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Department of Energy
Republic of the Philippines

The Study on Capability Enhancement on Policy and Planning for a More Effective and Comprehensive Philippine Energy Plan (PEP) Formulation

Final Report

(Summary)

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Preface to Summary

This report is a summary of the JICA Study on Capability Enhancement on Policy and Planning for a More Effective and Comprehensive Philippine Energy Plan (PEP) Formulation conducted since September 2007. In this study, we constructed a comprehensive energy database, an energy demand forecasting model and an energy supply optimization model as tools to improve preparation of the PEP. The PEP is published every year covering 10 years ahead. This time we have extended the model coverage to 2030 to enable longer term consideration. Changing the study period on the model is easy, but more important challenge is to set out appropriate hypothesis to foresee longer period.

The principal report consists of four parts; Part 1 Present Status of Energy Plan Formulation and Challenges, Part 2 Long-term Energy Outlook and its Implication, Part 3 Challenges in Energy and the Philippine Energy Plan and Part 4 Tools for Energy Assessment. This summary focuses on the long term energy outlook and inferred issues and measures in the energy sector. As a brief explanation on the analytical tools is given in Chapter 1, please refer to the models on computer for more detail information. We set out the preconditions for the study in May 2008 with a crude oil price scenario starting from $120/Bbl. However, in view of the recent plunge, supplemental analyses are added in Chapter 5 with oil price of $70/Bbl. Perhaps, more analysis on the world energy trend is needed.

After the Asian currency crisis of 1997, the Philippines has recorded steady growth and this trend is accelerating recently. The country produces indigenous energy such as coal, natural gas and geothermal, but its self-sufficiency of commercial energy is about 45%. The government has tried to improve this with "Energy Independency" campaign. Despite the efforts, import dependence may deteriorate in the long run as domestic energy production may peak out. Increasing energy consumption shall give another impact on environment. Thus, construction of energy efficient economy and lower fossil energy structure shall be the fundamental elements of the energy policy.

For example, in the BAU case assuming the current trend, primary energy demand increases from 17.4 million toe in 2005 to over 49.7 million toe in 2030 by 2.9-fold and the energy import ratio rises to 65%. With this anxious outcome, we adopted the *Reference Case* of 17% lower energy consumption for 2030 with enhanced energy conservation. In the Reference case, the energy consumption reduces to 41.3 million toe and import dependence to 61%. Other cases are also examined such as introduction of nuclear, LNG and promotion of bio-fuel production.

With development of analytical tools under this study, scenario analyses as above have become much easier, but it is another issue for more serious study if the scenarios and/or policy options to be examined are practicable and favorable for the society. We should also note that it is meaningless to illustrate future picture of a growing society only by trend analysis. Future would not be, and should not be a copy of the past. World trend will change and technology will progress greatly toward solution of the energy and environmental problems. Considering energy policies under changeable global current, it is necessary to draw up a *grand design of future* discerning what kind of society, what type of economy the Philippines should aim at.

We hope that the analytical tools developed under this study will be mastered quickly and utilized effectively for compilation of the comprehensive Philippine Energy Plan.

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Chapter 1 Structure of Energy Model and Preconditions for Forecast

1.1 Structure of Long-term Energy Forecasting Model

The long-term energy model developed for the purpose of this study is designed to cover all the energy sectors as a comprehensive model, to cover the period until 2030 and to give calculated demand/supply figures for each year, which will finally be compiled as annual energy balance tables. It is designed to carry out various case studies to examine outcome of different scenarios and policy options. Analytical tools used in this model are composed of three blocks, namely, Energy Database, Demand Forecasting Model and Supply Optimization Model. The energy database is a tool to compile the energy data of the Philippines consistently and is designed applying the IEA (International Energy Agency) method as the standard. The database shall be operated independently from the analytical models; the data compiled and aggregated in the database are not directly linked to the models as a system, but are used from time to time being copied to these models.

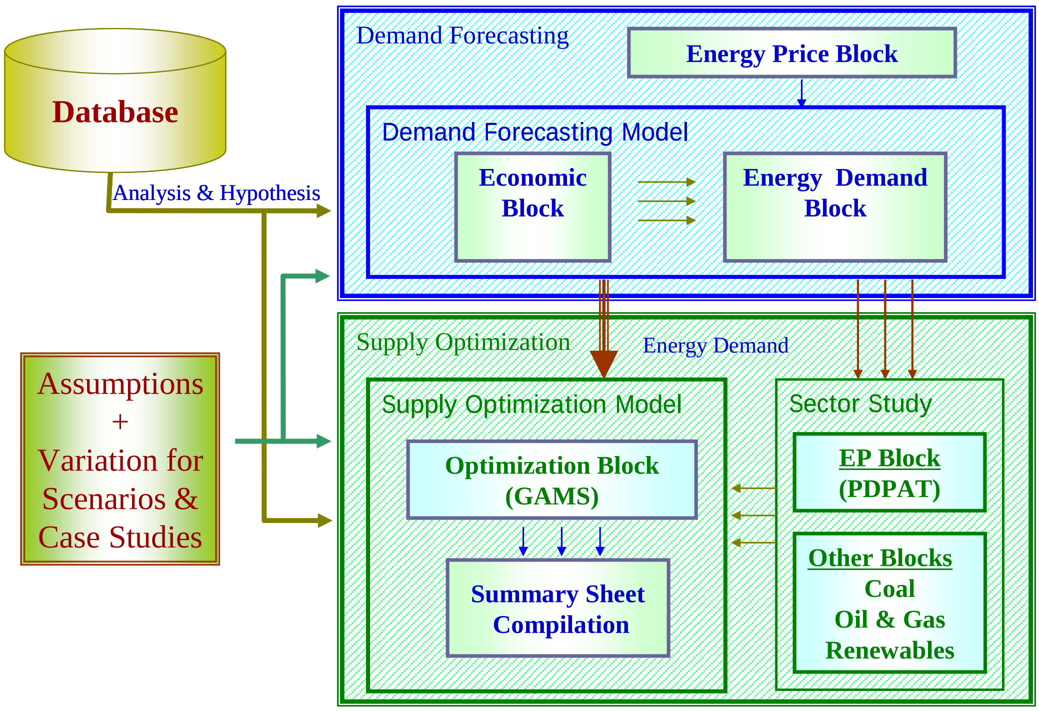


Figure 1.1-1 Composition of Long-term Energy Model

The model section is divided into two blocks, the Demand Forecasting Model and the Supply/Demand Optimization Model and adopts a one-way flow method "from demand forecasting to supply optimization" in view of operational convenience. While the first priority is given to appropriately express the energy system of the Philippines in these models, simplification is tried to the maximum extent to avoid excess enlargement of them. For example, since it is not the main objective of this study to analyze socio-economic trend of the country in detail, it is designed to give socio-economic development scenarios selectively for case studies as preconditions to the model.

Starting from such preconditions, the system is designed to analyze energy demand tendencies and policy options to realize energy supply optimization.[1]

In the demand forecasting model, the energy demand estimation results will be obtained by giving major assumptions on economic and price elements. Calculation results are output on EXCEL summary sheets to be given to the supply model as inputs. Then, energy supply optimization calculation will be made by the Energy Supply/Demand Optimization Model (the “Supply Model”) using linear programming method. Calculation results will be output on EXCEL summary sheets including annual energy balance tables. A brief summary table is also output for easy reference to the calculated energy structure and other major indicators. In order to avoid excess expansion of the Supply Model, studies on detail aspects of energy supply system shall be conducted separately as sector studies, and the outcome will be used to define and adapt assumptions, equations and parameters in the Supply Model.

In the above system, the linear programming (LP) method is applied to logically assure the calculation of the “optimum solution as the whole system”. However, the solution calculated by the model is determined by the assumptions and parameters given to the model. Whether the calculated solution indicates the true solution closely or not depends on how closely these assumptions and parameters are given to reflect the reality.

In the real world, it is impossible to give the model perfect assumptions and parameters. And, from model operation viewpoint, it is desirable to make the model as simple as possible. After all, we should keep it in mind that these models are the tools to evaluate differences among future scenarios and/or effects of policy options, so as to project and examine future plans for the desirable society (a dream as objective), measures to realize it (strategies) and paths toward it (roadmaps) by iteration of trial and error. As a consequence, it is not that the model will automatically give us a solution on the energy best mix but that the policy planner shall set out the policy objectives, strategies and roadmaps in pursuit of the energy best mix through examinations by the model. The model prepared for this study is not more than a tool to conduct such investigations.

1.2 Scope of Energy Supply/Demand Analysis

As the long-term economic outlook is supposed to be provided by NEDA (National Economic Development Agency), we apply economic development scenarios for trial model run in this study as assumed below.

The Asian Development Bank (ADB) has estimated the contributions of economic factors for the past development of the Philippines as shown in the Table 1.2-1. Economy of the Philippines has returned on to a high-growth trend in 2003 after the Asian currency crisis of 1997 and is recording strong growth in these years. Real GDP growth rate rose to 5.0% in 2005 and further strengthened to 5.4% in 2006 and 7.3% in 2007. It is expected to remain high at 6.5-7.0% in 2008. Given that the

[1] In this study, the analytical model is designed referring to the experiences of IEEJ and methods applied by various research institutes, and giving a priority on the operational convenience. The detail concept is explained in Part 4 of the principal report.

current trend persists, real GDP growth rate between 2005 and 2010 may record a historically high rate of 6.5% per annum.

Table 1.2-1 Contributions of Each Factors to GDP Growth of the Philippines

	Contribution of TFP Growth	Contribution of Labor Growth	Contribution of Capital Stock Growth	Contribution of TFP and Capital Growth
	(⊿A/A)	α (⊿L/L)	(1－α) (⊿K/K)	
	(a)	(b)	(c)	(a+c)
	%	%	%	%
1961-1970	0.06	1.18	3.98	4.04
1971-1980	-0.64	1.38	4.57	3.93
1981-1990	-1.62	1.37	2.05	0.43
1991-2000	0.25	0.87	1.77	2.02
2000-2006	2.41	1.24	1.12	3.53

Source: Asian Development Bank Country Diagnostics Studies "Philippines: Critical Development Constraints", December 2007.

In the past, the Philippines recorded very high population growth rate exceeding annual 2%, but according to the forecast of the United Nations it will slow down nearer to 1% in the long run. The world economy led by extremely strong Chinese and Indian economic growth may slow down facing various issues relating to energy supply, global financial system and climate change. Thus, we assume that the average growth rate would be 5% for the entire period of 2005 through 2030 as the base case, and 6% for a high growth case and 4% for a low growth case. However, viewing that recent vulnerable energy price together with the US financial crisis are going to seriously affect the world economy, the long-term economic scenario should be examined carefully.

Table 1.2-2 Economic Development Scenarios

	Population	R-GDP		
		Reference	High Case	Low Case
	%	%	%	%
05 --> 15	1.7	6.0	6.8	4.5
15 --> 30	1.3	4.4	5.5	3.7
05 --> 30	1.5	5.0	6.0	4.0

Source: Population growth rates cited from UN Population Division's annual estimates and projections

Under the above scenario, the Philippines will overtake the current Thailand in aggregate GDP by 2015 and in per capita GDP by 2030. Size of the economy will expand 3.4-fold between 2005 and 2030 for the Reference Case, 4.3-fold for the High Growth case and 2.7-fold for the Low Growth case. That is, 2/3 of the 2030 economy will be totally new additions to the current one. These newly emerging economic sectors could not be projected on the extension of the past economic trend. Instead, it should be thought that future economic growth will be brought about by development of new business sectors that the past Philippine did not have. Therefore, in compiling long-term energy outlook, it is important to imagine and draw up *the grand design of the future economy* rather than simply applying the past trend.

The greatest driving force toward such economic growth may be induced by the foreign direct investment (FDI) favoring the economic difference with neighboring countries. To attract them appropriately, however, it is very important to upgrade the quality of labor and infrastructure, and securing stable energy supply is one of important factors to realize this.

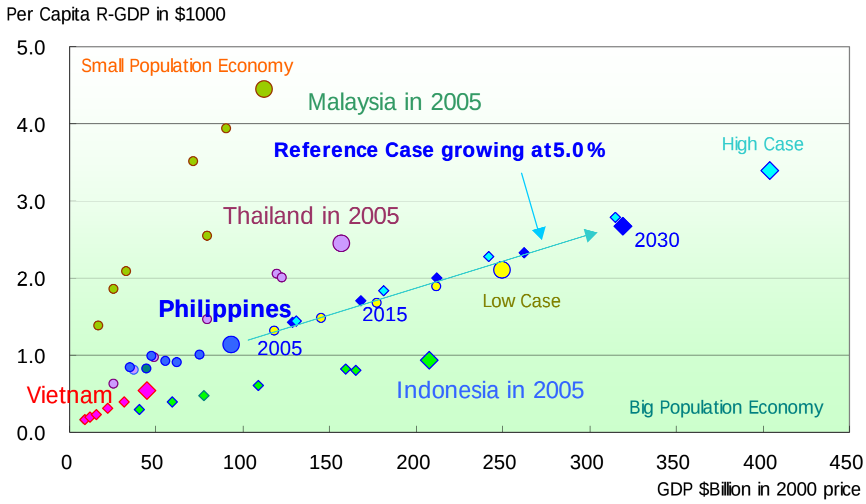
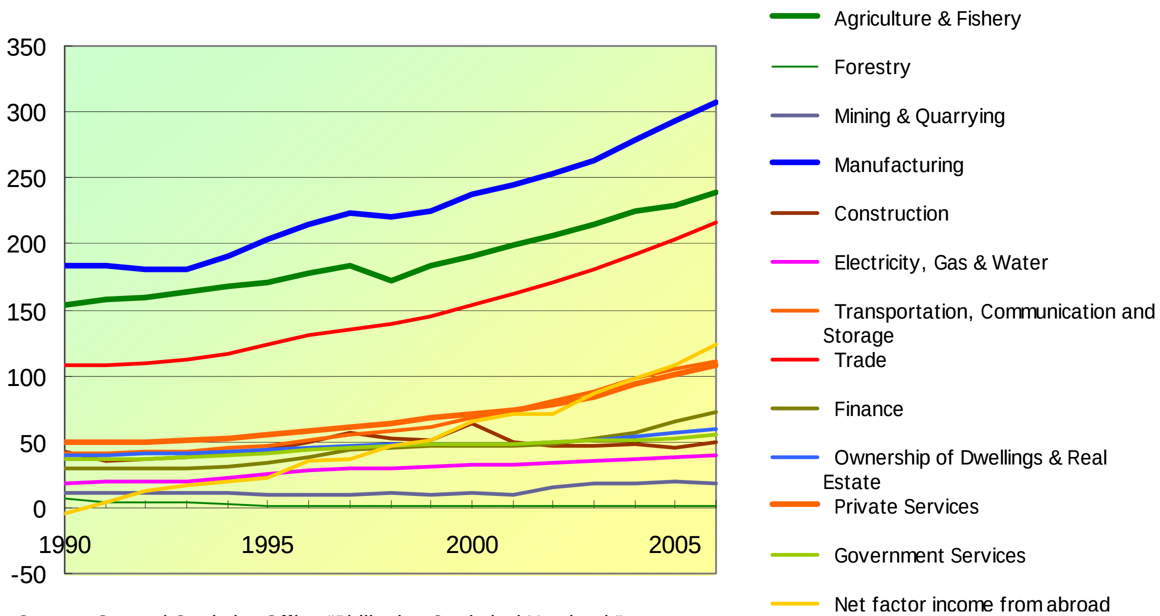


Figure 1.2-1 The Philippines and ASEAN countries

In considering the energy demand trend, it is important to identify which sectors would play important roles as the leading sector of economic development. Sectoral indices such as sector GDP or IIP are important to indicate characteristics of economic growth.



Source: General Statistics Office "Philippine Statistical Yearbook"

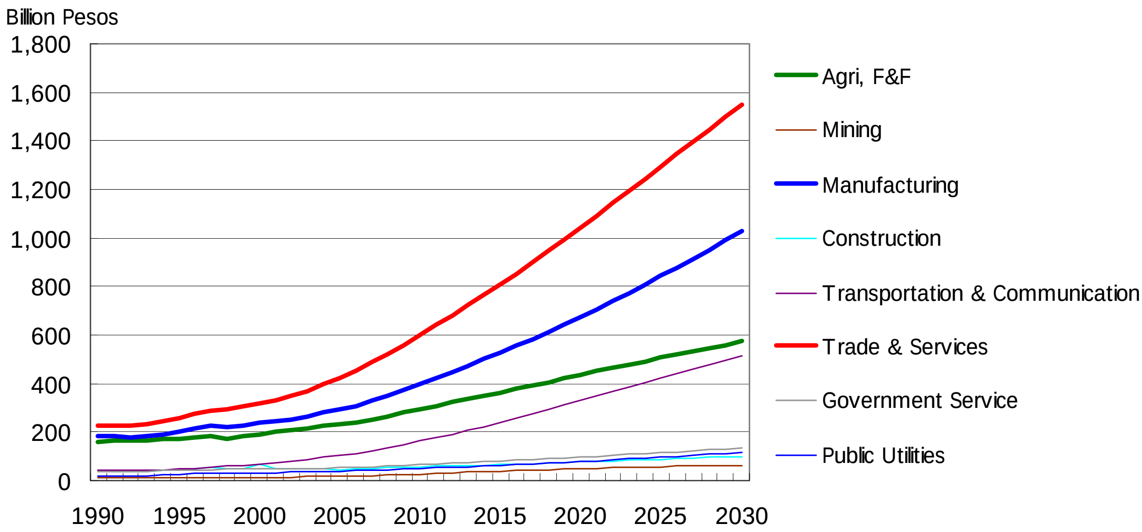
Figure 1.2-2 Sector GDP of the Philippines

While the Sectoral GDP should be projected with in-depth analysis engaging econometric model, a conventional method is applied here to derive provisional assumptions for model test run giving attention on the point how each sector would perform in relation to the overall economic movement. The following equation is applied for projection of sector GDPs to consider changes in elasticity of sector GDP against the aggregate GDP.

$$Y_t = Y_{t-1} \times (1 + \text{GDP Growth Rate} \times (A - B \times \text{Year}))$$

Here, "A" is the elasticity of the sector GDP over the aggregate GDP in the previous year, and "B" is the annual change of the elasticity. In the stagnant economic sector, the current elasticity "A" is already low, and it would not change greatly in future.

Projection of sector GDP applying the conventional method is shown in Figure 1.2-3. We do not elaborate on the background of these assumptions here. However, in discussion of appropriateness on the long term economic outlook, it is necessary to demonstrate the long term grand design of the economy and examine coherence of these assumptions and projections.



Growth Rate	Agri & FF	Mining	Manufactur-ing	Construc-tion	TranspCom	Public Utilities	Trade & Services	Govt Services	GDP
	%	%	%	%	%	%	%	%	%
1990-2006	2.5	3.4	3.3	1.0	6.4	4.9	4.4	2.6	3.6
1998-2006	4.2	7.4	4.2	-0.6	8.4	3.5	5.5	2.2	4.6
2005-2010	4.9	6.3	6.2	4.2	9.2	5.6	7.1	4.5	6.3
2010-2020	4.0	6.1	5.4	3.2	7.3	4.8	5.7	4.0	5.3
2020-2030	2.8	2.5	4.3	2.7	4.6	3.9	4.0	3.3	3.9

Figure 1.2-3 Projection of Sector GDP: Reference Case

1.3 Scenarios on Energy Price

In this Study, we set out four scenarios on the future crude oil price trend, referring to studies run by IEA and other research institutes, such as "Reference Scenario", "High-Price Scenario", "Super High Price Scenario" and "Low-Price Scenario". "Super High-Price Scenario" is prepared to examine what situation would appear for the Philippines when the crude oil price rises extremely and "Low Price Scenario" on the other extreme.[2]

(1) "Reference scenario"

World crude oil price fluctuates widely affected by various factors. In the "Reference Scenario", we suppose the following factors.

a) Oil demand-supply situation (crude and refined products) will continue the present trend.

b) World economic growth will continue the present trend.

c) Speculative capital movement in the "Futures market" will continue the present trend.

Taking account of these market circumstances, many organizations such as IEA and The Institute of Energy Economics, Japan adopt "Leveling-off" or "a marginal rise in real term" price scenario as their "Reference Scenario." As the "Reference Scenario" for this study, considering the fact that 1) the actual world import FOB price was $70/Bbl in 2007 (the World export FOB price of USDOE database), 2) but the recent WTI futures is at the level exceeding $130/Bbl, and that 3) the crude oil price CIF Japan recorded $100/Bbl in April 2008, it is assumed that it will increase to $120/Bbl in 2008 on average and, extending the current trend, it will reach $160/Bbl by 2030 in real term of 2006 value.

(2)"High-price scenario" and "Super High-Price Scenario"

"High-price scenario" is the case that the international oil market would become very tight supply-demand situation and crude oil price would soar considerably more than the "Reference Scenario". Background to suggest such a situation is as follows.

a) Investment in oil field development would delay while oil demand continues to increase in Asian continues, such as China and India, and the USA.

b) Constraint of oil resources would be clearly recognized worldwide as the Peak Oil theory suggests.

c) Speculative capital like investment funds would actively play around in the futures market exaggerating the price fluctuation bandage and yielding more volatile situation.

It is assumed that the oil price will rise to $200/Bbl by 2030 in the High Price Scenario and $240/Bbl in the Super High-Price Scenario.

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[2] The price scenario explained here is the analysis made in May 2008. The world oil price plunged sharply upon the Lehman-shock of September 2008. Therefore, supplemental analysis on its impact was run and a brief summary is given in Chapter 5.

(3) "Low-Price Scenario"

Judging that the present crude oil price is raised more than the expectation by factors other than the demand and supply balance, that such abrupt price hike would invite demand reduction and that demand/supply balance in the market would be restored sooner or later, it is possible to consider a scenario that crude oil price would fall back to the ordinary situation. In this scenario, we suppose preconditions as follows.

a) World economic growth would slow down reflecting the various elements such as "sub-prime loan crisis" in the USA and completion of the Beijing Olympic Game. Oil demand increase may take a breather.

b) Investment in energy supply would increase reflecting high energy price, and thus world energy demand/supply balance would loosen.

c) Speculative capitals would draw back to other markets or get short of fund.

In this scenario, crude oil price may settle down at around $120/Bbl and then continue the same level up to 2030 in real term of 2006 value. Figure 1.3-1 shows actual changes in the world crude oil import price (nominal term) and future assumptions by above price scenarios.

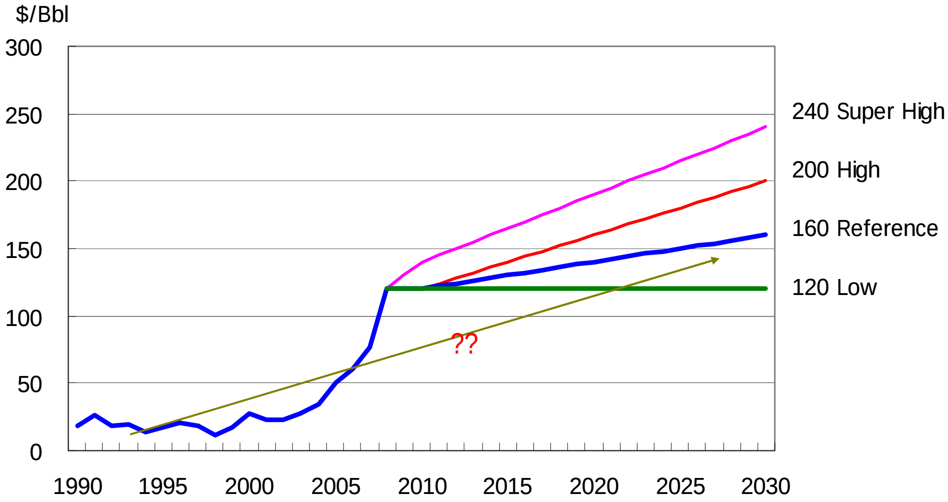


Figure 1.3-1 Actual World Average Import Price (FOB) and Forecast by Scenario

We have applied similar scenarios to the other energies as below.

(a) Natural Gas

In this study, it is assumed that international natural gas or LNG price changes in parallel with crude oil price at around 70% of the latter. Then, in the Reference Case, the LNG price CIF Japan is forecast to be $12.7/MMbtu in 2008 corresponding to crude oil price of $120/Bbl. This price may reach $19.5/MMbtu in 2030. In the High Price scenario, it will jump to $24.3/MMbtu corresponding to crude oil price of $200/Bbl and in the Super High-Price Scenario $29.2/MMbtu corresponding to crude oil price of $240/Bbl. In the Low Price scenario, instead, LNG price will be $12.7/MMbtu corresponding to crude oil price of $120/Bbl.

(b) LPG

LPG price in the international market fluctuate most roughly among various energies. The international price of LPG has been at around 110% of crude oil price in the international market, and this trend is adopted in the projection. It will reach $1,000/ton in response to the crude oil price of $120/Bbl in 2008, and will further rise to $1,400/ton by 2030. It is assumed to reach $1,800/ton in the High Price case and $2,200/ton in the Super High-Price case. However, it should be noted here that LPG supply balance in the international market would be affected by the alternation of the existing LPG demand in emerging countries, with substantial quantities being substituted by piped gas and/or LNG as observed in China when natural gas based city gas system is introduced. LPG supply is not on the one-way trend toward tightening like this, and thus we need to watch the global market movement closely.

(c) Coal

Traditionally, international coal price has been substantially lower than those of oil and natural gas in heat value equivalent. This is because coal is deposited abundant and widely in the world and neither clean nor convenient for use. However, even coal price is increasing rapidly in these years. In this study, it is assumed that coal price would cease to be traditional slow coach and move in parallel with changes in crude oil price because of such uncertainties. For the Reference Case, the Australian coal price (FOB) will become $120/ton in 2008 corresponding to crude oil price of $120/Bbl. After then it will reach $160/ton in 2030 in real term of 2006 value. In the High Price scenario, it will jump to $200/ton and in the Super High-Price scenario $240/ton in 2030. In the Low Price scenario, it would remain at $120/ton until 2030.

Recent movement of domestic energy prices in the Philippines compared with the international prices is as shown in Table 1.4-2. While prices of crude oil and natural gas are in the range of international prices, coal is relatively cheaper as domestic production is of low quality. The international LPG price is CIF price. On the other hand, the domestic price includes delivery and marketing cost and therefore it is about 50% higher than the international price.

Table 1.3-1 Energy Prices: International Price versus Domestic Price

		Unit	2000	2001	2002	2003	2004	2005	2006	Average
Crude oil	Intrnational	PHP/litter	7.53	7.29	7.62	9.24	12.20	17.28	19.47	11.52
	Philippines	PHP/litter	7.30	7.30	7.70	9.14	11.86	17.84	19.83	11.57
	Ratio	%	97%	100%	101%	99%	97%	103%	102%	100%
Coal	Intrnational	PHP/kg	1.53	1.99	1.85	1.97	3.12	3.54	3.26	2.47
	Philippines	PHP/kg	2.11	1.20	1.10	1.00	1.70	2.00	1.90	1.57
	Ratio	%	138%	60%	59%	51%	54%	57%	58%	64%
Natural Gas	Intrnational	PHP/MMBtu	215	226	229	259	300	352	366	278
	Philippines	PHP/MMBtu	192	271	260	293	318	347	380	294
	Ratio	%	89%	120%	114%	113%	106%	99%	104%	106%
LPG	Intrnational	PHP/litter	7.63	7.11	7.77	8.60	10.98	13.86	13.85	9.97
	Philippines	PHP/litter	9.90	10.60	10.40	12.30	15.40	19.10	24.30	14.57
	Ratio	%	130%	149%	134%	143%	140%	138%	176%	146%

Source: International price by IEEJ and domestic price by DOE

In the projection for this study, we assume that the domestic energy prices will move in principle being linked to international prices, to be projected as follows.

1) Crude oil and natural gas prices will move at almost in the same range with international prices.

2) Coal price may be affected by increase of export demand as well as international prices with increased import, and the ratio against the international price will increase to 70% gradually.

3) LPG price may, as the import CIP price soars, decrease its domestic cost ratio gradually and will become 140% of the international price.

4) Prices of petroleum prices such as gasoline and diesel oil will move along with crude oil price. Same principles will apply for the High Price and Low Price cases.

5) Though it may be necessary to conduct in-depth analysis on the electric tariff, we set out a conventional fuel price index composed of coal, natural gas and fuel oil with a ratio of 1:1:0.5 and assume that the electricity tariff will change according to this index. However, in view that energy prices are soaring in recent years, we assume that the ratio of electricity tariff against this index would gradually go down.

Table 1.3-2 Projection of Domestic Energy Price: Reference Case

	Unit	2000	2005	2010	2020	2030	Versus 2005 2010	Versus 2005 2020	Versus 2005 2030
							%	%	%
Crude Oil	Peso / litter	7.3	17.8	33.9	39.5	45.2	190	222	253
Coal	Peso / kg	2.1	2.0	3.2	4.1	4.9	161	203	246
Natural Gas	Peso / mmBtu	192.0	346.9	642.1	749.1	856.1	185	216	247
LPG	Peso / litter	9.9	19.1	30.8	37.0	43.1	161	194	226
Gasoline	Peso / litter	15.0	30.7	53.1	65.3	79.9	173	213	260
Kerosene	Peso / litter	11.7	29.5	52.8	64.9	79.3	179	220	269
Jet Fuel	Peso / litter	15.2	32.6	59.6	74.1	91.6	183	227	281
Diesel	Peso / litter	12.1	28.8	50.4	61.7	75.0	175	214	260
Fuel Oil	Peso / litter	9.7	18.9	38.2	45.3	53.0	202	240	280
Electricity(Average)	Peso / kWh	4.5	6.8	12.0	14.0	16.1	176	206	236
Electricity(Residential)	Peso / kWh	4.8	7.0	12.8	14.8	16.8	182	211	240
Electricity(Commercial)	Peso / kWh	4.5	7.2	12.3	14.4	16.5	171	200	230
Electricity(Industrial)	Peso / kWh	4.3	6.2	11.2	13.1	14.9	181	211	241

1.4 Indigenous Energy Supply Outlook in the Philippines

(1) Coal

In 2007, coal supply in the Philippines is estimated at approx. 11.4 million tons, of which 3.7 million tons or 32% is domestic coal, whereas 7.7 million tons or 78% is imported coal. Therefore two thirds of the coal supply is dependent heavily on imported coal.

Semirara Mining Corporation that accounts for 94% of coal production for the whole country has a production capacity of 4.0 to 4.5 million tons in 2007. Meanwhile, domestic coal delivery in 2007 grew by 7.3% to 2.78 million tons, although it did not reach the production capacity. The production capacity at Semirara is planned to expand to 5.0 million tons per year by the end of 2008. This is based on the strategy to expand coal exports commencing from February 2007. Destinations for the exports are India, China and Hong Kong, and they are projected to continuously expand in the future.

According to the coal supply plan by the DOE, coal deposits of 580 million tons will be confirmed by 2030, and it is also expected to increase the domestic production to 10 million tons annually that is

2.5 times the current level by concluding 25 coal production contracts in total. Furthermore, the DOE has a plan to approve 10 of the coal bed methane development projects between 2011 and 2030 to promote the development and utilization of the resources.

(2) Oil

Crude oil production of the Philippines in 2006 was 0.18 million Bbls. Most of the liquid hydrocarbon production comes from the Malampaya gas field as a form of condensate, while there is a small quantity of crude production as a lasting tail production of old oil fields. Malampaya condensate is directly exported from the offshore production facility as it is too light for processing at domestic refineries. At present, however, Galoc oil field offshore northwest Palawan is under development and expected to start production in 2009 at a rate of about 20,000 Bbls per day. Nearby Octon oil field is also deemed to be prospective. At any rate, the current proved recoverable reserve of the Philippines is not substantial. Based on it, oil production in the Philippines may remain in minimal quantity and most of the required oil needs to be imported.

(3) Natural Gas

Natural gas production from the Malampaya field started in 2001 and is now supplying a substantial quantity for power generation in the Batangas area. While the gas field is expected to reach its peak production of 400 MCFD (annual 146 Bcf) by 2010, the gas pipeline plan connecting to the metropolitan Manila area is still facing uncertainties and the gas production remains at about 80% of the plan. The recoverable reserve of the Malampaya gas field is estimated at around 3 Tcf. Should the plateau production reach 140 MMcfd as planned, gas production from this field may peak out at around 2015 as shown in Figure 1.5-1. If its production were kept at the current level (80% of the original plan), it would possibly peak out before 2020.

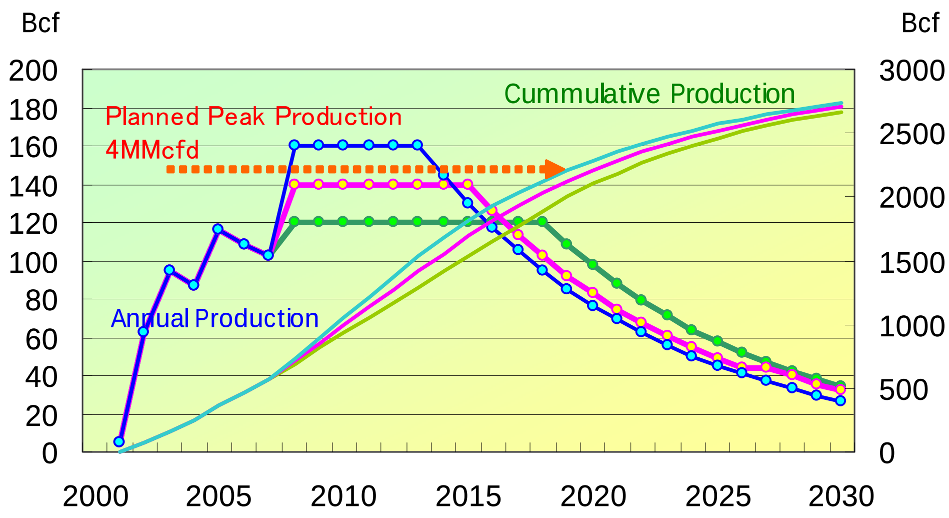


Figure 1.4-1 Production Profile of Malampaya Gas Field

Any additional gas required beyond this such as LPG substitute needs to be supplied by other sources. In recent years, use of LPG as a clean fuel is developing in the country in particular at household and commercial buildings. LPG is a clean fuel easy to use. As it does not require huge facilities in handling like LNG, it is easy to introduce. It is the most suitable fuel for cooking where firewood and charcoal were used, and as recommended under the UN Millennium Goal it will serve improving health condition of housewives at household. Small regional grids with conventional system as well as large scale utilization of LPG for co-generation at shopping malls and buildings may develop in future.

(4) Renewable Energy

According to "Renewable Energy Policy Framework" (2003), DOE has set out goals for renewable energy development to increase RE-based power generating capacity by 100% by 2013 and to increase non-power contribution of RE to the energy mix by 10 million Bbls of fuel oil equivalent (MMBFOE, 1,444 ktoe) in the next ten years

Table 1.4-1 Installed RE Generating Capacity

(Unit:MW)

Resource	Installed Capacity (as of 2002)	Target Capacity	Total Capacity
Geothermal	1,931	1,200	3,131
Hydro	2,518	2,950	5,468
Wind	0	417	417
Biomass, Solar & Ocean	0	131	131
Total	**4,449**	**4,698**	**9,147**

Biofuels Act of 2006 stipulates that ethanol blend ratio on gasoline should be raised to 5% in 2009 and 10% in 2011, and the bio-diesel blend ratio on diesel oil to 2% in 2009. Potential of biofuel is great in the Philippines endowed with good natural condition. However, to materialize further increase, it is necessary to establish a comprehensive promotion plan covering land and agricultural policy. We have run cases to examine possible changes in the energy balance once such innovative policy is implemented.

(5) Nuclear

In the 1970s, Philippines government planned to introduce nuclear power generation facing the world oil crisis. The PWR-type (Pressurized-Water Reactor) 620 MW nuclear power plant, manufactured by Westinghouse, was constructed in Bataan and almost completed by 1984. However, the plan was withheld in 1986, and the plant has been preserved since then by the Philippine Nuclear Research Institute (PNRI). Nuclear is deemed as an important candidate to cope with energy security and global warming as the fuel can be used longer time without emitting CO2. Thus, we ran cases that a 1,000MW nuclear station will start operation in 2025.

1.5 Scenario Setting and Case Studies

Implementing the various analyses in this study, setting of assumptions for the Reference Case is the most important job to be carefully worked out since it represents the fundamental direction of the Philippine Energy Plan. In this study, the BAU (Business as Usual) case was studied at first assuming that the Philippines economy would grow at a speed of annual 5.0% and the world energy price would remain at the current level throughout the simulation period. However, it would not be possible for the Philippines to continue the current trend unchecked as projected in the BAU Case, as the world energy balance is tightening. Thus, the Reference Case is set out as a long term energy policy goal that energy consumption should be decreased by 8% in 2015 and by 15% in 2030 with a practicable energy conservation rate of annual 0.5%.

As shown in Figure 1.6-1, various cases were run in this study starting from the Reference Case. Factors examined in these case studies may be classified into those relating to (1) change of energy demand and (2) change of supply condition as follows.

1) Factors relating to change of energy demand

a. Economic growth scenario

Setting the economic growth rate for the reference Case at 5%, growth rate changes of plus/ minus 1% should be examined.

b. Energy price scenario

Setting the crude oil price at $160/Bbl in 2030 for the Reference Case, High Price case of $200/Bbl, Super High Price case of $240/Bbl and Low Price case of $120/Bbl will be examined.

c. Energy conservation scenario

Setting the annual 0.5% EEC for the Reference Case, EEC Promotion case of annual 1.0% and Super EEC case of 1.5% will be examined.

d. Motorization scenario

In addition to the Reference Case, Vehicle Plus case will be examined where car ownership may increase 10 to 25% in 2030.

2) Factors relating to change of supply conditions

a. Introduction of nuclear power plants of 1,000 MW from 2025, while the Reference Case does not include any nuclear power.

b. Natural gas utilization: Decline of domestic gas production from Malampaya gas field may occur during the projection period. In order to compensate this, LNG import may start from 2020, which may be implemented in two phases. Phase-1 starts in 2020 with 0.5 million tons per annum import and gradually build up to 1.5 MTPA in three years. Then, Phase-2 starts in 2025 similarly building up to 1.5 MTPA in three years.

c. Geothermal power plant scheduled to start operation in 2015 onward will be accelerated to double the currently scheduled incremental capacity.

d. Introduction of biofuel will be accelerated and the incremental quantity may become double of that assumed for the Reference Case. In addition, various biofuel promotion scenarios will be examined.

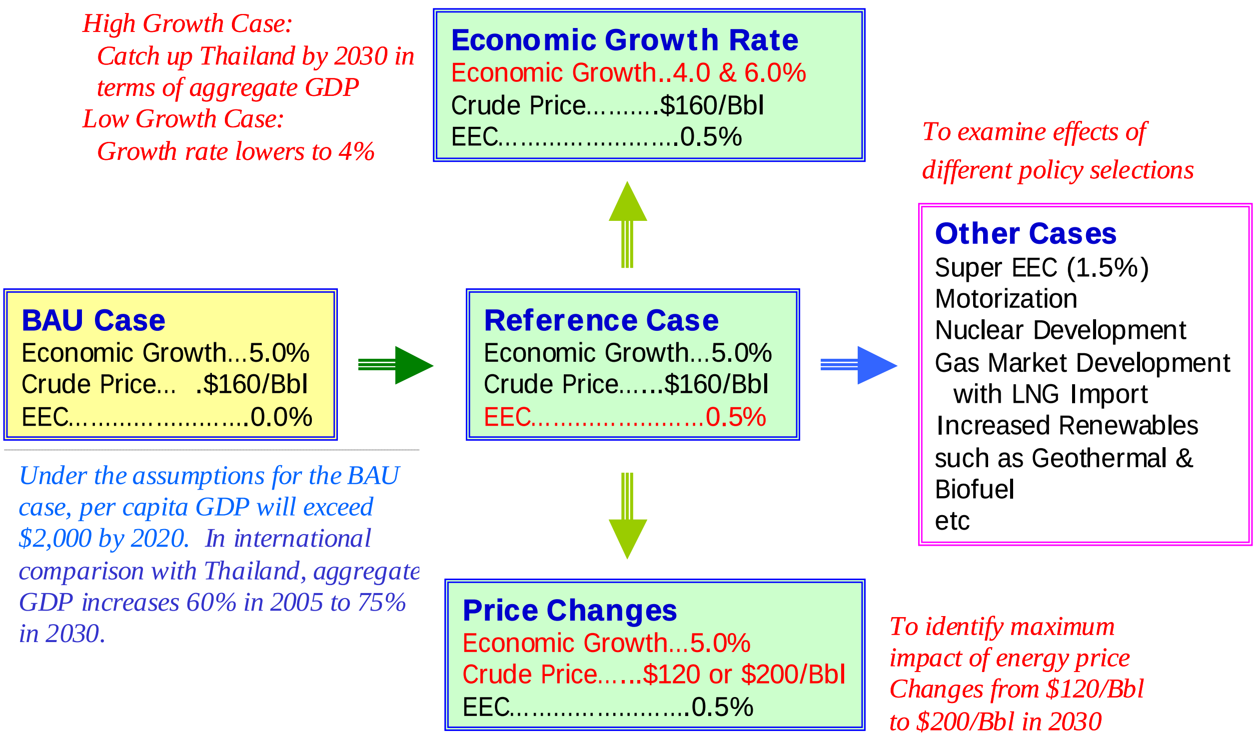


Figure 1.5-1 Case Setting

Chapter 2 Long-Term Energy Demand Outlook

2.1 Outlook of Final Energy Consumption

Outcome of the simulation of various cases according to the above setting is shown below. As the final energy demand in 2005 was 17,401 thousand tons in oil equivalent (ktoe), in the BAU Case where no positive EEC is assumed, it will grow at annual 4.3% and will reach 49.7 million toe or 2.86-fold. However, in the Reference Case where annual 0.5% EEC is applied, the annual growth rate slows down to 3.6% and the final energy demand in 2030 will become a substantially lower amount of 41.2 million toe. This energy conservation rate compares to 8.1 million toe or 17% of the annual consumption.

Table 2.1-1 Outlook of Final Energy Consumption

	BAU	Reference	High Growth	Low Growth	High Price	Super High Price	Low Price	EEC	Super EEC
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
2010	22,931	21,787	22,135	21,085	21,787	21,409	21,706	21,460	21,137
2015	29,531	27,120	28,350	24,903	26,901	26,354	27,249	26,049	25,016
2020	36,445	32,363	35,142	28,552	31,888	31,216	32,768	30,312	28,382
2025	43,253	37,148	42,165	31,872	36,413	35,628	37,866	33,930	30,975
2030	49,668	41,273	49,265	34,820	40,287	39,403	42,317	36,759	32,720
Growth Rate									
05-10	5.7%	4.6%	4.9%	3.9%	4.6%	4.2%	4.5%	4.3%	4.0%
10-20	4.7%	4.0%	4.7%	3.1%	3.9%	3.8%	4.2%	3.5%	3.0%
20-30	3.1%	2.5%	3.4%	2.0%	2.4%	2.4%	2.6%	1.9%	1.4%
05-30	4.3%	3.5%	4.3%	2.8%	3.4%	3.3%	3.6%	3.0%	2.6%

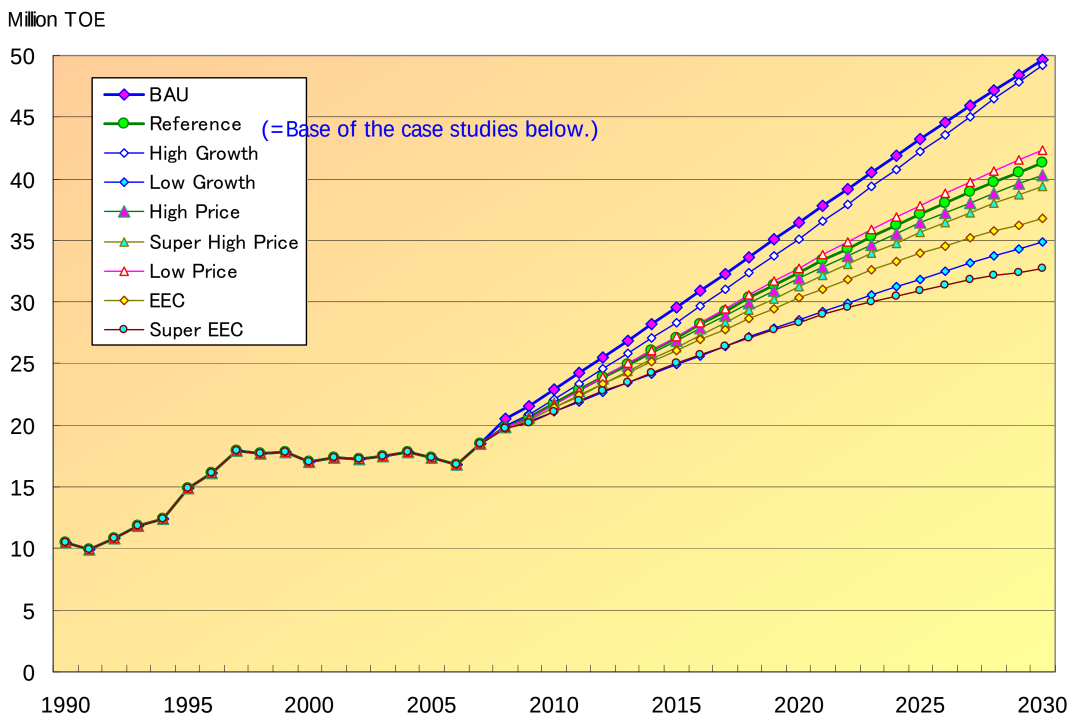


Figure 2.1-1 Outlook of Final Energy Demand

Among various factors, impact of economic growth change is greatest followed by the extent of EEC promotion, and the impact of energy price change is smallest. When the economic growth rate becomes 1% higher than the Reference Case, energy conservation efforts of annual 0.5% will be totally offset. Economic growth itself is a good thing improving quality of life. It is an important thing to be decided through nation-wide discussion what kind of economic policy for development should be implemented after due consideration on the balance with energy and environment issues.

(1) Economic Growth Scenario

From the simulation result of the Reference Case, as the average annual growth rate of the final energy demand is 3.5% over the projection period of 2005 through 2030 against the assumed GDP growth rate of 5.0%, the GDP elasticity of the final energy demand built-in in this model is 0.70. In general, in a stage when economic growth accelerates, an economy requires materials and energy for construction of industrial and social capital, and therefore the GDP elasticity of energy demand exceeds 1.0. In case of the Philippines, weight of the energy intensive industries in its industrial structure is low, and supply of basic materials such as steel and chemical products mostly depends upon import. Drivers of its economic growth are industries with relatively less energy intensity such as trade, high quality services and general manufacturing. At the same time, transfer from overseas workers has increased in recent years (9.6% of GDP in 2006) pushing up personal consumption. Reflecting such background, the GDP elasticity of energy demand is positioned relatively low.

Table 2.1-2 Final Energy Consumption: Ratio against Reference Case

	BAU	Reference	High Growth	Low Growth	High Price	Super High Price	Low Price	EEC	Super EEC
2020	112.6%	100.0%	108.6%	88.2%	98.5%	96.5%	101.3%	93.7%	87.7%
2030	120.3%	100.0%	119.4%	84.4%	97.6%	95.5%	102.5%	89.1%	79.3%

(2) Energy Conservation Scenario

In this study, we have set out cases of energy conservation promotion such as annual 0.5% for the Reference Case, 1.0% for the EEC promotion Case and 1.5% for the Super EEC case. Annual 0.5% difference of EEC rate brings about 10% difference in energy demand in 2030. In terms of GDP elasticity, against 0.86 for the BAU Case, it goes down to 0.70 for the Reference Case, 0.60 for the EEC Case and 0.52 for the Super EEC Case.

Then, a question arises about possibility of realizing such energy conservation. Energy efficiency of home and electric appliances has been improved dramatically in recent years. It is estimated that the difference between the average energy efficiency of the social stock and that of the latest models may be more than 10% to 20%. For example, suppose that there is 5% difference of energy efficiency between the average social stock and the latest model, and that such durable goods or energy using equipments would be replaced in 10 years, annual energy efficiency improvement is 0.5%. Energy conservation of this magnitude is sufficiently possible on durable goods such as electric appliances and passenger cars as well as office equipments. However, we need to conduct further study whether it is possible or not to implement energy conservation beyond the Reference Case assumption looking into possibility of technical improvement, change of life style and/or effect of energy conservation policies.

(3) Price Scenarios and Price Effects

As the price effect of energy demand is generally thought to be between -0.1 and -0.2, price effect is set at -0.10 in this demand forecasting model. This parameter can be alternated easily in the model operation. As a result, assuming the crude oil price of 2030 at $160 per Bbl, effect of price changes of plus/minus $40 (25%) remains at only 3%. However, we should note that, when the share of an expenditure item is small among other expenditures of household or business entities, not much care is paid on such item. Then, as the share of such expenditure goes up caused by price hike and possibly backed by increasing social cautions, price effect itself would increase. As energy has become one of the most concerned goods worldwide, together with energy conservation, there is a good possibility for the price effect to increase in future.

2.2 Energy Demand Outlook by Sector

Energy demand outlook by sector for the Reference Case is as shown in Table 2.2-1 and Figure 2.2-1. In the energy demand structure of the Philippines, transportation fuel shares very high ratio over 50%. Large scale energy intensive industry is scarce, and the total energy consumption of the whole manufacturing sector remains at around 20%. Shares of energy consumption at household and commercial sector are relatively high. This tendency is forecast to continue in future.

Table 2.2-1 Energy Demand Outlook by Sector

	Agriculture	EI Industry	Gen Mfg.	Transport	Commercial	Residential	Total
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
2005	313	2,653	1,430	8,939	1,660	2,405	17,401
2010	254	3,071	1,480	12,032	2,187	2,763	21,787
2020	337	4,311	2,366	17,277	3,638	4,434	32,363
2030	402	5,591	3,279	20,563	5,218	6,219	41,273
05-30	1.0%	3.0%	3.4%	3.4%	4.7%	3.9%	3.5%
Composition	%	%	%	%	%	%	%
2005	1.8	15.2	8.2	51.4	9.5	13.8	100.0
2010	1.2	14.1	6.8	55.2	10.0	12.7	100.0
2020	1.0	13.3	7.3	53.4	11.2	13.7	100.0
2030	1.0	13.5	7.9	49.8	12.6	15.1	100.0

Energy demand of general sectors is divided and separately estimated by sector, which are agriculture, forestry and fishery, six energy intensive manufacturing industries (hereinafter called "energy intensive industry"), other manufacturing industry (hereinafter called "general manufacturing"), trade and services and residential sectors. Among them, energy demand of the energy intensive industry is estimated separately and individually on six industries. Energy demand outlook by sector is as explained below.

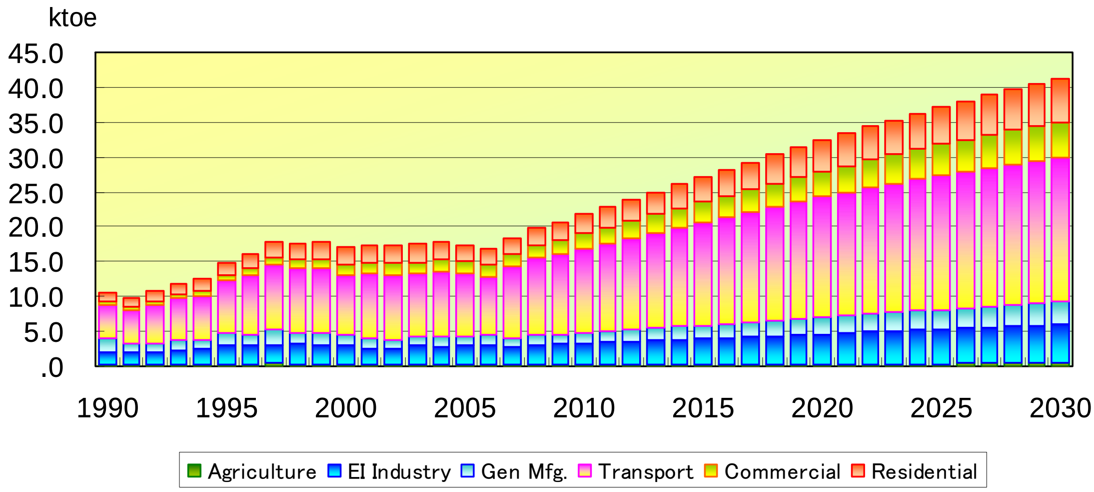


Figure 2.2-1 Energy Demand Outlook by Sector

2.2.1 Agriculture, Forestry and Fishery

Energy consumption of the Agriculture, Forestry and Fishery Sector share merely one percent (1%) of the aggregate energy consumption, and the impact of this sector on the overall energy trend is negligible.

Table 2.2-2 Energy Demand Outlook of Agriculture, Forestry and Fishery Sector

	Kerosene	Diesel	Fuel Oil	Fossil	Electricity	Total
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
2005	4.5	244.2	21.8	270.6	42.2	312.8
2010	5.1	161.7	38.0	204.8	49.5	254.4
2020	6.7	209.0	49.1	264.7	72.2	336.9
2030	7.8	244.6	57.4	309.8	92.6	402.4
2005 ->30	2.2%	0.0%	3.9%	0.5%	3.2%	1.0%

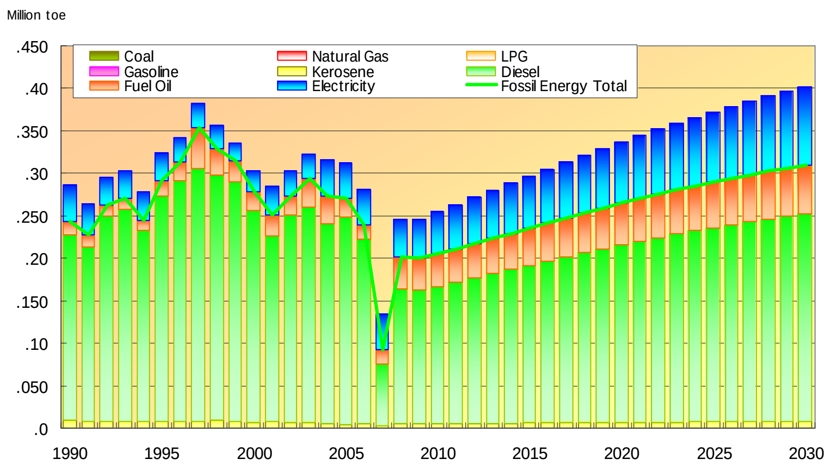


Figure 2.2-2 Energy Demand Outlook of Agriculture, Forestry and Fishery Sector

The average demand growth rate of this sector between 2005 and 2030 is 1.0%, of which it is 0.5% for fossil fuel and 3.2% for electricity. Among them, if we pick up the calculated growth rate, demand growth of diesel oil is lowest at 0.0%, but this is affected by the irregular statistics in 2006 and 2007. Demand growth rate after 2008 is 2.0% for diesel oil and fossil fuel total, and 2.3% for energy total, which would not be very small.

2.2.2 Energy Intensive Industry

Among manufacturing industries, energy demand by six energy intensive industries, namely, cement, paper & pulp, food processing, chemical products, sugar and steel, will increase at annual 3.0%, and in 2030 it will amount to 2.1-fold of that of 2005. Consumption of coal and fuel oil shares 2/3 of the total energy consumption while the rest is shared by electricity. This tendency will be maintained in future. As explained later, substantial quantity of conventional type biomass fuel (non-commercial energy) is consumed in this sector such as bagasse in sugar industry and coconut residue in food processing industry. They amount to 45% of the total commercial energy consumption of the six industries.

Table 2.2-3 Energy Outlook of Energy Intensive Industry

	Coal	LPG	Kerosene	Diesel	Fuel Oil	Fossil Energy	Electricity	Total
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
2005	1,031.2	45.7	23.0	186.8	678.2	1,964.8	688.7	2,653.5
2010	1,353.0	39.5	16.3	244.5	654.0	2,307.4	763.2	3,070.6
2020	1,953.9	88.8	19.0	368.6	868.7	3,298.9	1,012.1	4,311.0
2030	2,590.7	156.8	20.8	493.9	1,068.4	4,330.7	1,260.3	5,591.0
2005->30	3.8%	5.1%	-0.4%	4.0%	1.8%	3.2%	2.4%	3.0%

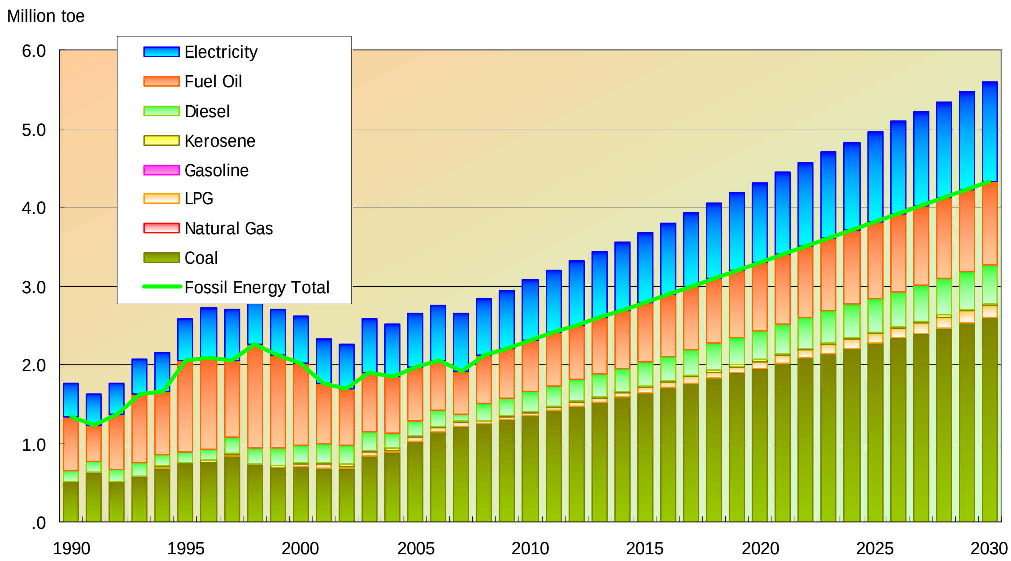


Figure 2.2-3 Energy Outlook of Energy Intensive Industry

2.2.3 General Manufacturing

Energy consumption of the general manufacturing industry will grow at annual 4.6% and in 2030 it will reach 4.4 million toe or 3.08-fold of that of 2005. Since most of the industries included in this category are of less energy intensive, electricity demand for motors, lighting and air conditioning share 45% of the total energy consumption, followed by fuel oil for heat source at 30%.

Table 2.2-4 Energy Outlook of General Manufacturing

	Coal	Natural Gas	LPG	Kerosene	Diesel	Fuel Oil	Fossil Energy	Electricity	Total
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
2005	25.3	12.2	23.6	5.0	299.8	427.7	793.6	636.7	1,430.3
2010	31.2	77.4	54.7	0.0	117.2	413.1	693.6	786.4	1,479.9
2020	47.2	77.4	227.1	0.0	177.1	519.6	1,048.4	1,317.7	2,366.1
2030	62.4	77.4	463.5	0.0	234.1	548.2	1,385.6	1,893.6	3,279.2
2005->30	3.7%	7.7%	12.6%	***	-1.0%	1.0%	2.3%	4.5%	3.4%

With regard to fossil fuel trend, demand for LPG may grow to some extent, while diesel oil and fuel oil may be waived in view of recent abrupt price hike reflecting increased environmental concern. Fuel oil demand would become stagnant as low-sulfur fuel oil is not available in the Philippines and LPG would be preferred instead. Natural gas demand is assumed to be flat as there is no concrete plan to develop natural gas supply at present. Possibility of natural gas penetration depends upon preparation of gas supply systems such as construction of city gas grid.

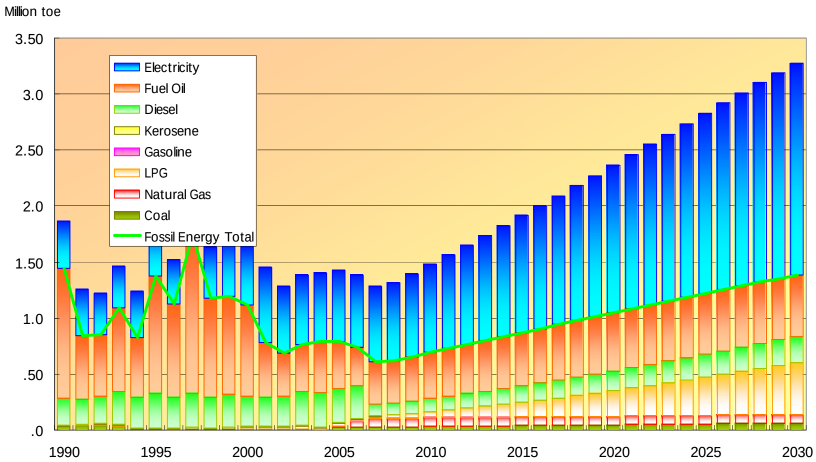


Figure 2.2-4 Energy Outlook of General Manufacturing

2.2.4 Commercial Sector; Trade and Services

Energy consumption of the commercial sector will grow at annual 4.7% and by 2030 it will reach 3.1-fold of that of 2005. About 70% of the energy consumption in this sector is electricity. Since main demand sectors are office buildings, shopping malls and hospitals, ratio of diesel oil and fuel oil will further decline, and electricity and LPG will become the core energy sources.

Table 2.2-5 Energy Outlook of Commercial Sector

	LPG	Diesel	Fuel Oil	Fossil Eergy	Electricity	Total
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
2005	219.3	124.5	186.9	530.7	1,129.6	1,660.2
2010	507.3	70.0	127.5	704.8	1,482.1	2,186.9
2020	963.5	70.0	76.3	1,109.8	2,528.0	3,637.8
2030	1,389.3	70.0	45.7	1,505.0	3,713.4	5,218.4
2005->30	7.7%	-2.3%	-5.5%	4.3%	4.9%	4.7%

Energy consumption of the commercial sector at offices and shopping malls are expected to converge to electricity for lighting and air-conditioning and LPG for cocking. On the other hand, diesel oil and fuel oil mainly used for smaller generators and boilers may be replaced by electricity and LPG as their delivery system develops. As the Philippines economy is in a developing stage, electricity intensity will rise steadily outrunning efficiency improvement of appliances.

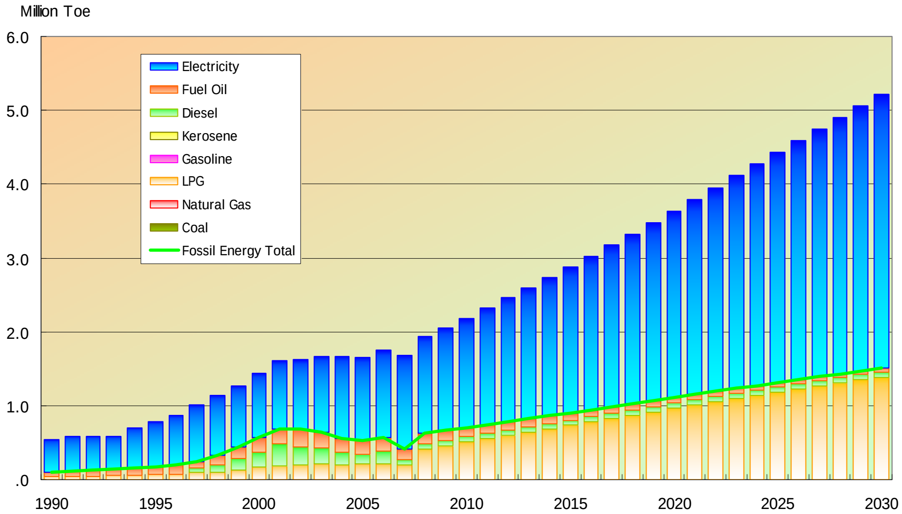


Figure 2.2-5 Energy Outlook of Commercial Sector

We have not scheduled conversion of LPG to natural gas in the commercial sector in this study. However, if natural gas supply becomes available in and adjacent areas of Metro-Manila, co-generation for air conditioning purpose at hotels and hospitals may become possible in addition to cooking use. Then, there is a good possibility that a part of electricity demand may convert to city gas. Therefore, it is necessary to consider future energy selection coherently with natural gas market development plan.

2.2.5 Residential Sector

Most of the residential sector energy consumption comprises biomass, electricity and LPG. Biomass energy such as fuel wood and charcoal will be replaced by modern energies such as electricity and LPG in due course. Commercial energy demand of the residential sector during the projection period is estimated to grow at annual 3.9%, and it will increase 2.6-fold from 2.4 million toe in 2005 to 6.19 million toe in 2030. Since city gas service is not available, substantial part of the incremental energy demand may be supplied by LPG and electricity.

Table 2.2-6 Energy Outlook of Residential Sector

	LPG	Kerosene	Fossil Energy	Electricity	Commercial Total	Charcoal	Fuel wood	Agri-Waste	Total
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
2005	773.7	252.7	1,026.4	1,378.7	2,405.1	537.1	3,373.0	0.0	6,315.2
2010	882.4	155.0	1,037.4	1,725.4	2,762.9	509.3	2,891.8	0.0	6,163.9
2020	1,523.0	92.8	1,615.8	2,818.2	4,434.0	332.4	1,887.4	0.0	6,653.9
2030	2,186.5	55.6	2,242.1	3,976.7	6,218.7	149.2	847.0	0.0	7,214.9
2005->30	4.2%	-5.9%	3.2%	4.3%	3.9%	-5.0%	-5.4%	***	0.5%

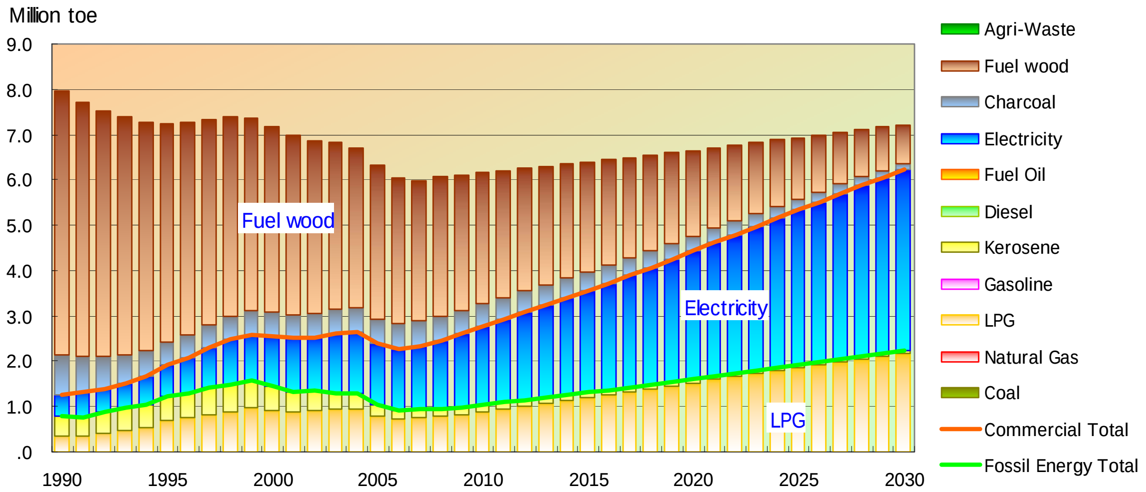


Figure 2.2-6 Energy Outlook of Residential Sector

As a result, we project that usage of the on-grid electricity will reach 90% in 2030 from the current ratio of slightly below 80%, and LPG use ratio will increase from 60% to 75% during the projection period. Electrification ratio including off-grid supply will become almost 100%. On the other hand, conventional biomass energy such as fuel wood and charcoal will decrease being replaced by LPG. Biomass consumption may decrease by double quantity of the LPG consumption increase reflecting energy efficiency.

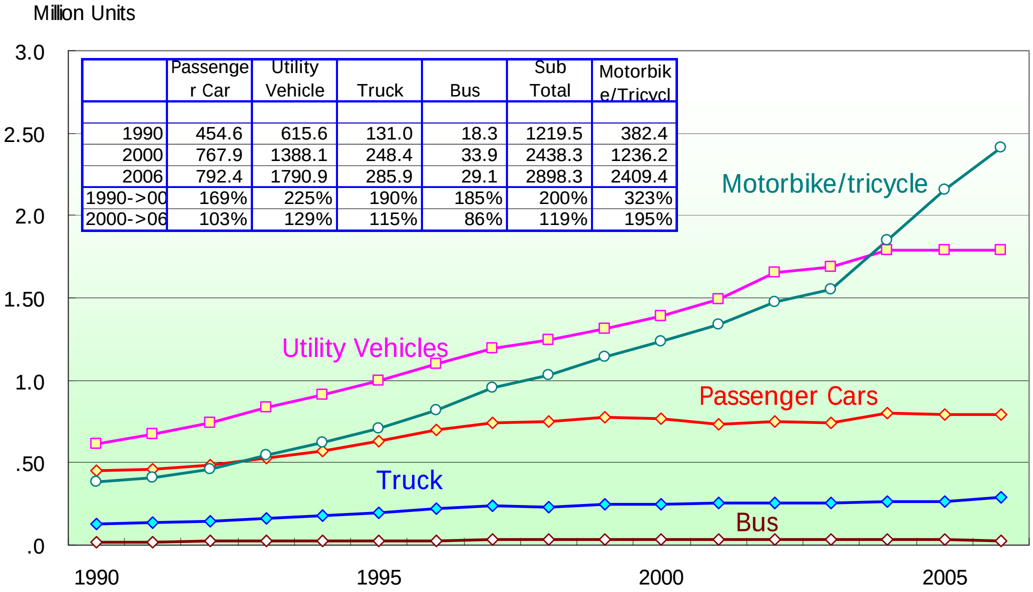
2.3 Transportation Sector

In 2007, energy consumption in the transportation sector recorded 10,406 ktoe. It is the largest energy consumption sector sharing 55% of the total energy consumption of the Philippines. Energy demand in this sector can be divided into four sectors, that is, those for motor vehicles, railway, marine transportation and aviation services. In 2007, fuel consumption for motor vehicles shared 75% of the transportation sector energy use, while marine fuel shared 14% and aviation fuel 11%, and energy for railway was merely 0.09 % (9.2 ktoe).

Motor vehicle diffusion in the Philippines is still in an early stage, and it is difficult and not appropriate to estimate to what extent it would develop applying the historical data. Comprehensive future design should be drawn up with thorough discussion on life style, business style, transportation policy, etc., and fuel policy should be set out based on such investigations.

2.3.1 Number of Automotive Vehicles Owned

Numbers of automotive vehicles in the Philippines are 2.9 million units of four wheeler or larger vehicles and 2.4 million units of motorbike and tricycles.



	Passenger Car	Utility Vehicle	Truck	Bus	Sub Total	Motorbike/Tricycl
1990	454.6	615.6	131.0	18.3	1219.5	382.4
2000	767.9	1388.1	248.4	33.9	2438.3	1236.2
2006	792.4	1790.9	285.9	29.1	2898.3	2409.4
1990->00	169%	225%	190%	185%	200%	323%
2000->06	103%	129%	115%	86%	119%	195%

Figure 2.3-1 Historical Record of Motor Vehicle Ownership

Trucks for freight transportation are mainly large sized vehicles and less than 300,000 units. Number of vehicles has doubled during the 1990s, but the increasing pace has slowed down since 2000. Number of bus is decreasing and passenger car is stagnant. Among them, utility vehicles (those vehicles with passenger capacity of less than 18 such as jeepneys, wagons and SUVs) are increasing steadily. In addition, number of motorbike is increasing fast suggesting a possibility of explosive diffusion as seen in Thailand and Vietnam. There is also a possibility that, from the examples of Japan and front running ASEAN countries, number of light truck may increase in future, though any sign of such tendency is not found yet in the Philippines.

2.3.2 Number of Automotive Vehicles and Fuel Consumption

Watching statistics of the Philippines as shown on the graph, we find that fuel consumption record is considerably unstable while vehicle number is relatively stable. Estimating fuel demand, we need to verify how to assess the relationship of these statistics.

In order to verify the relationship between the vehicle number and fuel consumption, unit fuel consumption is illustrated in Figure 2.3-2, which are calculated per passenger car equivalent gasoline vehicles and per truck equivalent diesel vehicles. For this aggregation, Japanese statistics of fuel consumption by vehicle type is applied. While unit fuel consumptions are on the declining trend both for gasoline and diesel oil in the recent years, they are substantially below the trend in these years. For example, two lines are illustrated in the graph to show the hypothetical gasoline and diesel oil demand assuming that the unit fuel consumptions were kept at the level of 2000 and another case that they were improved annual one percent or 6.8% during six years. Actual records of both gasoline and diesel oil consumption in 2005 and 2006 substantially undershoot these trends. It is curious enough that diesel oil consumption suddenly returned to this trend line in 2007, though gasoline continued undershooting. Perhaps, it may be appropriate to think that oil statistics would be problematic.

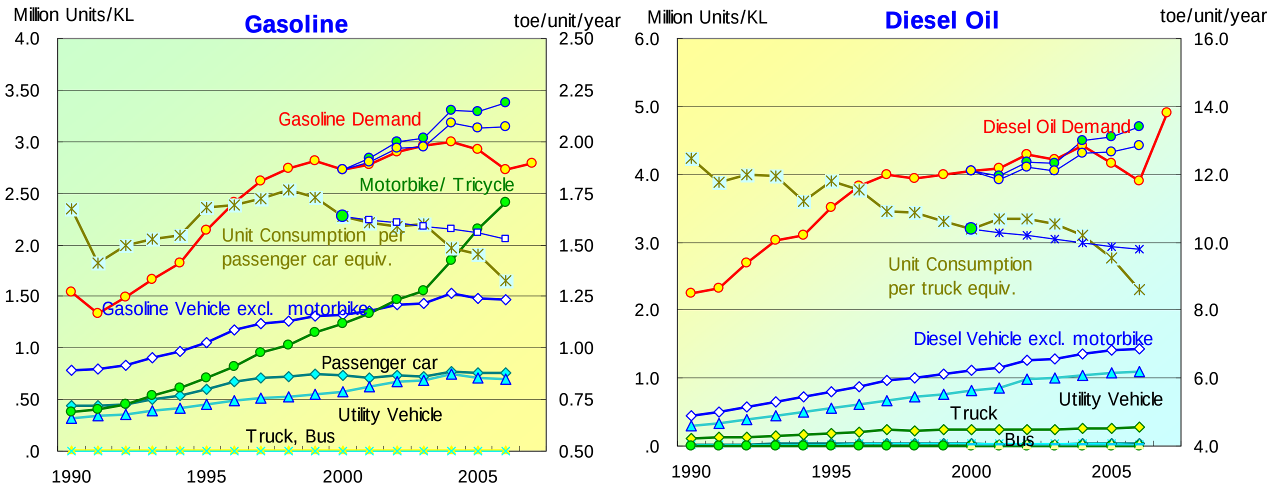


Figure 2.3-2 Number of Vehicles and Fuel Consumption

2.3.3 Outlook of Automotive Fuel Demand

Estimated number of automotive vehicles and fuel consumption are shown in Table 2.3-1 and Figure 2.3-3 below.

Table 2.3-1 Outlook of Automotive Vehicles

	Passenger Cars	Utility Vehicles	Trucks	Buses	Motorcycles/Tricycles	Total	Passenger Car Equiv.
Gasoline Vechicles : 1000 units							
2005	756	708	9	1	2158	3632	2013
2010	825	897	16	3	3610	5351	2588
2020	1307	1299	21	4	6497	9127	4082
2030	1816	1516	23	5	8010	11370	5131
2005->30	3.6%	3.1%	3.7%	6.8%	5.4%	4.7%	3.8%
							Truck Equiv.
Diesel Vehicles : 1000 units							
2005	32	1084	258	30	0	1404	420
2010	37	1537	341	28	0	1944	557
2020	39	2645	484	30	0	3199	835
2030	41	3267	572	32	0	3913	1000
2005->30	1.0%	4.5%	3.2%	0.2%	***	4.2%	3.5%

Among gasoline vehicles, passenger cars and utility vehicles such as one-box cars and SUV will be the popular vehicles. At present the total number of both type amounts to 1.5 million units. This will reach 2.6 million units in 2020 and exceed 3.3 million units in 2030. Another surprise may be fast increase of motorbike. We have projected that the current diffusion rate of 30.4 units per 1,000 persons would increase to 65 units in 2030. Yet, it is substantially below the level of Thailand, which is close to 300 units per 1,000 persons.

Among diesel vehicles, big increase may be expected on one box-cars and Sporting Utility Vehicles. In Japan, number of smaller trucks was 4.28 million units or 1.74-fold of large sized trucks and gasoline-driven light trucks 9.38 million units or 3.83-fold. At present we do not find any sign that light trucks would increase like this. As jeepneys and tricycles are playing the role in the Philippines, we need to watch any changes in the trend.

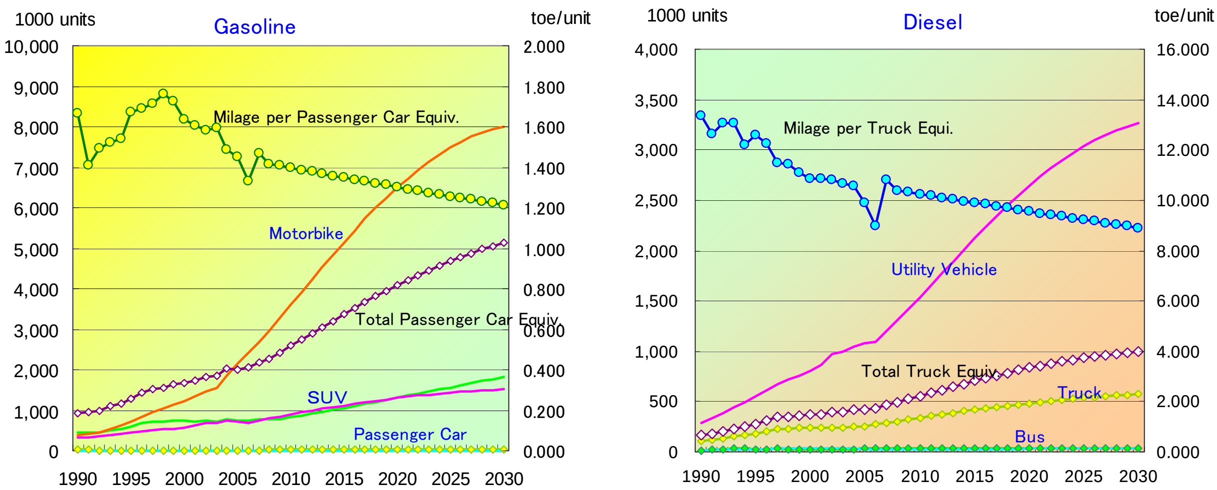


Figure 2.3-3 Automotive Vehicles and Fuel Demand

Table 2.3-2 Motor Fuel Consumption by Vehicle Type

	Passenger Car	Utility Vehicle	Truck	Bus	Motorbike
	litters	litters	litters	litters	litters
Gasoline	1,460	1,725	2,677	3,650	270
Diesel	1,186	1,356	12,191	11,771	***
Conversion Rate					
Gasoline	100	118	183	250	18
Diesel	10	11	100	97	2

Source: Ministry of Transportation "Automotive Transportation Statistics"

With regard to introduction of biofuels, we assume that the target set out under the Biofuel Act of 2006 will be applied as follows.

1) Bio-ethanol will be introduced 5% in 2009 and expanded to 10% from 2011
2) Bio-diesel is deemed to have been introduced to 1% in 2007 already, and this ratio will be raised to 2% from 2009.

On gaseous fuels, we assume that CNG and LPG will be introduced mainly in gasoline driven vehicles such as taxi. CNG is already introduced into buses, but the quantity may remain minimal.

Table 2.3-3 Motor Fuel Demand by Fuel Type

	CNG	LPG	Gasoline	Ethanol	Diesel	Bio-Diesel	Total
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
2005	-	1	2,923	1	4,168	-	7,094
2010	5	72	3,362	181	5,594	114	9,329
2020	31	106	4,669	531	7,797	160	13,294
2030	101	124	5,463	622	8,647	178	15,136
2005->30	***	20.5%	2.5%	27.6%	3.0%	***	3.1%
Compisition	%	%	%	%	%	%	%
2005	0.0	0.0	41.2	0.0	58.8	0.0	100.0
2010	0.1	0.8	36.0	1.9	60.0	1.2	100.0
2020	0.2	0.8	35.1	4.0	58.7	1.2	100.0
2030	0.7	0.8	36.1	4.1	57.1	1.2	100.0

Outlook of motor fuel demand under the above consideration is shown in Table 2.3-3. As introduction of gaseous fuels and biofuels is stipulated in the Philippine Energy Plan, the aggregate share of these new motor fuels is only 6%. It is necessary to further investigate into possibilities and pros and cons of boosting such targets including studies in the aspects of commerciality, energy security and environmental impacts..

2.3.4 Other Transportation Fuels

Other transportation fuels share 1/4 of the total transportation fuel consumption. Being an archipelago country, demand of marine and aviation fuels is big in the Philippines. On the other hand, railway system is limited to the Manila area and its energy demand is minimal.

Table 2.3-4 Outlook of Other Transportation Fuels

	Aviation Fuel	Marine Diesel	Marine Fuel Oil	Rail	Total
	ktoe	ktoe	ktoe	ktoe	ktoe
2008	1,003	354	482	13	1,851
2010	1,245	258	1,191	10	2,703
2020	1,828	500	1,643	12	3,983
2030	2,494	845	2,075	13	5,428
2005->30	3.7%	3.5%	6.0%	0.1%	4.4%

As shown in Figure 2.3-6, record of marine fuel consumption shows extraordinary fluctuation. In particular, demand of fuel oil for long haul vessels fluctuates greatly, maybe because these vessels are able to choose refueling port considering the available fuel prices inside or outside of the country. In addition, refueling could be made not at a fixed point but flexibly with refueling boats. Therefore, accuracy of actual marine fuel demand is generally problematic. Compared with this, aviation fuels with fixed refueling points at airports show relatively steady figures.

While demand increase during the projection period is about annual 3%, development of public transportation system such as railway will have substantial impact on the automotive fuel demand. It is necessary to consider the fuel demand tendency in close relation with transportation and traffic policy.

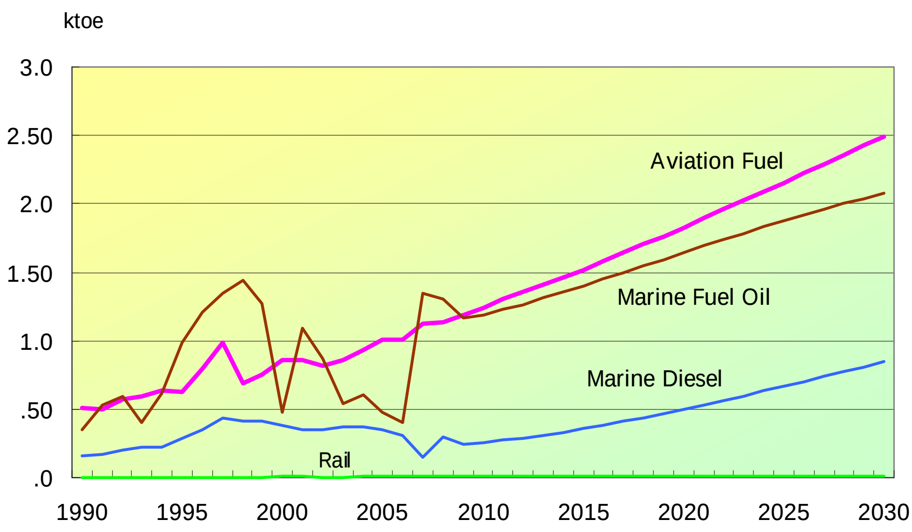


Figure 2.3-4 Fuel Demand for Marine, Aviation and Railway

2.4 Energy Demand Outlook by Fuel

2.4.1 Electricity Demand

In the Philippines where large scale manufacturing industry is scarce, the largest electricity consumption sector is the residential sector followed by manufacturing and commercial sectors. As railway service is quite limited, electricity consumption at the transportation sector includes very small quantity for driving power and is mostly for use at offices and service facilities. Since technology progress of energy efficiency in equipments and electrical appliances used in these sectors is fast, demand trend in these sectors should be looked into carefully.

Table 2.4-1 Electricity Demand by Sector

	Agriculture	El Industry	Gen Mfg.	Transport	Commercial	Residential	Total
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
2005	42.2	688.7	636.7	7.8	1,129.6	1,378.7	3,883.7
2010	49.5	763.2	786.4	9.8	1,482.1	1,725.4	4,816.4
2020	72.2	1,012.1	1317.7	11.7	2,528.0	2,818.2	7,759.9
2030	92.6	1,260.3	1893.6	13.4	3,713.4	3,976.7	10,950.0
05-30	3.2%	2.4%	4.5%	2.2%	4.9%	4.3%	4.2%
Composition	%	%	%	%	%	%	%
2005	1.1	17.7	16.4	0.2	29.1	35.5	100.0
2010	1.0	15.8	16.3	0.2	30.8	35.8	100.0
2020	0.9	13.0	17.0	0.2	32.6	36.3	100.0
2030	0.8	11.5	17.3	0.1	33.9	36.3	100.0

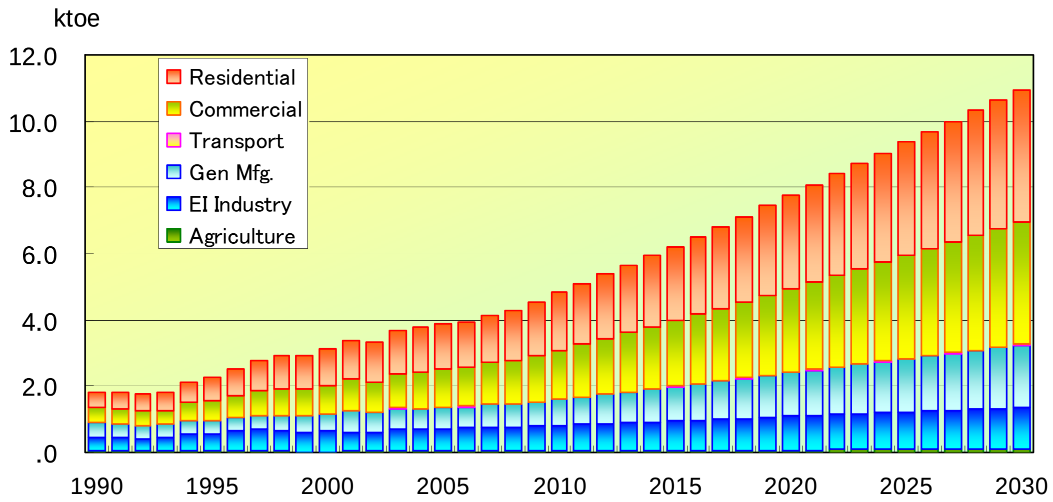


Figure 2.4-1 Electricity Demand by Sector

2.4.2 Coal Sector

For other than electric power generation, coal is used mostly by the cement industry with minimal quantity by general manufacturing. This tendency will continue in the Philippines where large manufacturing industry does not exist. Therefore, coal consumption in the general sector is estimated in relation to cement production.

Table 2.4-2 Coal Demand by Sector

	Agriculture	EI Industry	Gen Mfg.	Transport	Commercial	Residential	Total
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
2005	0.0	1,031.2	25.3	0.0	0.0	0.0	1,056.5
2010	0.0	1,353.0	31.2	0.0	0.0	0.0	1,384.3
2020	0.0	1,953.9	47.2	0.0	0.0	0.0	2,001.2
2030	0.0	2,590.7	62.4	0.0	0.0	0.0	2,653.1
05-30	***	3.8%	3.7%	***	***	***	3.8%
Composition	%	%	%	%	%	%	%
2005	0.0	97.6	2.4	0.0	0.0	0.0	100.0
2010	0.0	97.7	2.3	0.0	0.0	0.0	100.0
2020	0.0	97.6	2.4	0.0	0.0	0.0	100.0
2030	0.0	97.6	2.4	0.0	0.0	0.0	100.0

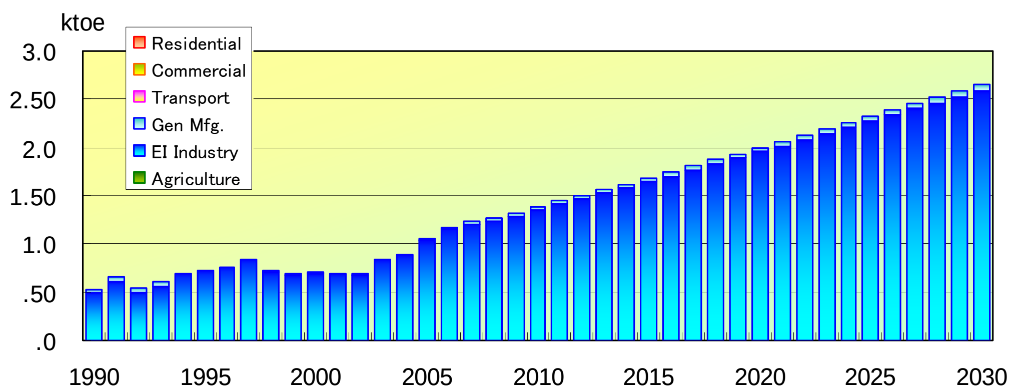


Figure 2.4-2 Coal Demand by Sector

2.4.3 Gas Sector

In the Philippines, natural gas is mostly used for power generation, and only a limited quantity is used in other sectors at Batangas, the landing point of the gas pipeline from the Malampaya field. On the other hand, use of LPG is developing in commercial and residential sectors and this trend is expected to continue. In other areas, CNG and LPG use is starting in the transportation sector.

Table 2.4-3 Gas Demand by Sector

	Natural Gas			LPG						Grand
	Gen Mfg.	Transport	Total	EI Industry	Gen Mfg.	Transport	Commercial	Residential	Total	Total
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
2005	12.2	0.0	12.2	45.7	23.6	1.2	219.3	773.7	1,063.5	1,075.7
2010	77.4	5.1	82.4	39.5	54.7	72.3	507.3	882.4	1,556.2	1,638.7
2020	77.4	31.0	108.4	88.8	227.1	106.3	963.5	1,523.0	2,908.5	3,016.9
2030	77.4	100.8	178.1	156.8	463.5	124.5	1,389.3	2,186.5	4,320.6	4,498.8
05-30	7.7%	***	11.3%	5.1%	***	20.5%	7.7%	***	5.8%	5.9%
Composition	%	%	%	%	%	%	%	%	%	%
2005	1.1	0.0	1.1	4.2	2.2	0.1	20.4	71.9	98.9	100.0
2010	4.7	0.3	5.0	2.4	3.3	4.4	31.0	53.8	95.0	100.0
2020	2.6	1.0	3.6	2.9	7.5	3.5	31.9	50.5	96.4	100.0
2030	1.7	2.2	4.0	3.5	10.3	2.8	30.9	48.6	96.0	100.0

Consumption of gaseous energy, clean and easy to use, will continue to develop at a certain pace. In the transportation sector, large scale introduction of CNG buses and LPG vehicles is planned. If city gas grid were constructed in the metropolitan area, co-generation would develop at office buildings, large scale shopping facilities, hospitals and medium/small factories. As the country comprises many islands, regional demand centers are relatively small and scattered except for the Metro-Manila region, LPG may be more convenient fuel than natural gas in transportation and handling. LPG would be used as a gas source for small scale gas grid in regional cities and towns. However, there are many uncertainties on future supply of LPG and natural gas within the Philippines and in the international market. It is necessary to carry out detail study on the possibility and direction of developing domestic gas market together with evaluation of various supply options.

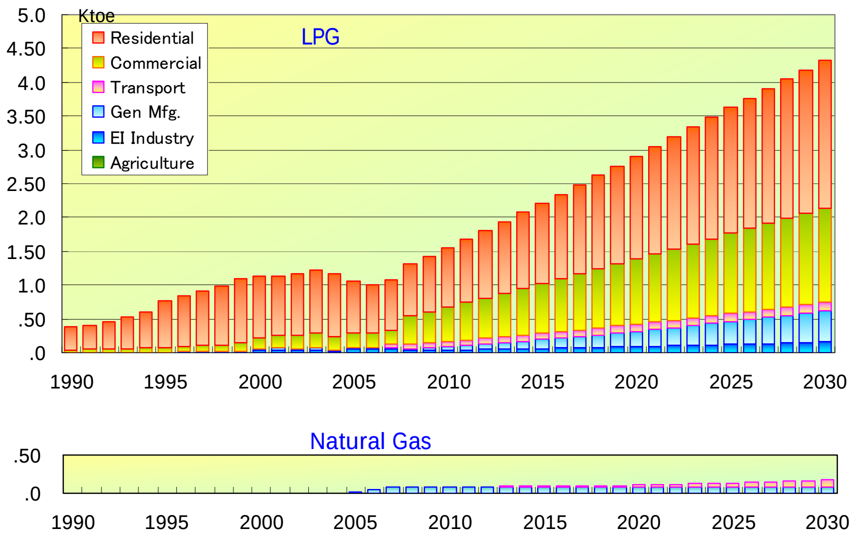


Figure 2.4-3 Gas Demand by Sector

2.4.4 Petroleum Products Demand

In the Philippines, almost 80% of the petroleum products excluding LPG is used in the transportation sector. Kerosene use for lighting and cooking in commercial and residential sectors are being replaced with electricity and LPG. This trend will continue. With the recent oil price boost, petroleum products demand in the Philippines will tend to concentrate in the transportation use.

Table 2.4-4 Petroleum Products Demand by Sector (Excluding LPG)

	Agriculture	EI Industry	Gen Mfg.	Transport	Commercial	Residential	Total
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
2005	270.6	887.9	732.5	8,930.5	311.4	252.7	11,385.6
2010	204.8	914.8	530.3	11,944.9	197.5	155.0	13,947.4
2020	264.7	1256.2	696.7	17,127.8	146.3	92.8	19,584.6
2030	309.8	1583.1	782.3	20,324.5	115.7	55.6	23,171.0
05-30	0.5%	2.3%	0.3%	3.3%	-3.9%	-5.9%	2.9%
Composition	%	%	%	%	%	%	%
2005	2.4	7.8	6.4	78.4	2.7	2.2	100.0
2010	1.5	6.6	3.8	85.6	1.4	1.1	100.0
2020	1.4	6.4	3.6	87.5	0.7	0.5	100.0
2030	1.3	6.8	3.4	87.7	0.5	0.2	100.0

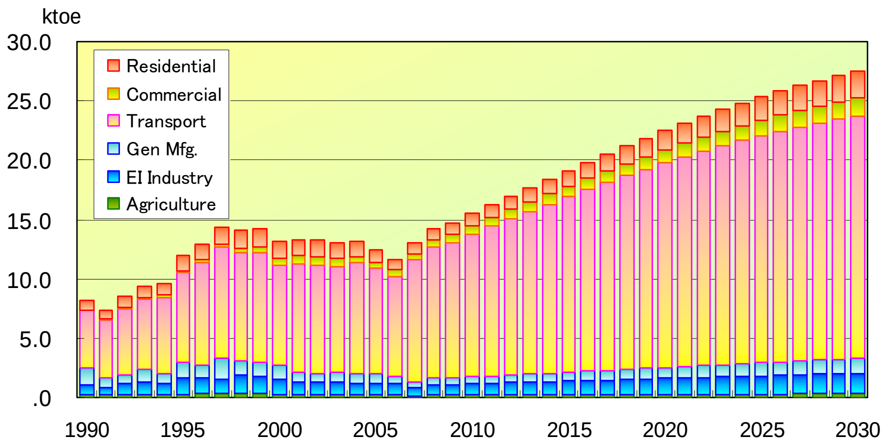


Figure 2.4-4 Petroleum Products Demand by Sector (excluding LPG)

In the fuel type distribution, fuel oil decreases its share while jet fuel increases steadily to enhance shift to lighter products. However, since introduction of biofuel will progress, shift to lighter products will proceed moderately.

Table 2.4-5 Petroleum Products Demand by Fuel Type

	Aviation gasoline	Gasoline	Ethanol	Jet fuel	Kerosene	Diesel	Bio-diesel	Fuel Oil	Total	LPG
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
2007	3.8	2,789.5	2.0	1,124.6	199.8	5,375.5	28.3	2,452.9	11,976.3	1,073.8
2010	4.3	3,362.2	180.8	1,240.4	176.5	6,445.5	114.2	2,423.5	13,947.4	1,556.2
2020	4.3	4,668.7	531.3	1,823.5	118.5	9,121.8	159.6	3,156.8	19,584.6	2,908.5
2030	4.3	5,462.6	622.4	2,489.7	84.1	10,534.9	178.2	3,794.7	23,171.0	4,320.6
2005->30	0.6%	3.0%	28.4%	3.5%	-3.7%	3.0%	***	1.9%	2.9%	6.2%
Composition	%	%	%	%	%	%	%	%	%	%
2007	0.0	23.3	0.0	9.4	1.7	44.9	0.2	20.5	100.0	9.0
2010	0.0	24.1	1.3	8.9	1.3	46.2	0.8	17.4	100.0	11.2
2020	0.0	23.8	2.7	9.3	0.6	46.6	0.8	16.1	100.0	14.9
2030	0.0	23.6	2.7	10.7	0.4	45.5	0.8	16.4	100.0	18.6

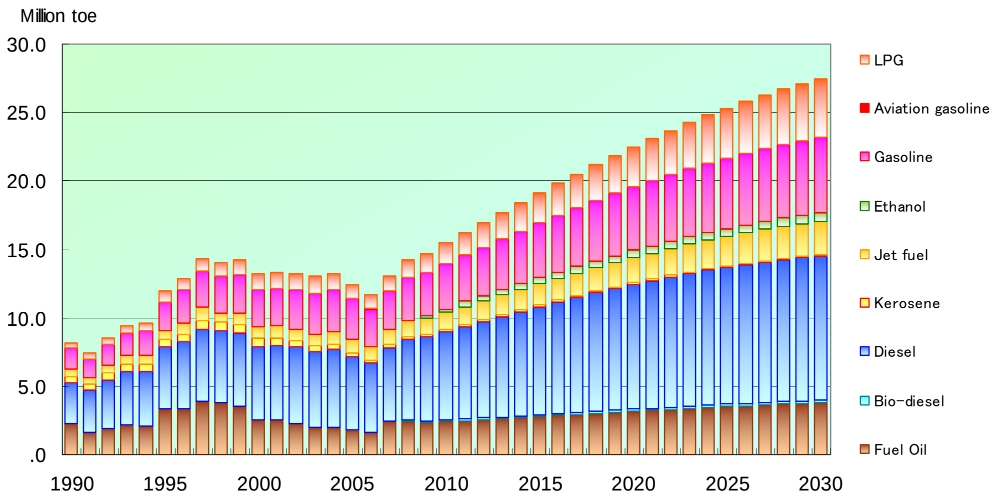


Figure 2.4-5 Petroleum Products Demand by Fuel Type

2.4.5 Biomass Energy Demand

Biomass energies are being replaced with modern and healthy energy such as electricity and LPG. In other sectors, production of sugar and coconuts will increase as materials for biofuels and their residues such as bagasse and coconuts residue will be utilized in the industrial sector. Overall, however, use of biomass is on the declining trend.

Table 2.4-6 Biomass Energy Demand by Sector

	Agriculture	Energy Intensive Industry				General Manufacturing	Commercial	Residenntial	Non-commercial Biomass Total
		Total	Bagasse	Coconut residue	Others				
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
2005	0.0	1,201.7	711.2	299.3	191.2	10.0	298.2	4,256.5	5,766.3
2010	0.0	1,681.4	1,053.3	386.2	241.9	247.8	282.7	3,688.6	5,900.6
2020	0.0	2,790.2	1,752.6	637.9	399.7	412.4	184.5	2,407.5	5,794.6
2030	0.0	4,028.8	2,513.8	931.4	583.5	591.5	82.8	1,080.4	5,783.5
2005 ->30	***	5.0%	5.2%	4.6%	4.6%	17.7%	-5.0%	-5.3%	0.0%

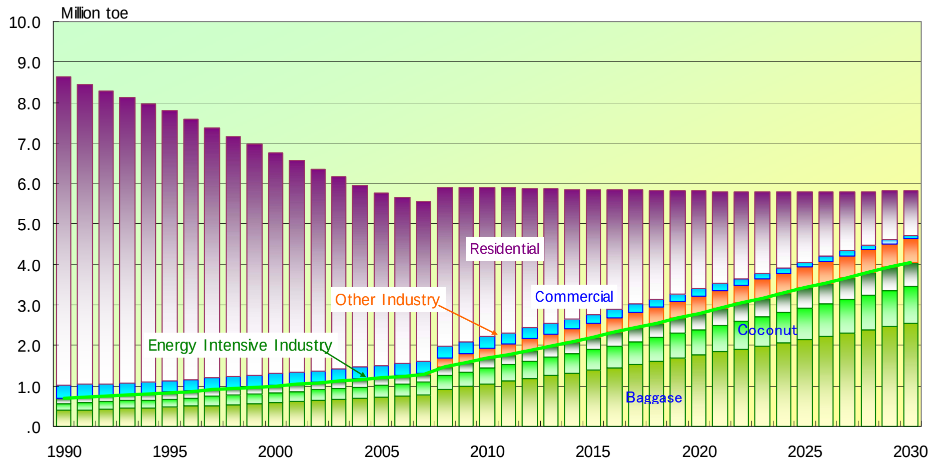


Figure 2.4-6 Biomass Energy Demand by Sector

Chapter 3 Long-term Energy Supply/Demand Outlook

3.1 Long-term Energy Supply/Demand Outlook

3.1.1 Trend of Primary Energy Supply

Primary energy supply for the Reference Case is shown in Figure 3.1-1. It tells that domestic coal production may keep its robust increasing pace, while gas production will start decreasing from 2019 due to its limited reserve amount.

Calculation result indicates that crude oil import remains almost the same level, and simple increase of petroleum products import occurs after 2008. This is because no expansion of the domestic refining capacity is considered at all. Therefore, after all the capacity is fully utilized in 2007, increasing demand will be simply supplied by the increase of petroleum product import. At this moment, no foreign petroleum companies seem to be interested in investing to this country, and no specific plan for new installation or expansion of refining facility is proposed.

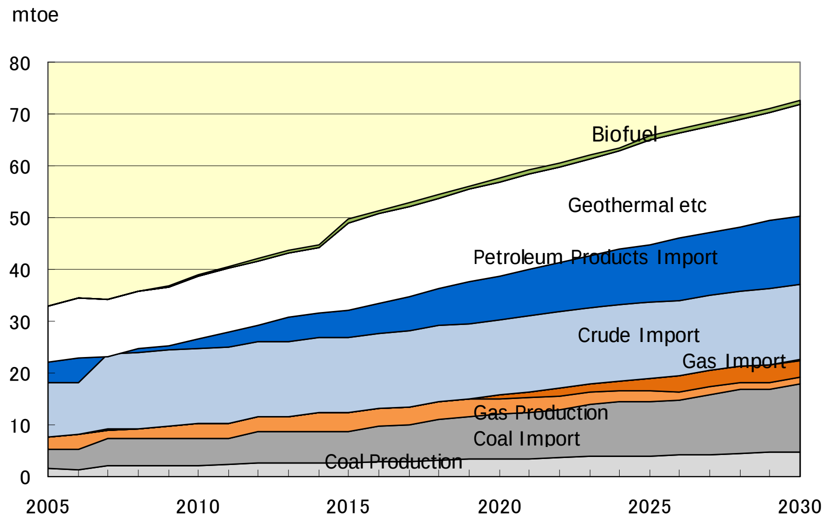


Figure 3.1-1 Primary Energy Supply in Reference Case

Primary energy supply configuration in the Reference Case is shown in every five years in Table 3.1-1. Fossil fuels such as coal, oil and gas will keep playing the major role in energy supply for 25 years from now through 2030.

Table 3.1-1 Primary Energy Supply in Reference Case (%)

	Coal	Gas	Oil	Geothermal etc	Biofuel
	%	%	%	%	%
2005	16.0	7.6	44.0	32.4	0.0
2010	19.0	7.2	42.2	30.9	0.8
2015	17.5	7.3	39.7	34.3	1.2
2020	20.9	6.5	39.9	31.5	1.2
2025	22.2	6.8	39.2	30.7	1.2
2030	24.7	6.2	38.3	29.7	1.1

3.1.2 Trend of Power Source Mix

Although renewable energies such as geothermal and hydro are given due focus in the Philippines, there are ultimate limitations in their supply potential. Consequently, a considerable part of the power demand growth shall be supplied by fossil fuels. It should be noted that almost 99% of coal and 97% of natural gas supply go for power generation, and their consumption for other purposes is quite limited.

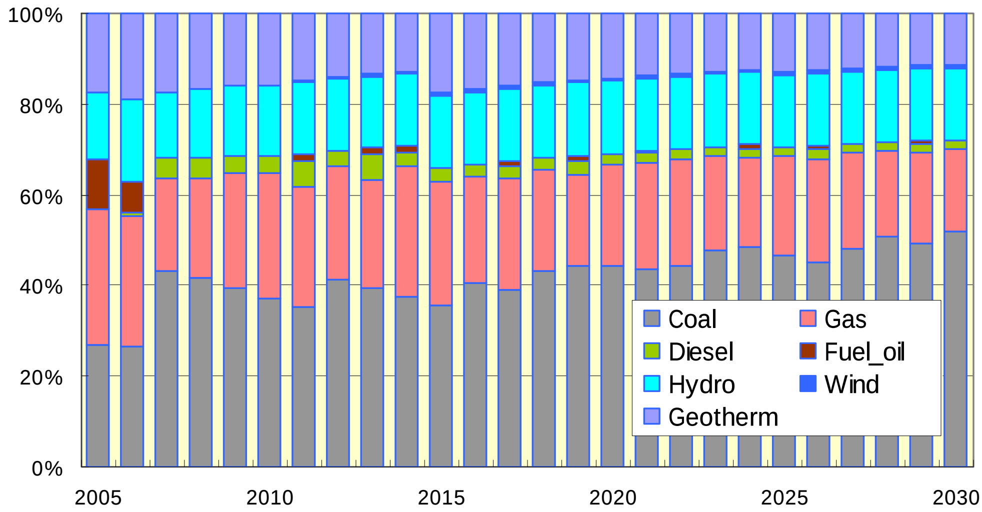


Figure 3.1-2 Trend of Power Source Mix

Table 3.1-2 Trend of Power Source Mix

	Coal	Gas	Diesel	Fuel Oil	Nuclear	Hydro	RNE	Geotherm.
	%	%	%	%	%	%	%	%
2005	27.0	30.0	0.0	10.7	0.0	14.8	0.0	17.5
2010	37.2	27.5	3.8	0.0	0.0	15.5	0.3	15.7
2015	35.7	27.3	2.9	0.0	0.0	16.0	0.5	17.6
2020	44.5	22.2	2.3	0.0	0.0	16.0	0.6	14.3
2025	46.7	21.7	2.0	0.0	0.0	16.0	0.7	12.9
2030	51.8	18.4	1.8	0.0	0.0	15.9	0.7	11.4

3.2 Supply / Demand Balance by Energy

3.2.1 Crude Oil

The crude oil supply/demand balance is shown in Figure 3.2-1, which includes the portion of oil import for stockpiling. In the Reference Case, as the refinery capacity is set at a fixed figure, petroleum product import is monotonously increasing in response to the demand increase, with refineries at full operation mode.

The stockpiling starts storing oil in 2006, and the storage amounts are calculated as a sum of 7 days of the LPG demand and 15 days for other petroleum products and converted into crude oil equivalent quantity. No withdrawal from the inventory is considered.

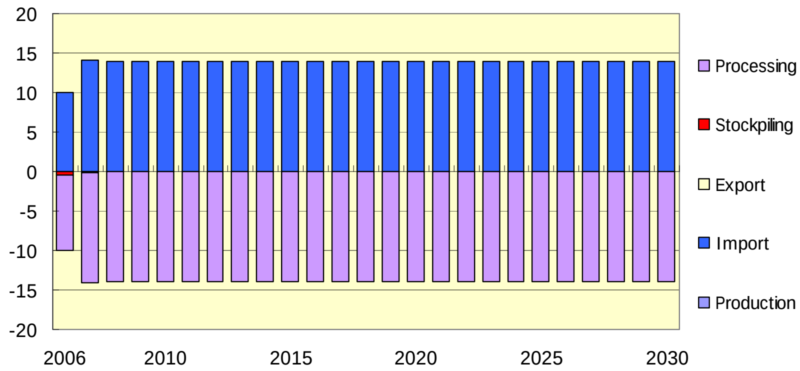


Figure 3.2-1 Crude Oil Balance

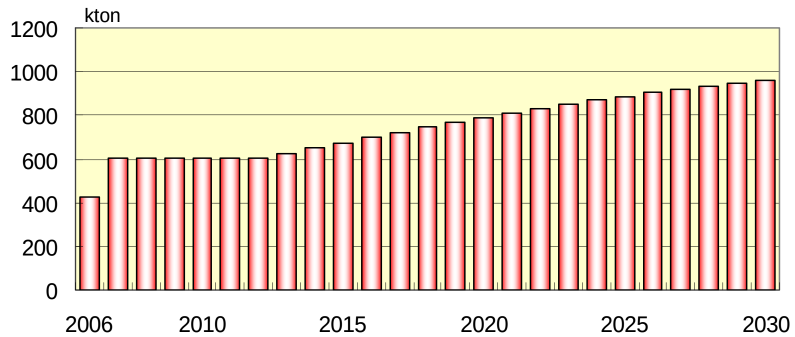


Figure 3.2-2 Petroleum Stockpiling

3.2.2 Coal

Most of the coal is used for power generation. The price advantage over other kinds of energies works strongly, and thus coal thermal power will play core role in the future expansion of thermal power generation capacity. Due to high alkaline-containing property of the domestic coal, there is a limitation that domestic coal must be kept at 20% or less of the whole for combustion at power plant. Therefore, as the coal demand increases, the required quantity of imported coal also increases.

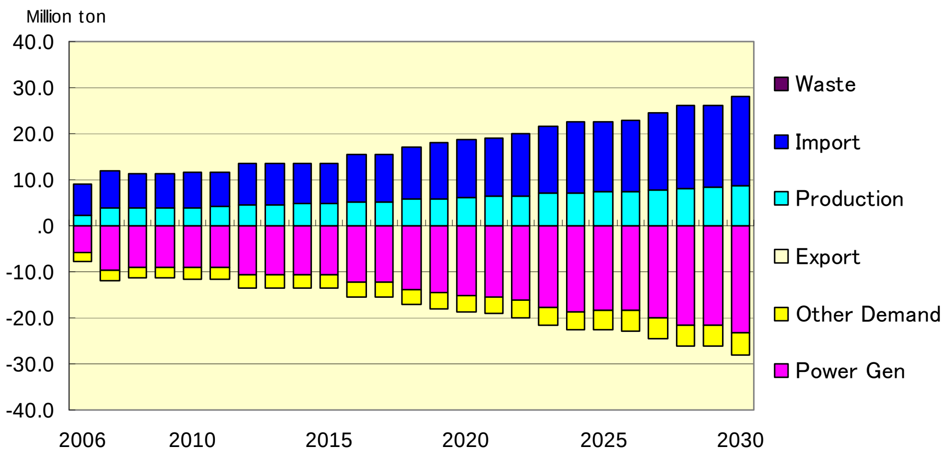


Figure 3.2-3 Coal Balance

3.2.3 Natural Gas

In the Reference Case, production from the domestic Malampaya gas field is anticipated to start declining from 2019. In order to compensate this, it is deemed in this model that import of natural gas shall start in 2020. Unless a new natural gas field is discovered in the country, it is a matter of time that the Malampaya gas field starts to deplete. Therefore, it is urged to seriously consider now how to procure fuels to supplement for operation of the existing gas fired power plants. Although global LNG production is on the increasing trend, it still needs a long preparation period to procure and accept LNG physically. Recognizing this issue properly, it is important to advance discussion and examination on the matter at an early timing.

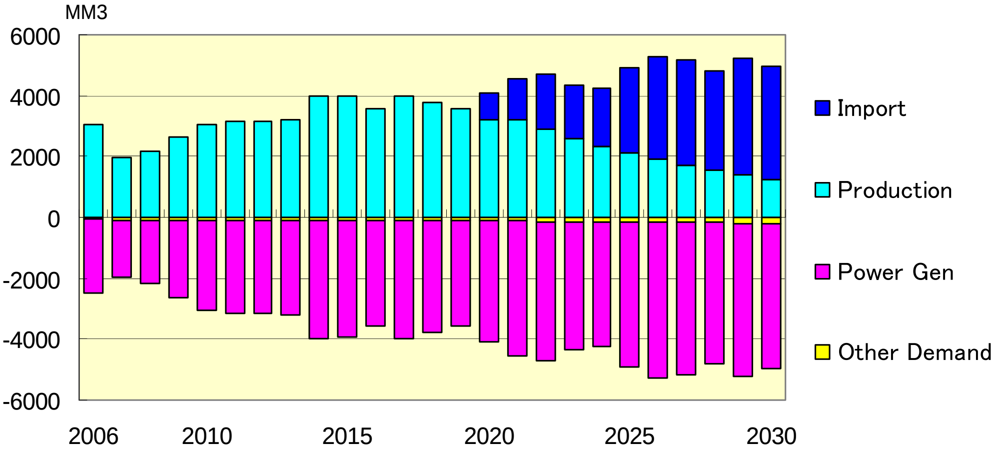


Figure 3.2-4 Natural Gas Balance

3.2.4 LPG

Since fluctuation is fierce in the international LPG market, as a yardstick of the maximum possible import quantity 2 million ton per year is assumed. When the demand exceeds this level, alternative fuel for LPG may be imported. In the model, kerosene is assumed as the LPG substitution fuel. It shall be a more favorable option to construct natural gas infrastructure and set up town gas system including natural gas delivery grid by this time and develop natural gas use in residential, commercial and industrial sectors besides power generation.

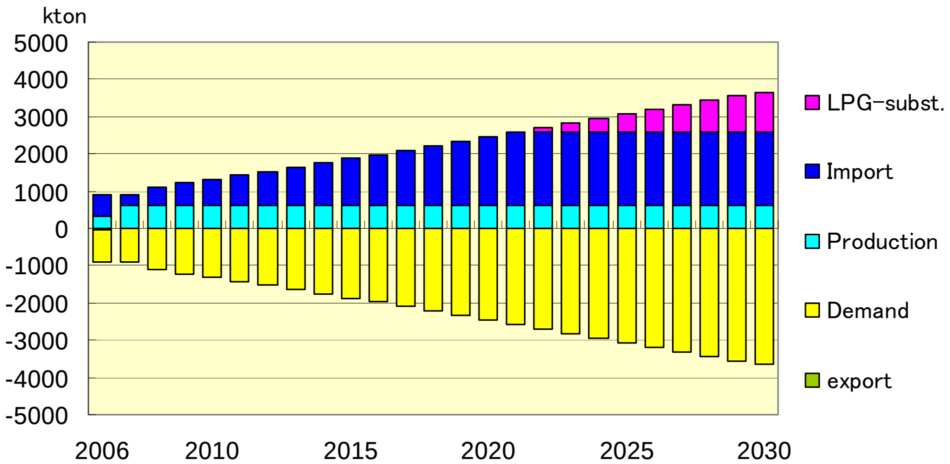


Figure 3.2-5 LPG Balance

3.2.5 Electric Power Supply

Fossil fuels will play a major role in power generation and growth of coal is especially large. Since coal power has been regarded as advantageous in economics compared with oil or gas from various examinations, coal power is mainly chosen in this model as the newly installed power supply source in response to the power demand increase. However, choosing power supply sources, we should consider issues on energy security, modernization of energy structure and global warming in addition to economic performance.

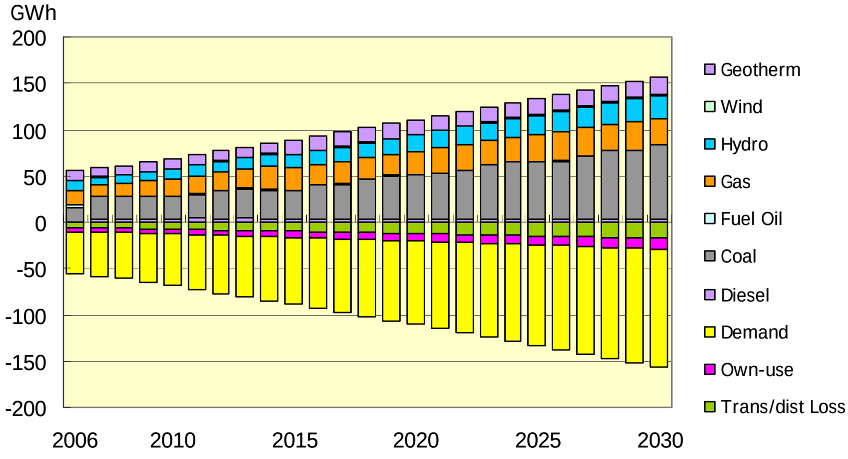


Figure 3.2-6 Electric Power Balance

3.2.6 Other Indices

(1) CO_2 emission

Although per capita CO_2 emission is increasing reflecting the increase in energy consumption, the CO_2 emission per GDP of 1,000 dollars is decreasing slightly. The CO_2 emission per unit primary energy supply is leveling off.

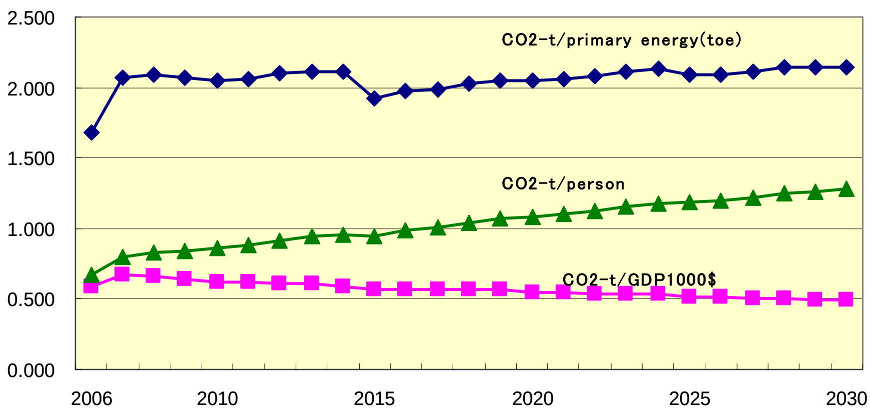


Figure 3.2-7 Trend of CO_2 Emission by Intensities

Because energy intensive manufacturing industry is small in the Philippines, it is working in the direction to reduce the energy consumption rate as a whole economy as well as CO_2 emission per GDP. On the other hand, per capita CO_2 emission is increasing because per capita energy consumption increases with increase of income and resultant admiration toward living standard improvement. As achieving higher living standard is a social requirement, the energy efficiency improvement of electric apparatus used at offices and home will be a big issue.

The CO_2 emission per primary energy supply is more or less leveling off. CO_2 emission structure in the energy sector would not change so much since incremental electricity demand will be supplied with coal power plant in future. In case bio-fuel, nuclear or LNG would increase in future, this index will go down.

(2) Energy Cost

Per capita energy cost will increase more than double, i.e., from 7,000 pesos per year in 2008 to 16,000 pesos per year in a real price in 2030. It is important from a viewpoint of national economy, to decrease the energy cost by energy saving. Furthermore, the energy cost per primary energy supply (as in oil equivalent ton) increases from 18,000 pesos to 27,000 pesos and becomes about 1.5 times caused by the rising energy prices. Since the investment expenditure required building additional energy supply facilities is not included in these costs, actual energy cost may soar more than stated here.

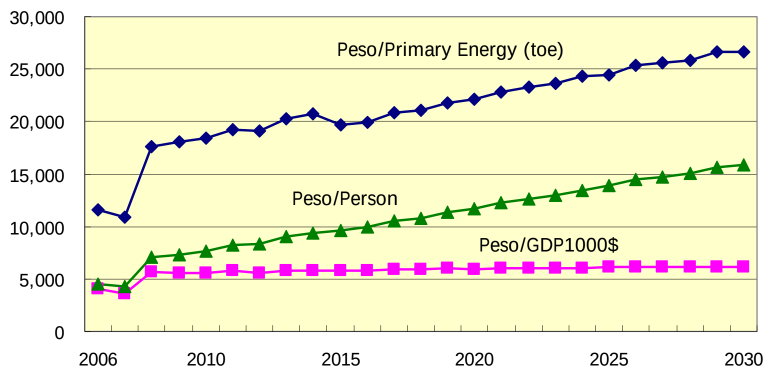


Figure 3.2-8 Trend of Energy Cost by Intensities

3.3 Various Demand Scenarios and Energy Outlook

3.3.1 Primary Energy Supply in Various Cases

In terms of larger primary energy supply in 2030, 12 cases projected may be lined up in the following order.

High Growth > BAU > Low Price > Increased Automotive Vehicle > Reference > E20/B20
> E85 > High Price > Super-High Price > EEC > Low Growth > Super-EEC

Based on the demand size, they may be divided into the following four groups:

1) High Growth Group (High Growth, BAU)
2) Reference Group (Low Price, Increased Automotive Vehicle, Reference, E20/B20, E85/B20, High Price, Super-High Price)
3) EEC Group
4) Low Growth Group (Low Growth, Super-EEC)

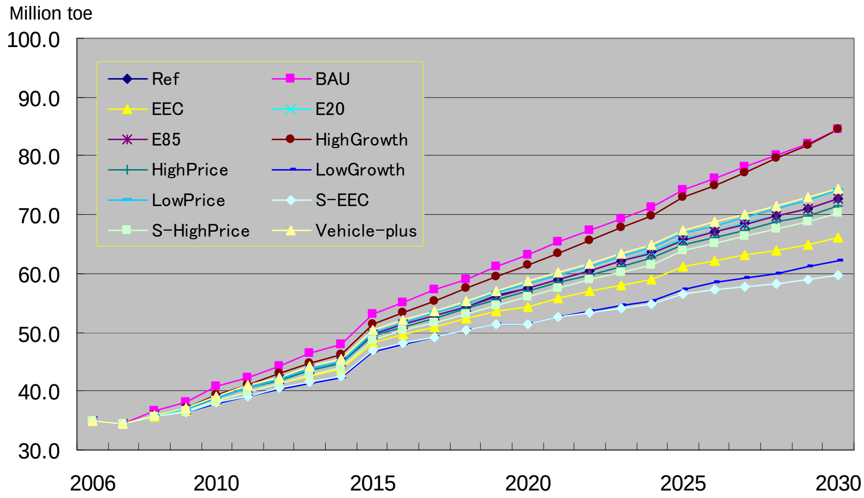


Figure 3.3-1 Primary Energy Supply by Case

From the above grouping, we can observe that effect of price hike is smaller than those of economic growth rate and energy conservation rate. The high growth case and the BAU case are in the same cluster, and the effects of economic growth rate of annual 1% and EEC rate of annual 0.5% are same. The unnatural jumps of primary energy supply in 2015 is because geothermal capacity is expanded in this year and its thermal efficiency is calculated at 10%. Although the standard of IEA is applied here, we may need to reconsider this principle.

3.3.2 Coal

Step-wise increases of domestic coal production are seen in the High Growth Case. This illustrates that as domestic coal production is supposed to increase stepwise in every 5 years based on the development plan of DOE. For the cases such as the Reference Case and the EEC Case where coal consumption growth is smoother, we may rather slow down the pace. With regard to such adjustment of development speed, we need to run in-depth studies elaborating on various factors relating to coal demand and supply.

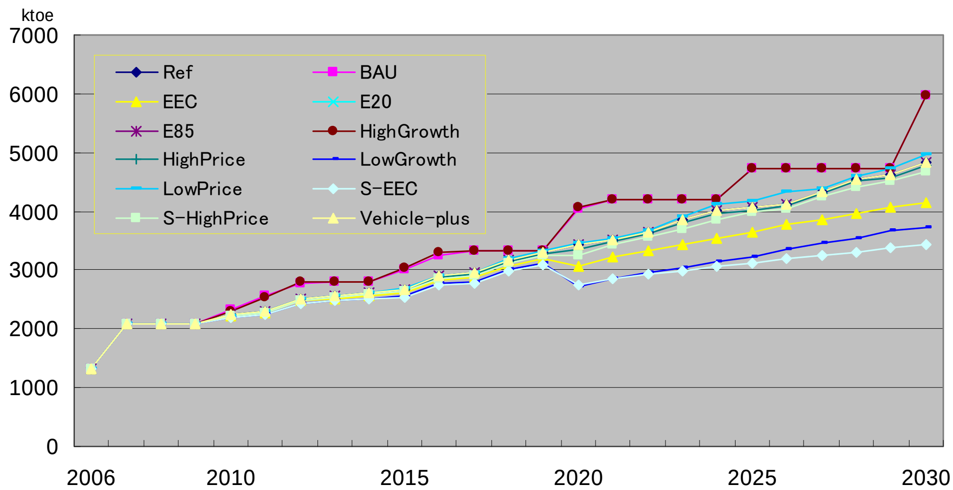


Figure 3.3-2 Domestic Coal Production by Case

3.3.3 Natural Gas

The optimum supply of natural gas is simulated within the range of the maximum possible production until 2019. During this period, except for a case of strong power demand like the BAU Case, coal power generation is taken in first as far as supply capacity is available, and gas power works as back up. However, due to the binding of “Take or Pay” clause in the purchase contract, gas power is actually operated rather rigidly like base load power source. When natural gas production starts declining in 2020, the full amount of maximum possible production is taken in as the production, considering supply decrease and efficiency of gas field operation. The same rule is applied for the Low Growth case and EEC cases that the maximum possible production is taken in as the actual production.

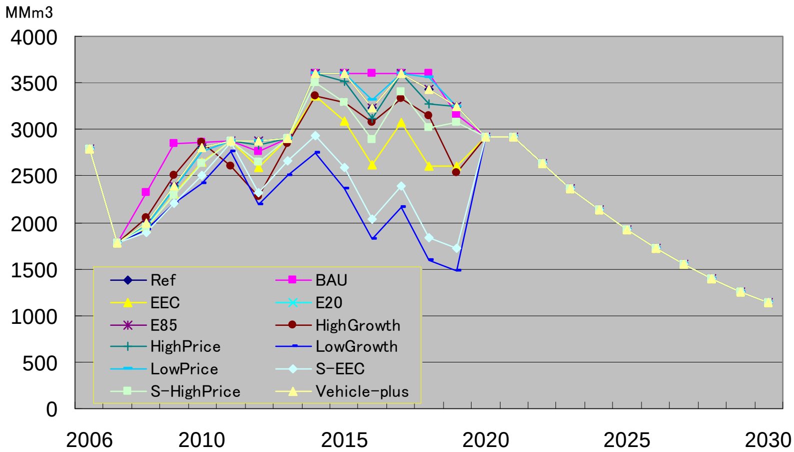


Figure 3.3-3 Natural Gas Production by Case

3.3.4 CO_2 Emission

CO_2 emissions in 2030 for various cases and their ratio relative to the Reference Case are summarized in Table 3.3-1 in the order of small to larger emission amount. The table also suggests that energy conservation will have greater effect on the CO_2 emission reduction.

Table 3.3-1 CO_2 Emission in 2030

Case	CO_2 Emission	Comparison
	Million CO_2-ton	%
Super-EEC	113.09	72.40
Low Growth	119.88	76.74
EEC	134.40	86.04
E85/B20	137.68	88.14
Double RE	148.76	95.23
Super High Price	149.32	95.59
E20/B20	149.42	95.65
High Energy Price	152.96	97.92
Reference	**156.21**	**100.00**
Low Energy Price	160.74	102.90
Vehicle Plus	161.39	103.32
High Growth	194.40	124.45
BAU	195.13	124.92

3.3.5 Increased Biofuel Supply

While bio-fuel supply is assumed to replace 10% of gasoline and 2% of diesel oil, respectively, in 2030 for the Reference Case, we examine accelerated biofuel cases here, namely, the E20/B20 Case where ethanol and bio-diesel are blended in gasoline and diesel by 20%, respectively, and the ambitious E85/B20 Case where ethanol is blended in gasoline by 85%.

The impact of accelerated bio-fuel introduction is greater on diesel oil than gasoline, since only 2% blending is assumed in the Reference Case and the diesel oil demand is greater than that of gasoline.

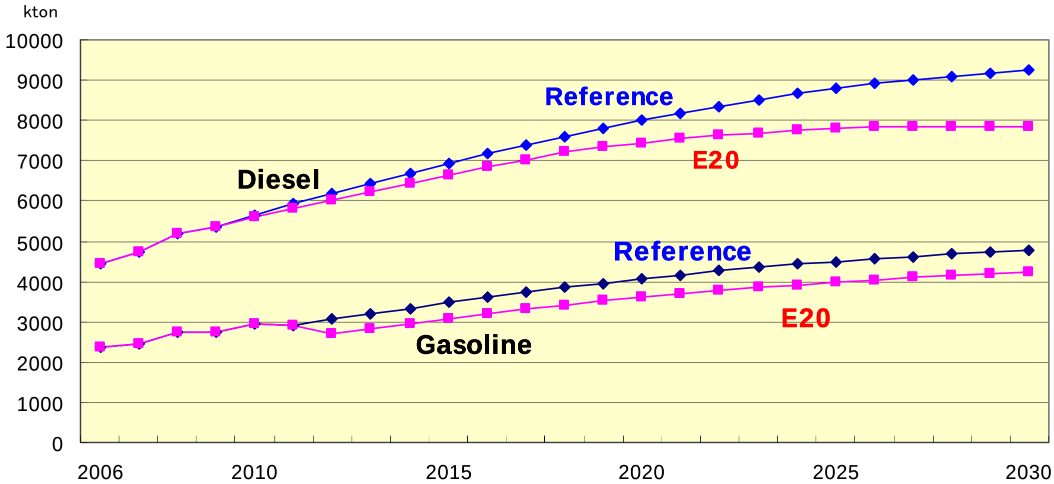


Figure 3.3-4 Gasoline and Diesel Demand in E20/B20 Case

Although bio-fuel portion is relatively high in E20/B20 case, majority of the primary energy supply increase must be supplied by fossil fuel as an overall trend. On the other hand, in the E85/B20 Case where ambitious bio-fuel introduction is projected, 85% of gasoline demand will be coming from non-petroleum origin. Although effect of bio-fuel introduction is not so large from the overall viewpoint of the primary energy supply, there are favorable effects in energy security and global warming issues such that the amount of gasoline and diesel oil equivalent to the introduced bio-fuel will be certainly reduced and similar reduction of CO_2 emission can be expected.

Table 3.3-2 Primary Energy Supply (E20)

	Coal	Gas	Oil	NRE	Biomass
	%	%	%	%	%
2005	16.0	7.6	44.0	32.4	0.0
2010	19.0	7.2	42.1	30.9	0.9
2015	17.5	7.2	38.2	34.3	2.7
2020	20.9	6.4	37.9	31.5	3.2
2025	22.0	6.6	37.1	30.5	3.7
2030	24.3	6.0	36.3	29.3	4.1

As indicated in Table 3.3-3, CO_2 emission is reduced by 4.3% in 2030 compared to the Reference Case and the reduction increases year by year.

Table 3.3-3 further illustrates the equivalent amount of coal and gas when the same amount of CO_2

emission is reduced by saving of coal and gas consumption. This suggests that, accelerating biofuel introduction, reduction of 6.78 million tons of CO_2 emission in 2030 can be expected compared with the Reference case. If we are to reduce the same quantity of CO_2 emission by reducing coal power generation, 2.5 million tons of coal has to be cut off, or it will be 3.2 million m^3 of gas if reduced at gas power generation.

Table 3.3-3 CO_2 Emission Reduction and Amount of Coal or Gas Reduction to Reduce CO_2 Emission

	CO2 Emission		Reduction ratio	Equivalent	
	Reference	E20		Coal	Gas
	mton	mton	%	ktoe	MMm3
2010	79.64	79.46	0.2	66	84
2015	95.64	93.35	2.4	845	1,071
2020	118.02	114.49	3.0	1,303	1,650
2025	137.16	131.97	3.8	1,916	2,426
2030	156.21	149.42	4.3	2,506	3,174

3.3.6 Energy Efficiency and Conservation (EEC)

In the EEC Case, it is assumed that energy conservation is enhanced to annual 1.0% from 0.5% in the Reference Case. The result is shown in Figure 3.3-5 compared with the Reference Case.

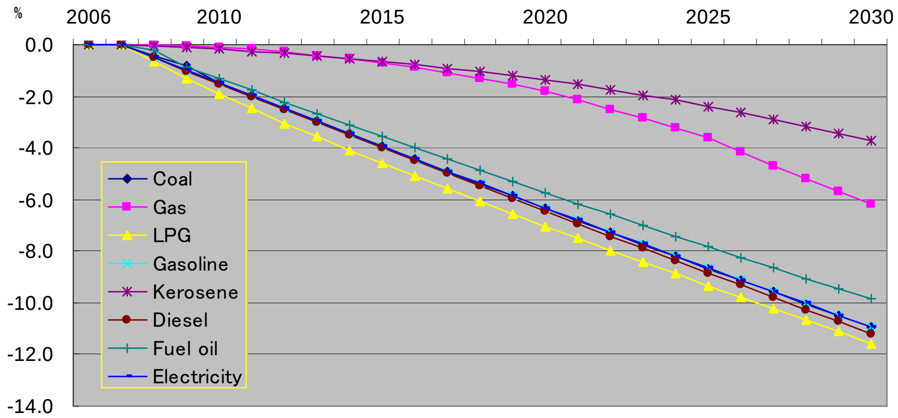


Figure 3.3-5 Reduction Rate of Energy Demand (EEC Case against REF)

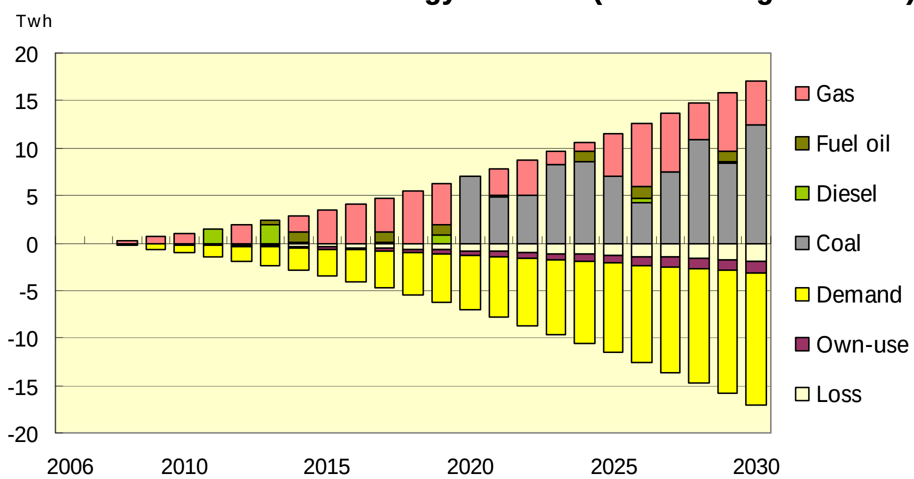


Figure 3.3-6 Power Generation Difference in EEC and Reference Case

Greater reduction ratios are seen in the order of LPG, diesel oil, coal, gasoline, electricity, fuel oil, kerosene, and gas. Most of the demand decrease reveals to be coal power reduction with slight affects on gas power. However, decrease of gas demand observed here after 2020 is the decrease in LNG import.

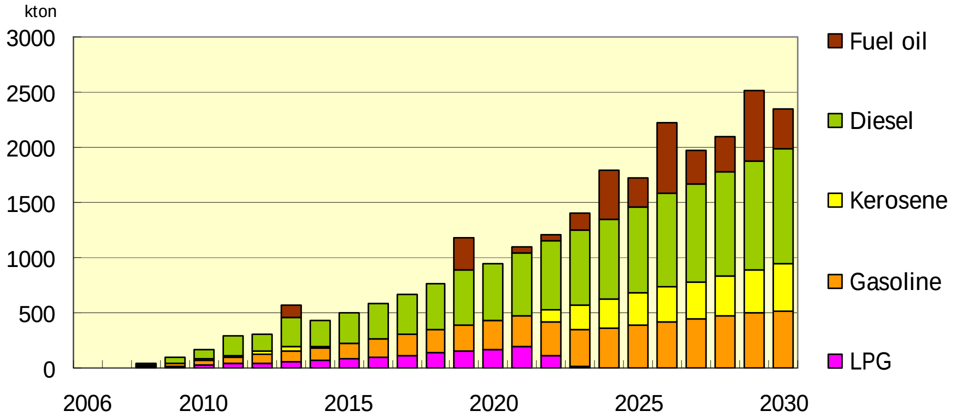


Figure 3.3-7 Petroleum Product Import Difference in EEC and Reference Case

Due to balancing of power supply under the power development plan, temporally operation of oil-based power plants is observed in the Reference Case, which is typically indicated in Figure 3.3-7. This will in turn reveals to be differences in petroleum product import.

3.4 Various Supply Scenarios and Energy Outlook

3.4.1 Nuclear Power

Introduction of nuclear power is examined from the viewpoint that it will enhance energy supply diversification and CO_2 emission reduction. We assume in this study that a new 1,000MW nuclear power plant will be introduced in the Bataan Peninsula with start-up in 2025.

Figure 3.4-1 shows changes in operation of other power sources, that is, fossil fuels composition such as coal and natural gas to be incurred when a nuclear power station of 1,000 MW would start operation in 2025 at 80% operability. Supply increase by nuclear power introduction causes minimization of diesel power, shutdown of fuel oil power, and turndown of gas power in this order, and finally balanced by coal thermal power.

Although the introduced nuclear power occupies only 2.4% of the primary energy supply in 2030, this will reduce natural gas by 1%, import coal by 0.7% and domestic coal by 0.1%.

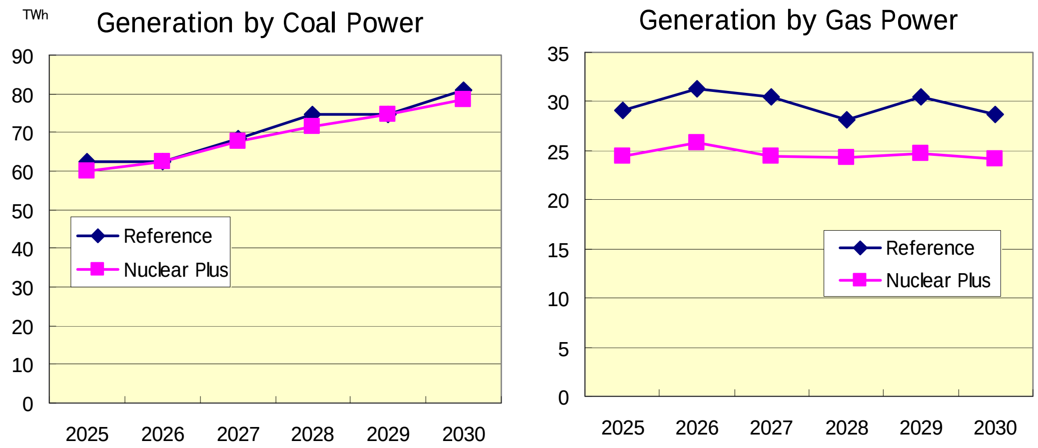


Figure 3.4-1 Trend of Coal and Gas Power Generation

Table 3.4-1 Primary Energy Supply (Nuclear Introduction：2030)

Case	Domestic Coal	Imported Coal	Oil	Biofuel	Natural Gas	Hydro & Geotherm	Nuclear	Total
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
Reference	4825	13143	27841	899	4509	21544	0	72762
Nuclear	4749	12682	27841	899	3786	21544	1826	73327
Change	-76	-461	0	0	-723	0	1826	566
Composition	%	%	%	%	%	%	%	%
Reference	6.6	18.1	38.3	1.2	6.2	29.6	0.0	100.0
Nuclear	6.5	17.4	38.0	1.2	5.2	29.4	2.5	100.0
Change	-0.1	-0.7	-0.3	0.0	-1.0	-0.2	2.5	0.0

3.4.2 Liquefied Natural Gas (LNG)

LNG import is assumed to start in 2020 into the greater Manila area, responding to potential increase of gas demand and production depletion of the Malampaya gas field. The ultimate contract size will be 3 million tons per year, with step-wise increase of supply. From 2025, 1000 MW nuclear power plant will be added as a base load plant as described in the previous section.

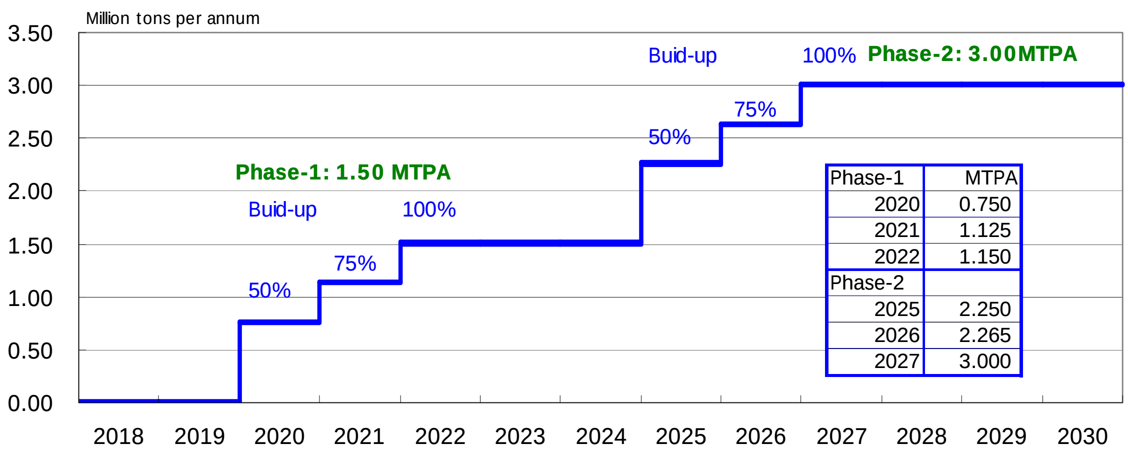


Figure 3.4-2 LNG Introduction Schedule

Figure 3.4-3 shows the trend in power generation by coal and gas. The requirement for coal thermal power is reduced remarkably after 2025, with substantial difference of 8330 GWh compared with the Reference Case.

Primary energy supply for this LNG introduction case is compared with the Reference Case in Figure 3.4-4 and Table 3.4-2. As nuclear is already introduced to share 2.5% of the primary energy supply, LNG is introduced in addition causing considerable reduction of coal lowering the share of import coal by 2.1% and domestic coal by 0.4%.

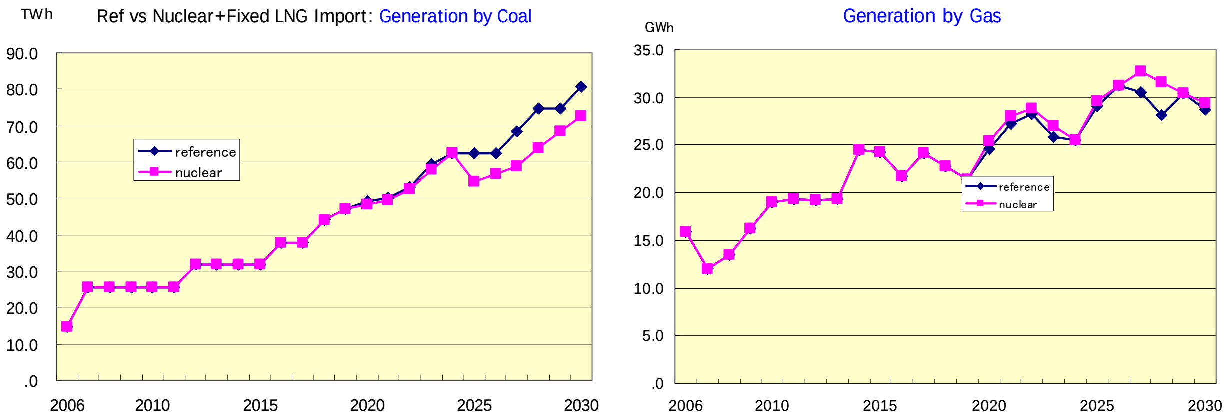


Figure 3.4-3 Coal, Gas and Nuclear Power Generation (GWh)

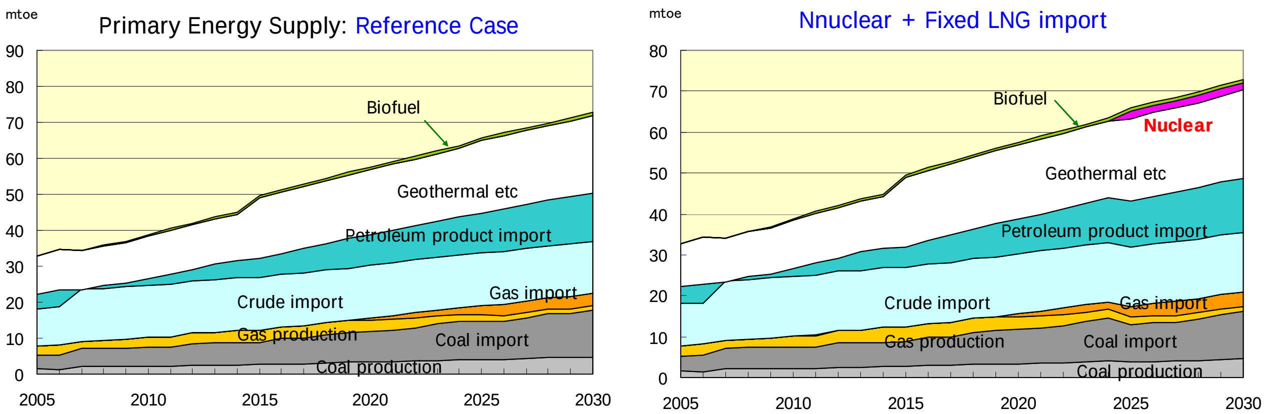


Figure 3.4-4 Comparison of Primary Energy Supply (REF versus LNG)

Table 3.4-2 Primary Energy Supply (LNG Introduction: 2030)

Case	Domestic Coal	Imported Coal	Oil	Biofuel	Domestic Nat Gas	Imported LNG	Hydro & Geotherm	Nuclear	Total
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
Reference	4825	13143	27841	899	1132	3377	21544	0	72762
LNG	4582	11672	27841	899	1132	3500	21544	1826	72996
Change	-243	-1471	0	0	0	123	0	1826	234
Compositior	%	%	%	%	%	%	%	%	%
Reference	6.6	18.1	38.3	1.2	1.6	4.6	29.6	0.0	100.0
LNG	6.3	16.0	38.1	1.2	1.6	4.8	29.5	2.5	100.0
Change	-0.4	-2.1	-0.1	0.0	0.0	0.2	-0.1	2.5	0.0

As 156.2 million tons of CO_2 is exhausted in the Reference Case, while it is reduced by 4.3% to 149.4 million tons of CO_2 in the LNG introduction case combined with introduction of nuclear power.

3.4.3 Accelerated Renewable Energy Use

Power development plan using renewable energies such as geothermal, hydro and wind until 2030 is set out by DOE as shown in Table 3.4-3. Corresponding amount of power generation by geothermal, hydro and wind is projected in the Reference Case with consideration on the status of the existing facility and realistic operation level.

Table 3.4-3 Power Development Plan: DOE (Renewable)

	2008-2010	2011-2015	2016-2020	2021-2025	2026-2030
	MW	MW	MW	MW	MW
Geothermal	90	680	40	190	90
Hydro	3100				
Wind	415				

In the Accelerated Renewable Energy case, challenging increase of renewable energy capacity is considered; that is, after 2016, geothermal is double, hydro is 30% up, wind is double.

Figure 3.4-5 indicates trends of power generation by coal and gas, where both of them are remarkably reduced after 2020, and the difference in 2030 amounts to 6,330GWh for coal and 4,570GWh for gas, respectively.

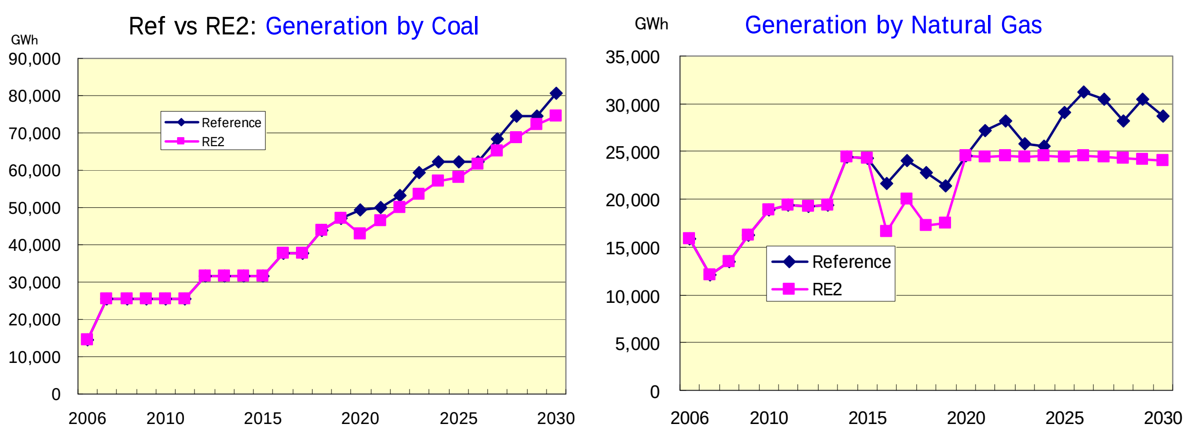


Figure 3.4-5 Coal Power Generation（GWh）

As 156.2 million tons of CO_2 is emitted in the Reference Case, it will be reduced by 4.8% to 148.8 million tons in the Accelerated Renewable Use case as a result that fossil fuel consumption is further reduced in addition to introduction of nuclear energy.

Table 3.4-4 Primary Energy Supply (Renewable Max.: 2030)

Case	Domestic Coal	Imported Coal	Oil	Biofuel	Natural Gas	Hydro & Geothermal	Nuclear	Total
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
Reference	4,825	13,143	27,841	899	4,509	21,544	0	72,762
Nuclear	4,749	12,682	27,841	899	3,786	21,544	1,826	73,327
Change	-76	-461	0	0	-723	0	1,826	566
Composition	%	%	%	%	%	%	%	%
Reference	7	18	38	1	6	30	0	100
Nuclear	7	17	38	1	5	29	2	100
Change	0	-1	0	0	-1	0	2	0

3.4.4 Refinery Expansion

As no refining capacity increase is slated in the Reference Case, refining capacity expansion of 100,000 B/D in 2020 is examined in a form of "scrap and build" that a new refinery with a capacity of 200,000 B/D will be constructed in place for the existing 100,000 B/D capacity.

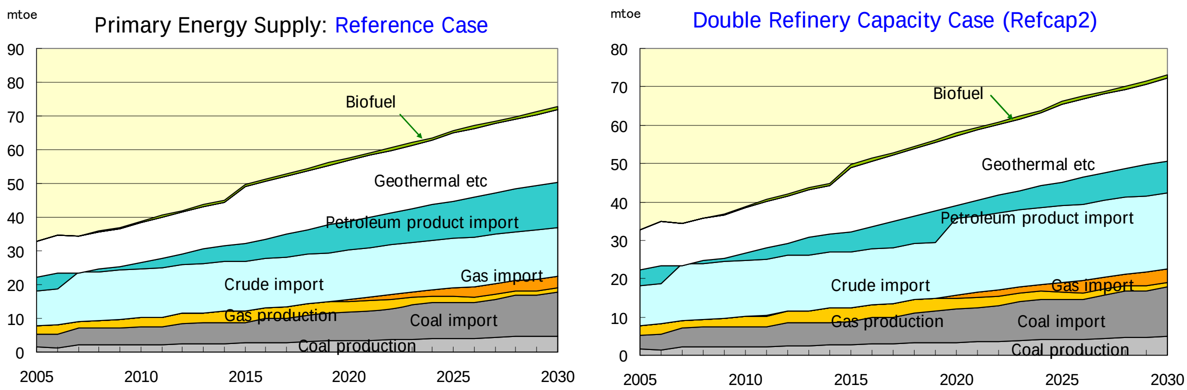


Figure 3.4-6 Comparison of TPE (REF, RE2)

Table 3.4-5 Primary Energy Supply (Refinery Expansion Case: 2030)

Case	Coal	Crude Processing	Imported Oil Products	Biofuel	Natural Gas	Hydro & Geothermal	Nuclear	Total
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
Reference	17,968	14,621	13,220	899	4,509	21,544	0	72,762
Refining Expansion	17,968	19,914	8,308	899	4,509	21,544	0	73,142
Change	0	5,293	-4912	-0	0	0	0	381
Composition	%	%	%	%	%	%	%	%
Reference	24.7	20.1	18.2	1.2	6.2	29.6	0.0	100.0
Refining Expansion	24.6	27.2	11.4	1.2	6.2	29.5	0.0	100.0
Change	-0.1	7.1	-6.8	0.0	0.0	-0.2	0.0	0.0

Supply/demand balances of gasoline and diesel oil are compared with the Reference Case. In the Reference Case, both gasoline and diesel oil import are increasing monotonously since refining capacity remains fixed. In the Refinery Expansion case, on the other hand, petroleum product import decreases from 2,385 ktoe to 1,476 ktoe for gasoline and from 4,539 ktoe to 2,797 ktoe for diesel oil, respectively, by about 40%. However, petroleum product import ratio in whole demand is still high, and further expansion of refining capacity shall be considered as mentioned above.

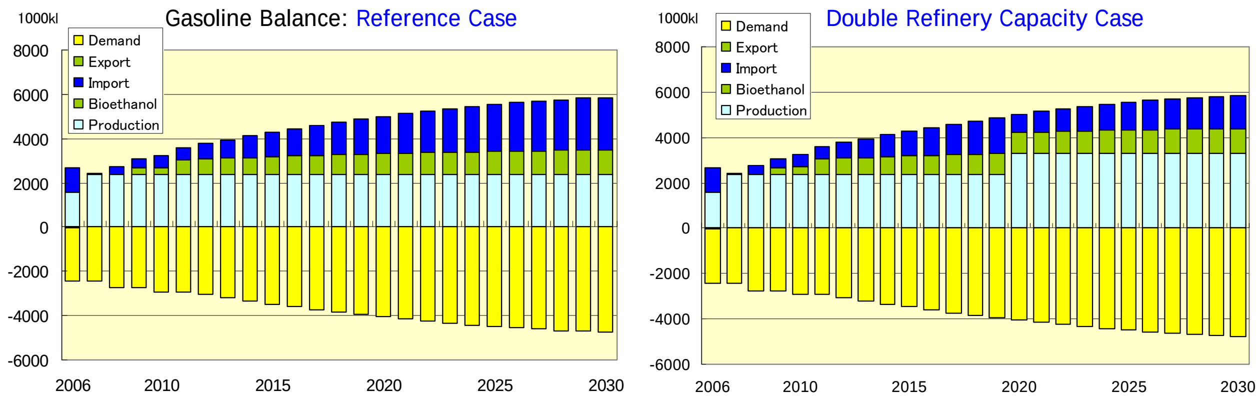


Figure 3.4-7 Comparison of Gasoline (REF, RE2)

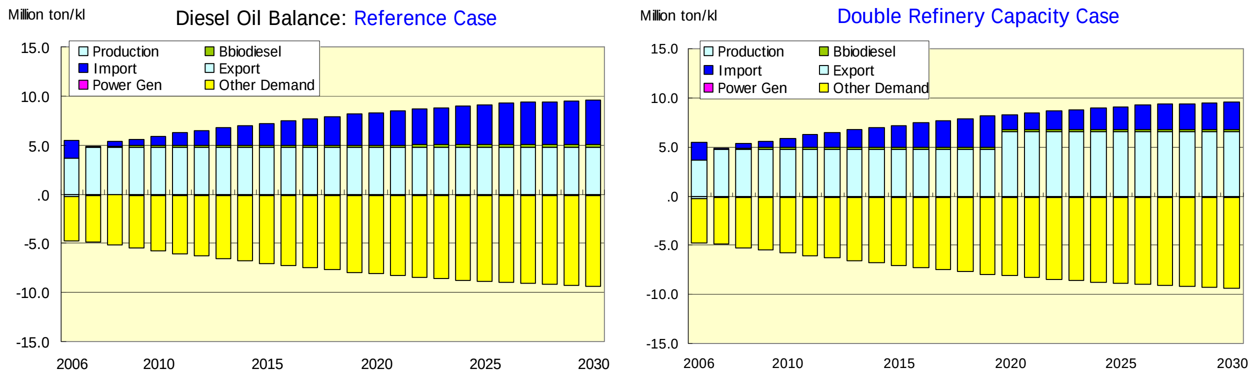


Figure 3.4-8 Comparison of Diesel Oil (REF, RE2)

In addition to the above cases, increase of bio-fuel supply is also considered from a viewpoint of reducing the volume of import of gasoline and diesel. Table 3.4-6 shows the summary of comparison with cases of 1) biofuel supply increase volume, in particular E85 is taken up as an extreme case and 2) the refining capacity expansion.

Table 3.4-6 Effect of Biofuel Introduction on Gasoline Import (2030)

(Unit:ktoe)

	Production			Import			Export		
	Reference	E85	Ref.Cap	Reference	E85	Ref.Cap	Reference	E85	Ref.Cap
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
LPG	795.3	795.3	1255.2	2360.0	2360.0	2360.0	0.0	0.0	0.0
Gasoline	2723.9	2723.9	3768.9	2743.0	0.0	1698.0	0.0	1924.8	0.0
Bio Ethanol	622.4	5290.2	622.4	-	-	-	-	-	-
Kerosene	0.0	0.0	0.0	1249.5	1249.5	789.6	0.0	0.0	0.0
Jet Fuel	1399.5	1399.5	1665.7	1090.2	1090.2	824.0	0.0	0.0	0.0
Diesel	5486.2	5486.2	7472.2	5261.3	3657.5	3275.2	0.0	0.0	0.0
Bio Diesel	178.2	1782.4	178.2	-	-	-	-	-	-
Fuel Oil	3858.7	3858.7	5013.4	602.1	602.3	0.0	0.0	0.0	552.5
FG	260.0	260.0	440.5	-	-	-	-	-	-

The extreme increase of bio-ethanol supply results in gasoline export of 1,925 ktoe that is equivalent to 70% of the domestic production at 2,724 ktoe as exceeding the domestic demand. On the other hand, 3,658 ktoe of diesel oil, equivalent to 67% of the domestic production at 5,486 ktoe, is still in short and requires import. Production balance is quite abnormal between gasoline and diesel. Considering that petroleum products are so-called chain-products linked each other, extremely high bio-ethanol blending would cause serious problems. We should consider well-balanced production yields for gasoline and diesel oil in planning ambitious bio-fuel promotion.

Chapter 4 Issues and Objectives of Long-term Energy Plan

4.1 Long-term Energy Outlook and Direction of Energy Policy

4.1.1 Economic Growth Incurring Greater Energy Demand

The economic growth scenario in this study is set forth that the Philippines will continue to grow at the current trend of annual 5%. In the coming 20 years, economy of the Philippines will reach the current level of the leading ASEAN countries in terms of economy size and living standard and shall have achieved substantial modernization.

Table 4.1-1 Final Energy Demand Outlook by Sector (Reference Case)

	Agriculture	EI Industry	Gen Mfg.	Transport	Commercial	Residential	Total
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
2005	313	2,653	1,430	8,939	1,660	2,405	17,401
2010	254	3,071	1,480	12,032	2,187	2,763	21,787
2020	337	4,311	2,366	17,277	3,638	4,434	32,363
2030	402	5,591	3,279	20,563	5,218	6,219	41,273
05-30	1.0%	3.0%	3.4%	3.4%	4.7%	3.9%	3.5%
Composition	%	%	%	%	%	%	%
2005	1.8	15.2	8.2	51.4	9.5	13.8	100.0
2010	1.2	14.1	6.8	55.2	10.0	12.7	100.0
2020	1.0	13.3	7.3	53.4	11.2	13.7	100.0
2030	1.0	13.5	7.9	49.8	12.6	15.1	100.0

The distinctive feature of the energy demand structure in the Philippines is that the transport sector consumes more than 50% of the country's energy demand, and that three quarters of the latter is used for road transportation. Without substantial energy intensive industries, energy consumption by the manufacturing industry remains at around 20%. This trend will continue and energy consumption will increase mainly in the commercial and residential sector reflecting modernization at offices and households.

Table 4.1-2 Final Energy Demand by Energy Source (Reference Case)

	Coal	Natural Gas	Oil	Fossil Fuel Total	Electricity	Total
Compisition	%	%	%	%	%	%
2005	6.1	0.1	71.5	77.7	22.3	100.0
2010	6.4	0.4	71.2	77.9	22.1	100.0
2020	6.2	0.3	69.5	76.0	24.0	100.0
2030	6.4	0.4	66.6	73.5	26.5	100.0
Growth Rate	%	%	%	%	%	%
05-10	5.6	46.5	4.5	4.7	4.4	4.6
10-20	3.8	2.8	3.8	3.8	4.9	4.0
20-30	2.9	5.1	2.0	2.1	3.5	2.5
05-30	3.8	11.3	3.2	3.3	4.2	3.5

In addition to the fact that transportation fuel accounts for large portion of energy consumption, oil has been widely used by industrial users. Thus, petroleum products accounts for about 70% of the primary energy requirement, and one quarter is borne by electricity. As social modernization progresses in future, demand for electricity and gas may increase. However, since city gas system is not developed in the Philippines, conversion from traditional biomass fuels such as firewood and charcoal may be replaced mainly by LPG. In promoting this, it is necessary to study pros and cons of introducing natural gas or LPG in a large quantity for modernization of life and cleaner environment. Since these fuels may be mainly procured from aboard, such study must include analysis of international market movement.

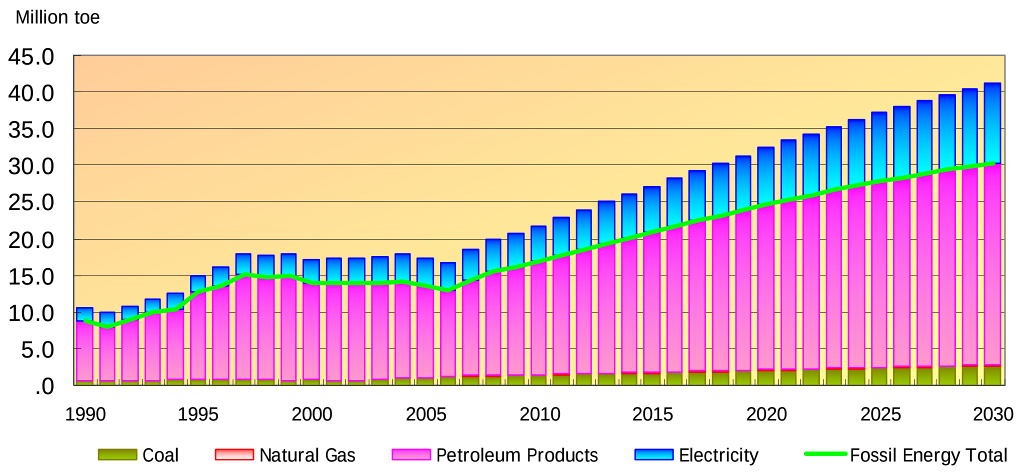


Figure 4.1-1 Final Energy Consumption by Energy Source

4.1.2 Primary Energy Supply Structure

In the Philippines, deposits of indigenous energies are limited and it is difficult to expect that their production could keep pace with the increasing indigenous demand. As the energy demand is concentrating in transportation and power generation, import coal and oil are bound to supply major portion of the incremental energy demand. Since regional markets are divided into separate parts in this archipelago country, there are certain constraints for large-scale utilization of geothermal energy.

Thus, the energy supply structure of the Philippines would not change largely in future. The fundamental trend is moving in the direction that, as indigenous natural gas production would deplete and geothermal and hydro productions would peak out in the middle of the projection period, import of oil for supply of motor fuel and import of coal for power generation will steadily increase. As a result, fossil fuel ratio in the energy supply structure will rise from 67.6% in 2005 to 69.2% in 2030. The indigenous energy supply ratio will decrease from 52.9% to 43.5% if non-commercial energy is counted and from 44.7% to 39.1% if they are excluded.

Table 4.1-3 Energy Supply Structure of the Philippines (Reference Case)

	2005	2010	2020	2030	05 --> 20	20 --> 30	05-->30
	ktoe	ktoe	ktoe	ktoe	%	%	%
Coal	5,190	7,373	12,021	17,968	5.8	4.1	5.1
Oil (Excl.LPG)	13,735	15,554	20,795	24,315	2.8	1.6	2.3
LPG	695	846	2,198	3,525	8.0	4.8	6.7
Natural Gas	2,504	2,797	3,716	4,509	2.7	2.0	2.4
Hydro	2,088	2,661	4,425	6,189	5.1	3.4	4.4
Nuclear	0	0	0	0	***	***	***
Geothermal	8,516	9,327	13,667	15,354	3.2	1.2	2.4
Renewables	3	312	749	899	44.4	1.8	25.6
Total Commercial	32,731	38,871	57,571	72,761	3.8	2.4	3.2
Non-Commercial	5,766	5,901	5,795	5,784	0.0	0.0	0.0
Total	38,498	44,771	63,366	78,545	3.4	2.2	2.9
	%	%	%	%	%	%	%
Coal	13.5	16.5	19.0	22.9	5.5	3.9	9.4
Oil (Excl.LPG)	35.7	34.7	32.8	31.0	-2.9	-1.9	-4.7
LPG	1.8	1.9	3.5	4.5	1.7	1.0	2.7
Natural Gas	6.5	6.2	5.9	5.7	-0.6	-0.1	-0.8
Hydro	5.4	5.9	7.0	7.9	1.6	0.9	2.5
Nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Geothermal	22.1	20.8	21.6	19.5	-0.6	-2.0	-2.6
Renewables	0.0	0.7	1.2	1.1	1.2	0.0	1.1
Total Commercial	85.0	86.8	90.9	92.6	0.0	0.0	0.0
Non-Commercial	15.0	13.2	9.1	7.4	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	***	***	***

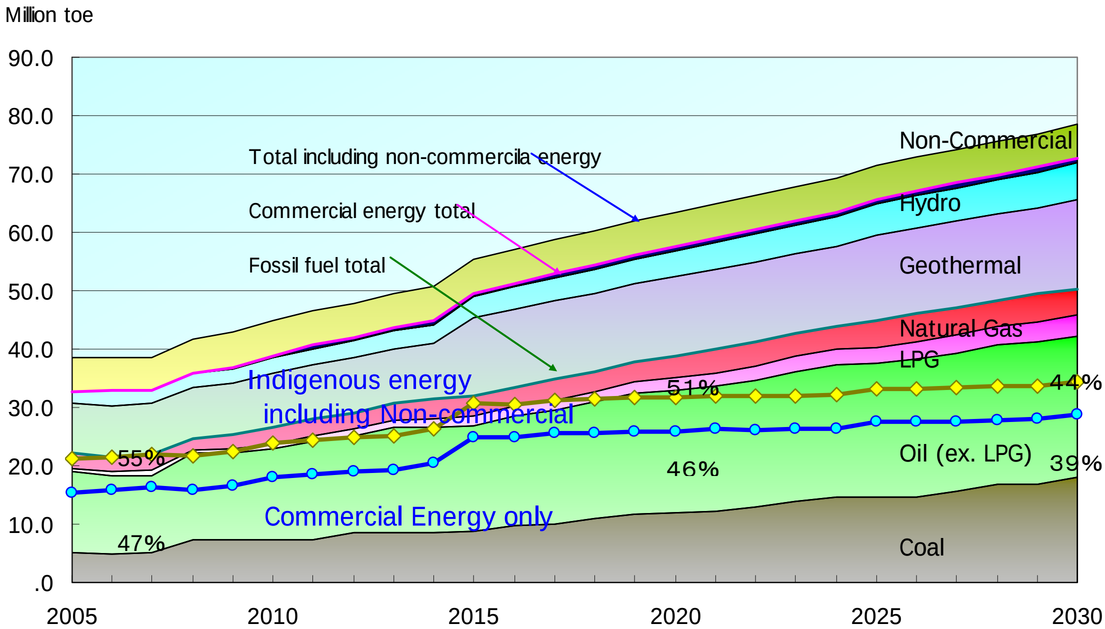


Figure 4.1-2 Energy Supply Structure of the Philippines (Reference Case)

Table 4.1-4 summarizes the analysis on the relation of energy demand size and energy supply structure. Given that indigenous energies will be used first, 90% of the demand change will occurs as changes in oil and coal supply. Increase of energy demand implies increase of energy import incurring greater economic burden and deteriorated energy security. If energy demand is smaller, fossil fuel import becomes less. Energy conservation will directly affect the energy import. Although reduction of energy import would become moderate in the more energy conserving cases, such efforts will still bring certain effect to lower the energy import ratio.

Table 4.1-4 Energy Demand Trend and Energy Supply Structure

	2010			2020			2030		
	HG	Ref	LG	HG	Ref	LG	HG	Ref	LG
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
Coal	7,440	7,373	7,336	14,123	12,021	8,360	24,963	17,968	12,142
Natural Gas	2,854	2,793	2,420	3,692	3,692	3,691	4,632	4,423	3,697
Oil	16,743	16,404	15,930	24,635	23,017	20,559	32,255	27,927	24,014
Geothermal	9,327	9,327	9,327	13,667	13,667	13,667	15,354	15,354	15,354
Hydro	2,661	2,661	2,661	4,425	4,425	4,425	6,189	6,189	6,189
Nuclear	0	0	0	0	0	0	0	0	0
Renewables	317	312	302	801	749	667	1,020	899	778
Commercial Total	39,343	38,871	37,977	61,343	57,571	51,368	84,412	72,761	62,174
Non-Commercial	5,922	5,901	5,850	5,972	5,795	5,520	6,423	5,784	5,224
Total	84,608	83,642	81,804	128,659	120,937	108,257	175,247	151,306	129,573
Composition	%	%	%	%	%	%	%	%	%
Coal	8.8	8.8	9.0	11.0	9.9	7.7	14.2	11.9	9.4
Natural Gas	3.4	3.3	3.0	2.9	3.1	3.4	2.6	2.9	2.9
Oil	19.8	19.6	19.5	19.1	19.0	19.0	18.4	18.5	18.5
Geothermal	11.0	11.2	11.4	10.6	11.3	12.6	8.8	10.1	11.8
Hydro	3.1	3.2	3.3	3.4	3.7	4.1	3.5	4.1	4.8
Nuclear	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Renewables	0.4	0.4	0.4	0.6	0.6	0.6	0.6	0.6	0.6
Non-Commercial	7.0	7.1	7.2	4.6	4.8	5.1	3.7	3.8	4.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 4.1-5 Case Studies on Energy Import Quantity

	Energy Import			Import Ratio		
	2005	2020	2030	2005	2020	2030
Reference	Mtoe	Mtoe	Mtoe	%	%	%
Coal	3.7	8.6	13.1	71.5	71.5	73.1
Oil	13.7	23.0	27.8	99.8	99.8	99.8
LPG	0.7	2.2	3.5	65.4	75.6	81.6
Natural Gas	0.0	0.8	3.4	0.0	0.0	74.9
Total	18.1	32.3	44.3	55.3	56.2	60.9
BAU Case	18.1	37.3	54.7	55.3	59.0	64.8
High Growth	18.1	35.4	54.8	55.3	57.7	64.8
Low Growth	18.1	26.9	34.9	55.3	52.4	56.2
EEC	18.1	29.6	38.3	55.3	54.4	58.1
Super EEC	18.1	27.0	32.9	55.3	52.5	55.1
LNG + Nuclear	18.1	32.3	43.0	55.3	56.2	58.9

On the supply side, it is necessary to carry out in-depth studies on the pros and cons of importing LPG and natural gas that would become major energy carriers in modernization of the residential and commercial sectors, including studies on world gas market trend and environmental effect of introducing gas energy. It is also necessary to study on the possible government initiative and engagement appropriate in securing supply, preparing infrastructure and developing market. While introduction of nuclear power is not considered in the Reference Case, it will bring substantial effects on reducing import dependence of fossil energy and greenhouse gas emission. It is of course necessary to carefully consider various elements such as necessary technology, economics and international politics, etc. Introduction of renewable energies will have similar effects as seen in the case of nuclear. Promoting them, it is necessary to prepare sufficient conditions on technology development, economics and social impacts.

4.1.3 Fundamental Direction of Energy Policy

Steps to be taken against the twin energy related problems of energy security and global warming will be divided into three as follows.

1) Curbing energy requirement
2) Reducing requirements of import energies and fossil energies
3) Reinforcing security of fossil fuel procurement

After implementing due measures stated above, it is inevitable for many countries to supplement the balance with energy import, and the Philippines is not an exception. Therefore, it is necessary to establish *strategic energy selection* policy to realize stable energy procurement as much as possible. Common features of these means are that technology development from a long-term viewpoint will play an important role and they will have synergistic effects in curbing the twin problems relating to energy. For example, promotion of energy conservation will substantially reduce energy consumption, decreasing energy import requirement as well as greenhouse gas emission at the same time. Introduction of nuclear and renewable energies gives same effect. In this context, future energy policy should be directed toward effective integration of the policy measures to cope with the issues as discussed above.

4.2 Energy Efficiency and Conservation

In the Philippines, as its dependence on import energy is high, the most important objective of the energy policy will be to guide the country to the direction of slower increase in energy requirement and import necessity. In order to materialize sustainable development under the circumstance, it is important to establish an economic development strategy under which energy would not become shackles. Then, the most effective card is promotion of energy efficiency and conservation, and/or enhancement of rational energy use.

Looking to the effect of energy conservation comparing the BAU Case that assumes the current trend to continue and the Reference Case that implements annual 0.5% energy conservation, the final energy demand in 2030 will differ by 20%. In the EEC case where the energy conservation efforts will be enhanced to annual 1.0%, another 10% reduction will be expected. There would also be substantial differences in energy input dependence among these cases. In considering these effects, we should take note that effects of EEC will be accumulated with lapse of time, and therefore daily and persevering efforts are required to materialize the goal.

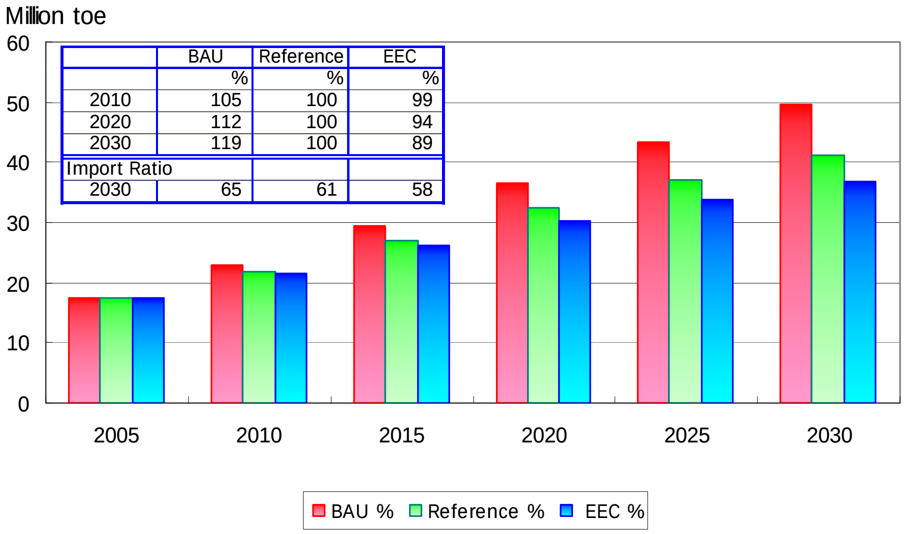


Figure 4.2-1 Outlook of Final Energy Consumption

In the Philippines, as the economy would grow 3.4-fold in the coming 20 years, new factories and buildings will come up one after another during the projection period. In other words, ratio of the factories and buildings currently supporting the economic activities would become less than 1/3 of those prevailing in 2030. Therefore, setting out an appropriate energy supply plan, it is necessary to give greater consideration on the future development plans rather than extrapolating the past trend. In this regard, it is important to draw up a *Grand Design* of the economy how to structure the future industry system and people's life style.

4.3 Issues Relating to Energy Supply

4.3.1 Oil Refining Capacity

In the past several years, we have seen withdrawal of Caltex from refining business and SaudiAramco from investment in Petron. The refining industry in the Philippines is apparently on the declining trend. However, indigenous demand for petroleum products is expected to increase steadily and the operation of the indigenous refineries is already at a high rate. Indigenous demand will exceed the refining capacity around 2010, and after then the supply/demand balance will require straight increase of product import. Thus, expansion needs to be considered by about 100,000 BD around 2015 through 2020, and another expansion may be after 2025.

It is of course necessary to investigate into international market movement and investment economics. However, when the import ratio of petroleum products is too high, the indigenous market would be exposed to drastic fluctuations of international market supply balance that would be dominated by big players with a giant market such as China and India. Although the oil refining industry is a private sector business, if we consider the stable supply of petroleum products in the domestic market and growing environmental concerns that require improvement of product quality, time is ripe for the government to set out guidelines with regard to future refining industry in the Philippines.

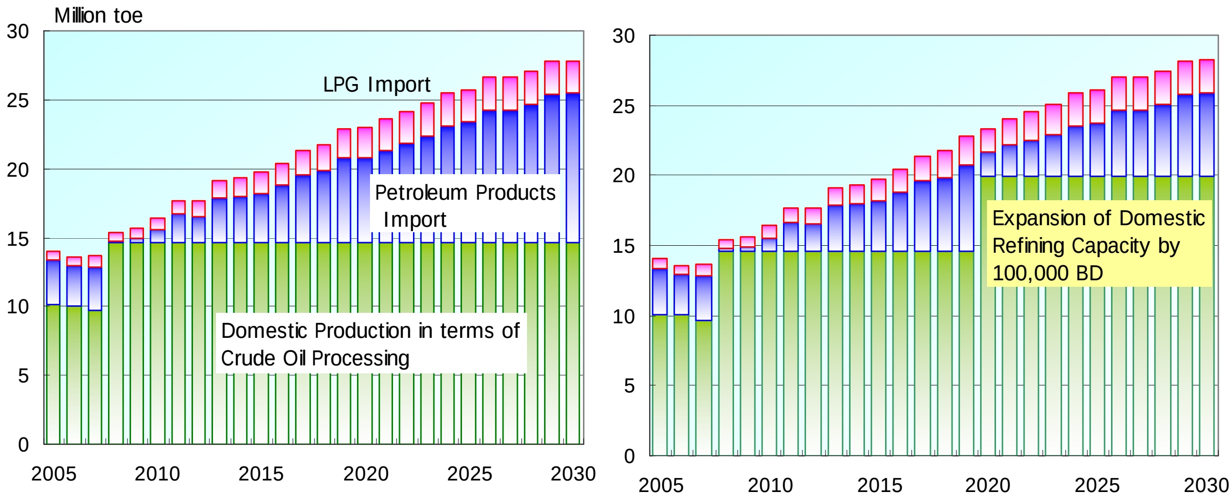


Figure 4.3-1 Expansion of Indigenous Refining Capacity

4.3.2 Supply of Natural Gas and LPG

As the main gas field Malampaya may start declining between 2015 and 2020, we are already coming to a timing to consider how to supplement it. As oil and gas exploration is not quite active in the Philippines, it is lack of responsible policy if we are simply hoping for luck of successful drilling.

On the other hand, LPG demand will also continue to increase and its import requirement will reach 2 million tons a year around 2020. The international LPG market has been exposed to drastic fluctuation. Figure 4.3-2 illustrates the supply/demand balance of gas and LPG combined giving a focus on the LPG import quantity and identifying the 2 million ton LPG import. Horizontal lines of indigenous natural gas production, indigenous LPG supply produced at refineries and LPG import of maximum 2 million tons are shown cumulatively, and the blue line indicates the total supply of these gases.

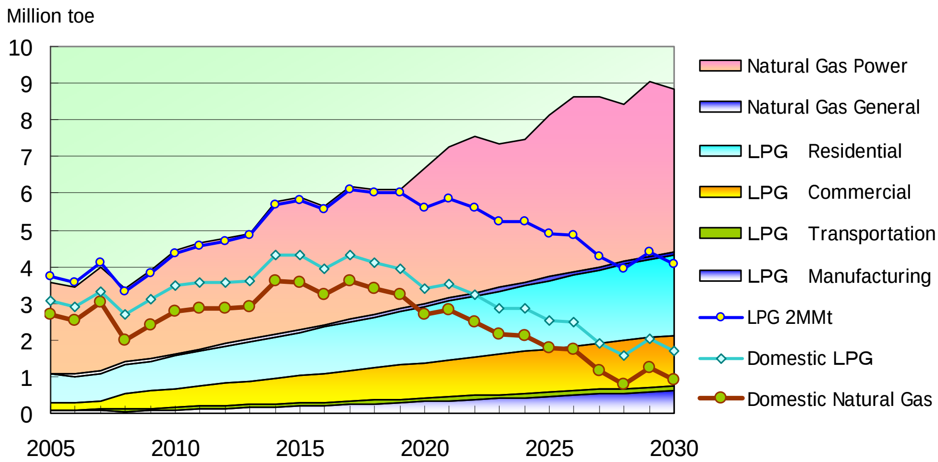


Figure 4.3-2 Supply/Demand Balance of Gas Energy

Applying the current demand trend, supply/demand gap of these gases (LPG + natural gas) will start to expand around 2020. Introducing LNG and developing city gas supply grid in Metro Manila region would be one of the effective measures to alleviate LPG import requirement. However, we may need a great political initiative to construct the city gas grid in the central capital area. In addition, as LNG is a business that requires long lead time, we need to start preparation with sufficient time allowance in case LNG is preferred as the favorable goal.

On the other hand, there is an observation that trend of international LPG market is changing. This is caused by the natural gas conversion in the large LPG consuming countries such as Japan and China, and LPG has been pushed out from the gas market in these countries. LPG price in the international market is easing, and the LPG supply situation is deemed to be stabilizing. As the Philippines is composed of many islands and markets are separated, development of LNG that requires large scale supply grid may be possible only in Metro Manila area for the time being. In the central archipelago regions where individual markets are smaller and scattered, LPG would be more favorable fuel as it could be developed with smaller scale systems. Considering complicated circumstance of LPG business, in-depth studies should be carried out to investigate into the points raised as above.

4.3.3 Introduction of Nuclear Power

Introduction of nuclear power station would decrease dependence on the fossil fuels that are exposed to short-term market fluctuation and would also reduce greenhouse gas emission. Thus, simulation results are shown in Figure 4.3-3 on the energy structure change and CO_2 emission in 2030 in case nuclear power is introduced from 2025 with a capacity of 1,000 MW.

2030	Primary Energy Supply			Composition		
	Ref	N Fix L Free	L+N	Ref	N Fix L Free	L+N
	ktoe	ktoe	ktoe	%	%	%
Coal	17968	17431	16254	22.9	22.0	20.6
Natural Gas	4509	3786	4632	5.7	4.8	5.9
Oil	27841	27841	27841	35.4	35.2	35.3
Geothermal	15354	15354	15354	19.5	19.4	19.5
Hydro	6189	6189	6189	7.9	7.8	7.9
Nuclear	0	1826	1826	0.0	2.3	2.3
Renewables	899	899	899	1.1	1.1	1.1
Non-Commercial	5784	5784	5784	7.4	7.3	7.3
Total	78545	79110	78780	100.0	100.0	100.0
CO_2 (million CO_2-t)	156	152	149	100.0	97.5	95.7

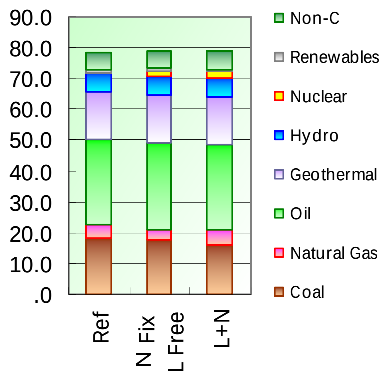


Figure 4.3-3 Primary Energy Supply Mix: Nuclear Power Case

As the size of nuclear power introduced here is relatively small, although it may give certain impact on the natural gas that is economically less favorable than coal, impact on the coal with large demand size is limited. Another feature of this case study is the changes in CO_2 emission, which changes substantially introducing nuclear and LNG together.

These energies may work friendly on the global warming issue, though we need to conduct in-depth study on huge investment, technology and international policy balance before the final decision.

4.3.4 Promotion of Biofuel

Biofuels to be produced from sugar cane, coconuts, palm oil and Jatropha are the energy sources that we can expect substantial production in the Philippines. At present there is an official plan to implement 10% blend of ethanol with gasoline (E10) and 2% blend of CME with diesel gas oil (B2) by 2011. With this policy, about 3% of the petroleum demand may be replaced in 2030.

Introduction of biofuel shall give considerable impacts on the energy supply structure, in particular on the supply pattern of petroleum products. While the composition of the petroleum products demand in the E20/B20 case represents moderate change, a drastic increase of ethanol supply and consequently a drastic decrease of gasoline supply may occur in the E85/B20 case. Since petroleum products are linked each other in the production process, the E85/B20 case requires a too extreme change. In this consideration, it is preferable that biofuel introduction should be made to similar extents for both gasoline and diesel oil demands.

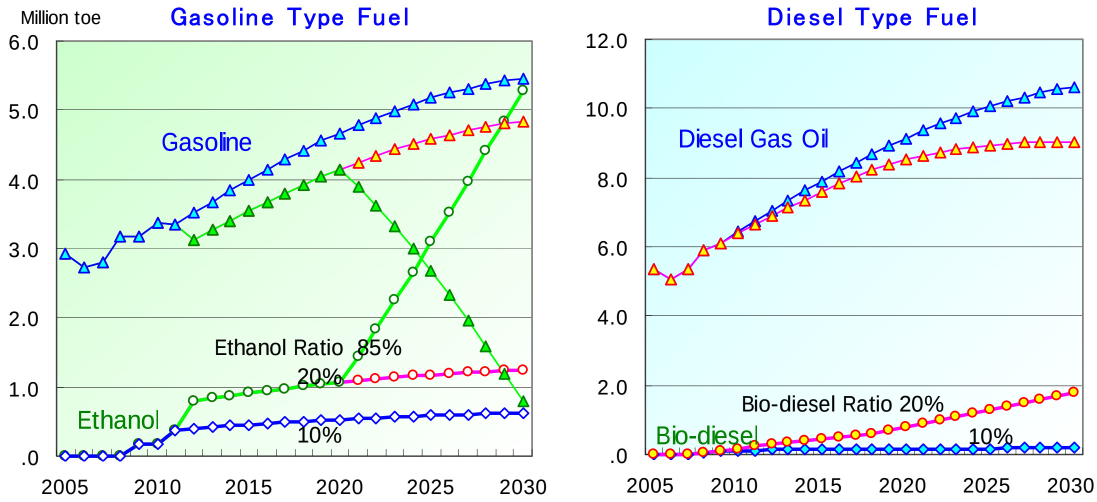


Figure 4.3-4 Introduction of Biofuel and Petroleum Demand

The Philippines is endowed with favorable natural conditions to grow sugar cane and oil palm that would supply feedstock for biofuel in a large scale production system. The country has an achievement of large scale production of sugar and technology to produce ethanol from sugar is established. However, many developing countries are commonly facing with the issue that young generation is going out of agriculture, and the Philippines is not an exception. Therefore, it is necessary to establish a business model that large-scale biofuel production is feasible as a commercial project. In order to prepare the social conditions to enable large-scale biofuel production, it is necessary to review and reform the social system, laws and regulations, on the land ownership and national agriculture promotion program based on nation-wide consensus.

According to the Cebu declaration adopted at the East Asia Summit meeting held in January 2007 with an intension to develop renewable energies widely, “Biofuel Initiative” program is being promoted in Asia under support of the Japanese government. It is desirable that studies on developing technology and social system to realize large-scale production of biofuel should be implemented under this program, and efforts to formulate practicable projects should be made utilizing worldwide institutions such as the CDM system.

4.4 Important Issues to Be Considered in the Energy Policy

Major energy issues facing the Philippines may be summarized as follows.

1) Soaring energy prices
2) Energy structure with higher oil share
3) Stagnant exploration/development and production depletion of indigenous energy and increase of energy import
4) Increasing environmental burden incurred by more consumption of energy
5) Construction of rational and efficient energy market

To cope with the situation, following issues should be considered in the energy policy as its major objectives.

1) Promotion of energy efficiency and conservation
2) Promotion of indigenous energy development
3) Securing stable energy import and reinforcement of energy security
4) Construction of reliable and efficient energy supply system
5) Rationalization of energy market to realize reasonable and appropriate energy prices

While it is not the main purpose of this study to discuss detail aspect of desirable energy policy, the gist of the above policies is briefly summarized below.

(1) Energy Efficiency and Conservation

In order to realize sustainable economic growth for the long-term period under the circumstance that the world supply/demand balance of fossil fuel is tightening, it is necessary for the Philippines at first to implement thorough energy efficiency and conservation. Energy consumption of the Philippines would increase from the present 32.7 million tons in oil equivalent (toe) in 2005 to 62.7 million toe in 2020 and 85.5 million toe in 2030 in the BAU Case. This shall be controlled hopefully as shown in the Reference Case in a manner that the energy demand of 2020 should be reduced by 10% to 57 million toe and that of 2030 by 15% to 73 million toe. The increasing speed of the energy consumption should be curbed down and an energy efficient society should be created.

(2) Indigenous Energy Development

It is one of the important energy policy measures to promote exploration and development of indigenous energy resources. Success of E&P in the coal, oil and natural gas sector is the most desirable energy security achievement and thus efforts should be made to raise the activity level in these sectors. However, it is not preferable to put too great expectation on the outcome of high risk activities.

Considering the fact that fossil resource potential is not substantial and uncertainty on the exploration outcome is high, promotion of nuclear and renewable energies is a more steady measure to materialize certain outcome. Therefore, it is desirable to study intensively on the possible introduction of them as follows.

1) Nuclear energy

It is necessary to consider economics as well as political condition within and outside of the country. As the construction requires long lead time and huge investment, it is necessary to establish firm platform based upon national consensus and implement the plan slow but steady.

2) Renewable energies

On the biofuel, it is desirable to develop a *Philippine Model* to effectively utilize the favorable natural condition of the country. It is also recommended to utilize the fund and resources provided by international institutions or systems. In promoting this, due consideration must be paid to the land and agricultural policies.

To take in electricity generated by renewable energies into the national grid in a large scale, it is necessary to study on the preferable power source composition and the grid structure based on long-term view point.

(3) Securing Stable Energy Import and Reinforcement of Energy Security

As the dependence on import energy rises, attention should be paid to the supply characteristics of each energy source and the following principles.

1) Energy diversification policy should be promoted with due attention to the supply characteristics of each energy
2) Based on the characteristics of energy market, procurement strategies should be established on each energy. It is also necessary to establish the country's presence in the international market and among import channels.
3) Energy import infrastructure should be constructed with careful investigation on the regional demand distribution and the applicable economics of scale.
4) Energy security measures should be established to mitigate the impact of abrupt changes in the international market, such as national strategic oil stockpiling and standardization of petroleum product specifications.
5) In implementing the above measures, roles of the government and private sectors should be clearly defined and the private sector activities should be effectively promoted.

(4) Construction of Reliable and Efficient Energy Supply System

In construction of large-scale energy infrastructure, huge amount of investment and a long lead-time is necessary from site selection to facility completion. Initiative of the government sector needs to be strengthened in these projects taking account of the following principles.

1) On important energy infrastructure projects, it is necessary to clearly define the projects to be implemented by the government sector and those left for the private sector. Their progress should be reviewed periodically in the long-term energy plan.
2) A comprehensive plan to construct an efficient energy system in view of the long-term benefit should be proposed.
3) It is necessary to prepare good coordination system to implement energy projects development

well harmonized with regional societies and stakeholders.

For example, proper orientation of the government is necessary to implement big projects such as refineries, LNG terminals, city gas grid, nuclear power and/or geothermal plants.

(5) Energy Market to realize Reasonable and Appropriate Energy Prices

In order to ensure sustainable development of the economy and the society, it is appropriate to consider energy sector reform and modernization that shall assure stable supply and efficient use of energy based on peer review of the world trend. In principle, an open and efficient energy market is aimed at adopting market principles/mechanisms to the maximum extent. We should take note, however, that serious market failures have been experienced even in the United States and Europe in the past market liberalization causing collapse of energy supply systems. In construction and operation of market rules, following points should be considered.

1) Clearly define the role of the government sector to set forth the market rule and that of the private sector as players, and set out fair and transparent transaction rules.
2) Liberate the energy market and promote participation of efficient players, while the government should reserve certain control on the energy market to protect national interest. Any entity to participate in the market should qualify certain criteria.
3) Establish the principle that market energy price should be decided without prejudice to the procurement of energy from the international market. To this end, consideration on socially week people shall be made in a form other than implicit cross subsidies artificially lowering energy price.

Please refer to Chapter 9 through Chapter 12 of the principal report for more detail discussion on the above.

Chapter 5 Supplemental Analysis with Revised Price Scenario

During a period of slightly over one year since we started this survey in September 2007, the world has experienced drastic changes in energy price. After hitting the record high of $147 per barrel on July 11, WTI futures plunged to $60 per Bbl upon the Lehman-shock of September 15. In early November, it is hovering around $70 per Bbl.

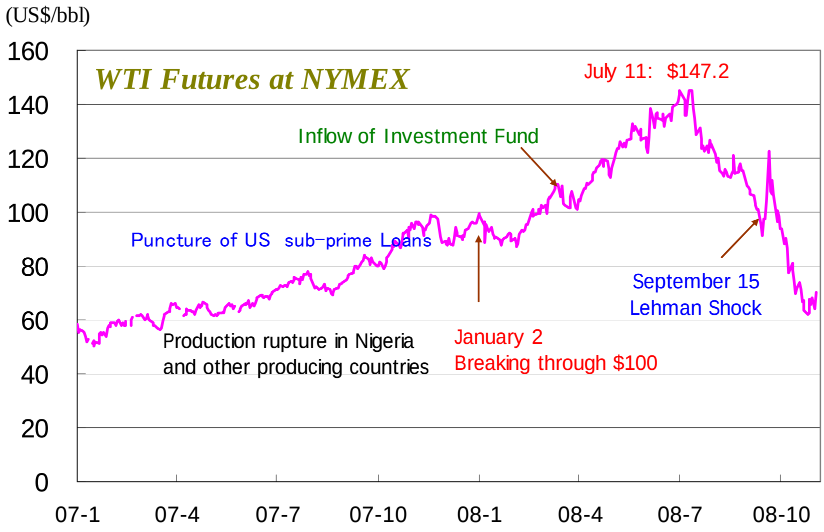


Figure 5.1-1 WTI Futures at NYMEX

As we set out the preconditions for the analysis in this survey around the end of May 2008 when the oil price was still on the upward trend, we adopted a hypothesis that oil price would increase upward starting from $120 per Bbl. Looking at the recent happening, however, everybody may wonder that the price projection was excessively high and what would happen under a lower price scenario. Therefore, we ran a supplemental case that price scenario starts from $70 per Bbl and examine its implication. As the average crude oil price for 2008 may settle down at about $100 per Bbl, it may be natural to consider the immediate crude oil price of $70 will become the basis for the price of 2009. After then, we assume that the oil price would climb up gradually to $100 per barrel in 2030 reflecting tightening trend of the world oil market. Energy prices other than crude oil price may follow the same trend.

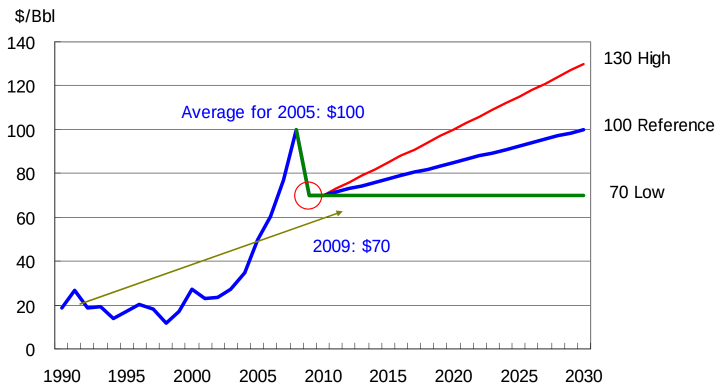


Figure 5.1-2 Crude Oil Price Scenario

It is also anticipated that the world economy may plunge facing the global financial crisis. The Philippines could not be free from the effect. Thus, we set out another scenario that the economic growth rate for the period of 2008 – 2010 may slow down from the original assumption of annual 6.4% to the half of 3.2% and that for the overall projection period from 5.0% to 4.0%. In this case, the size of economy or GDP may become lower than the former Low growth case (4% growth) for the time being, but it will catch up the latter at around 2020.

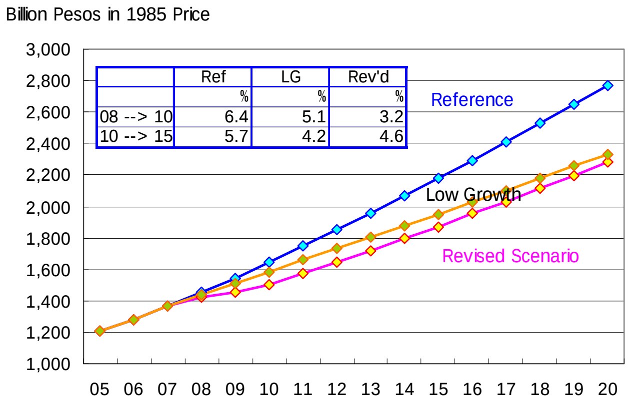


Figure 5.1-3 Revised Scenario for Economic Growth

In Figure 5.1-4 is shown demand outlook for the three cases, namely, 1) Reference Case starting with crude price of 120/Bbl, 2) Revised Price Scenario case starting with $70/Bbl, and 3) Revised economic scenario case that economic growth of the Philippines would slow down reflecting world recession. Energy import quantities and import ratios are also shown in Table 5.1-1.

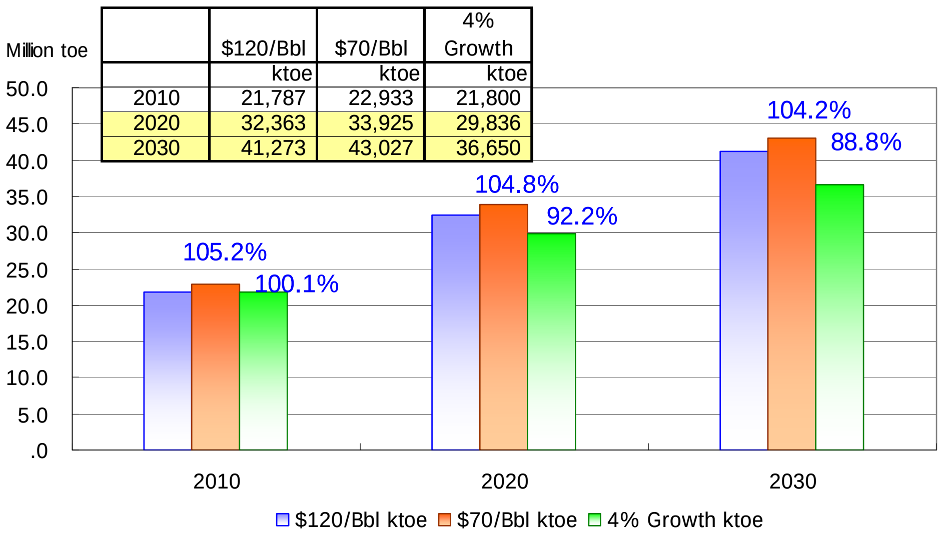


Figure 5.1-4 Final Energy Demand Outlook

Table 5.1-1 Energy Balance and Import Quantity

Case	GDP Growth	Primary Energy 2020	Primary Energy 2030	Import Quantity/Ratio 2020		Import Quantity/Ratio 2030	
(Original)	%	Mtoe	Mtoe	Mtoe	%	Mtoe	%
Reference	5.0	63.4	78.5	32.3	56.2	44.3	60.9
Low Growth	4.0	56.9	67.4	26.9	52.4	34.9	56.2
(Reviesed)							
Price	5.0	57.2	80.7	27.3	53.2	46.5	61.9
Price+GR	4.0	53.6	70.5	25.0	52.2	37.8	58.0

From the above case studies, it is noticed that the variances of these cases is within the variance range of the various cases as studies in this report[3] although substantial changes are introduced into the price scenario. With downward change of crude oil price from \$120 to \$70 per Bbl, the final energy demand may increase 4 – 5% compared with the Reference Case. On the other hand, as economy slows down, energy demand increase in the long run would be curbed even under the lower price scenario. Though price is an important factor when we consider energy policy, we observe that those elements such as economic trend and energy conservation efforts shall have greater impact in the long run.

[3] As shown in Table 6.1-1 of the principal report, final energy consumption outlooks of various cases for 2030 range between 32.7 to 49.7 million toe.

Postscript

It is needless to say that continuous improvement should be made on the database and model developed under this study, additional studies and improvements to this end may be classified into following categories.

Category-1: Further studies on important factors, preconditions and/or scenarios to be considered or incorporated into the comprehensive energy plan.

Caterogy-2: Detail studies on sectoral demand and supply trends, which are important components of sectoral plans as well as important elements of the overall national plan.

Category-3: In-depth analyses on various themes that should support sectoral plans.

Because of time constraints, it was not possible to incorporate those changes and/or analyses in the study that occurred after May 2008 when we finalized the preconditions for this study, such as drastic changes in the global economy and energy. As we have added preliminary supplemental analysis in Chapter 5, it is necessary to look into issues under Category-1 such as economic trend and other elements more in detail. In addition, we think that amplification on the subjects under Categories 2 and 3 should be considered in the next step study. We expect that further studies will be conducted on the Philippine side, while we are pleased to provide every support.

Now our friends will start operating the model by your own hands and discuss the outcome for evaluation of policy options among yourselves. Then, you will realize that there are far more approaches to evaluate and structure energy policies than considered in this report. This report is just a starting point of such trials. We look forward to the day when our friends will take in these models as your own tool and improve them for formulation of the Philippine Energy Plan.

December 2008

K. Kanekiyo on behalf of the JICA Study Team

Appendix 1

1.1 BAU Case

	Unit	2005	2010	2015	2020	2025	2030	Growth Rate (%) 05-10	10-15	15-20	20-25	25-30	05-30
Economic Indicators													
Population	Million	85.3	93.0	101.1	108.7	115.9	122.4	1.8	1.7	1.5	1.3	1.1	1.5
Real GDP in 1985 price	Billion PHP	1,210	1,647	2,177	2,772	3,413	4,079	6.3	5.7	5.0	4.3	3.6	5.0
RGDP per capita	PHP/person	14,198	17,708	21,536	25,491	29,456	33,332	4.5	4.0	3.4	2.9	2.5	3.5
Energy Prices													
Crude oil	Peso / litter	17.8	33.9	36.7	39.5	42.3	45.2	13.7	1.6	1.5	1.4	1.3	3.8
Coal	Peso / kg	2.0	3.2	3.6	4.1	4.5	4.9	9.9	2.4	2.3	2.1	1.8	3.7
Natural Gas	Peso / mmBtu	347	642	696	749	803	856	13.1	1.6	1.5	1.4	1.3	3.7
LPG	Peso / litter	19.1	30.8	33.9	37.0	40.0	43.1	10.0	1.9	1.8	1.6	1.5	3.3
Gasoline	Peso / litter	30.7	53.1	59.0	65.3	72.3	79.9	11.6	2.1	2.1	2.0	2.0	3.9
Kerosene	Peso / litter	29.5	52.8	58.6	64.9	71.8	79.3	12.3	2.1	2.1	2.0	2.0	4.0
Jet Fuel	Peso / litter	32.6	59.6	66.5	74.1	82.4	91.6	12.8	2.2	2.2	2.2	2.1	4.2
Diesel	Peso / litter	28.8	50.4	55.8	61.7	68.1	75.0	11.8	2.1	2.0	2.0	2.0	3.9
Fuel Oil	Peso / litter	18.9	38.2	41.7	45.3	49.1	53.0	15.1	1.8	1.7	1.6	1.5	4.2
Electricity (Average)	Peso / kWh	6.8	12.0	13.0	14.0	15.0	16.1	12.0	1.6	1.5	1.4	1.3	3.5
Energy Indicators													
TPE per capita	kgoe/person	384	438	525	582	640	690	2.7	3.7	2.1	1.9	1.5	2.4
TPE per GDP	toe/mil. PHP	27.0	24.7	24.4	22.8	21.7	20.7	-1.8	-0.3	-1.3	-1.0	-1.0	-1.1
Electricity per capita	kWh/person	530	636	781	936	1,094	1,251	3.7	4.2	3.7	3.2	2.7	3.5
Passenger Cars	1,000 units	788	862	1,094	1,346	1,605	1,857	1.8	4.9	4.2	3.6	3.0	3.5
Utility Vehicles	1,000 units	1,792	2,434	3,238	3,944	4,470	4,784	6.3	5.9	4.0	2.5	1.4	4.0
Trucks	1,000 units	267	358	437	505	558	595	6.0	4.1	2.9	2.0	1.3	3.3
Buses	1,000 units	31	31	32	34	35	37	-0.2	1.1	0.9	0.8	0.7	0.7
Motorcycles/Tricycles	1,000 units	2,158	3,610	5,134	6,497	7,479	8,010	10.8	7.3	4.8	2.9	1.4	5.4
CO2 Emission	CO_2-kton	64,452	85,090	106,750	136,670	165,150	195,130	5.7	4.6	5.1	3.9	3.4	4.5
Total Primary Energy Supply	*ktoe*	*38,498*	*46,510*	*58,665*	*68,601*	*79,236*	*89,245*	*3.9*	*4.8*	*3.2*	*2.9*	*2.4*	*3.4*
Coal	ktoe	5,190	7,458	9,975	14,688	18,789	23,903	7.5	6.0	8.0	5.0	4.9	6.3
Natural Gas	ktoe	2,504	2,858	3,608	3,797	4,542	4,632	2.7	4.8	1.0	3.6	0.4	2.5
Oil	ktoe	14,430	18,096	21,841	25,829	29,728	33,288	4.6	3.8	3.4	2.9	2.3	3.4
Geothermal	ktoe	8,516	9,327	13,426	13,667	14,812	15,354	1.8	7.6	0.4	1.6	0.7	2.4
Hydro	ktoe	2,088	2,661	3,543	4,425	5,307	6,189	5.0	5.9	4.5	3.7	3.1	4.4
Nuclear	ktoe	0	0	0	0	0	0						
Renewables	ktoe	3	327	681	834	962	1,061	155.0	15.8	4.1	2.9	2.0	26.4
Commercial Energy	ktoe	32,731	40,727	53,074	63,241	74,141	84,428	4.5	5.4	3.6	3.2	2.6	3.9
Non-commercial Energy	*ktoe*	*5,766*	*5,783*	*5,591*	*5,360*	*5,095*	*4,818*	*0.1*	*-0.7*	*-0.8*	*-1.0*	*-1.1*	*-0.7*
Coal	%	13.5	16.0	17.0	21.4	23.7	26.8						
Natural Gas	%	6.5	6.1	6.1	5.5	5.7	5.2						
Oil	%	37.5	38.9	37.2	37.7	37.5	37.3						
Others	%	27.6	26.5	30.1	27.6	26.6	25.3						
Non-commercial Energy	%	15.0	12.4	9.5	7.8	6.4	5.4						
Final Demand (excl. Non-Con	*ktoe*	*17,401*	*22,931*	*29,531*	*36,445*	*43,253*	*49,668*	*5.7*	*5.2*	*4.3*	*3.5*	*2.8*	*4.3*
Agriculture	ktoe	313	269	324	381	435	485	-3.0	3.8	3.3	2.7	2.2	1.8
Industry	ktoe	4,084	4,822	6,125	7,562	9,109	10,717	3.4	4.9	4.3	3.8	3.3	3.9
Energy Intensive	ktoe	2,653	3,260	4,035	4,894	5,815	6,772	4.2	4.4	3.9	3.5	3.1	3.8
Other	ktoe	1,430	1,562	2,090	2,668	3,294	3,944	1.8	6.0	5.0	4.3	3.7	4.1
Commercial	ktoe	1,660	2,312	3,145	4,107	5,163	6,278	6.9	6.3	5.5	4.7	4.0	5.5
Residential	ktoe	2,405	2,908	3,870	4,988	6,208	7,463	3.9	5.9	5.2	4.5	3.8	4.6
Transport	ktoe	8,939	12,619	16,066	19,408	22,338	24,724	7.1	4.9	3.9	2.9	2.1	4.2
Energy Net Import	*ktoe*	*18,112*	*23,198*	*28,779*	*37,323*	*46,390*	*54,688*	*5.1*	*4.4*	*5.3*	*4.4*	*3.3*	*4.5*
Coal	ktoe	3,710	5,139	6,975	10,656	14,074	17,937	6.7	6.3	8.8	5.7	5.0	6.5
Natural Gas	ktoe	0	0	0	875	2,625	3,500				24.6	5.9	
Oil	ktoe	14,402	18,059	21,805	25,793	29,692	33,251	4.6	3.8	3.4	2.9	2.3	3.4
Energy Import Ratio	*%*	*55.3*	*57.0*	*54.2*	*59.0*	*62.6*	*64.8*						
Coal	%	71.5	68.9	69.9	72.5	74.9	75.0						
Natural Gas	%	0.0	0.0	0.0	23.0	57.8	75.6						
Oil	%	99.8	99.8	99.8	99.9	99.9	99.9						

1.2 Reference Case

	Unit	2005	2010	2015	2020	2025	2030	Growth Rate (%) 05-10	10-15	15-20	20-25	25-30	05-30
Economic Indicators													
Population	Million	85.3	93.0	101.1	108.7	115.9	122.4	1.8	1.7	1.5	1.3	1.1	1.5
Real GDP in 1985 price	Billion PHP	1,210	1,647	2,177	2,772	3,413	4,079	6.3	5.7	5.0	4.3	3.6	5.0
RGDP per capita	PHP/person	14,198	17,708	21,536	25,491	29,456	33,332	4.5	4.0	3.4	2.9	2.5	3.5
Energy Prices													
Crude oil	Peso / litter	17.8	33.9	36.7	39.5	42.3	45.2	13.7	1.6	1.5	1.4	1.3	3.8
Coal	Peso / kg	2.0	3.2	3.6	4.1	4.5	4.9	9.9	2.4	2.3	2.1	1.8	3.7
Natural Gas	Peso / mmBtu	347	642	696	749	803	856	13.1	1.6	1.5	1.4	1.3	3.7
LPG	Peso / litter	19.1	30.8	33.9	37.0	40.0	43.1	10.0	1.9	1.8	1.6	1.5	3.3
Gasoline	Peso / litter	30.7	53.1	59.0	65.3	72.3	79.9	11.6	2.1	2.1	2.0	2.0	3.9
Kerosene	Peso / litter	29.5	52.8	58.6	64.9	71.8	79.3	12.3	2.1	2.1	2.0	2.0	4.0
Jet Fuel	Peso / litter	32.6	59.6	66.5	74.1	82.4	91.6	12.8	2.2	2.2	2.2	2.1	4.2
Diesel	Peso / litter	28.8	50.4	55.8	61.7	68.1	75.0	11.8	2.1	2.0	2.0	2.0	3.9
Fuel Oil	Peso / litter	18.9	38.2	41.7	45.3	49.1	53.0	15.1	1.8	1.7	1.6	1.5	4.2
Electricity (Average)	Peso / kWh	6.8	12.0	13.0	14.0	15.0	16.1	12.0	1.6	1.5	1.4	1.3	3.5
Energy Indicators													
TPE per capita	kgoe/person	384	418	491	529	567	595	1.7	3.3	1.5	1.4	0.9	1.8
TPE per GDP	toe/mil. PHP	27.0	23.6	22.8	20.8	19.3	17.8	-2.7	-0.7	-1.8	-1.5	-1.5	-1.6
Electricity per capita	kWh/person	530	602	716	830	939	1,040	2.6	3.5	3.0	2.5	2.1	2.7
Passenger Cars	1,000 units	788	862	1,094	1,346	1,605	1,857	1.8	4.9	4.2	3.6	3.0	3.5
Utility Vehicles	1,000 units	1,792	2,434	3,238	3,944	4,470	4,784	6.3	5.9	4.0	2.5	1.4	4.0
Trucks	1,000 units	267	358	437	505	558	595	6.0	4.1	2.9	2.0	1.3	3.3
Buses	1,000 units	31	31	32	34	35	37	-0.2	1.1	0.9	0.8	0.7	0.7
Motorcycles/Tricycles	1,000 units	2,158	3,610	5,134	6,497	7,479	8,010	10.8	7.3	4.8	2.9	1.4	5.4
CO2 Emission	CO_2-kton	64,452	79,640	95,640	118,020	137,160	156,210	4.3	3.7	4.3	3.1	2.6	3.6
Total Primary Energy Supply	*ktoe*	*38,498*	*44,771*	*55,455*	*63,366*	*71,498*	*78,545*	*3.1*	*4.4*	*2.7*	*2.4*	*1.9*	*2.9*
Coal	ktoe	5,190	7,373	8,696	12,021	14,579	17,968	7.3	3.4	6.7	3.9	4.3	5.1
Natural Gas	ktoe	2,504	2,797	3,600	3,716	4,448	4,509	2.2	5.2	0.6	3.7	0.3	2.4
Oil	ktoe	14,430	16,400	19,718	22,993	25,741	27,841	2.6	3.8	3.1	2.3	1.6	2.7
Geothermal	ktoe	8,516	9,327	13,426	13,667	14,812	15,354	1.8	7.6	0.4	1.6	0.7	2.4
Hydro	ktoe	2,088	2,661	3,543	4,425	5,307	6,189	5.0	5.9	4.5	3.7	3.1	4.4
Nuclear	ktoe	0	0	0	0	0	0						
Renewables	ktoe	3	312	630	749	839	899	152.7	15.1	3.5	2.3	1.4	25.6
Commercial Energy	ktoe	32,731	38,871	49,614	57,571	65,727	72,761	3.5	5.0	3.0	2.7	2.1	3.2
Non-commercial Energy	*ktoe*	*5,766*	*5,901*	*5,840*	*5,795*	*5,770*	*5,784*	*0.5*	*-0.2*	*-0.2*	*-0.1*	*0.0*	*0.0*
Coal	%	13.5	16.5	15.7	19.0	20.4	22.9						
Natural Gas	%	6.5	6.2	6.5	5.9	6.2	5.7						
Oil	%	37.5	36.6	35.6	36.3	36.0	35.4						
Others	%	27.6	27.5	31.7	29.7	29.3	28.6						
Non-commercial Energy	%	15.0	13.2	10.5	9.1	8.1	7.4						
Final Demand (excl. Non-Con	*ktoe*	*17,401*	*21,787*	*27,120*	*32,363*	*37,148*	*41,273*	*4.6*	*4.5*	*3.6*	*2.8*	*2.1*	*3.5*
Agriculture	ktoe	313	254	297	337	373	402	-4.0	3.1	2.6	2.0	1.6	1.0
Industry	ktoe	4,084	4,551	5,590	6,677	7,785	8,870	2.2	4.2	3.6	3.1	2.6	3.2
Energy Intensive	ktoe	2,653	3,071	3,674	4,311	4,957	5,591	3.0	3.7	3.2	2.8	2.4	3.0
Other	ktoe	1,430	1,480	1,916	2,366	2,828	3,279	0.7	5.3	4.3	3.6	3.0	3.4
Commercial	ktoe	1,660	2,187	2,878	3,638	4,429	5,218	5.7	5.6	4.8	4.0	3.3	4.7
Residential	ktoe	2,405	2,763	3,556	4,434	5,342	6,219	2.8	5.2	4.5	3.8	3.1	3.9
Transport	ktoe	8,939	12,032	14,800	17,277	19,220	20,563	6.1	4.2	3.1	2.2	1.4	3.4
Energy Net Import	*ktoe*	*18,112*	*21,502*	*25,700*	*32,349*	*38,751*	*44,324*	*3.5*	*3.6*	*4.7*	*3.7*	*2.7*	*3.6*
Coal	ktoe	3,710	5,139	6,019	8,599	10,515	13,143	6.7	3.2	7.4	4.1	4.6	5.2
Natural Gas	ktoe	0	0	0	794	2,531	3,377				26.1	5.9	
Oil	ktoe	14,402	16,363	19,682	22,957	25,705	27,804	2.6	3.8	3.1	2.3	1.6	2.7
Energy Import Ratio	*%*	*55.3*	*55.3*	*51.8*	*56.2*	*59.0*	*60.9*						
Coal	%	71.5	69.7	69.2	71.5	72.1	73.1						
Natural Gas	%	0.0	0.0	0.0	21.4	56.9	74.9						
Oil	%	99.8	99.8	99.8	99.8	99.9	99.9						

1.3 Revised price Scenario Case

	Unit	2005	2010	2015	2020	2025	2030	Growth Rate (%) 05-10	10-15	15-20	20-25	25-30	05-30
Economic Indicators													
Population	Million	85.3	93.0	101.1	108.7	115.9	122.4	1.8	1.7	1.5	1.3	1.1	1.5
Real GDP in 1985 price	Billion PHP	1,210	1,647	2,177	2,772	3,413	4,079	6.3	5.7	5.0	4.3	3.6	5.0
RGDP per capita	PHP/person	14,198	17,708	21,536	25,491	29,456	33,332	4.5	4.0	3.4	2.9	2.5	3.5
Energy Prices													
Crude oil	Peso / litter	17.8	19.8	21.9	24.0	26.1	28.2	2.1	2.1	1.9	1.7	1.6	1.9
Coal	Peso / kg	2.0	3.2	3.6	4.1	4.5	4.9	9.9	2.4	2.3	2.1	1.8	3.7
Natural Gas	Peso / mmBtu	347	440	477	523	569	615	4.9	1.6	1.9	1.7	1.6	2.3
LPG	Peso / litter	19.1	18.5	21.6	24.6	27.7	30.8	-0.7	3.1	2.7	2.4	2.1	1.9
Gasoline	Peso / litter	30.7	39.0	44.2	49.8	56.0	62.9	4.9	2.5	2.4	2.4	2.3	2.9
Kerosene	Peso / litter	29.5	38.6	43.8	49.4	55.5	62.3	5.5	2.5	2.4	2.4	2.3	3.0
Jet Fuel	Peso / litter	32.6	45.5	51.7	58.6	66.2	74.7	6.9	2.6	2.5	2.5	2.4	3.4
Diesel	Peso / litter	28.8	36.3	41.0	46.2	51.8	58.1	4.7	2.5	2.4	2.3	2.3	2.8
Fuel Oil	Peso / litter	18.9	24.1	26.9	29.8	32.8	36.0	5.0	2.2	2.1	2.0	1.9	2.6
Electricity (Average)	Peso / kWh	6.8	8.2	9.0	9.9	10.8	11.7	3.8	1.9	1.9	1.7	1.6	2.2
Energy Indicators													
TPE per capita	kgoe/person	384	436	509	548	586	614	2.6	3.1	1.5	1.3	0.9	1.9
TPE per GDP	toe/mil. PHP	27.0	24.6	23.6	21.5	19.9	18.4	-1.9	-0.8	-1.9	-1.5	-1.5	-1.5
Electricity per capita	kWh/person	530	627	743	860	971	1,074	3.4	3.5	3.0	2.5	2.0	2.9
Passenger Cars	1,000 units	788	951	1,220	1,492	1,768	2,034	3.8	5.1	4.1	3.5	2.8	3.9
Utility Vehicles	1,000 units	1,792	2,434	3,238	3,944	4,470	4,784	6.3	5.9	4.0	2.5	1.4	4.0
Trucks	1,000 units	267	358	437	505	558	595	6.0	4.1	2.9	2.0	1.3	3.3
Buses	1,000 units	31	31	32	34	35	37	-0.2	1.1	0.9	0.8	0.7	0.7
Motorcycles/Tricycles	1,000 units	2,158	3,610	5,134	6,497	7,479	8,010	10.8	7.3	4.8	2.9	1.4	5.4
CO2 Emission	CO_2-kton	64,452	84,520	101,470	124,710	144,070	163,490	5.6	3.7	4.2	2.9	2.6	3.8
Total Primary Energy Supply	*ktoe*	*38,498*	*46,320*	*57,150*	*65,281*	*73,545*	*80,718*	*3.8*	*4.3*	*2.7*	*2.4*	*1.9*	*3.0*
Coal	ktoe	5,190	7,416	9,304	12,824	15,187	18,575	7.4	4.6	6.6	3.4	4.1	5.2
Natural Gas	ktoe	2,504	2,858	3,608	3,729	4,542	4,632	2.7	4.8	0.7	4.0	0.4	2.5
Oil	ktoe	14,430	17,922	20,872	24,177	27,184	29,392	4.4	3.1	3.0	2.4	1.6	2.9
Geothermal	ktoe	8,516	9,327	13,426	13,667	14,812	15,354	1.8	7.6	0.4	1.6	0.7	2.4
Hydro	ktoe	2,088	2,661	3,543	4,425	5,307	6,189	5.0	5.9	4.5	3.7	3.1	4.4
Nuclear	ktoe	0	0	0	0	0	0						
Renewables	ktoe	3	329	666	789	881	942	155.3	15.2	3.4	2.2	1.3	25.8
Commercial Energy	ktoe	32,731	40,513	51,419	59,611	67,914	75,085	4.4	4.9	3.0	2.6	2.0	3.4
Non-commercial Energy	*ktoe*	*5,766*	*5,807*	*5,731*	*5,670*	*5,631*	*5,633*	*0.1*	*-0.3*	*-0.2*	*-0.1*	*0.0*	*-0.1*
Coal	%	13.5	16.0	16.3	19.6	20.6	23.0						
Natural Gas	%	6.5	6.2	6.3	5.7	6.2	5.7						
Oil	%	37.5	38.7	36.5	37.0	37.0	36.4						
Others	%	27.6	26.6	30.9	28.9	28.6	27.9						
Non-commercial Energy	%	15.0	12.5	10.0	8.7	7.7	7.0						
Final Demand (excl. Non-Con	*ktoe*	*17,401*	*22,933*	*28,528*	*33,925*	*38,825*	*43,027*	*5.7*	*4.5*	*3.5*	*2.7*	*2.1*	*3.7*
Agriculture	ktoe	313	307	360	405	444	476	-0.3	3.2	2.4	1.9	1.4	1.7
Industry	ktoe	4,084	4,729	5,797	6,912	8,045	9,153	3.0	4.2	3.6	3.1	2.6	3.3
Energy Intensive	ktoe	2,653	3,183	3,802	4,454	5,114	5,762	3.7	3.6	3.2	2.8	2.4	3.1
Other	ktoe	1,430	1,546	1,995	2,457	2,931	3,391	1.6	5.2	4.3	3.6	3.0	3.5
Commercial	ktoe	1,660	2,291	3,005	3,788	4,601	5,409	6.7	5.6	4.7	4.0	3.3	4.8
Residential	ktoe	2,405	2,879	3,693	4,593	5,520	6,413	3.7	5.1	4.5	3.7	3.0	4.0
Transport	ktoe	8,939	12,727	15,673	18,228	20,216	21,576	7.3	4.3	3.1	2.1	1.3	3.6
Energy Net Import	*ktoe*	*18,112*	*23,024*	*27,332*	*34,186*	*40,754*	*46,460*	*4.9*	*3.5*	*4.6*	*3.6*	*2.7*	*3.8*
Coal	ktoe	3,710	5,139	6,497	9,239	10,982	13,604	6.7	4.8	7.3	3.5	4.4	5.3
Natural Gas	ktoe	0	0	0	807	2,625	3,500				26.6	5.9	
Oil	ktoe	14,402	17,885	20,835	24,141	27,148	29,355	4.4	3.1	3.0	2.4	1.6	2.9
Energy Import Ratio	*%*	*55.3*	*56.8*	*53.2*	*57.3*	*60.0*	*61.9*						
Coal	%	71.5	69.3	69.8	72.0	72.3	73.2						
Natural Gas	%	0.0	0.0	0.0	21.6	57.8	75.6						
Oil	%	99.8	99.8	99.8	99.8	99.9	99.9						

1.4 Revised Price with Lower GDP

	Unit	2005	2010	2015	2020	2025	2030	Growth Rate (%) 05-10	10-15	15-20	20-25	25-30	05-30
Economic Indicators													
Population	Million	85.3	93.0	101.1	108.7	115.9	122.4	1.8	1.7	1.5	1.3	1.1	1.5
Real GDP in 1985 price	Billion PHP	1,210	1,455	1,795	2,198	2,644	3,122	3.7	4.3	4.1	3.8	3.4	3.9
RGDP per capita	PHP/person	14,198	15,641	17,760	20,212	22,814	25,513	2.0	2.6	2.6	2.5	2.3	2.4
Energy Prices													
Crude oil	Peso / litter	17.8	19.8	21.9	24.0	26.1	28.2	2.1	2.1	1.9	1.7	1.6	1.9
Coal	Peso / kg	2.0	3.2	3.6	4.1	4.5	4.9	9.9	2.4	2.3	2.1	1.8	3.7
Natural Gas	Peso / mmBtu	347	440	477	523	569	615	4.9	1.6	1.9	1.7	1.6	2.3
LPG	Peso / litter	19.1	18.5	21.6	24.6	27.7	30.8	-0.7	3.1	2.7	2.4	2.1	1.9
Gasoline	Peso / litter	30.7	39.0	44.2	49.8	56.0	62.9	4.9	2.5	2.4	2.4	2.3	2.9
Kerosene	Peso / litter	29.5	38.6	43.8	49.4	55.5	62.3	5.5	2.5	2.4	2.4	2.3	3.0
Jet Fuel	Peso / litter	32.6	45.5	51.7	58.6	66.2	74.7	6.9	2.6	2.5	2.5	2.4	3.4
Diesel	Peso / litter	28.8	36.3	41.0	46.2	51.8	58.1	4.7	2.5	2.4	2.3	2.3	2.8
Fuel Oil	Peso / litter	18.9	24.1	26.9	29.8	32.8	36.0	5.0	2.2	2.1	2.0	1.9	2.6
Electricity (Average)	Peso / kWh	6.8	8.2	9.0	9.9	10.8	11.7	3.8	1.9	1.9	1.7	1.6	2.2
Energy Indicators													
TPE per capita	kgoe/person	384	418	474	491	517	533	1.7	2.6	0.7	1.1	0.6	1.3
TPE per GDP	toe/mil. PHP	27.0	26.7	26.7	24.3	22.7	20.9	-0.3	-0.0	-1.9	-1.4	-1.6	-1.0
Electricity per capita	kWh/person	530	595	671	750	827	898	2.4	2.4	2.3	2.0	1.7	2.1
Passenger Cars	1,000 units	788	862	1,015	1,190	1,373	1,557	1.8	3.3	3.2	2.9	2.5	2.8
Utility Vehicles	1,000 units	1,792	2,244	2,834	3,365	3,768	4,013	4.6	4.8	3.5	2.3	1.3	3.3
Trucks	1,000 units	267	355	421	477	519	548	5.9	3.5	2.5	1.7	1.1	2.9
Buses	1,000 units	31	31	32	34	35	37	-0.2	1.1	0.9	0.8	0.7	0.7
Motorcycles/Tricycles	1,000 units	2,158	3,622	4,979	6,163	7,016	7,497	10.9	6.6	4.4	2.6	1.3	5.1
CO2 Emission	CO_2-kton	64,452	79,880	91,690	103,680	118,570	131,340	4.4	2.8	2.5	2.7	2.1	2.9
Total Primary Energy Supply	*ktoe*	*38,498*	*44,637*	*53,584*	*58,912*	*65,337*	*70,519*	*3.0*	*3.7*	*1.9*	*2.1*	*1.5*	*2.5*
Coal	ktoe	5,190	7,273	8,495	9,317	11,650	13,824	7.0	3.2	1.9	4.6	3.5	4.0
Natural Gas	ktoe	2,504	2,686	2,785	3,716	3,741	3,787	1.4	0.7	5.9	0.1	0.2	1.7
Oil	ktoe	14,430	16,562	19,040	21,537	23,642	25,243	2.8	2.8	2.5	1.9	1.3	2.3
Geothermal	ktoe	8,516	9,327	13,426	13,667	14,812	15,354	1.8	7.6	0.4	1.6	0.7	2.4
Hydro	ktoe	2,088	2,661	3,543	4,425	5,307	6,189	5.0	5.9	4.5	3.7	3.1	4.4
Nuclear	ktoe	0	0	0	0	0	0						
Renewables	ktoe	3	317	617	713	785	833	153.5	14.2	2.9	1.9	1.2	25.2
Commercial Energy	ktoe	32,731	38,827	47,906	53,375	59,937	65,231	3.5	4.3	2.2	2.3	1.7	2.8
Non-commercial Energy	*ktoe*	*5,766*	*5,810*	*5,677*	*5,537*	*5,399*	*5,288*	*0.2*	*-0.5*	*-0.5*	*-0.5*	*-0.4*	*-0.3*
Coal	%	13.5	16.3	15.9	15.8	17.8	19.6						
Natural Gas	%	6.5	6.0	5.2	6.3	5.7	5.4						
Oil	%	37.5	37.1	35.5	36.6	36.2	35.8						
Others	%	27.6	27.6	32.8	31.9	32.0	31.7						
Non-commercial Energy	%	15.0	13.0	10.6	9.4	8.3	7.5						
Final Demand (excl. Non-Con	*ktoe*	*17,401*	*21,800*	*25,839*	*29,836*	*33,485*	*36,650*	*4.6*	*3.5*	*2.9*	*2.3*	*1.8*	*3.0*
Agriculture	ktoe	313	278	309	338	365	389	-2.3	2.1	1.8	1.5	1.3	0.9
Industry	ktoe	4,084	4,465	5,227	6,068	6,945	7,829	1.8	3.2	3.0	2.7	2.4	2.6
Energy Intensive	ktoe	2,653	2,992	3,459	3,975	4,511	5,049	2.4	2.9	2.8	2.6	2.3	2.6
Other	ktoe	1,430	1,472	1,768	2,093	2,434	2,779	0.6	3.7	3.4	3.1	2.7	2.7
Commercial	ktoe	1,660	1,998	2,440	2,954	3,506	4,077	3.8	4.1	3.9	3.5	3.1	3.7
Residential	ktoe	2,405	2,884	3,620	4,413	5,211	5,957	3.7	4.7	4.0	3.4	2.7	3.7
Transport	ktoe	8,939	12,175	14,242	16,063	17,458	18,398	6.4	3.2	2.4	1.7	1.1	2.9
Energy Net Import	*ktoe*	*18,112*	*21,664*	*25,022*	*28,821*	*33,746*	*37,821*	*3.6*	*2.9*	*2.9*	*3.2*	*2.3*	*3.0*
Coal	ktoe	3,710	5,139	6,019	6,527	8,317	9,960	6.7	3.2	1.6	5.0	3.7	4.0
Natural Gas	ktoe	0	0	0	794	1,824	2,655				18.1	7.8	
Oil	ktoe	14,402	16,525	19,003	21,500	23,605	25,207	2.8	2.8	2.5	1.9	1.3	2.3
Energy Import Ratio	*%*	*55.3*	*55.8*	*52.2*	*54.0*	*56.3*	*58.0*						
Coal	%	71.5	70.7	70.8	70.1	71.4	72.0						
Natural Gas	%	0.0	0.0	0.0	21.4	48.8	70.1						
Oil	%	99.8	99.8	99.8	99.8	99.8	99.9						

Appendix 2

2.1 Overall energy Outlook: Reference Case

Reference Case

Reference	Summary sheet									
TERM 1	TERM 2	TERM 3	Unit	2005	2010	2020	2030	05 -> 10	25 -> 30	05 -> 30
Economic Indicat	Population		Million	85.26	93.00	108.73	122.37	1.8	1.1	1.5
	GDP at 1985 price on PHP base		Billion PHP	1,210.5	1,646.8	2,771.6	4,078.8	6.3	3.6	5.0
	GDP per capita on 1985 PHP base		PHP/person	14,198	17,708	25,491	33,332	4.5	2.5	3.5
Energy Indicators	TPE per capita		kgoe/person	383.9	418.0	529.5	594.6	1.7	0.9	1.8
	TPE per GDP		TOE/million PHI	27.0	23.6	20.8	17.8	-2.7	-1.5	-1.6
	Electricity per capita		kWh / person	530	602	830	1,040	2.6	2.1	2.7
	Vehicle number	Total	1000Unit	5,036	7,295	12,326	15,283	7.7	1.6	4.5
		Passenger Cars	1000Unit	788	862	1,346	1,857	1.8	3.0	3.5
		Utility Vehicles	1000Unit	1,792	2,434	3,944	4,784	6.3	1.4	4.0
		Trucks	1000Unit	267	358	505	595	6.0	1.3	3.3
		Buses	1000Unit	31	31	34	37	-0.2	0.7	0.7
		Motorcycles/Tricycles	1000Unit	2,158	3,610	6,497	8,010	10.8	1.4	5.4
		Total No. of vehicle per perso	unit/1000psn	59.1	78.4	113.4	124.9	5.8	0.5	3.0
		Passenger Cars	unit/1000psn	9.2	9.3	12.4	15.2	0.0	1.8	2.0
		Utility Vehicles	unit/1000psn	21.0	26.2	36.3	39.1	4.5	0.3	2.5
		Trucks	unit/1000psn	3.1	3.8	4.6	4.9	4.2	0.2	1.8
		Buses	unit/1000psn	0.4	0.3	0.3	0.3	-1.9	-0.3	-0.8
		Motorcycles/Tricycles	unit/1000psn	25.3	38.8	59.8	65.5	8.9	0.3	3.9
	CO2 Emission		CO2-kton	64,452	79,640	118,020	156,210	4.3	2.6	3.6
	Total Primary Energy	Commercial Total	kTOE	32,731	38,871	57,571	72,761	3	2.1	3.2
	Domestic Requirement	Coal	kTOE	5,190	7,373	12,021	17,968	7.3	4.3	5.1
	excluding Stockpiling	Natural Gas	kTOE	2,504	2,797	3,716	4,509	2.2	0.3	2.4
		Oil	kTOE	14,430	16,400	22,993	27,841	2.6	1.6	2.7
		Crude Oil Processing	kTOE	10,493	14,621	14,621	14,621	6.9	0.0	1.3
		Petroleum Products Impor	kTOE	3,937	1,778	8,372	13,220	-14.7	3.5	5.0
		Fossil total	kTOE	22,124	26,570	38,730	50,318	3.7	2.4	3.3
		Fossil ratio	%	67.6	68.4	67.3	69.2	0.2	0.3	0.1
		Geothermal	kTOE	8,516	9,327	13,667	15,354	1.8	0.7	2.4
		Hydro	kTOE	2,088	2,661	4,425	6,189	5.0	3.1	4.4
		Nuclear	kTOE	0	0	0	0			
		Renewables	kTOE	3	312	749	899	152.7	1.4	25.6
		Non-Commercials	kTOE	5,766	5,901	5,795	5,784	0.5	0.0	0.0
		Total	kTOE	38,498	44,771	63,366	78,545	*3.1*	*1.9*	*2.9*
	Final Energy Demand	Total	kTOE	17,401	21,787	32,363	41,273	4.6	2.1	3.5
		Agricluture	kTOE	313	254	337	402	-4.0	1.6	1.0
		Industry (Energy Insentive)	kTOE	2,653	3,071	4,311	5,591	3.0	2.4	3.0
		Industry (Other)	kTOE	1,430	1,480	2,366	3,279	0.7	3.0	3.4
		Commercial	kTOE	1,660	2,187	3,638	5,218	5.7	3.3	4.7
		Residential	kTOE	2,405	2,763	4,434	6,219	2.8	3.1	3.9
		Transport	kTOE	8,939	12,032	17,277	20,563	6.1	1.4	3.4
	Energy Net Import	Total	kTOE	18,112	21,502	32,349	44,324	3.5	2.7	3.6
		Coal	kTOE	3,710	5,139	8,599	13,143	6.7	4.6	5.2
		Natural Gas	kTOE	0	0	794	3,377		5.9	
		Oil	kTOE	14,402	16,363	22,957	27,804	2.6	1.6	2.7
	Import Ratio	Total	%	55	55	56	61	0.0	0.7	0.4
	(excl. oil stockpiling)	Coal	%	71.5	69.7	71.5	73.1	-0.5	0.3	0.1
		Natural Gas	%	0.0	0.0	21.4	74.9		5.6	
		Oil	%	99.8	99.8	99.8	99.9	0.0	0.0	0.0

Note: Sample sheets are attached to illustrate items included in the summary sheets. As only sample years are shown here because of space constraints, estimation is made for all the years from 2005 through 2030. Please refer to annual figures, if necessary, developed on the Excel spread sheet on computer screen.

2.2 Oil and Gas Sector Outlook: Reference Case

Reference	Oil and Gas Sector									
TERM 1	TERM 2	TERM 3	Unit	2005	2010	2020	2030	05 -> 10	25 -> 30	05 -> 30
Oil & Gas sector	Primary Energy Supply	Total	kTOE	16,376	19,050	26,958	32,793	3.1	1.4	2.8
		Natural gas	kTOE	2,504	2,797	3,716	4,509	2.2	0.3	2.4
		Final demand	kTOE	12	82	108	178	46.5	6.1	11.3
		For electricity	kTOE	2,492	2,715	3,608	4,331	1.7	0.1	2.2
	including Biofuel	Petroleum Products Total	kTOE	13,872	16,252	23,242	28,284	3.2	1.6	2.9
		LPG	kTOE	1,063	1,556	2,909	3,155	7.9	0.3	4.4
		LPG substitute	kTOE	0	0	0	1,165		17.6	
	including Bio-ethanol	Gasoline	kTOE	2,928	3,547	5,204	6,089	3.9	1.1	3.0
		Ethanol	kTOE	1	181	531	622	164.5	1.1	27.6
		Gasoline	kTOE	2,926	3,366	4,673	5,467	2.8	1.1	2.5
		Jet fuel	kTOE	1,000	1,240	1,824	2,490	4.4	3.0	3.7
		Kerosene	kTOE	285	177	118	84	-9.1	-3.2	-4.8
	including Bio-diesel	Diesel	kTOE	5,582	6,681	9,403	10,839	3.7	1.0	2.7
		Final demand	kTOE	5,377	6,560	9,281	10,713	4.1	1.0	2.8
		Bio-Diesel	kTOE	0	114	160	178		0.6	
		Diesel	kTOE	5,377	6,445	9,122	10,535	3.7	1.0	2.7
		For electricity	kTOE	205	121	121	126	-9.9	0.4	-1.9
		Fuel oil	kTOE	3,014	3,051	3,784	4,461	0.2	1.5	1.6
		Final demand	kTOE	1,796	2,424	3,157	3,795	6.2	1.6	3.0
		For electricity	kTOE	1,218	627	627	666	-12.4	0.6	-2.4
	Crude oil	Production (crude oil)	kTOE	28	37	37	37	5.6	0.0	1.1
		Production (condensate)	kTOE	582	687	718	278	3.4	-10.0	-2.9
		Import	kTOE	10,465	14,584	14,584	14,584	6.9	0.0	1.3
		Export	kTOE	0	0	0	0			
		Processing	kTOE	10,116	14,621	14,621	14,621	7.6	0.0	1.5
		Net Balance (export)	KTOE	582	687	718	278	3.4	-10.0	-2.9
	Natural gas	Production	kTOE	2,701	2,797	2,922	1,132	0.7	-10.0	-3.4
		Import	kTOE	0	0	794	3,377		5.9	
		Export	kTOE	0	0	0	0			
		Consumption	kTOE	2,504	2,797	3,716	4,509	2.2	0.3	2.4
		Net Balance (export)	KTOE	197	0	0	0	-109.4	-235.9	-164.8
	Oil & Gas product net imp	Total	KTOE	13,819	15,676	23,032	30,903	2.6	2.2	3.3
		Natural gas	KTOE	0	0	794	3,377		5.9	
		Crude oil	KTOE	10,465	14,584	14,584	14,584	6.9	0.0	1.3
		Condensate	KTOE	-582	-687	-718	-278	3.4	-10.0	-2.9
		LPG	KTOE	695	846	2,198	2,360	4.0	0.0	5.0
		LPG substitute	KTOE	0	0	0	1,165		17.6	
		Gasoline	KTOE	1,150	643	1,949	2,743	-11.0	2.3	3.5
		Jet fuel	KTOE	259	0	424	1,090	-100.0	7.7	5.9
		Kerosene	KTOE	94	17	118	84	-28.7	-3.2	-0.5
		Diesel	KTOE	2,024	1,081	3,757	5,175	-11.8	2.1	3.8
		Fuel oil	KTOE	-286	-808	-74	602	23.1	15.6	-203.0

2.3 Electric Power Sector Outlook: Reference Case

Reference	Electric Power Sector									
TERM 1	TERM 2	TERM 3	Unit	2005	2010	2020	2030	05 -> 10	25 -> 30	05 -> 30
Electric Power Se	Power Generation		GWh	56,477	68,877	110,795	156,099	4.0	3.2	4.2
	Electricity Tariff	Average	PHP/kWh	6.8	12.0	14.0	16.1	12.0	1.3	3.5
		Residential	PHP/kWh	7.0	12.8	14.8	16.8	12.8	1.2	3.6
		Commercial	PHP/kWh	7.2	12.3	14.4	16.5	11.4	1.3	3.4
		Industrial	PHP/kWh	6.2	11.2	13.1	14.9	12.5	1.3	3.6
	Electricity per capita		kWh/person	662	741	1,019	1,276	2.3	2.0	2.7
	Sectoral Demand	Total	GWh	45,159	56,005	90,232	127,325	4.4	3.2	4.2
		Agriculture	GWh	491	576	840	1,077	3.2	2.2	3.2
		Industry (Energy Insentive)	GWh	8,008	8,874	11,769	14,655	2.1	2.0	2.4
		Industry (Other)	GWh	7,404	9,144	15,322	22,019	4.3	3.4	4.5
		Commercial	GWh	13,134	17,234	29,395	43,179	5.6	3.6	4.9
		Residential	GWh	16,031	20,063	32,770	46,240	4.6	3.1	4.3
		Transport	GWh	91	114	136	156	4.5	1.3	2.2
	Power Supply	Total	GWh	56,568	68,877	110,795	156,099	4.0	3.2	4.1
		Coal	GWh	15,257	25,613	49,281	80,801	10.9	5.3	6.9
		Natural Gas	GWh	16,951	18,941	24,587	28,675	2.2	-0.2	2.1
		Oil	GWh	6,051	2,586	2,586	2,761	-15.6	0.6	-3.1
		Geothermal	GWh	9,902	10,846	15,892	17,854	1.8	0.7	2.4
		Hydro	GWh	8,387	10,689	17,773	24,858	5.0	3.1	4.4
		Nuclear	GWh	0	0	0	0			
		Renewables	GWh	19	201	676	1,150	60.4	4.7	17.8
	Power Capacity	Total	MW		15,903	22,503	31,353		3.3	
		Coal	MW		4,177	8,177	13,177		5.3	
		Natural Gas	MW		2,763	4,263	5,763		1.8	
		Oil	MW		3,602	3,602	3,152		-3.2	
		Geothermal	MW		1,978	2,478	3,078		2.8	
		Hydro	MW		3,357	3,957	5,757		3.9	
		Nuclear	MW		0	0	0			
		Renewables	MW		26	26	426		27.6	

2.4 Coal and Renewable Energy Outlook: Reference Case

Reference	Coal & Renewable Energy Sector									
TERM 1	TERM 2	TERM 3	Unit	2005	2010	2020	2030	05 -> 10	25 -> 30	05 -> 30
Coal sector	Demand	Total	kTOE	5,190	7,373	12,021	17,968	7.3	4.3	5.1
		General	kTOE	1,056	1,384	2,001	2,653	5.6	2.7	3.8
		For electricity	kTOE	4,134	5,988	10,020	15,315	7.7	4.6	5.4
		Export	kTOE	0	0	0	0			
	Supply	Total	kTOE	5,230	7,373	12,021	17,968	7.1	4.3	5.1
		Production	kTOE	1,520	2,234	3,422	4,825	8.0	3.5	4.7
		Import	kTOE	3,710	5,139	8,599	13,143	6.7	4.6	5.2
Reference	Non-commercial Energy Sector									
Non-commercial	Supply & Demand	Total	kTOE	5,766	5,901	5,795	5,784	0.5	0.0	0.0
		Rice hull	kTOE	48	55	82	113	2.8	3.1	3.5
		Charcoal	kTOE	677	644	420	189	-1.0	-8.9	-5.0
		Fuel wood	kTOE	3,669	3,220	2,291	1,345	-2.6	-5.7	-3.9
		Bagasse	kTOE	711	1,301	2,165	3,105	12.8	3.3	6.1
		Agriculture waste	kTOE	646	674	826	1,016	0.9	2.1	1.8
		Animal waste	kTOE	15	6	11	16	-15.5	3.6	0.1