

Japan International Cooperation Agency (JICA)

Department of Energy
The Republic of The Philippines

A Master Plan Study
on
The Development of the Natural Gas Industry
in
The Republic of The Philippines

Appendix

JICA LIBRARY



J116746111

January 2002

The Institute of Energy Economics, Japan

Osaka Gas Co., Ltd.

MPN

JR

01-124

Japan International Cooperation Agency (JICA)

**Department of Energy
The Republic of The Philippines**

**A Master Plan Study
on
The Development of the Natural Gas Industry
in
The Republic of The Philippines**

Appendix

January 2002

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



1167461【1】

CONTENTS

Appendix A

Natural Gas Quality and Energy Unit Conversion

Appendix B

Forecast of Potential Gas Demand for Power Generation

Appendix C

Potential Demand and Energy Consumption Tables

Appendix D

Model Manual for Energy Supply / Demand Balance Model
in the Philippines

Appendix E

Model Manual for Economic / Financial Analysis

Appendix F

Economic Evaluation (Pay Back Period) for Absorption Chiller,
Cogeneration and Gas Heat Pump

Appendix G

LNG System Configuration and Construction Schedule

Appendix H

Gas Pipeline Route Map and Gas Distribution Plan

Appendix A

Natural Gas Quality and Energy Unit Conversion

Natural Gas Quality and Energy Unit Conversion

Energy units involving natural gas are seriously affected by the gas composition. Information on the exact composition of the gas from Camago/Malampaya after gas processing has not been available at the time of finalizing this Report. Information on an example composition on the Malampaya gas reservoir and a preliminary composition at the inlet of gas power generation has been available as the gas "A" and "B" in Table A-2, which also shows the results of thermal value calculation as well as others.

The contractual thermal value of the gas for a gas-power generation company in Tabangao is defined in terms of "net calorific value" (LHV or LCV, i.e., lower calorific value) as to be in a range of 42 to 47.5 MJ/kg, while normal energy trade and energy statistics are handled in the gross calorific value (HHV or HCV, i.e., higher calorific value). The theoretical calculation of fuel into gas conversion is occasionally done by using the net calorific value, though its direct calorific measurement is difficult without knowing the composition. Power generations often use net calorific values for efficiency calculation giving apparently higher efficiency rates. In most cases, however, higher or gross calorific values are used. Unlike past, since gas could be ultimately used to a level of reaching latent heat (e.g., by the use of condensing boilers), it is not inconsistent to use gross thermal values for conversion calculation.

As a stark difference from solid fuels, a thermal value of a gas per volume changes with temperature and we have to define the standard temperature for thermal value expression. A state of atmospheric pressure combined with zero (0) degree Celsius is called a normal state and "N" is attached to a volume unit as in MJ/Nm³ or kcal/Nm³. The state at the temperature of 60 F (Fahrenheit) or 15 C (or 15.5C) is called a standard state and we attach "S" or "s" as in mscf (thousand standard cubic feet) or Bscm (billion standard cubic meters). For an American unit of cubic feet, a standard state is normally assumed even without "s". For other regions in the world, standard temperatures for natural gas are: 15 C in Europe, 0 C (i.e., normal temperature) in the Far East, 20 C in Former Soviet Union and 27 C in Indonesia (domestic).

A gas having a value of, e.g., 10,161 kcal(IT)/Nm³ is converted into the 15 C condition as in the following:

$$10,161 \text{ kcal/Nm}^3(0\text{C}) := 10,161 * 273.15 / (273.15 + 15.5) = 9,615 \text{ kcal/sm}^3(60\text{F})$$

$$:= 9,615 * 3.968 / 35.314 = 1,080 \text{ Btu/scf (60F)}$$

The preliminary gas components at the gas power generation company, shown as the gas "B" in Table A-2, includes unusual heavy hydrocarbons like heptane (n-C7H16) and octane (n-C8H18), as well as high content of CO2, giving HCV of the gas as 9,780 kcal/Nm3 (at 0 C), 9,250 kcal/m3 (15.5 C or 60 F) or 1,040 Btu/scf (at 60 F), and LCV as 8,359 kcal/m3 (60 F), 10,408 kcal/kg or 43.577 MJ/kg. Gas containing higher hydrocarbons hopefully will not cause serious problems, except in case of peak shaving liquefaction, if such is installed, in which heavy ends are removed causing the resultant quality to significantly change. Some gas users needing high precision flame length control like glass industries may have to install a thermal value control facility. Also gas tariff will better be adjusted to respond to the changes of thermal values in the gas network.

In the long term planning in which introduction of LNG is forecast, we have considered the quality of regasified LNG, too. Table A-1 shows an example of a typical composition of LNG, the gas "C", which is comparatively close to an average in Asia in 2000. The gas from normal LNG is considerably higher in thermal content, which centers around 10,500 kcal/Nm3 at 0 C (or 1,121 Btu/cf at 60F), than a usual pipeline gas.

For future projection of gas volumes in the JICA study, if certain precision is required, we will basically use an average of the compositions of First Gas Power and of a typical LNG, as the composition "D" shown in Table A-2 for a simplification purpose.

The gas compositions on the gas field, the gas "A", will be used for technical calculations of upstream pipelines, the "B" for power generation and the "C" for LNG terminal relevant pipelines and LNG power generation.

For thermal conversion between gas and petroleum products, DOE presents the Conversion Tables in PEP 2002. Philippine petroleum volumes, as well as other energy quantities, are normally interpreted in "barrels fuel oil equivalent" or "BFOE" and the PEP2002 defines this as:

1 lb. (pound) of fuel oil = 18,600 Btu (British thermal units).

While the “pound” is a unit of mass or weight, the quantities are shown in “barrel” or volume; thus we need the values of density or specific gravity as a connecting factor to know the calorie or Btu values for a volume of a petroleum product. This requires the knowledge of relations between thermal values and density of various petroleum products. This can be done through the use of the API (American Petroleum Institute) degree, a petroleum density index for regular oil products.

The “API degree” of various petroleum products is defined as:

$$\text{API deg} = 141.5 / \text{specific_gravity}(15/15) - 131.5;$$

$$\text{i.e., Specific_gravity} = 141.5 / (\text{API} + 131.5)$$

where, the specific _gravity (15/15), is the specific _gravity of the product at 15C (degree Celsius) compared to that of water at 15C. The formula is normally applicable at API = 0 to 65.

The knowledge on the relations between thermal values and API degrees of petroleum products are further necessary and are occasionally found in engineering books for approximate values. The relation does not follow a straight line. The author uses self made empirical formulae for EXCEL sheet as:

$$\text{HCV}(\text{kcal}_{IT}/\text{kg}) = \text{IF}(\text{API} < 19.62375, 9849.98 + 32.194 * \text{API} - 0.060695 * \text{API}^2, \text{IF}(\text{API} < 46.80979, 9673.92 + 47.1211 * \text{API} - 0.36417 * \text{API}^2, 9662.71 + 52.9835 * \text{API} - 0.640277 * \text{API}^2 + 0.033323 * \text{API}^3))$$

$$\text{LCV}(\text{kcal}_{IT}/\text{kg}) = \text{IF}(\text{API} < 20.64204, 9356.20 + 26.9166 * \text{API} - 0.039274 * \text{API}^2, \text{IF}(\text{API} < 43.99918, 9132.092 + 45.3645 * \text{API} - 0.40702 * \text{API}^2, 9089.44 + 53.86026 * \text{API} - 0.77357 * \text{API}^2 + 0.044431 * \text{API}^3))$$

$$\text{API} = \text{IF}(\text{HCV}(\text{kcal}/\text{kg}) < 10488, -96.6205 - 0.011319 * \text{HCV} + 2.14507\text{E-}6 * \text{HCV}^2, \text{IF}(\text{HCV} < 10920, 9824.5232 - 0.561223 * \text{HCV} + 2.80205\text{E-}5 * \text{HCV}^2, 5279.6987 - 1.010685 * \text{HCV} + 4.8592\text{E-}5 * \text{HCV}^2))$$

where HCV is the higher or gross calorific value in kcal(IT)/kg and LCV is the lower or net calorific value. The unit “kcal(IT)”, or kcal_{IT}, is “kilo-calorie international” which is defined as: 1 cal_{IT} = 4.1868 J, and 1 Mcal_{IT} = 1.163 kWh. There are other “calories” used

in other communities: 1 cal(15), or cal₁₅, = 4.1855 J, 1cal(th), or cal_{th}, = 4.184 J. These depend on what temperature a thermal value is defined at when it is determined as the thermal quantity to raise a gram of water by one degree. For reference, a Btu is defined as: 1 Btu= 1055.056 J, in the ISO 31-4 which, however, recommends to use Joule related units only.

The PEP2002 shows standard BFOE (barrels fuel oil equivalent) values of petroleum products. These numbers can be interpreted into "Btu/lb" (Btu per pound) values and then to "kcal/kg". By reverse calculations based on the above formulae, we find API values as well as density and thermal values per a volume expressed in MJ/liter, kcal/liter or Btu/bl (Btu per barrel). The results are shown below:

Table A-1 Thermal Values of Oil Products in The Philippines

Standard Thermal Values Derived from PEP2001

	1 Blfoe: 18600 Btu/lb=API:15.465	1 Blfoe=	6.2763 mmBtu	
	<u>Bblfoe/bl</u>	<u>kcal/liter</u>	<u>mmBtu/bl</u>	<u>MJ/liter</u>
Philippine Petroleum Products	(standard fo)	9,949	6.276	41.655
Reg. Gasoline	0.8470	8,427	5.316	35.282
Prem. Gasoline	0.8624	8,580	5.413	35.923
Kerosene	0.8798	8,753	5.522	36.648
Diesel	0.9328	9,281	5.855	38.856
LPG	0.6384	6,351	4.007	26.592
Aviation oil	0.8475	8,432	5.319	35.302
Fuel oil	1.0058	10,007	6.313	41.896
Coal (Btu/lb)	10,000	5,556 kcal(IT)/kg		23.260 MJ/kg
LPG (Btu/lb)	21,600	12,000 kcal(IT)/kg		50.242 MJ/kg

The Philippine standard energy unit "blfoe", originating from the PEP2002, is hereby established as:

$$1 \text{ blfoe} = 6.2763 \text{ mmBtu} = 6,621.85 \text{ MJ} = 1,581,600 \text{ kcal(IT)}.$$

Our standard gas, for the JICA study, has a thermal value (gross) of either 1080 Btu/scf, 10,161 kcal(IT)/Nm³ or 9,610 kcal(IT)/m³(15C). Combinations of this and above formula will now more easily convert our gas volumes into Philippine oil volumes and vice versa. For more details see Table A-2 for gas quality and Table A-3 for conversion.

Table A-2 Gas Composition and Quality

Philippine Gas Quality in the Study

Compositions:		Higher Cal		Compositions:			
		Value (ideal)	kcal(15)/N	"A"	"B"	"C"	"D"
(T, P conditions for functions)		%		Malampaya Reservoir	First Gas Pwr Preliminary	Typical LNG	Average "B" and "C"
T1=	15.5	CO2	0	3.65	4.79	0	2.40
T2=	0	N2	0	0.7	0.58	0.04	0.31
Patm=	1	CH4	9500	86.15	88.08	89.97	89.03
PTUnit=	AtmC	C2H6	16644	2.74	3.87	6.64	5.26
Summation		C3H8	23688	1.38	1.63	2.46	2.05
adjustment: yes		iC4H10	30640	0.4	0.33	0.44	0.39
		nC4H10	30713	0.65	0.42	0.44	0.43
		iC5H12	37645	0.35	0.11	0.01	0.06
		nC5H12	37730	0.31	0.1	0	0.05
		C6H14	44758	0.44	0.05	0	0.03
		C7H16	51830	3.23	0.04	0	0.02
		O2	0	0	0	0	0
				100	100	100	100
Original Components:							
		C7H16		2.4225	0.04	} C8H18 was merged into C7H16 for simpler calculation.	
		C8H18		0.8075	0.01		
Molecular Weight etc.:							
0	kgMol kg	MW		21.758	18.954	18.045	18.500
0	Spec. Grav.	SpGr		0.760	0.657	0.625	0.641
15.5	m3/ton	SpV		1,085	1,245	1,307	1,276
Calorific Values at 0 or 15.5 deg C below (real gases):							
0	kcal/Nm3	HCV 0C		11,460	9,780	10,542	10,161
15.5	kcal/m3	HCV 15C		10,836	9,250	9,970	9,610
15.5	MJ/m3	HCVMJ/m3		45,358	38,719	41,732	40,226
0	kcal/Nm3	LCV 0C		10,402	8,838	9,533	9,185
15.5	kcal/m3	LCV 15C		9,836	8,359	9,015	8,687
15.5	Btu/scf	HCVcf		1,217.8	1,039.6	1,120.5	1,080.0
15.5	Btu/scf	LCVcf		1,105.4	939.4	1,013.2	976.3
15	kcal/kg	HCVkg		11,725	11,517	13,043	12,262
	MJ/kg= 0.0041868	HCV kJ/kg		49,092	48,220	54,610	51,337
15	kcal/kg	LCVkg		10,652	10,408	11,795	11,085
	MJ/kg= 0.0041868	LCV kJ/kg		44,596	43,577	49,385	46,410
15.5	(kcal/m3)	Wobbe		12,432	11,412	12,606	12,001
0	Combustion potential	FSCP		36.19	37.45	41.71	39.55
Compare with First Gas Power's Spec.:							
		Mol Wt.:		18.956	and HHV:	48,273	kJ/kg

Note 1) HCV is higher or gross calorific value, and LCV is lower or net calorific value; HHV is higher heating value or the same as HCV. The calorific value calculation on the ISO base here involves compressibility factors at atmospheric pressure usually affecting 4th digit. The "kcal" is "kcal (15degC)" based.

Note) The Gas "D" is a standard for fuel-gas conversion in this Study.

Table A-3 Gas Energy Conversion

Unit Conversion Based on the Gas "D":

Gross or higher calorific value 10.161 kcal(15)/Nm3 or 1080.0 Btu/scf based:				1 Btfoe (Phil)=	6.2763	mmBtu		
1 mmBtu =	0.925523	mscf =	24.8007	m3 =	0.019232	t LNG eq. =	0.1593	Bbl foe
1 mscf =	1.080470	mmBtu =	26.79643	m3 =	0.020780	t LNG eq. =	0.1722	Bbl foe
1 mmscfd =	0.365	bscfy =	9.792	mmcm/y =	7593	t LNG eq./y =	0.06283	mBbl foe /y
100 mmscfd =	36.50	bscfy =	979.18	mmcm/y =	759,316	t LNG eq./y =	6.2835	mmBbl foe/y
1mil. ton-LNG/y:	48.0696	bscfy =	1289.55	mmcm/y =	131.7	mmscfd =	8.2752	mmBbl foe/y

Note) m=1,000, mm=1,000,000 as suffix; cm=cubic meter; Btu=British thermal unit; Bbl = barrels.

Appendix B

Forecast of Potential Gas Demand For Power Generation

Appendix C

Potential Gas Demand and Energy Consumption Tables

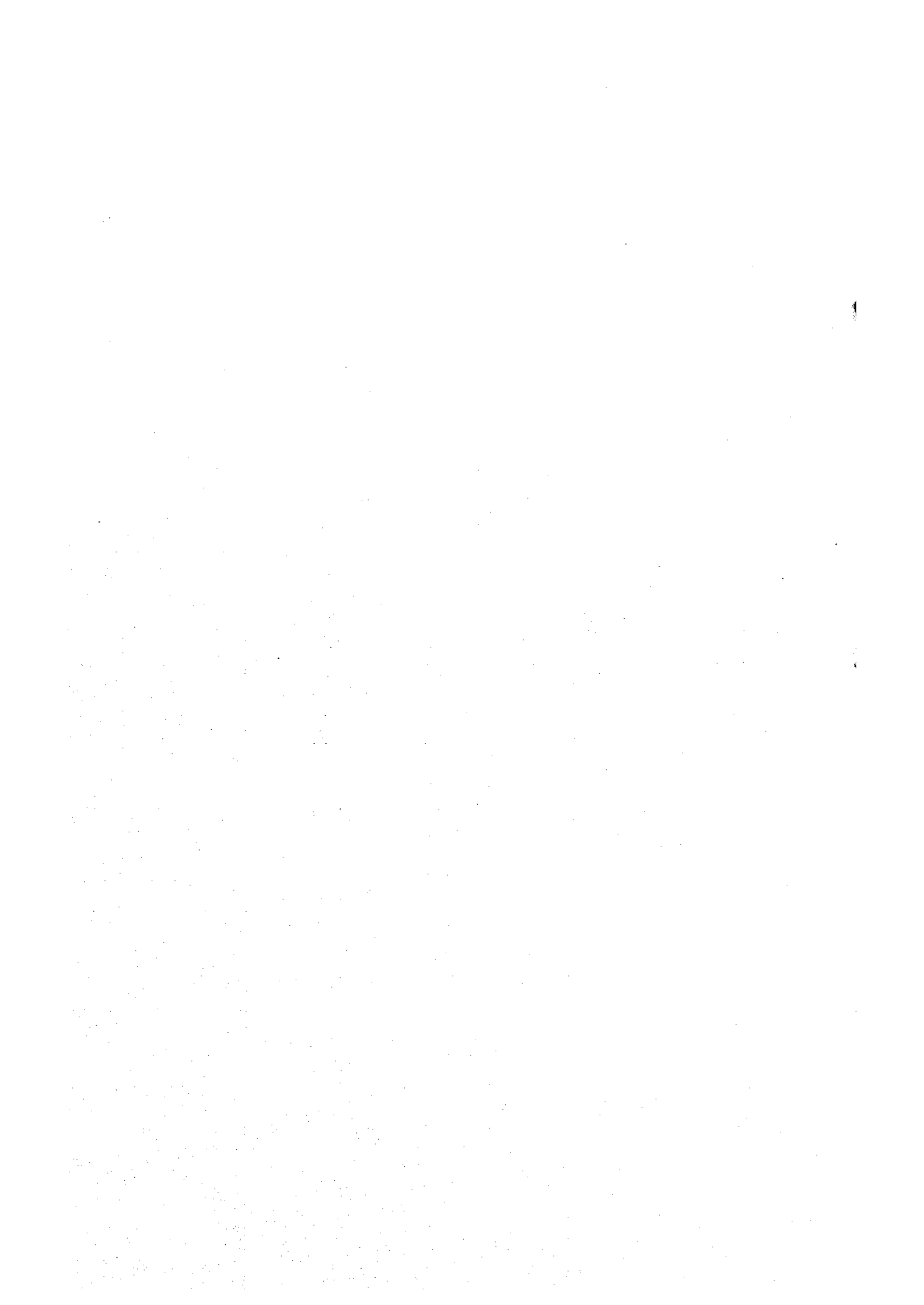
Table C-1	Potential Demand of Natural Gas (Total Philippines)
Table C-2	Potential Demand of Natural Gas (NCR: Area L-1)
Table C-3	Potential Demand of Natural Gas (Southern Tagalog: Area L-2)
Table C-4	Potential Demand of Natural Gas (Central Luzon: Area L-3)
Table C-5	Potential Demand of Natural Gas (Central Visayas: Area C-M)
Table C-6	Potential Demand of Natural Gas (Southern Mindanao: Area D)
Table C-7	Price and Conversion Factor & Results of Estimation
Table C-8	Mo. Gasoline
Table C-9	Kerosene
Table C-10	Diesel Oil
Table C-11	Fuel Oil
Table C-12	LPG
Table C-13	Electricity

Potential Substitution to NG by Fuel

Philippine Total

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	
Previous Formula																											
No Gasoline	0.00																										
Transportation Gasoline	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.07
Kerosene																											
Residential Kerosene	3.64	2.78	2.04	3.13	3.36	4.21	4.86	5.62	6.46	7.42	6.43	9.34	10.29	11.28	12.30	13.35	14.45	15.58	16.75	17.96	19.22	20.34	21.50	22.70	23.93	25.16	
Diesel																											
Industry Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.07	0.12	0.16	0.20	0.25	0.30	0.36	0.41	0.47	0.53	0.60	0.67	0.74	0.81	0.89	0.97	1.06	
Transportation Diesel	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.07	0.08	0.08	0.09	0.09	0.10	
Fuel Oil																											
Industry Fuel Oil	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.08	0.08	0.10	0.13	0.16	0.19	0.21	0.25	0.28	0.31	0.35	0.39	0.43	0.47	0.51	0.56	0.60	0.65	0.71	
Transportation Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Commercial Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.04	0.05	0.06	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	
LPG																											
Industry LPG	0.29	0.30	0.31	0.32	0.34	0.36	0.41	0.46	0.50	0.56	0.61	0.67	0.73	0.79	0.86	0.92	1.00	1.08	1.16	1.24	1.34	1.43	1.52	1.62	1.72	1.84	
Residential LPG	0.37	0.38	0.40	0.42	0.45	0.48	0.56	2.00	3.54	10.08	16.82	23.61	30.59	37.76	45.13	52.69	61.44	70.41	79.61	89.05	98.72	108.13	117.64	127.25	136.97	146.48	
Commercial LPG	5.47	0.12	0.13	0.13	0.14	1.48	2.58	4.29	6.11	8.33	10.68	12.97	15.40	17.97	20.68	23.55	26.58	29.78	33.16	36.74	40.52	44.24	48.16	52.28	56.62	61.19	
Electricity																											
Industry Electricity	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	
Residential Electricity	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	
Commercial Electricity	0.09	0.10	0.10	0.11	0.11	0.12	0.13	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.25	0.26	0.28	0.29	0.31	0.32	0.34	0.36	
Potential Substitution Total to NG	9.92	3.75	3.05	4.18	4.48	6.73	8.64	12.65	16.97	26.82	37.06	47.22	57.73	68.61	79.88	91.55	104.62	118.13	132.10	146.55	161.50	175.99	190.62	206.01	221.57	237.17	
Total Energy Consumption (mmecfd)	1,199.87	1,279.65	1,409.82	1,448.70	1,554.82	1,631.39	1,744.13	1,827.27	1,951.40	2,046.51	2,181.85	2,308.89	2,442.86	2,583.39	2,731.13	2,886.49	3,049.89	3,222.29	3,404.57	3,596.92	3,799.82	3,987.40	4,184.08	4,390.86	4,606.91	4,838.82	
Total by Sector																											
Industry	0.30	0.32	0.33	0.34	0.36	0.38	0.45	0.53	0.62	0.74	0.87	1.00	1.13	1.27	1.41	1.57	1.74	1.91	2.09	2.29	2.49	2.70	2.91	3.13	3.37	3.62	
Transportation	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.06	0.06	0.07	0.07	0.08	0.08	0.09	0.09	0.10	0.11	0.12	0.12	0.13	0.14	0.15	0.16	0.17	
Residential	4.02	3.18	2.45	3.56	3.82	4.70	5.44	7.63	10.82	17.52	25.26	32.90	40.91	49.06	57.45	66.07	75.92	86.02	96.39	107.04	117.97	128.51	139.18	149.99	160.94	171.68	
Commercial	5.57	0.22	0.23	0.21	0.26	1.60	2.71	4.41	6.27	8.50	10.87	13.18	15.62	18.21	20.94	23.82	26.87	30.09	33.50	37.10	40.91	44.65	48.59	52.71	57.11	61.71	
by Fuel																											
No Gasoline	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.07	
Kerosene	3.64	2.78	2.04	3.13	3.36	4.21	4.86	5.62	6.46	7.42	6.43	9.34	10.29	11.28	12.30	13.35	14.45	15.58	16.75	17.96	19.22	20.34	21.50	22.70	23.93	25.16	
Diesel	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.04	0.06	0.10	0.15	0.19	0.24	0.29	0.35	0.40	0.46	0.53	0.59	0.67	0.74	0.82	0.89	0.98	1.06	
Fuel Oil	0.01	0.01	0.01	0.01	0.01	0.02	0.04	0.07	0.10	0.13	0.16	0.19	0.23	0.26	0.30	0.34	0.39	0.43	0.48	0.53	0.58	0.63	0.69	0.75	0.81	0.87	
LPG	6.13	0.88	0.84	0.88	0.93	2.33	3.55	6.75	10.16	18.96	28.11	37.26	46.72	56.52	66.66	77.16	89.02	101.27	113.93	127.03	140.58	153.79	167.31	181.15	195.31	209.50	
Electricity	0.11	0.11	0.12	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.25	0.26	0.28	0.29	0.31	0.33	0.34	0.36	0.38	0.40	0.42	

Table C-1 Potential Demand of Natural Gas (Total Philippine)



Potential Substitution to HG by Fuel
NCR Metropolitan Manila (L1 Area)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
No Gasoline																										
Transportation Gasoline	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02
Kerosene																										
Residential Kerosene	2.08	1.54	1.13	1.74	1.87	2.34	2.71	3.13	3.61	4.14	4.71	5.22	5.76	6.31	6.88	7.47	8.09	8.72	9.38	10.06	10.77	11.40	12.05	12.73	13.42	14.11
Diesel																										
Industry Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.05	0.06	0.08	0.10	0.12	0.14	0.16	0.19	0.21	0.24	0.27	0.29	0.32	0.35	0.38	0.42
Transportation Diesel	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
Fuel Oil																										
Industry Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.10	0.11	0.12	0.14	0.15	0.17	0.19	0.20	0.22	0.24	0.26	0.28
Transportation Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commercial Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.07	0.08	0.09	0.09
LPG																										
Industry LPG	0.11	0.12	0.12	0.13	0.14	0.14	0.16	0.18	0.20	0.22	0.24	0.27	0.29	0.31	0.34	0.37	0.40	0.43	0.46	0.49	0.53	0.56	0.60	0.64	0.68	0.73
Residential LPG	0.21	0.21	0.22	0.23	0.25	0.27	0.31	1.12	1.98	5.65	9.43	13.24	17.16	21.19	25.32	29.57	34.40	39.53	44.70	50.00	55.44	60.73	66.08	71.40	76.96	82.31
Commercial LPG	3.12	0.07	0.07	0.07	0.08	0.83	1.44	2.40	3.42	4.67	5.99	7.28	8.64	10.08	11.61	13.22	14.92	16.72	18.62	20.63	22.76	24.85	27.05	29.36	31.80	34.37
Electricity																										
Industry Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Residential Electricity	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Commercial Electricity	0.05	0.05	0.06	0.06	0.06	0.07	0.07	0.07	0.08	0.08	0.09	0.09	0.10	0.10	0.11	0.12	0.12	0.13	0.14	0.15	0.15	0.16	0.17	0.18	0.19	0.20
Potential Substitution Total to HG	5.60	2.02	1.63	2.26	2.42	3.63	4.73	6.97	9.37	14.88	20.60	26.28	32.16	38.25	44.55	51.08	58.39	65.95	73.77	81.86	90.23	98.34	106.64	115.15	123.86	132.59
Total Energy Consumption (MMCFD)	501.14	521.58	547.83	585.73	627.94	681.39	746.18	746.57	798.57	842.68	899.58	953.18	1,009.37	1,068.30	1,130.13	1,195.83	1,263.10	1,334.84	1,410.38	1,489.88	1,573.52	1,651.84	1,732.15	1,817.80	1,905.78	1,997.80
Total by Sector																										
Industry	0.12	0.12	0.13	0.14	0.14	0.15	0.18	0.21	0.25	0.29	0.34	0.39	0.45	0.50	0.56	0.62	0.69	0.76	0.83	0.91	0.99	1.07	1.15	1.24	1.33	1.43
Transportation	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05
Residential	2.29	1.76	1.36	1.98	2.13	2.62	3.03	4.26	5.60	9.80	14.14	18.47	22.93	27.51	32.22	37.06	42.59	48.27	54.10	60.08	66.23	72.15	78.16	84.24	90.40	96.44
Commercial	3.18	0.12	0.13	0.13	0.14	0.89	1.51	2.48	3.51	4.76	6.09	7.39	8.77	10.22	11.75	13.37	15.08	16.90	18.81	20.83	22.97	25.08	27.29	29.62	32.08	34.67
Total by Fuel																										
No Gasoline	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02
Kerosene	2.08	1.54	1.13	1.74	1.87	2.34	2.71	3.13	3.61	4.14	4.71	5.22	5.76	6.31	6.88	7.47	8.09	8.72	9.38	10.06	10.77	11.40	12.05	12.73	13.42	14.11
Diesel	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.04	0.06	0.07	0.09	0.11	0.13	0.16	0.18	0.20	0.23	0.26	0.29	0.32	0.35	0.38	0.41	0.45
Fuel Oil	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.04	0.06	0.07	0.08	0.10	0.11	0.13	0.15	0.16	0.18	0.20	0.23	0.26	0.27	0.29	0.32	0.34	0.37
LPG	3.45	0.40	0.42	0.44	0.46	1.24	1.91	3.70	5.61	10.53	15.66	20.79	26.89	31.58	37.27	43.16	49.80	56.68	63.78	71.13	78.72	86.14	93.73	101.50	109.44	117.41
Electricity	0.06	0.06	0.06	0.07	0.07	0.08	0.08	0.09	0.09	0.10	0.10	0.11	0.12	0.12	0.13	0.14	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23

Table C-2 Potential Demand of Natural Gas (NCR: L1 Area)

Potential Substitution to NG by Fuel
Study Area in Southern Tagalog (L2 Area)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
No Gasoline																										
Transportation Gasoline	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Kerosene																										
Residential Kerosene	0.34	0.28	0.20	0.31	0.33	0.41	0.47	0.54	0.62	0.71	0.80	0.88	0.96	1.05	1.14	1.24	1.33	1.43	1.54	1.65	1.76	1.85	1.95	2.06	2.17	2.27
Diesel																										
Industry Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.03	0.04	0.05	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.15	0.16
Transportation Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Fuel Oil																										
Industry Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.08	0.08	0.09	0.10	0.11
Transportation Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commercial Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
LPG																										
Industry LPG	0.04	0.04	0.05	0.05	0.05	0.05	0.06	0.07	0.08	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.19	0.20	0.21	0.23	0.24	0.26	0.28
Residential LPG	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.19	0.33	0.92	1.54	2.15	2.77	3.42	4.07	4.75	5.52	6.32	7.13	7.96	8.84	9.63	10.46	11.30	12.14	12.96
Commercial LPG	0.52	0.01	0.01	0.01	0.01	0.14	0.24	0.40	0.56	0.76	0.97	1.18	1.39	1.62	1.86	2.12	2.39	2.67	2.97	3.29	3.62	3.95	4.29	4.65	5.04	5.44
Electricity																										
Industry Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commercial Electricity	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03
Potential Substitution Total to NG	0.96	0.39	0.32	0.43	0.46	0.68	0.86	1.23	1.63	2.53	3.47	4.38	5.33	6.32	7.33	8.38	9.55	10.76	12.00	13.29	14.62	15.90	17.21	18.55	19.92	21.29
Total Energy Consumption (MMCFD)	134.40	149.11	164.83	168.45	188.40	188.01	201.46	218.56	224.41	234.79	248.86	264.85	278.96	294.62	311.89	328.42	348.53	365.91	386.29	407.80	430.52	451.52	473.55	496.66	520.89	546.17
Total by Sector																										
Industry	0.04	0.05	0.05	0.05	0.05	0.06	0.07	0.08	0.09	0.11	0.13	0.15	0.17	0.19	0.21	0.24	0.26	0.29	0.32	0.35	0.38	0.41	0.44	0.47	0.51	0.55
Transportation	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02
Residential	0.38	0.32	0.24	0.35	0.37	0.46	0.53	0.73	0.95	1.63	2.34	3.03	3.74	4.47	5.22	5.99	6.86	7.76	8.67	9.61	10.57	11.49	12.42	13.36	14.31	15.24
Commercial	0.53	0.02	0.02	0.02	0.03	0.16	0.26	0.41	0.58	0.78	0.99	1.20	1.42	1.65	1.89	2.14	2.42	2.70	3.00	3.32	3.66	3.99	4.33	4.70	5.08	5.48
Total by Fuel																										
No Gasoline	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Kerosene	0.34	0.28	0.20	0.31	0.33	0.41	0.47	0.54	0.62	0.71	0.80	0.88	0.96	1.05	1.14	1.24	1.33	1.43	1.54	1.65	1.76	1.85	1.95	2.06	2.17	2.27
Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.15	0.16
Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.08	0.08	0.09	0.10	0.11	0.12
LPG	0.60	0.10	0.10	0.10	0.11	0.25	0.36	0.65	0.97	1.77	2.60	3.43	4.28	5.16	6.07	7.00	8.06	9.15	10.28	11.44	12.64	13.80	14.98	16.20	17.44	18.68
Electricity	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04

Table C-3 Potential Demand of Natural Gas (Southern Tagalog: L2 Area)

Potential Substitution to NG by Fuel
Study Area in Central Luzon (L3 Area)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Mo Gasoline																										
Transportation Gasoline	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kerosene																										
Residential Kerosene	0.12	0.10	0.07	0.11	0.12	0.14	0.17	0.19	0.22	0.25	0.28	0.32	0.35	0.38	0.41	0.45	0.48	0.52	0.56	0.60	0.64	0.68	0.72	0.75	0.79	0.83
Diesel																										
Industry Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.06	0.07
Transportation Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fuel Oil																										
Industry Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.05
Transportation Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commercial Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
LPG																										
Industry LPG	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.07	0.08	0.08	0.09	0.09	0.10	0.11	0.11	0.12
Residential LPG	0.04	0.01	0.01	0.01	0.02	0.02	0.02	0.07	0.12	0.34	0.56	0.79	1.02	1.25	1.50	1.75	2.04	2.33	2.63	2.94	3.26	3.57	3.88	4.19	4.51	4.82
Commercial LPG	0.18	0.00	0.00	0.00	0.00	0.05	0.09	0.14	0.20	0.28	0.36	0.43	0.51	0.60	0.69	0.78	0.88	0.99	1.10	1.22	1.34	1.46	1.59	1.73	1.87	2.02
Electricity																										
Industry Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commercial Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Potential Substitution Total to NG	0.33	0.14	0.12	0.15	0.17	0.24	0.31	0.45	0.59	0.92	1.27	1.61	1.96	2.33	2.70	3.09	3.53	3.98	4.45	4.93	5.43	5.91	6.40	6.90	7.42	7.94
Total Energy Consumption (MMCFD)	53.29	68.81	66.85	67.84	72.76	76.11	81.25	84.88	90.50	94.84	106.76	106.53	112.61	118.99	125.72	132.79	140.24	148.13	156.47	165.29	174.60	183.23	192.29	201.79	211.76	222.18
Total by Sector																										
Industry	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.04	0.05	0.06	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.14	0.15	0.16	0.18	0.19	0.20	0.22	0.24
Transportation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Residential	0.13	0.11	0.08	0.12	0.13	0.16	0.19	0.26	0.34	0.59	0.85	1.10	1.37	1.63	1.91	2.20	2.52	2.85	3.19	3.54	3.90	4.25	4.60	4.95	5.31	5.66
Commercial	0.18	0.01	0.01	0.01	0.01	0.05	0.09	0.15	0.21	0.28	0.36	0.44	0.52	0.60	0.69	0.79	0.89	1.00	1.11	1.23	1.35	1.48	1.60	1.74	1.88	2.03
Total by Fuel																										
Mo Gasoline	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kerosene	0.12	0.10	0.07	0.11	0.12	0.14	0.17	0.19	0.22	0.25	0.28	0.32	0.35	0.38	0.41	0.45	0.48	0.52	0.56	0.60	0.64	0.68	0.72	0.75	0.79	0.83
Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.07
Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.05	0.05
LPG	0.21	0.04	0.04	0.04	0.04	0.09	0.13	0.24	0.36	0.65	0.96	1.26	1.58	1.90	2.24	2.59	2.98	3.39	3.81	4.24	4.69	5.12	5.57	6.03	6.49	6.96
Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Table C-4 Potential Demand of Natural Gas (Central Luzon: L3 Area)

Potential Substitution to NG by Fuel
Study Area in Central Visayas (CM Area)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
No Gasoline																										
Transportation Gasoline	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kerosene																										
Residential Kerosene	0.12	0.09	0.07	0.10	0.11	0.14	0.16	0.19	0.21	0.25	0.28	0.31	0.34	0.37	0.41	0.44	0.48	0.52	0.56	0.60	0.64	0.67	0.71	0.75	0.79	0.83
Diesel																										
Industry Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.04
Transportation Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fuel Oil																										
Industry Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03
Transportation Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commercial Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
LPG																										
Industry LPG	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.05	0.05	0.05	0.06	0.06	0.06	0.07
Residential LPG	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.07	0.12	0.33	0.56	0.70	1.01	1.25	1.49	1.74	2.03	2.33	2.63	2.94	3.26	3.57	3.89	4.20	4.52	4.84
Commercial LPG	0.18	0.00	0.00	0.00	0.00	0.05	0.09	0.14	0.20	0.28	0.35	0.43	0.51	0.60	0.68	0.78	0.88	0.99	1.10	1.22	1.34	1.46	1.59	1.73	1.87	2.02
Electricity																										
Industry Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Residential Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Commercial Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Potential Substitution Total to NG	0.32	0.13	0.10	0.14	0.15	0.23	0.29	0.42	0.57	0.89	1.23	1.57	1.92	2.28	2.65	3.04	3.47	3.92	4.38	4.86	5.35	5.83	6.32	6.83	7.34	7.86
Total Energy Consumption (MMCFD)	47.82	52.14	57.87	63.48	63.82	66.74	71.31	74.44	79.43	83.82	88.44	93.55	98.92	104.57	110.51	116.76	123.33	130.30	137.66	145.46	153.67	161.26	169.21	177.56	186.31	195.44
Total by Sector																										
Industry	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.07	0.07	0.08	0.09	0.09	0.10	0.11	0.12	0.13	0.14
Transportation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Residential	0.13	0.11	0.08	0.12	0.13	0.16	0.18	0.25	0.33	0.58	0.84	1.09	1.36	1.63	1.90	2.19	2.51	2.85	3.19	3.54	3.90	4.25	4.60	4.96	5.32	5.67
Commercial	0.18	0.01	0.01	0.01	0.01	0.05	0.09	0.15	0.21	0.28	0.36	0.44	0.52	0.60	0.69	0.79	0.89	1.00	1.11	1.23	1.35	1.48	1.61	1.74	1.89	2.04
Total by Fuel																										
No Gasoline	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kerosene	0.12	0.09	0.07	0.10	0.11	0.14	0.16	0.19	0.21	0.25	0.28	0.31	0.34	0.37	0.41	0.44	0.48	0.52	0.56	0.60	0.64	0.67	0.71	0.75	0.79	0.83
Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.04	0.04
Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03
LPG	0.20	0.03	0.03	0.03	0.03	0.08	0.12	0.23	0.34	0.63	0.93	1.24	1.56	1.88	2.21	2.56	2.95	3.36	3.77	4.21	4.65	5.09	5.54	5.99	6.46	6.93
Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Table C-5 Potential Demand of Natural Gas (Central Visayas: CM Area)

Potential Substitution to HG by Fuel
Study Area in Southern Mindanao (D Area)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	
No Gasoline																											
Transportation Gasoline	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Kerosene																											
Residential Kerosene	0.12	0.07	0.05	0.08	0.09	0.11	0.13	0.15	0.18	0.20	0.23	0.26	0.28	0.31	0.34	0.37	0.40	0.43	0.46	0.50	0.53	0.57	0.60	0.63	0.67	0.70	
Diesel																											
Industry Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.04	
Transportation Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Fuel Oil																											
Industry Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	
Transportation Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Commercial Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
LPG																											
Industry LPG	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.06	0.06	
Residential LPG	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.06	0.10	0.28	0.47	0.66	0.85	1.05	1.26	1.47	1.72	1.97	2.23	2.50	2.77	3.04	3.31	3.58	3.86	4.13	
Commercial LPG	0.19	0.00	0.00	0.00	0.00	0.04	0.07	0.12	0.17	0.23	0.30	0.36	0.43	0.50	0.58	0.66	0.74	0.83	0.93	1.03	1.14	1.24	1.35	1.47	1.59	1.72	
Electricity																											
Industry Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Residential Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Commercial Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
Potential Substitution Total to HG	0.33	0.10	0.09	0.11	0.12	0.18	0.24	0.35	0.47	0.74	1.03	1.32	1.61	1.92	2.23	2.56	2.93	3.31	3.71	4.12	4.54	4.96	5.38	5.81	6.25	6.70	
Total Energy Consumption (MMCFD)	48.13	46.18	51.86	52.47	56.33	58.88	62.79	65.48	69.89	73.81	77.81	82.48	87.23	92.25	97.54	103.11	108.96	115.18	121.75	128.78	136.85	142.93	150.15	157.63	165.47	173.57	
Total by Sector																											
Industry	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.08	0.08	0.09	0.10	0.11	0.11	0.12	
Transportation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
Residential	0.13	0.08	0.07	0.10	0.10	0.13	0.15	0.21	0.27	0.48	0.70	0.91	1.14	1.36	1.60	1.84	2.12	2.40	2.70	3.00	3.31	3.61	3.91	4.22	4.53	4.84	
Commercial	0.19	0.01	0.01	0.01	0.01	0.04	0.07	0.12	0.17	0.24	0.30	0.37	0.44	0.51	0.58	0.67	0.75	0.84	0.94	1.04	1.15	1.25	1.37	1.48	1.61	1.74	
Total by Fuel																											
No Gasoline	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Kerosene	0.12	0.07	0.05	0.08	0.09	0.11	0.13	0.15	0.18	0.20	0.23	0.26	0.28	0.31	0.34	0.37	0.40	0.43	0.46	0.50	0.53	0.57	0.60	0.63	0.67	0.70	
Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04	
Fuel Oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.03	
LPG	0.21	0.02	0.03	0.03	0.03	0.06	0.10	0.19	0.28	0.53	0.78	1.04	1.31	1.58	1.87	2.16	2.50	2.84	3.20	3.57	3.95	4.33	4.71	5.11	5.51	5.91	
Electricity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	

Table C-6 Potential Demand of Natural Gas (Southern Mindanao: D Area)

Price Sensitivity		Case		1		Year																									
Product	Unit	kg	ton	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025		
Crude oil		kg	ton	26.1	23.0	19.1	22.3	23.4	24.4	24.7	27.1	27.4	28.8	30.1	30.5	30.8	31.2	31.5	31.8	32.3	32.7	33.2	33.6	34.1	34.0	35.0	37.0	39.0	39.1		
Crude oil (Gasoline/Transportation)		kg	ton	26.1	23.0	19.1	22.3	23.4	24.4	24.7	27.1	27.4	28.8	30.1	30.5	30.8	31.2	31.5	31.8	32.3	32.7	33.2	33.6	34.1	34.0	35.0	37.0	39.0	39.1		
Kerosene (Industry)		kg	ton	12,857	13,324	12,302	14,885	14,863	16,760	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	
Kerosene (Transportation)		kg	ton	12,857	13,324	12,302	14,885	14,863	16,760	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	18,286	
Diesel (Industry)		kg	ton	13,172	13,844	12,826	15,280	15,280	16,775	17,728	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688
Diesel (Transportation)		kg	ton	13,172	13,844	12,826	15,280	15,280	16,775	17,728	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	18,688	
Fuel oil (Industry)		kg	ton	10,282	10,688	9,889	11,588	11,588	12,688	13,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688
Fuel oil (Transportation)		kg	ton	10,282	10,688	9,889	11,588	11,588	12,688	13,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688
LPG (Industry)		kg	ton	17,448	17,839	16,833	19,771	19,771	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216
LPG (Transportation)		kg	ton	17,448	17,839	16,833	19,771	19,771	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216	22,216
Natural Gas (Industry)		kg	ton	11,211	13,885	14,743	15,203	15,477	15,857	15,852	16,182	16,288	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488
Natural Gas (Transportation)		kg	ton	11,211	13,885	14,743	15,203	15,477	15,857	15,852	16,182	16,288	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488	16,488

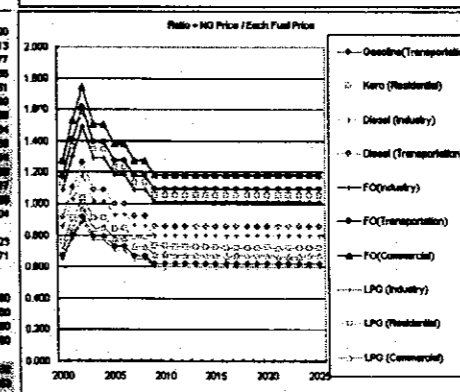
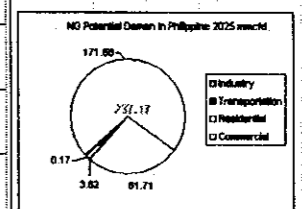
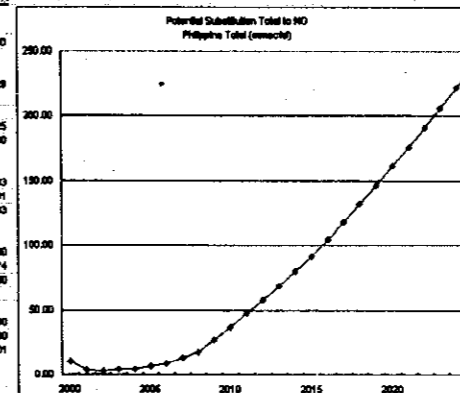
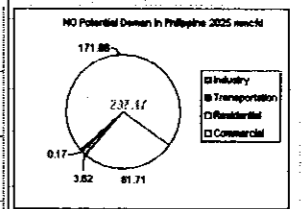
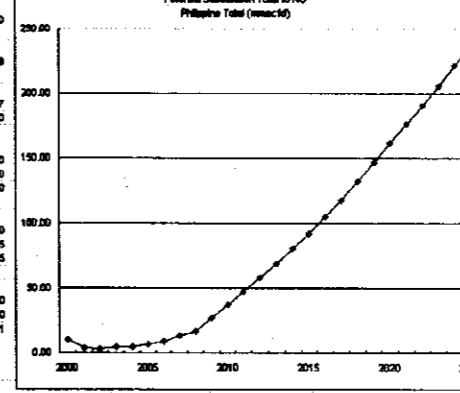
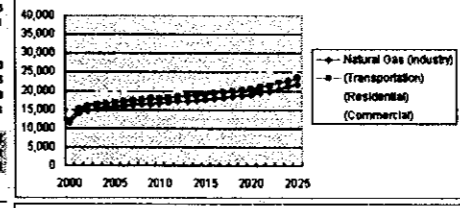
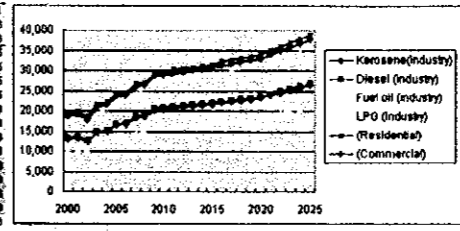


Table C-7 Price and Conversion Factor & Results of Estimation

Price Sensitivity				Case	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Price	Unit	kg	kg/kg	Case	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Cruise Oil	unit	kg	kg/kg	Case	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Peso/liter	0.85	10000	peso/kg	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Gasoline (Transportation)	Peso/liter	0.73	11200	peso/kg	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Kerosene (Industry)	Peso/liter	0.81	11100	peso/kg	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gasoline (Residential)	Peso/liter	0.73	11200	peso/kg	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gasoline (Commercial)	Peso/liter	0.73	11200	peso/kg	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Diesel (Industry)	Peso/liter	0.84	10900	peso/kg	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Diesel (Residential)	Peso/liter	0.84	10900	peso/kg	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Diesel (Commercial)	Peso/liter	0.84	10900	peso/kg	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Fuel Oil (Industry)	Peso/liter	0.94	10500	peso/kg	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Fuel Oil (Residential)	Peso/liter	0.94	10500	peso/kg	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Fuel Oil (Commercial)	Peso/liter	0.94	10500	peso/kg	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LPG (Industry)	Peso/liter	0.55	12100	peso/kg	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LPG (Residential)	Peso/liter	0.55	12100	peso/kg	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
LPG (Commercial)	Peso/liter	0.55	12100	peso/kg	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Natural Gas (Industry)	\$/Btu	35.31	10479	peso/kg	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Natural Gas (Residential)	\$/Btu	35.31	10479	peso/kg	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Natural Gas (Commercial)	\$/Btu	35.31	10479	peso/kg	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Electricity (Industry)	\$/kWh	5.28	5.28	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Electricity (Residential)	\$/kWh	4.81	4.81	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Electricity (Commercial)	\$/kWh	4.51	4.51	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

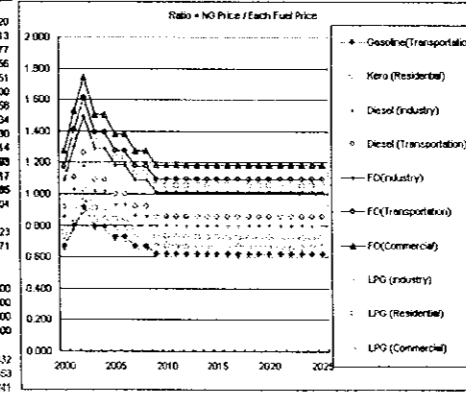
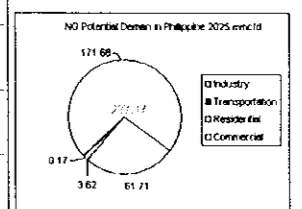
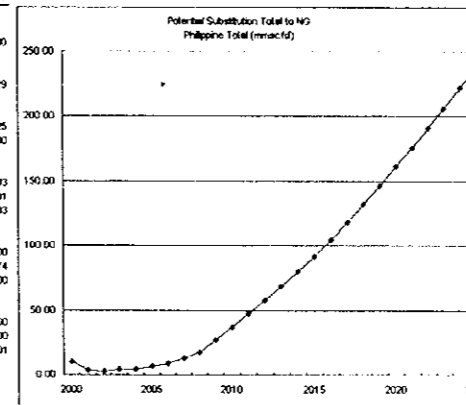
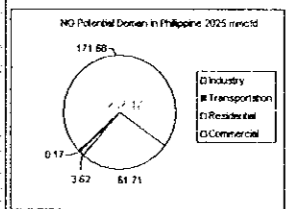
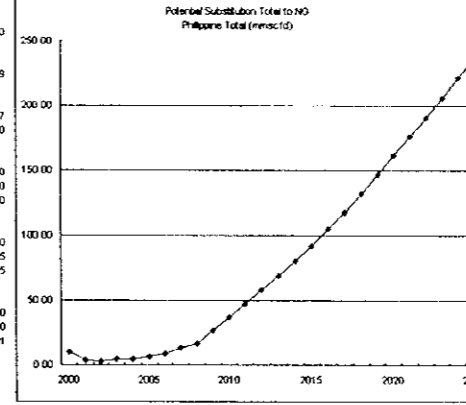
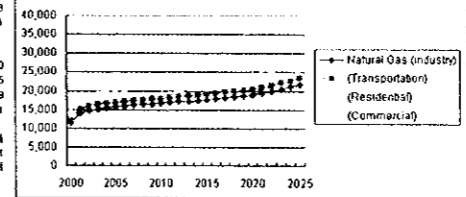
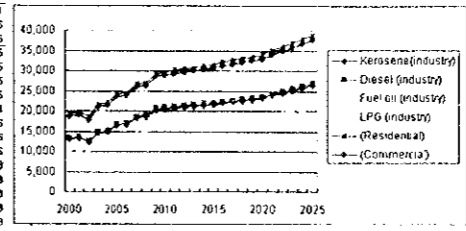


Table C-7 Price and Conversion Factor & Results of Estimation

