mm	110,000	110,000	0	
4- 10 bar	gas meter	1000M3/h	G250 4"	13,862,000	13,862,000		
		500M3/h	G100 3"	11,327,000	11,327,000		
300mm	gas meter	G6.0	10m3/h	815,000	815,000		
		G4.0	6m3/h	276,000	276,000		
		G2.5	4m3/h	255,000	255,000		
		G1.6	2.5m3/h	76,000	76,000		
>16 bar	gas valve	16 inch	>16bar	28,970,000	28,970,000		
		12 inch		19,077,000	19,077,000		
		10 inch		13,888,000	13,888,000		
		8 inch		10,207,000	10,207,000		
		6 inch		8,026,000	8,026,000		
		4 inch		4,249,000	4,249,000		
<16 bar		16 inch	<16bar	25,584,000	25,584,000		
-4 bar	PE valve	180 mm		0	0		
		125mm		2,608,000	2,608,000		
		90mm		908,000	908,000		
		63mm		722,000	722,000		
	Meter station	3900m3/h	Belawang	561,055,000	561,055,000		
		2100m3/h		505,390,000	505,390,000		
		2940m3/h		649,556,000	649,556,000		
		1340m3/h		393,800,000	393,800,000		
	Governor station	400m3/h	G100	58,728,000	58,728,000		
		900m3/h	G250	68,185,000	68,185,000		
		1900m3/h	G400	80,323,000	80,323,000		
		3000m3/h	G650	118,948,000	118,948,000		

1.2 Indoor Pipe Construction Cost

Table 2 INDOOR PIPE CONSTRUCTION COST

Max. pressure	Materials	Size	Note	Construction Cost (rp/m)
2bar(house)	steel	150mm		50,000
		100mm		40,000
300mm H2o	steel	50mm		26,000
		25mm		24,000
		32mm		20,000
		13mm		20,000

Appendix Estimate Sheet Example of Indoor Pipes for Residential Customers

Jakarta, 2 Juni 1996

Number : 008/PTD/P/VI/96

Mr. Taupik Mulyadi
Jl. Garuda No. 2
Jakarta Pusat

Dear Sir

QUOTATION LETTER

In order to meet your request of Budget Plan for Installation Work of pipe installation channel for natural gas in housing complex is explained as follows:

1. Material cost for channel exterior	: Rp.	350.000,-	
2. Material cost for channel interior	: Rp.	520.000,-	
3. Installation cost	: Rp.	80.000,-	
			Rp. 950.000,-
4. Transportation and Administration cost			Rp. 150.000,-
5. Third party cost (digging permit from DKI)			Rp. 70.000,-
6. Supervising/Testing cost			Rp. 100.000,-
		Total cost	Rp. 1.270.000,-
		10% VAT	Rp. 127.000,-
Advance payment of Gas consumption			Rp. 13.500,-
		Total	Rp. 1.410.500,-

In words: One million four hundred ten thousand and five hundred rupiah.

If you agree with this quotation, please make the payment of the above amount to our office in Jl. Klp. Nias III, Blok PA 9/9 Kelapa Gading, North Jakarta or payment can also be made through our appointed Officer. This work will be started after the settlement of the above payment.

J. New Technology

Absorption Chiller(Hotel)

Economic Evaluation (Air conditioning)
Absorption chiller vs. Turbo-chiller(PLN/IPP)

(1) Conditions/Assumptions

					Absorption chiller	Turbo-chiller	
Facility	Type	Hotel		Power cost			
	Floor area	24,500	m2	Source(PLN or IPP)	PLN	PLN	
	Operation	24	Hr/Day	Type	R-3/MV	R-3/MV	
	from	0	o'clock	Demand charge	5400	5400	Rp/kVA
	to	24	o'clock	Energy charge (off-P)	157.0	157.0	Rp/kWh
		360	Day/Year	Energy charge (on-P)	212.0	212.0	Rp/kWh
	Ave.Load	32.7	kcal/m2/Hr	Ave. energy charge	166.2	166.2	Rp/kWh
		265	RT	Fuel cost Gas	330	Rp/m3	
	Avg./Max.	0.36	-	Equipment cost	4641	4444	Mill.Rp
Chiller	Load Design	90.8	kcal/m2/Hr	Motor capacity	58	280	kW/operation
	Capacity/unit	368	RT	Gas consumption	65366	m3/M	
	No.of Operation	2	unit	* off-P:off peak hour			
	No.of Stand-by	0	unit	* on-P :peak hour			

(2) Economic Analysis

	Absorption chiller	Turbo-chiller	
Annual running cost			
Variable cost			
Fuel cost	258.8	-	
Power cost	88.4	425.4	
Sub-total	347.2	425.4	Mill.Rp/Year
Fixed cost			
Depreciation	278.4	266.6	
Maintenance cost	139.2	133.3	
Tax & Insurance	46.4	44.4	
Interest	76.6	73.3	
Sub-total	540.6	517.7	Mill.Rp/Year
Total	887.9	943.1	Mill.Rp/Year

Pay-back year: 2.7 Year

Absorption Chiller(Shopping Center)

Economic Evaluation (Air conditioning)
Absorption chiller vs. Turbo-chiller(PLN/IPP)

(1) Conditions/Assumptions

					Absorption chiller	Turbo-chiller	
Facility	Type	Shopping		Power cost			
	Floor area	32,500	m2	Source(PLN or IPP)	PLN	PLN	
	Operation	13	Hr/Day	Type	R-3/MV	R-3/MV	
	from	8	o'clock	Demand charge	5,180	5,180	Rp/kVA
	to	21	o'clock	Energy charge (off-P)	178.5	178.5	Rp/kWh
		360	Day/Year	Energy charge (on-P)	240.5	240.5	Rp/kWh
	Ave.Load	71.6	kcal/m2/Hr	Ave. energy charge	192.8	192.8	Rp/kWh
		770	RT	Fuel cost Gas	330	Rp/m3	
	Avg./Max.	0.67	-	Equipment cost	7,169	6,728	Mill.Rp
Chiller	Load Design	106.9	kcal/m2/Hr	Motor capacity	169	815	kW/operation
	Capacity/unit	1,149	RT	Gas consumption	102,912	m3/M	
	No.of Operation	1	unit	* off-P:off peak hour			
	No.of Stand-by	0	unit	* on-P :peak hour			

(2) Economic Analysis

	Absorption chiller	Turbo-chiller	
Annual running cost			
Variable cost			
Fuel cost	407.5	-	
Power cost	166.0	799.0	
Sub-total	573.5	799.0	Mill.Rp/Year
Fixed cost			
Depreciation	430.1	403.7	
Maintenance cost	215.1	201.8	
Tax & Insurance	71.7	67.3	
Interest	118.3	111.0	
Sub-total	835.2	783.8	Mill.Rp/Year
Total	1,408.7	1,582.7	Mill.Rp/Year

Pay-back year: 2.1 Year

Absorption Chiller(Hospital)

Economic Evaluation (Air conditioning)
Absorption chiller vs. Turbo-chiller(PLN/IPP)

(1) Conditions/Assumptions

					Absorption chiller	Turbo-chiller	
Facility	Type	Hospital		Power cost			
	Floor area	6,000	m2	Source(PLN or IPP)	PLN	PLN	
	Operation	14	Hr/Day	Type	SS-4/MV	SS-4/MV	
	from	5	o' clock	Demand charge	6060	6060	Rp/kVA
	to	19	o' clock	Energy charge (off-P)	144.0	144.0	Rp/kWh
		360	Day/Year	Energy charge (on-P)	194.5	194.5	Rp/kWh
	Ave.Load	31.0	kcal/m2/Hr	Ave. energy charge	147.6	147.6	Rp/kWh
		61	RT	Fuel cost Gas	330	Rp/m3	
	Avg./Max.	0.36	-	Equipment cost	1079	1051	Mill.Rp
Chiller	Load Design	86.0	kcal/m2/Hr	Motor capacity	14	65	kW/operation
	Capacity/unit	85	RT	Gas consumption	8844 m3/M		
	No.of Operation	2	unit	* off-P:off peak hour			
	No.of Stand-by	0	unit	* on-P :peak hour			

(2) Economic Analysis

	Absorption chiller	Turbo-chiller		
Annual running cost			Pay-back year	3.9 Year
Variable cost				
Fuel cost	35.0	-		
Power cost	11.3	54.3		
Sub-total	46.3	54.3	Mill.Rp/Year	
Fixed cost				
Depreciation..	64.8	63.1		
Maintenance cost	32.4	31.5		
Tax & Insurance	10.8	10.5		
Interest	17.8	17.3		
Sub-total	125.7	122.5	Mill.Rp/Year	
Total	172.0	176.8	Mill.Rp/Year	

Absorption Chiller(Factory; case of IPP customer)

Economic Evaluation (Air conditioning)
Absorption chiller vs. Turbo-chiller(PLN/IPP)

(1) Conditions/Assumptions

					Absorption chiller	Turbo-chiller	
Facility	Type	Factory		Power cost			
	Factory are	70,000	m2	Source(PLN or IPP)	IPP	IPP	
	Operation	16	Hr/Day	Type	I-4/MV	I-4/MV	
	from	7	o' clock	Demand charge	12,000	12,000	Rp/kVA
	to	23	o' clock	Energy charge (off-P)	140.0	140.0	Rp/kWh
		330	Day/Year	Energy charge (on-P)	140.0	140.0	Rp/kWh
	Ave.Load	200	kcal/m2/Hr	Ave. energy charge	140.0	140.0	Rp/kWh
		1,028	RT	Fuel cost Gas	330.0	Rp/m3	
	Avg./Max.	0.75	-	Equipment cost	10,986	10,211	Mill.Rp
Chiller	Load Design	1,370	RT	Motor capacity	226	1,088	kW/operation
	Capacity/unit	343	RT	Gas consumption	155,024 m3/M		
	No.of Operation	4	unit	* off-P:off peak hour			
	No.of Stand-by	0	unit	* on-P :peak hour			

(2) Economic Analysis

	Absorption chiller	Turbo-chiller		
Annual running cost			Pay-back year	5.0 Year
Variable cost				
Fuel cost	614	-		
Power cost	208	1,001		
Sub-total	822	1,001	Mill.Rp/Year	
Fixed cost				
Depreciation	659	613		
Maintenance cost	330	306		
Tax & Insurance	110	102		
Interest	181	168		
Sub-total	1,280	1,190	Mill.Rp/Year	
Total	2,102	2,199	Mill.Rp/Year	

GHP(Office Building)

Economic Evaluation (Air conditioning)
GHP vs. Air source package(PLN/IPP)

(1) Conditions/Assumptions

						GHP	Air source Package	
Facility	Type	Office		Power cost				
	Floor area	1,500	m2		Source(PLN or IPP)	PLN	PLN	
	Operation	10	Hr/Day		Type	L-3/MV	L-3/MV	
	from	8	o' clock		Demand charge	5,180	5,180	Rp/kVA
	to	18	o' clock		Energy charge (off-P)	178.5	178.5	Rp/kWh
		300	Day/Year		Energy charge (on-P)	240.5	240.5	Rp/kWh
	Ave.Load	68.5	kcal/m2/Hr		Ave. energy charge	178.5	178.5	Rp/kWh
		34	RT		Fuel cost Gas	330	Rp/m3	
	Avg./Max.	0.67	-		Equipment cost	344	211	Mill.Rp
Chiller	Load Design	102.2	kcal/m2/Hr		Motor capacity	8	67	kW/operation
	Capacity/unit	51	RT		Gas consumption	3,344	m3/M	
	No.of Operation	1	unit		* off-P:off peak hour			
	No.of Stand-by	0	unit		* on-P :peak hour			

(2) Economic Analysis

	GHP	Air source Package	
Annual running cost			
Variable cost			
Fuel cost	13.2	-	
Power cost	4.7	41.2	
Sub-total	18.0	41.2	Mill.Rp/Year
Fixed cost			
Depreciation	20.6	12.7	
Maintenance cost	10.3	6.3	
Tax & Insurance	6.9	4.2	
Interest	37.8	23.3	
Sub-total	75.6	46.5	Mill.Rp/Year
Total	93.6	87.7	Mill.Rp/Year

Pay-back year: 6.9 Year

Cogeneration(Factory; case of IPP customer)

Economic evaluation (Gas Engine Cogeneration) IPP

(1)Conditions/Assumptions

Facility : Factory

<Capacity>		<Fuel price>		<Price of power>	
Output	1	Gas	330	Type	1-4/MV
No.of equipment	1			Demand charge	12000
		<Heat>		Energy charge	140.0
		Heat of combustion	7.94		
<Cost of Equipment>		Unit price	2.08	<Accounting condition>	
Unit cost mil.Rp	3.35 /kW	Boiler eff. %	85.0	Depreciation yr.	15
Eq. cost mil.Rp	3355			Salvage value %	10
Others mil.Rp	0	<Efficiency %>		Interest %	20
Total mil.Rp	3355	Power	31.0	Maintenance Rp/kWh	19.6
		Steam	19.0		
		Hot water	32.0		
		Total	82.0		

<Unit> Power:MW;Time:hr;Fuel:kl or 1,000Nm3;Heat:Gcal;Money:1000Rp

(2)Result

<Amount> (-/Year)

	CG system	Conv.	CG benefit
Power demand MW	8760	8760	-
CG power generated MW	8760	-	8760
Purchased power MW	0	8760	-8760
Contract demand MW	0.00	1.00	-1.00
Heat demanded Gcal	12393	12393	-
CG high temp. Gcal	4617	-	4617
CG low temp. Gcal	7776	-	7776
Boiler Gcal	0	12393	-12393
CG fuel Nm3	3061	-	3061
Boiler fuel Nm3	0	1836	-1836

<Econoaic calc.> (mil.Rp/year)

	CG system	Conv.	CG benefit
Demand charge	0.0	144.0	144.0
Energy charge	0.0	1226.4	1226.4
CG fuel	1010.0	0.0	-1010.0
Boiler fuel	0.0	515.1	515.1
Sub-total	1010.0	1885.5	875.4
Interest pay	301.9	0.0	-301.9
Maintenance	156.8	0.0	-156.8
Sub-total	458.7	0.0	-458.7
Total	1468.8	1885.5	416.7
Depreciation	201.3	0.0	-201.3

<CG operation> (%)

Power generated	100.0
Heat supplied	100.0
Heat utilized	100.0
Operation time	100.0
Load factor	100.0
Overall eff.	82.0

<Pow. unit cost> (Rp/kWh)

Variable cost	56.50
Fixed cost	75.35
Sub-total	131.85
Purchased pow.	ERR
Average	ERR
Conventional	156.44

Economic evaluation>

Payback years 4.7

CG : Cogeneration system

Conv. : Conventional system

Self Power Generator (Hotel)

Gas Engine

Economic Evaluation (Self engine generator)
Gas engine generator vs. PLN/IPP

(1) Conditions/Assumptions

					Self power Generator	PLN/IPP	
Facility Type	Hotel		Power cost				
Floor area	30000	m2	Source (PLN or IPP)		Self	PLN	
Operation	24	Hr/Day	Type		C-3/MV	C-3/MV	
from	0	o'clock	Demand charge		5180	5180	Rp/kVA
to	24	o'clock	Energy charge (off-P)		178.5	178.5	Rp/kWh
	360	Day/Year	Energy charge (on-P)		240.5	240.5	Rp/kWh
Generator:Ave. Load	51.6	W/m2	Ave. energy charge		188.8	188.8	Rp/kWh
	1548	kW	Fuel cost	Gas	330	Rp/m3	
Avg./Max.	0.50	-	Generator efficiency		30	%	
Max. Load	3096	kW	Fuel LHV		7940	kcal/m3	
Gen. Load	83.0	% in Total	Equipment cost				
Max. Demand	3445	kW		Generator	9315	Mill.Rp	
Generator Load Design	3096	kW		PLN/IPP	1403	Mill.Rp	
Capacity/unit	1548	kW	Gas engine				
Purchased power	7609	kWh/Day		Gas	402402	m3/M	
No. of Operation	2	unit		Power generated	1114560	kWh/M	
No. of Stand-by	0	unit	Max. kVA from outside		436	kVA	

* off-P:off peak hour
* on-P :peak hour

(2) Economic Analysis

	Self power Generator	PLN/IPP	
Annual running cost			
Variable cost			
Fuel cost	1593.5	-	
Power cost	544.4	3310.5	
Sub-total	2137.9	3310.5	Mill.Rp/Year
Fixed cost			
Depreciation	558.9	84.2	
Maintenance cost	131.1	7.0	
Tax & Insurance	186.3	28.1	
Interest	1024.7	154.3	
Sub-total	1900.9	273.5	Mill.Rp/Year
Total	4038.8	3310.5	Mill.Rp/Year

Pay-back year 6.1 Year

Self Power Generator (Hotel)

Diesel Engine

Economic Evaluation (Self power generator)
Diesel engine generator vs. PLN/IPP

(1) Conditions/Assumptions

					Self power Generator	PLN/IPP	
Facility	Type	Hotel		Power cost			
	Floor area	30000	m2	Source(PLN or IPP)	Self	PLN	
	Operation	24	Hr/Day	Type	U-3/MV	U-3/MV	
	from	0	o'clock	Demand charge	5180	5180	Rp/kVA
	to	24	o'clock	Energy charge (off-P)	178.5	178.5	Rp/kWh
		360	Day/Year	Energy charge (on-P)	240.5	240.5	Rp/kWh
Generato	Ave.Load	51.6	W/m2	Ave. energy charge	188.8	188.8	Rp/kWh
		1548	kW	Fuel cost IDO	400	Rp/l	
	Avg./Max.	0.5	-	Generator efficiency	35	%	
	Max.Load	3096	kW	Fuel LHV	8870	kcal/l	
	Gen.Load	83.0	% in Total	Equipment cost			
	Max.Demand	3445	kW	Generator	6448	Mill.Rp	
Generator	Load Design	3096	kW	PLN/IPP	1403	Mill.Rp	
	Capacity/unit	1548	kW	Diesel engine			
	Purchased power	7609	kWh/Day	IDO	192970	l/M	
	No.of Operation	2	unit	Power generated	1114560	kWh/M	
	No.of Stand-by	0	unit	Max.kVA from outside	436.0	kVA	

* off-P:off peak hour
* on-P :peak hour

(2) Economic Analysis

	Self power Generator	PLN/IPP	
Annual running cost			
Variable cost			
Fuel cost	926.3	-	
Power cost	544.4	3310.5	
Sub-total	1470.6	3310.5	Mill.Rp/Year
Fixed cost			
Depreciation	386.9	84.2	
Maintenance cost	173.9	7.0	
Tax & Insurance	129.0	28.1	
Interest	709.3	154.3	
Sub-total	1399.0	273.5	Mill.Rp/Year
Total	2869.7	3584.1	Mill.Rp/Year

Pay-back year 2.5 Year

Boiler in Hotel and Hospital

Hotel

1 Ton steam/h: 114,000 m3/y(Natural Gas)

Investment Cost (1 ton steam/h)

	Conventional System Solar Rp	Gas System Rp
Bioler	40,000,000	50,000,000
Auxiliary	7,750,000	13,305,000
Total	47,750,000	63,305,000
Difference	Base	15,555,000

Running cost

	Conventional System Solar Rp/y	Gas System Rp/y
Fuel cost	43,305,000	37,620,000
Difference	5,685,000	Base

Pay-back year 2.7

Hospital

1 Ton steam/h: 60,500 m3/y(Natural Gas)

Investment Cost (1 ton steam/h)

	Conventional System Solar Rp	Gas System Rp
Bioler	40,000,000	50,000,000
Auxiliary	7,750,000	13,305,000
Total	47,750,000	63,305,000
Difference	Base	15,555,000

Running cost

	Conventional System Solar Rp/y	Gas System Rp/y
Fuel cost	22,982,000	19,965,000
Difference	3,017,000	Base

Pay-back year 5.2 years

Cooking System

Typical Restaurant: 18,000 m3/y from PGN data; 26 samples

Investment Cost

	Conventional System LPG Rp	Gas System Rp
Cooking Appliance		
Gas pipe		3,535,000
Total	0	3,535,000
Difference	Base	3,535,000

Running cost

	Conventional System LPG Rp/y	Gas System Rp/y
Fuel cost	9,021,000	5,940,000
Difference	3,081,000	Base

Pay-back year 1.1 years

K. Theoretical Background and Application of Simultaneous Consumption Rate

Theoretical Background and Application of Simultaneous Consumption Rate

1. Definition of Simultaneous Consumption Rate

When we design a pipeline network for a group of residential customers, it is necessary to estimate the total gas load of the group. Suppose there exists a group of n housing units which have the same type of gas appliances with the input of q [m^3/h]. Then, the total load of the group is usually smaller than $n \times q$ since all of n customers do not necessarily use gas at the same time. If X [unit] customers use gas at the same time among the group of n customers, we define the ratio of X to n as the simultaneous consumption ratio and denote it as Y, that is

$$Y = \frac{X}{n} \qquad \cdots (1).$$

Using the simultaneous consumption ratio Y, we can express the load of one customer as $q \cdot Y$ and the total load of n customers Q [m^3/h] as

$$Q = (q \cdot Y) \cdot n \qquad \cdots (2)$$

2. Theoretical Background

2.1 Modeling

Whether a customer uses gas or not depends on the will of him or her when we consider the only one customer. However, when we take n customers, we can induce some law on the total consumption since some customers use gas and others do not usually, especially in case that n is large. In order to make a quantitative analysis, we consider the following model.

[Simultaneous Consumption Ratio Model]
a customer is "ON" when the customer uses gas equal to or more than q_0 [m^3/h]
a customer is "OFF" when the customer uses gas less than q_0 [m^3/h]
where q_0 is standard gas consumption level and $q_0 \leqq q$.

Here we suppose the probability that one customer is "ON" in a peak hour is equal to p.

2.2 Binomial Distribution

When p is given, the probability that k customers are "ON" among the total of n customers, that is, P(X=k), follows the binomial distribution B(n, p). Since the combination that k customers are selected from n customers is given by ${}_nC_k$, P(X=k) is

$$P(X = k) = {}_nC_k \cdot p^k \cdot (1-p)^{n-k} \qquad \cdots (3)$$

$$\text{where } {}_nC_k = \frac{n \cdot (n-1) \cdots (n-k+1)}{k!}$$

Also the probability that k or less than k customers are ON, that is $P(X \leqq k)$, can be

calculated by the following formula.

$$P(X \leqq k) = P(X=0) + P(X=1) + \cdots + P(X=k) = \sum_{i=0}^{k} P(X=i) \quad \cdots (4)$$

For example, if p = 0.20, the probability that only 3 customers are ON among n = 10 customers, P(X=3), is calculated as the following manner ;

$$P(X=3) = {}_{10}C_3 \cdot p^3 \cdot (1-p)^{10-3} = 120 \cdot (0.20)^3 \cdot (0.80)^7 = 0.201$$

$$\text{since } {}_{10}C_3 = \frac{10 \cdot (10-1) \cdot (10-3+1)}{3!} = \frac{10 \cdot 9 \cdot 8}{3 \cdot 2 \cdot 1} = 120$$

Calculating P(X=k) for k=1 to 10, the values of P(X≦k) are shown on Table 2-2-1.

Table 2-2-1. Value of P(X=k) and P(≦k) (n=10, p=0.20)

k	P(X=k)	P(X≦k)	k	P(X=k)	P(X≦k)
0	0.107	0.107	6	0.006	0.999
1	0.268	0.376	7	0.001	1.000
2	0.302	0.678	8	0.000	1.000
3	0.201	0.879	9	0.000	1.000
4	0.088	0.967	10	0.000	1.000
5	0.026	0.994			

From the above table, the probability that 5 or less customers are ON is 0.994. Therefore the probability that more than 5 customers use gas at the same time is

$$P(X>5) = 1 - P(X \leqq 5) = 1 - 0.994 = 0.006 \ (= 0.6\%)$$

This means the probability is less than 1 %. If we choose the 99 % confidential level, X=5 is sufficient and we can calculate the simultaneous consumption ratio Y as

$$Y = \frac{X}{n} = \frac{5}{10} = 0.500$$

Also if we select the 95 % confidential level, Y is calculated as

$$Y = \frac{X}{n} = \frac{4}{10} = 0.400$$

As this example shows, the simultaneous consumption ratio differs by the confidential level.

2.3 Approximation by Normal Distribution

When n is large, the calculation of binomial distribution becomes difficult because the value of ${}_nC_k$ becomes very large. It is, therefore, general to use normal distribution as the approximation of the binomial distribution. The normal distribution is described by average μ and standard deviation σ. When we convert event X to event Z by formula $Z = \frac{X-\mu}{\sigma}$, Z follows standard normal distribution. The probability that Z is equal to or less than a, P(Z≦a), is given by Standard Normal Distribution Table.

Typical values of $P(Z \leqq a)$ and z are shown below.

Table 2-3-1 Typical Values of $P(Z \leqq z)$ and z

$P(Z \leqq a)$	0.900	0.950	0.975	0.990	0.995	0.999	0.9995
a	1.282	1.645	1.960	2.326	2.576	3.090	3.290

When $n \cdot p \geq 5$ and $n \cdot (1-p) \geq 5$, the binomial distribution B(n,p) can be approximated using the normal distribution $N(\mu, \sigma)$ by setting

$$\mu = n \cdot p, \quad \sigma = \sqrt{n \cdot p \cdot (1-p)}.$$

Using the above relationship, we can calculate the simultaneous consumption ratio Y for a large n. Suppose we choose a confidence level α and there exists the relationship $P(Z \leqq a) = \alpha$ for the standard normal distribution. Then,

$$X \leq \mu + a \cdot \sigma \quad \text{since} \quad Z = \frac{X-\mu}{\sigma} \leq a .$$

$$\therefore \; X \leq n \cdot p + a \cdot \sqrt{n \cdot p \cdot (1-p)}$$

From formula (1),

$$Y = \frac{X}{n} \leq \frac{1}{n} \cdot [n \cdot p + a \cdot \sqrt{n \cdot p \cdot (1-p)}]$$

$$= p + \frac{a \cdot \sqrt{p \cdot (1-p)}}{\sqrt{n}} \qquad \text{--- (5)}$$

This is the formula of the simultaneous consumption ratio Y for a large n

3. Application to Actual Data

3.1 Value of p

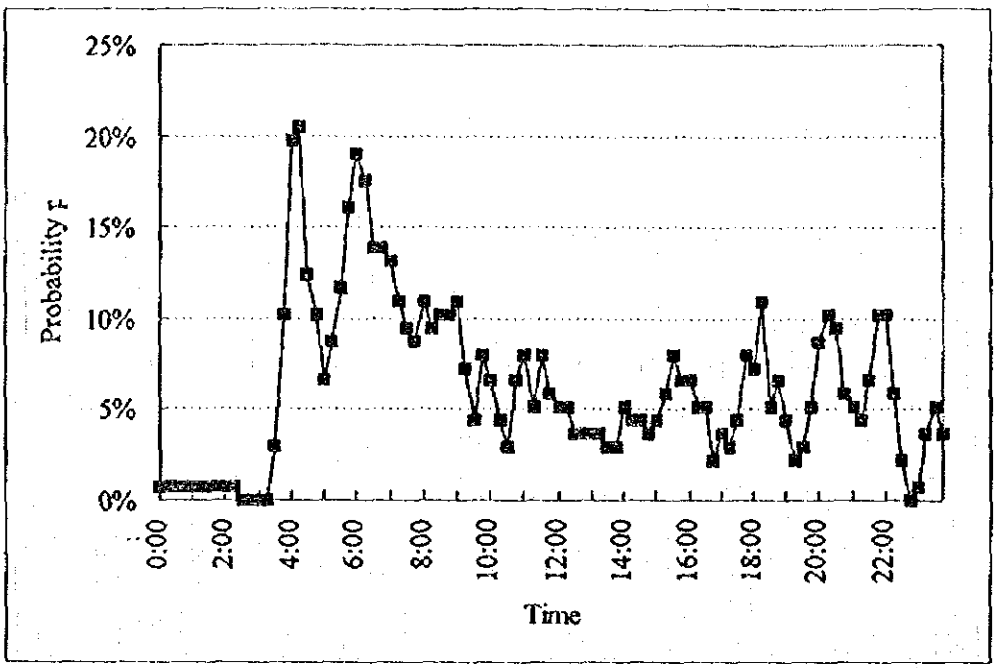
In order to determine the value of p, we calculated the probability that gas consumption is larger than a standard consumption level q_0. Here, we set the standard consumption level as q_0 = 350 liter/hour since the standard input of one gas burner is 0.35 m^3/hour in Jakarta from the hearing result to PGN. Using the load survey database, we calculate the probability p from the following formula.

$$p = \frac{k}{n}$$

where n is the total number of data to be examined (in this case, n = 137) and k is the number of data which are "ON" among the n customers. We calculated the value of p in every 15 minute and the result is shown in Fig. 3-1-1.

From the graph, the maximum value of p appears at 4:00 and its value is p=0.204. Therefore, we use p= 0.20 as the probability that one customer uses gas at the peak time in the Study.

Fig. 3-1-1 Value of p (Standard Consumption Level = 350 liter/hour)



Source : JICA Team

3.2 Calculation of Simultaneous Consumption Ratio

Using p= 0.20, we can calculate the simultaneous consumption ratio as the following manner. First, since n which satisfies $n \cdot p > 5$ is equal to or larger than 25, we will use the binomial distribution for $n \leq 25$ and the normal distribution for n>25. Secondly, we will select 99% and 99.9% as the confidence level α. In case of the binomial distribution, we will find k which satisfies $P(X \leqq k) > \alpha$ for each n from Table 3-2-1 and calculate the simultaneous consumption ratio by $Y = \frac{k}{n}$. In case of the normal distribution, the simultaneous consumption ratio Y is calculated by formula (5). Since p= 0.20 and $\sqrt{p \cdot (1-p)} = 0.40$,

$$Y = 0.20 + \frac{0.40 \cdot a}{\sqrt{n}} \qquad \cdots (6)$$

where a= 2.326 for α =99% and a= 3.090 for α =99.9%.

Table 3-2-1 Probability P(X≦k) for Binomial Distribution (p=0.20)

k	Number of Customers n							
	2	4	6	8	10	15	20	25
0	0.6400	0.4096	0.2621	0.1678	0.1074	0.0352	0.0115	0.0038
1	0.9600	0.8192	0.6554	0.5033	0.3758	0.1671	0.0692	0.0274
2	1.0000	0.9728	0.9011	0.7969	0.6778	0.3980	0.2061	0.0982
3		0.9984	0.9830	0.9437	0.8791	0.6482	0.4114	0.2340
4		1.0000	0.9984	0.9896	0.9672	0.8358	0.6296	0.4207
5			0.9999	0.9988	0.9936	0.9389	0.8042	0.6167
6			1.0000	0.9999	0.9991	0.9819	0.9133	0.7800
7				1.0000	0.9999	0.9958	0.9679	0.8909
8				1.0000	1.0000	0.9992	0.9900	0.9532
9					1.0000	0.9999	0.9974	0.9827
10					1.0000	1.0000	0.9994	0.9944
11						1.0000	0.9999	0.9985
12						1.0000	1.0000	0.9996
13							1.0000	0.9999
14							1.0000	1.0000
15								1.0000
16								1.0000
α	k which satisfies P(X<=k) > α							
99%	2	3	4	5	5	7	8	10
99.90%	2	4	5	6	6	8	10	12

Source : JICA Team

The result of calculation is shown on Table 3-2-2 and Fig. 3-2-1.

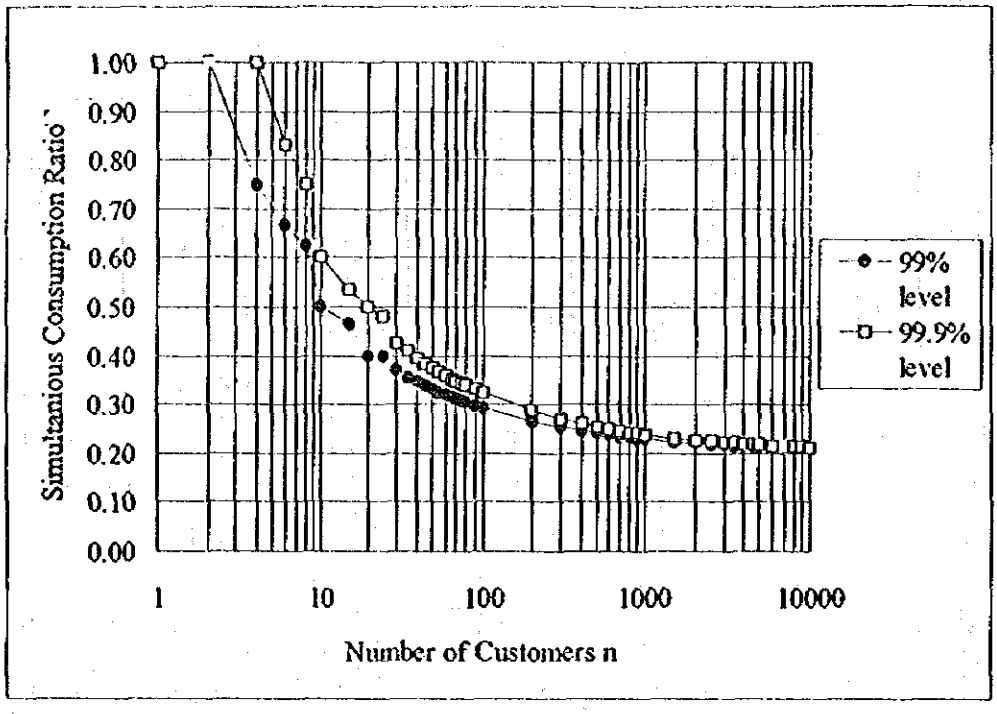
Table 3-2-2 Simultaneous Consumption Ratio

n	99% Level	99.9% Level	n	99% Level	99.9% Level	n	99% Level	99.9% Level
1	1.000	1.000	15	0.467	0.533	100	0.293	0.324
2	1.000	1.000	20	0.400	0.500	200	0.266	0.287
4	0.750	1.000	30	0.370	0.426	400	0.247	0.262
6	0.667	0.833	40	0.347	0.395	600	0.238	0.250
8	0.625	0.750	60	0.320	0.360	800	0.233	0.244
10	0.500	0.600	80	0.304	0.338	1,000	0.229	0.239

Source : JICA Team

If we adopt the confidence level of 99.9%, the simultaneous consumption ratios are 0.600 for the group of 10 customers, 0.324 for 100 customers and 0.239 for 1000 customers.

Fig. 3-2-1 Simultaneous Consumption Ratio for Residential Customers



Source : JICA Team

3.3 Value used in the Study

From the results of the load survey, we found it suitable to use q = 0.60 m^3/h as mentioned in section "5.2.2 Demand Fluctuations in the Residential Sector".

As for the simultaneous consumption ratio, it is recommended to use the safe value since this is the first time for PGN to survey the actual situation of residential gas consumption. Therefore, we adopt the 99.9% confidence level for the calculation of Y, that is, a = 3.09 in formula (6).

Table 3-3-1 Value used in the Study

Item	q	p	Y (for $n \geq 20$)
Value used	0.60 m^3/h	0.20	$Y = 0.20 + \frac{1.236}{\sqrt{n}}$

Source : JICA Team

As for the reference, simultaneous consumption ratios used in Japan are shown in Table 3-3-2.

Table 3-3-2 Simultaneous Consumption Ratios used in Japan

Type	Cooking	Heating & Hot Water Supply		Stored Type	Flat
n		Detached House	Flat for Family	Hot Water Supply	for Singles *
1	1.000	1.000	1.000	1.00	1.000
2	0.680	0.718	0.718	0.75	0.680
3	0.538	0.593	0.593	0.66	0.538
4	0.453	0.519	0.519	0.59	0.453
5	0.395	0.468	0.468	0.55	0.395
6	0.353	0.431	0.431	0.52	0.353
7	0.320	0.365	0.365	0.49	0.320
8	0.293	0.357	0.357	0.48	0.293
9	0.271	0.349	0.349	0.46	0.271
10	0.252	0.342	0.342	0.44	0.252
15	0.225	0.321	0.321	0.41	0.225
20	0.209	0.311	0.306	0.39	0.205
25	0.198	0.301	0.291	0.38	0.198
30	0.190	0.287	0.277	0.37	0.178
40	0.179	0.270	0.252	0.35	0.165
50	0.171	0.262	0.242	0.34	0.146
60	0.165	0.247	0.230	0.34	0.141
70	0.161	0.243	0.223	0.33	0.135
80	0.157	0.235	0.216	0.32	0.129
90	0.154	0.228	0.212	0.32	0.125
100	0.152	0.224	0.209	0.32	0.121
150	0.143	0.211	0.194	0.31	0.110
200	0.138	0.198	0.183	0.30	0.100
250	0.134	0.193	0.178	0.30	0.100
300	0.132	0.189	0.176	0.30	
400	0.128	0.184	0.171	0.30	
500	0.126	0.181	0.168	0.30	
600	0.124	0.178	0.166	0.30	
700	0.123	0.176	0.164	0.29	
over 1,000	0.120	0.173	0.161	0.29	

* : If customers live in "Flat for Singles", always use this column in spite of types of gas appliances.

Source : Osaka Gas Co., Ltd.

L. Flow Equation and its Parameters

Flow Equation and Its Parameters

1. Introduction

In gas network design, it is necessary to calculate the distribution pressure using the flow formula so that we can choose the suitable pipe diameter. The relationship between flow rate and pressure is given by the following flow equation in case of medium and high pressure lines.[1],[2]

$$Q = (0.2394 \cdot \frac{To}{Po} \cdot \sqrt{\frac{1}{z \cdot T}} \cdot \sqrt{1/f}) \cdot \sqrt{\frac{(P_1^2 - P_2^2) \cdot D^5}{S \cdot L}} \qquad \cdots\cdots (1)$$

where Q : flow rate at the base pressure and temperature [m^3/h],
P_1 : upstream pressure [Kg/cm^2.abs.],
P_2 : downstream pressure [Kg/cm^2.abs.],
D : pipe diameter [cm],
L : length [m],
z : compressibility factor,
T : gas temperature [°K],
Po : base pressure [Kg/cm^2.abs.],
To : base temperature [°K],
$\sqrt{1/f}$: transmission factor of the line,
S : specific gravity [air = 1.0].

The equation contains several variables and parameters. The variables, Q, P_1, P_2, D and L, change by study cases or the sections to which the formula is adopted. The parameters, z, T, T_0, $\sqrt{1/f}$ and S, are determined by the character of the gas distributed (z, T and S) or the condition of the pipeline used ($\sqrt{1/f}$). It is important to understand the theoretical background of the parameters in order to use the flow equation properly and this paper describes the outline of them and the value or formula which are used in the Study.

2. Character of Parameters

Among the parameters contained in formula (1), P_0 and T_0 are constants. Therefore we can omit them from our consideration. The remaining parameters are specific gravity S, gas temperature T, compressibility factor z and transmission factor $\sqrt{1/f}$.

2.1 Specific Gravity S

Specific gravity S is the relative value based on the molecule weight of air and can be calculated from the gas composition. For example, typical gas quality distributed in PGN Jakarta / Bogor Branch is shown in Table 2-1 and the specific gravity can be calculated from the average molecular weight of gas distributed as shown below.

Table 2-1 Specific Gravity of Gas distributed in PGN Jakarta Branch

Molecular	Gas Composition	Molecular Weight	Specific Gravity S
N2	1.39%	28.01	0.595 (=17.23/28.97*) *28.97 is molecular weight of air
CO2	1.38%	44.01	
CH4	93.30%	16.04	
C2H6	3.55%	30.07	
C3H8	0.19%	44.10	
n-C4H10	0.10%	58.12	
i-C4H10	0.09%	58.12	
Total	100.00%	17.23	

Source : Gas Composition is from PGN data

2.2 Gas Temperature

Gas temperature mainly depends on the ground temperature where pipelines are installed. Although we don't have any actual measurement data, 27℃ is used for standard temperature of gas in Indonesia. Therefore we also use this value as gas temperature.

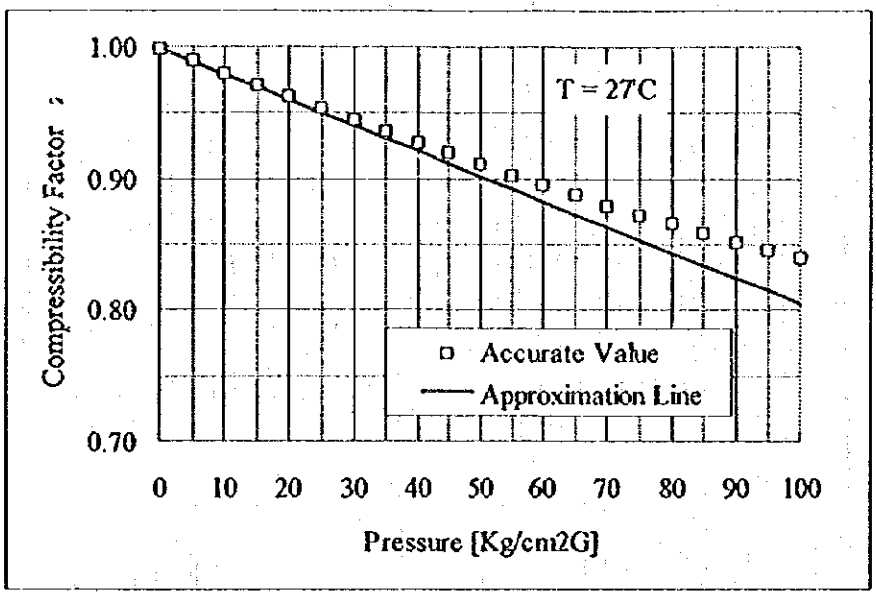
2.3 Compressibility Factor

Compressibility factor z changes by composition, pressure and temperature of gas. In general, the value of z gets smaller as the gas pressure increases and the gas temperature decreases in case of natural gas. However, when gas pressure is lower than 10 bar, z can be taken for 1.00. In order to calculate the accurate value of z at certain conditions, iterative calculation is necessary. [3] Instead, the approximation formula shown below is sometimes used.

$$z = 1 + (0.257 - \frac{0.5333 \times Tc}{T}) \times \frac{Pave}{Pc} \qquad \text{--- (2)}$$

where Tc is critical temperature of gas distributed, Pc is critical pressure of gas distributed and Pave is average pressure of gas in a certain section of pipeline. In case of the gas distributed in PGN Jakarta Branch, Tc=196.54 [K] and Pc=47.60 [Kg/cm^2] which are calculated from the gas composition. Fig. 2-1 shows the value of z for the gas distributed in PGN Jakarta Branch at the standard gas temperature.

Fig. 2-1 Compressibility Factor of Gas distributed in PGN Jakarta Branch



Source : JICA Team

2.4 Transmission factor

2.4.1 Theoretical Formula

f which is included in the transmission factor $\sqrt{1/f}$ represents the friction factor of pipeline. Therefore the value of transmission factor depends on the smoothness of inside pipe wall. According to flow mechanics theory, the value of transmission factor is given by the following formula. [4],[1],[2]

$$\sqrt{1/f} = \mathrm{Min}\left[E \cdot \sqrt{1/fsp},\ 4\log_{10}\left(\frac{3.7d}{\varepsilon}\right) \right] \qquad \text{--- (3)}$$

where E : flow efficiency of the line (no dimension),
fsp : friction factor for theoretically smooth pipe
d : pipe diameter d [m],
and ε ; internal pipe wall roughness [m].

The value of E and ε is usually determined by "Flow Test". The flow efficiency, E, ranges from 0.900 to 0.985 in case of a long length transmission line[3] and the internal pipe wall roughness, ε, is said to be from 10 to 20 [micron] in case of a new pipe which has a good internal coating. The value of fsp is given by the equation named "Smooth Pipe Law (S.P.L.)" shown in formula (4).

$$\sqrt{1/fsp} = 4 \cdot \log_{10}(Re \cdot \sqrt{fsp}) - 0.60 \qquad \text{---- (4)}$$

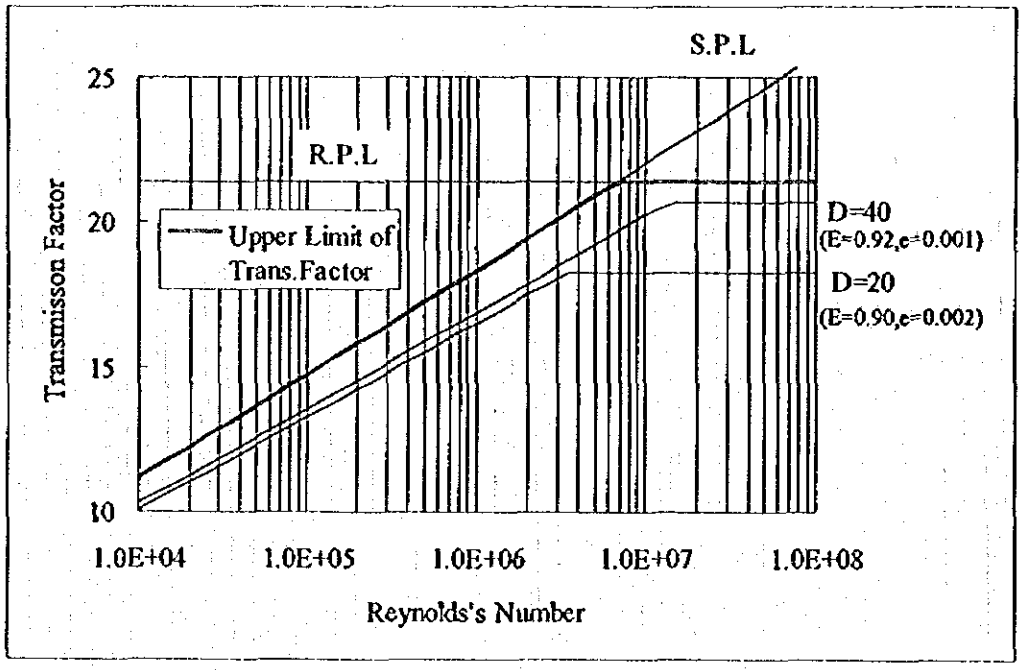
where Re is Reynolds number of the flow.

Since equation (4) is implicit, that is, fsp appears at the both sides of the equation, the

solution of the equation can be obtained only by using some numerical iteration such as Newton method.

The right hand term in function Min in formula (3), $4 \cdot \log_{10}(\frac{3.7 \cdot D}{\varepsilon})$, is called the rough pipe law (R.P.L.) and gives the upper limit of the transmission factor. Since the term gets large as D increases or ε decreases, the upper limit of transmission factor is bigger in case of the pipe with the larger diameter or with the smoother inside wall. Fig. 2-2 shows the transmission factor of the pipelines with the theoretically smooth surface and with some values of E and ε.

Fig. 2-2 Transmission Factor given by Flow Mechanics Theory



Source : JICA Team

2.4.2 Practical Formula

Since the iterative method is necessary to solve the smooth pipe law, several approximate formulas are utilized which facilitate the calculation. These practical formulas are divided by two groups, formulas which use Reynolds's number and formulas which do not depend on Reynolds's number.

(1) Practical Formula using Reynolds's Number

This type of formulas usually takes the following form in order to approximate the

smooth pipe law ;

$$\sqrt{1/f} = a \cdot Re^{b} \qquad \text{--- (5)}$$

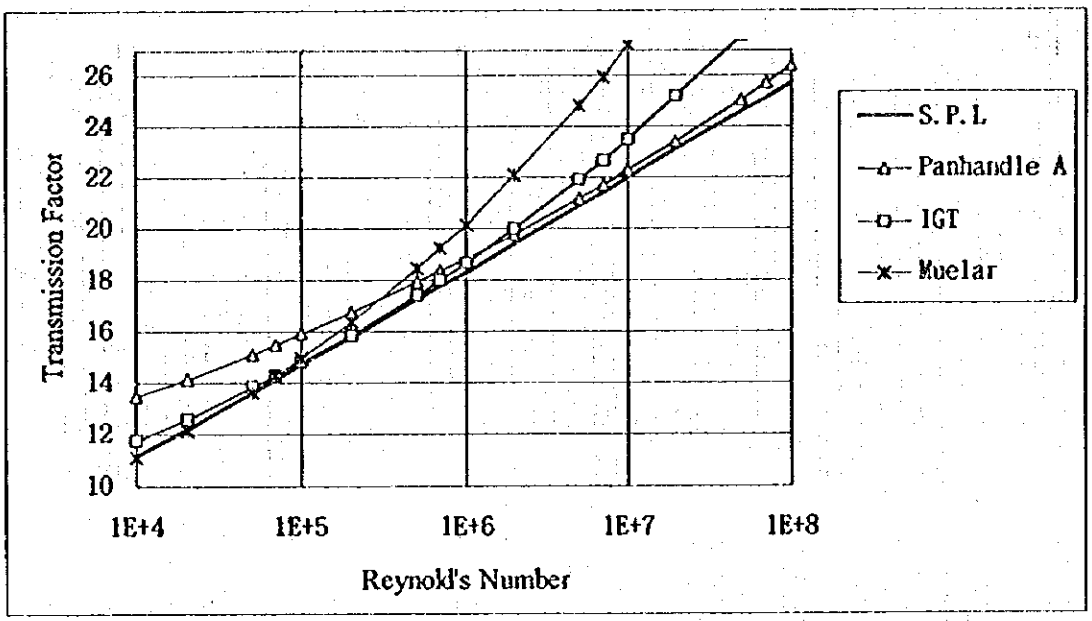
Here *a* and *b* are empirically determined constants selected to give a good fit of the smooth pipe law over the range of Reynolds numbers of interest.[2][5] Table 2-2 shows the popular flow formulas which have the style of formula (5) and Fig. 2-3 shows the fitness of these formula to the smooth pipe law.

Table 2-2 Practical Formulas with the style of $\sqrt{1/f} = a \cdot Re^{b}$

Name of Formula	Parameters		Range of Re which gives fitness	
	a	b	within ±1 % Error	within ±2 % Error
Mueller	3.35	0.130	3.0×10^{3} - 8.0×10^{4}	3.0×10^{3} - 1.2×10^{5}
IGT	4.691	0.100	2.5×10^{4} - 1.6×10^{6}	1.6×10^{4} - 3.0×10^{6}
Panhandle A	6.872	0.07305	3.3×10^{6} - 5.0×10^{7}	1.3×10^{6} - 7.5×10^{7}

Source : JICA Team

Fig. 2-3 Fit of Flow Formulas to S.P.L.



Source : JICA Team

As shown in Fig. 2-3, Panhandle A, IGT and Muelar formula give good fits to the smooth pipe law over the limited range of Reynolds number.

Reynolds's number *Re* is dimensionless number and defined by the following formula;

$$Re = \frac{\rho \cdot u \cdot d}{\mu} \qquad \text{--- (6)}$$

where ρ : density of gas [kg/m^3],
u : flow velocity of gas [m/sec],
d : pipe diameter [m],
and μ : viscosity of gas [kg / (m·sec)].

Formula (6) can be transformed as below using flow rate Q with the unit of m^3/h and specific gravity S:

$$Re = (4.572 \times 10^{-4}) \cdot \frac{S \cdot Q}{\mu \cdot d} \qquad \cdots (7)$$

Substituting the viscosity of methane $\mu = 1.036 \times 10^{-5}$[kg / (m·sec)] into formula (7),

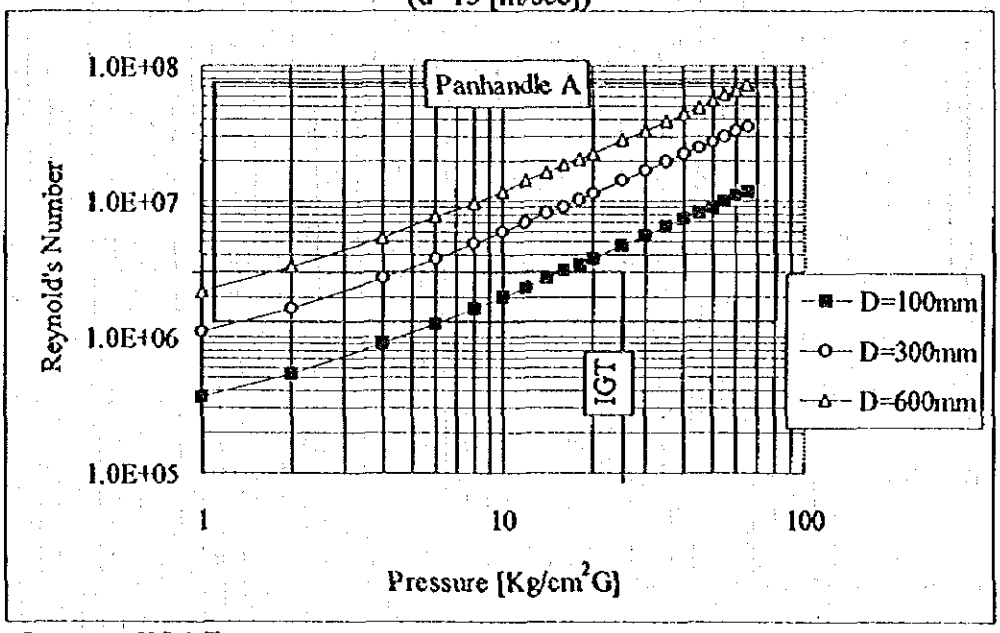
$$Re = 44 \times \frac{S \cdot Q}{d} \qquad \cdots (8)$$

Since flow rate Q can be expressed using flow velocity u and gas pressure P, another formula for Reynolds's number can be obtained as

$$Re = (1.2 \times 10^5) \times d \cdot P \cdot u \qquad \cdots (9)$$

Using formula (9), the relationship between gas pressure P and Reynolds's number is shown in Fig. 2-3. In the graph, the ranges that Panhandle A and IGT formula give the accurate value of transmission factor are also shown. From the graph, we can understand that Panhandle A formula is good for large diameter or high pressure pipeline whereas IGT formula is good for small diameter or medium pressure pipeline.

Fig. 2-3 Relationship between Gas Pressure and Reynolds's Number (u=15 [m/sec])



Source : JICA Team

(2) Practical Formula independent of Reynolds's Number

This type of formulas is usually a function of pipe diameter or merely constant. Although the accuracy of the formulas is less than the formulas using Reynolds's number, it is easy to handle these formulas. Table 2-3 shows the typical formulas which are widely used and Fig. 2-4 shows some values of these formulas.

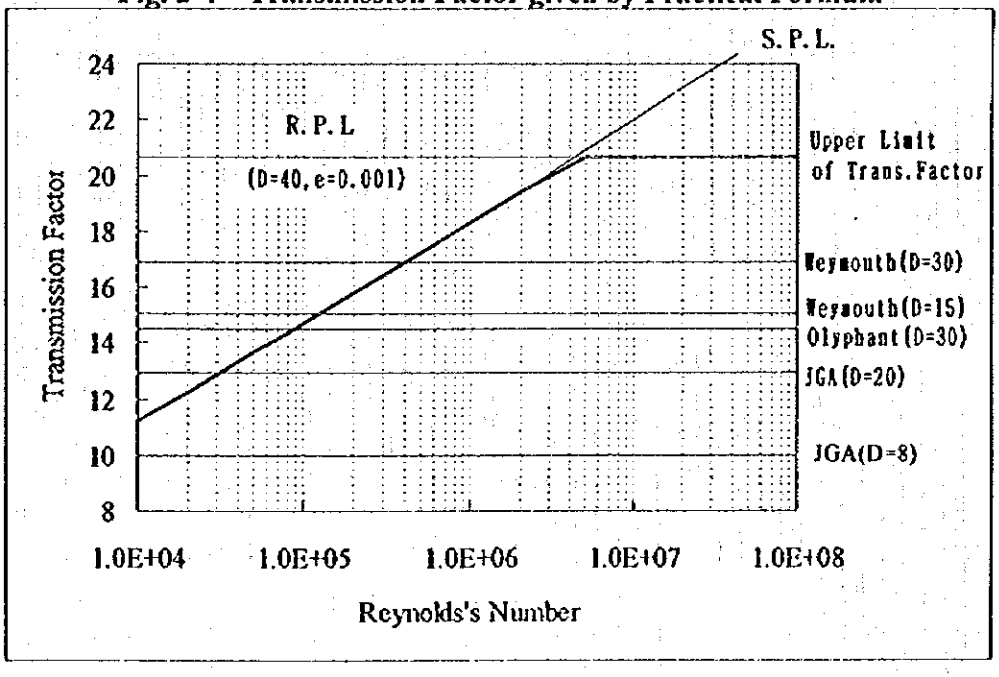
Table 2-3 Practical Formula independent of Reynolds's Number

Name of Formula	Transmission Factor
J.G.A	$\sqrt{1/f} = \begin{cases} 10.00 (D \le 8cm) \\ 11.54 (D = 10cm) \\ 11.95 (D = 15cm) \\ 12.90 (D \ge 20cm) \end{cases}$
Cox	$\sqrt{1/f} = 12.1$
Olyphant	$\sqrt{1/f} = 13.0 + 0.2717 \cdot \sqrt{D}$
Weymouth	$\sqrt{1/f} = 9.571 \cdot D^{1/6}$
Rough Pipe Law	$\sqrt{1/f} = 4 \cdot \log_{10}(\frac{3.7 \cdot D}{\varepsilon})$

(D:Pipe diameter[cm], ε :pipe inside wall roughness[cm])

Source : Osaka Gas Co., Ltd.

Fig. 2-4 Transmission Factor given by Practical Formula



Source : JICA Team

From Fig. 2-4, we can understand that any formula in Table 2-3 gives a good fit to the smooth pipe law only at the limited range of Reynolds's number. Therefore it is very important to know the application range of the flow formula independent of Reynolds's number.

3. Parameters used in the Study

3.1 Specific Gravity and Gas Temperature

As the specific gravity and the gas temperature, we use the value shown in Table 3-1.

Table 3-1 Value of S and T used in the Study

Parameter	Specific Gravity S	Gas Temperature T
Value	0.595	27℃

3.2 Compressibility Factor z

For medium and low pressure system, we assume that z = 1.00. Since we cannot neglect the effect of compressibility factor in high pressure system such as Pertamina's West Java line, we use formula (2) for the calculation of z. As the values of Tc, Pc and T, we use Tc= 196.54 [K], Pc= 47.60 [Kg/cm2] and T= 300.15 [K].

Table 3-2 Formula of z used in the Study

Network	Medium Pressure	High Pressure
Formula	$z = 1.00$	$z = 1 - 0.00194 \cdot P$

3.3 Transmission Factor

In order to obtain the accurate results of calculation, the best way is to use the smooth pipe law. However, S.P.L. is implicit and it requires iterative calculation to solve the equation. The second method to get the accurate value of transmission factor is to use the formula which uses Reynolds's number. In this case, formula (3) is transformed as

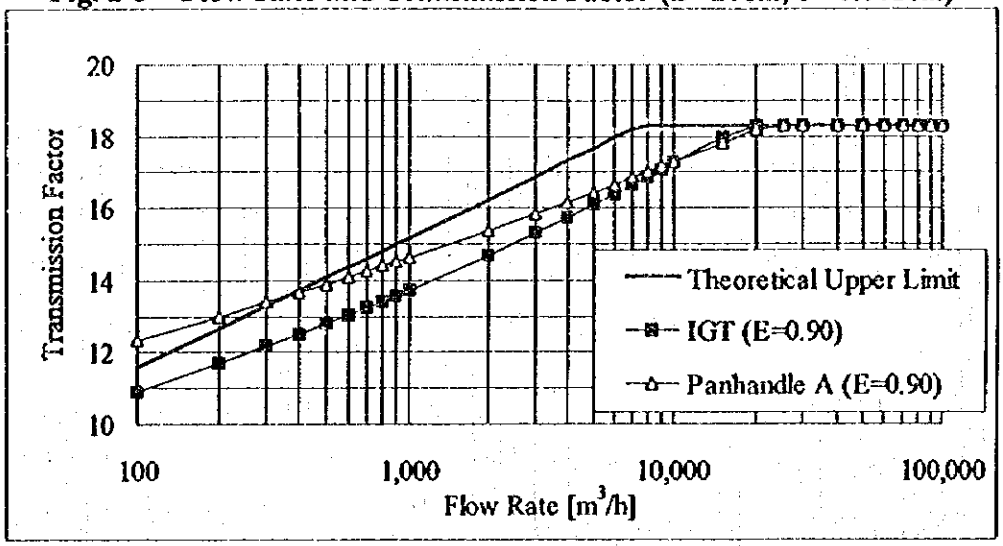
$$\sqrt{1/f} = \mathrm{Min}\left[E \cdot (a \cdot Re^{b}),\ 4\log_{10}\left(\frac{3.7d}{\varepsilon}\right) \right] \qquad \cdots (10)$$

As discussed in section 2.4.2, Panhandle A formula is good for the high pressure system and IGT formula is good for the medium pressure system. As for the value of flow efficiency E and internal roughness ε, we do not have any measurement data on PGN's existing network. Therefore we use E= 0.900 and ε =0.002 [cm] for the study which are relatively conservative (Table 3-3). Fig. 2-5 and Fig. 2-6 shows some examples of the relationship between the flow rate and the transmission factor.

Table 3-3 Formula of Transmission Factor used in the Study

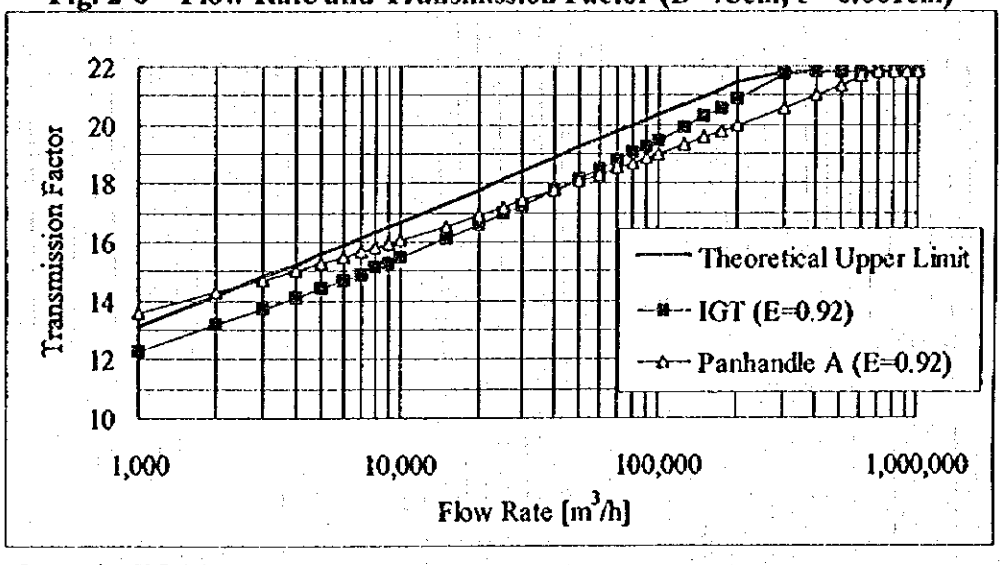
Network	Medium Pressure	High Pressure
Flow Formula	IGT	Panhandle A
	E= 0.900, ε =0.002 [cm]	

Fig. 2-5 Flow Rate and Transmission Factor (D=20cm, ε =0.002cm)



Source : JICA Team

Fig. 2-6 Flow Rate and Transmission Factor (D=75cm, ε =0.001cm)



Source : JICA Team

[References]
1. "Flow Calculation Handbook", Osaka Gas Co., Ltd, 1991
2. "System Design GEOP Series D-1", American Gas Association, 1990
3. "Compressibility and Supercompressibility for Natural Gas and Other Hydro-carbon Gases (TMC Report No.8) ", American Gas Association, 1985
4. "Steady Flow in Gas Pipelines", A.E.Uhl, American Gas Association, 1965

[Memorandom] **Flow Equatuon for Low Pressure line**

Formula (1) is usually adoptted for medium and high pressure system. If the formula is used for low pressure system, term $(P_1^2 - P_2^2)$ gets very small and it is incovenient for calculation since the unit of pressure is [Kg/cm^2.abs] and the difference between P_1 and P_2 is only little at the low pressure level. Therefore the unit of [mmH_2O] is utilized at the low pressure level instead of [Kg/cm^2.abs].

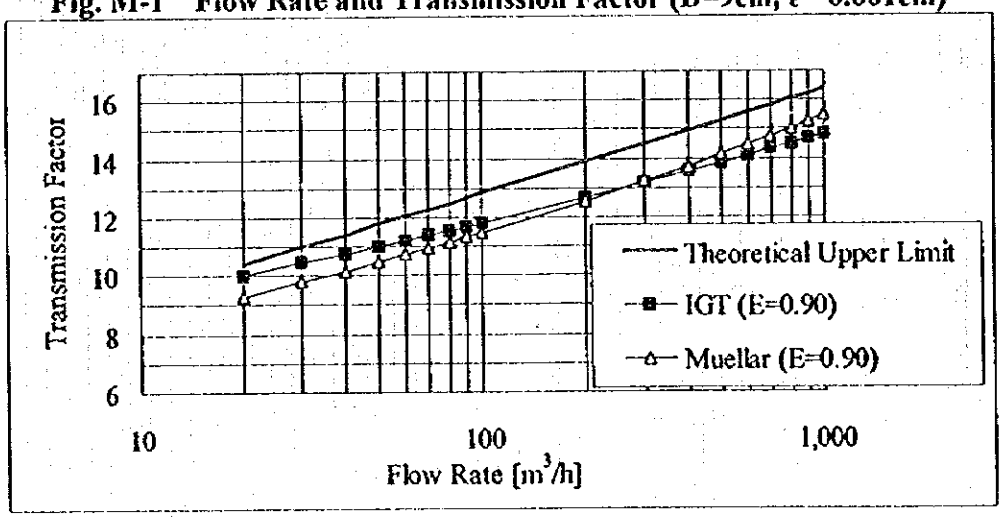
Since $(P_1^2 - P_2^2) = (P_1 + P_2)\cdot(P_1 - P_2)$ and 1 mmH_2O = 10^{-4} Kg/cm^2, formula (1) can be transformed as

$$Q = (0.0530\cdot\sqrt{1/f})\cdot\sqrt{\frac{(P_1 - P_2)\cdot D^5}{S\cdot L}} \qquad \cdots (11)$$

substituting z = 1.0, Po = 1.033 [Kg/cm^2 abs], To = 273[K], T = 300[K] and ($P_1 + P_2$) =2 × 200 [mmH_2O] = 2 × (1.033+0.02) × 10^{-4} [Kg/cm^2 abs] into formula (1).

At the low pressure level, Reynolds's number is from 10^4 to 10^5 and the transmission factor given by the smooth pipe law is from 11 to 14. Muellar's formula gives the best fit to the smooth pipe law in this range as shown below.

Fig. M-1 Flow Rate and Transmission Factor (D=9cm, ε =0.001cm)



Source : JICA Team