Part 3 Challenges in Energy and the Philippine Energy Plan

Chapter 8 Issues and Objectives of Long-term Energy Plan

8.1 Long-term Energy Outlook and Fundamental Direction of Energy Policy

8.1.1 Economic Growth Incurring Greater Energy Demand

The Filipino economy has kept high economic growth of over annual 5% in these years and the per capita GDP reached US$1,352 in 2006. Its economic growth has been accelerating since 2000 driven by development of the international services industry borne by IT technology and substantial increase of transfer by overseas Filipino workers. If we look to the fact that the economic differences with leading ASEAN countries and Chinese coastal provinces are the cause inviting FDI inflow and thus the driver of the high economic growth, this trend may continue well into the future. To materialize this, of course, it is necessary to prepare the circumstance to further promote the inflow of technology and fund, and securing stable energy supply that is essential for economic activity should be an important element of the strategy for long-term development.

From the above viewpoint, the economic growth scenario in this study is set forth that the Filipino economy will continue to grow at the current trend of annual 5%. By 2015, the Philippines will overtake the current Thailand in terms of aggregate GDP amount. Further, by 2030, the Philippines will catch up the current Thailand in terms of per capita GDP.[27] Thus, in the coming 20 years, the Filipino economy 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 8.1-1 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%. It is forecast that such trend will continue in future and

[27] These figures are shown in 2000 price, while the nominal per capita GDP would reach $2,700 in 2020 and $4,000 in 2030.

energy consumption will increase mainly in the commercial and residential sector reflecting modernization at offices and household.

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, demand for electricity and gas may increase in future. In the gas sector, 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. As large-scale gas supply system is not developed in the country, it is desirable to study benefit and appropriateness 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.

Table 8.1-2 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 Rat	%	%	%	%	%	%
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

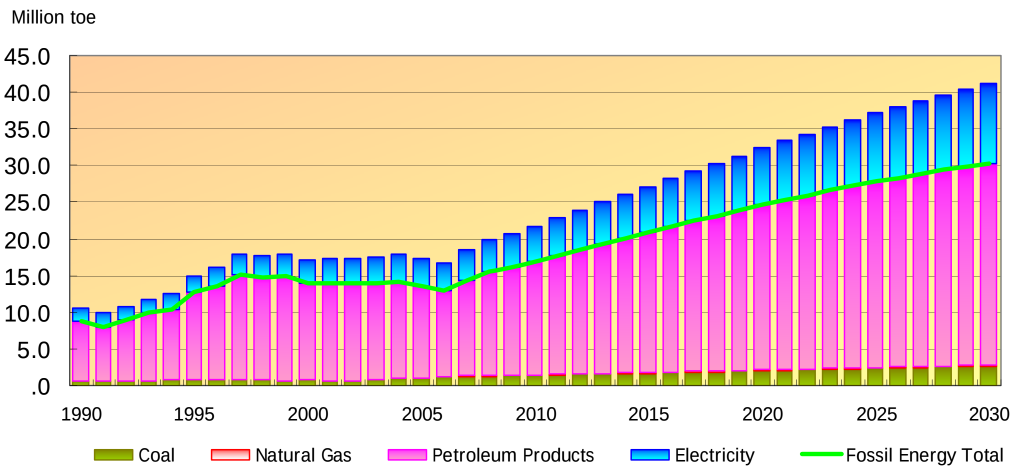

Figure 8.1-1 Final Energy Demand by Energy Source

As observed above, it is forecast that the energy structure of the Philippines will more or less maintain the current pattern. During the projection period, however, the size of the economy will expand 3.4-fold in real term and eleven-fold in nominal term. This means that most of the economic activities prevailing in 2030 shall be established newly from now. For example, there is a good possibility that the public transportation system could be developed widely in future pending land and transportation development policy, and this would affect the energy demand structure of the Philippines where transportation fuel represents the main energy requirement at present. The future should not be a copy of the past. In particular, when we talk about future of fast expanding economy, it is important not to simply extend the past trend but we should invite thorough discussion on desirable industry structure, urban planning and life style, and set forth a *Grand Design* of our future as a goal to be aimed at.

8.1.2 Primary Energy Supply Structure

A remarkable feature of the Philippines in its energy supply structure is that geothermal is utilized in the world second largest quantity after the United States. Among other indigenous sources, some quantities of natural gas and coal are produced. However, as discussed in Chapter 7, deposits of these 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. In addition, since regional markets are divided into separate parts in this archipelago country, there are certain constraints for large-scale utilization of geothermal energy.

Table 8.1-3 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	***	***	***

If we consider the above conditions, we may expect that the energy supply structure of the Philippines would not change largely in future. The Reference Case projection does not assume introduction of nuclear power. Then, the fundamental trend is moving in the direction that, while 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.

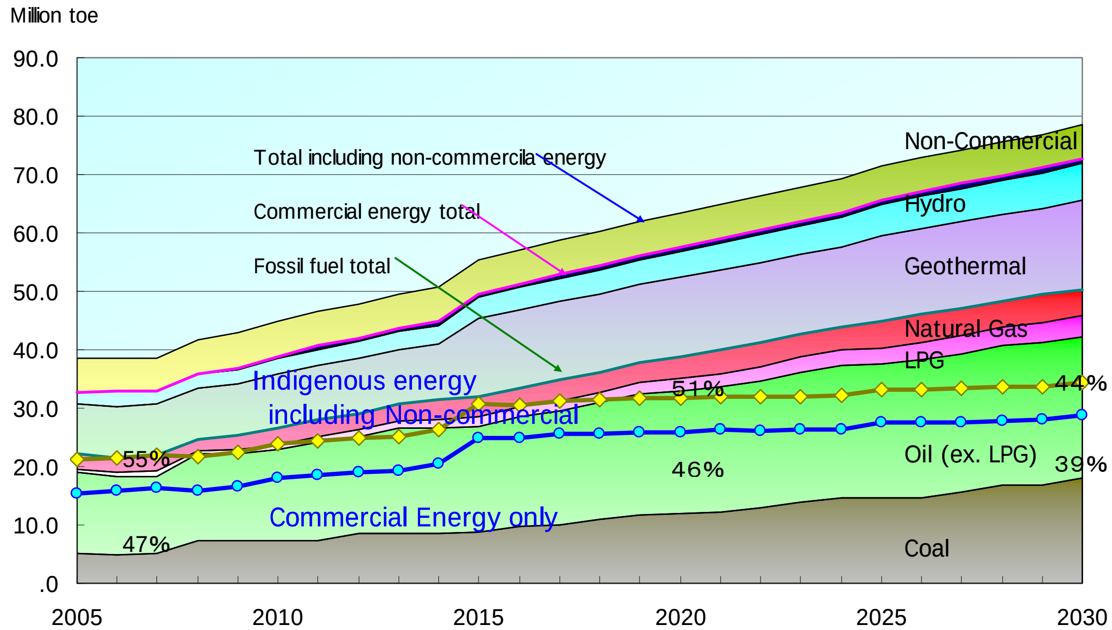

Figure 8.1-2 Energy Supply Structure of the Philippines (Reference Case)

Table 8.1-4 summarizes the analysis on the relation of energy demand size and energy supply structure. Assuming that indigenous energies will be used first, 90% of the demand change will occurs as changes in oil and coal supply. Oil supplies the largest amount among energy sources reflecting the fact that transportation fuel is the largest use among energy consumption sectors. Nevertheless, its share is forecast relatively stable against the total demand change. In contrast, difference in the economic growth rates appears in the scale of electricity demand. As certain quantity of indigenous geothermal and hydro are used for power generation, they are supposed to operate at maximum and requirement for coal, playing a role of swing energy, changes reflecting the fluctuation of the total energy demand.

As observed in Table 8.1-4, 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. The primary energy requirement projected at 84.4 million tonnes oil equivalent (toe) for the BAU Case would decrease to 72.8 million toe, by 11.7 million toe, in the Reference Case where annual 0.5% energy conservation is assumed. Reduction of fossil energy import will be 10.4 million toe (or 89%) out of the foregoing figure. This implies that, in the energy supply structure of the Philippines, 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 8.1-4 Energy Demand Size 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 Tota	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 8.1-5 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. When expansion of their import is deemed as desirable for development of the society, 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.

8.1.3 Fundamental Direction of Energy Policy

In the contemporary world, energy security and global warming are considered as the twin problems relating to energy. Energy security is a proposition how to secure necessary energy in stable quantity and price in order to assure stable economic activities and people's life, or to protect national interest. Global warming is a proposition how to take due actions as the citizen of the earth against the disasters common for the human being.[28]

Steps to be taken against the twin problems will be divided into three as follows.

1) Curbing energy requirement

Measures toward this goal are energy efficiency and conservation, and/or rational use of energy. In addition to construction of highly efficient energy system and thorough deployment of energy saving operation in individual sectors, improvement of industry structure, business style and life style is also important.

2) Reducing requirements of import energies and fossil energies

Introduction of renewable energies and nuclear power will have win-win effects in reducing dependency on import energy as well as greenhouse gas emission.

3) Reinforcing security of fossil fuel procurement

The world requires more energy for sustainable economic development and better quality of life. And, after implementing due measures stated above, we would still face with energy supply shortage against increasing demand. 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. As long lead-time and huge investments are necessary to prepare supply and utilization facilities accommodating respective energy sources, it is necessary to establish a coherent and practicable energy strategy based on a long-term viewpoint. In addition, to cope with short-term turbulence in the international energy market caused by terrorism and/or international disputes, it is a direct and effective measure to establish national oil stockpiling. In order to reinforce these measures, it is also necessary to promote international dialogue, alliances and regional cooperation.

Common features of the above 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. In this context, future energy policy should be directed toward effective integration of the policy measures to cope with the issues as discussed above.

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[28] With regard to reduction of greenhouse gas emission, UNFCCC requires developing countries also to take due action considering "common but differentiated responsibility".

8.2 Energy Efficiency and Conservation

As discussed in Chapter 6, energy demand increase incurred by economic growth is relatively moderate in the Philippines compared with other developing countries, since energy intensive industries are relatively small. Nevertheless, 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. The world energy supply balance is anticipated to become tighter and market fluctuation greater with substantial increase of energy demand in emerging countries with mega population such as China and India. 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.

As we will look into the effect of energy conservation and to what extent it would be possible more in detail in the next chapter, we show a result of simulation run by our model as illustrated in Figure 8.2-1. Comparing the extreme cases, namely, the BAU Case and the EEC Case, it is apparent that long-run continuous efforts of energy conservation will bring considerable differences in energy demand. Between 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. In this case, however, the final energy demand in 2030 will still increase 2.1-fold of the present amount. It is also apparent that there would be substantial differences in energy input dependence among these cases. If possible, it is desirable to realize super-EEC beyond this figure. In considering energy conservation, 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.

In the Philippines, as implicit power supply deficit is grumbled, electricity demand is anticipated to increase faster than other energies. In the less energy intensive industries and residential/commercial sectors, clean and convenient energies such as electricity and gas may be preferred even though they are

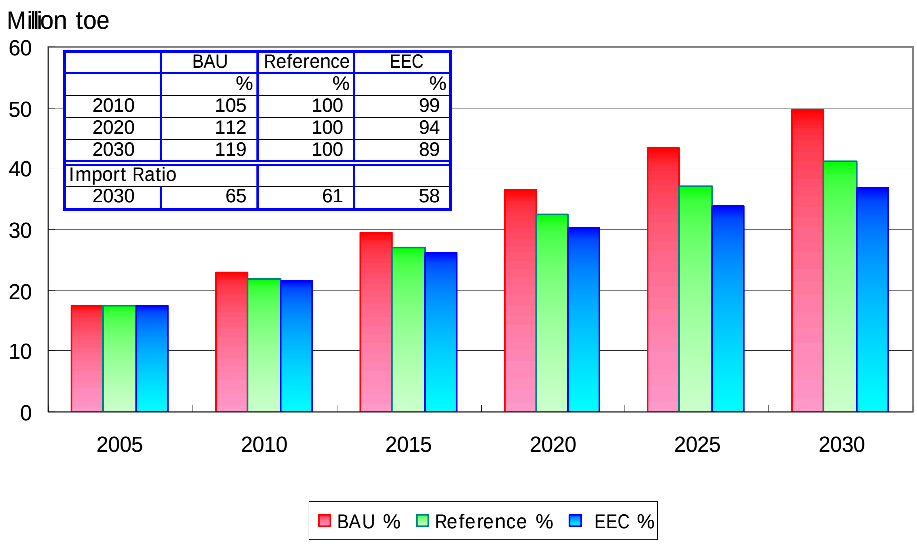


Figure 8.2-1 Outlook of Final Energy Demand

relatively expensive, as energy is not the major expense item in these sectors. Then, we should note that energy conservation tends to be set aside or forgotten. As discussed in Chapter 6, demand for electricity and gas (natural gas or LPG) will increase substantially in these sectors, and it is a big issue for the country how to supply them stably. As its reason, 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, or it will be much smaller if we consider depreciation of existing ones. Therefore, in projecting energy demand in fast growing sectors and setting out an appropriate energy supply plan, it is necessary to give more 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.

8.3 Issues relating to Energy Supply

8.3.1 Oil Refining Capacity

The oil refining industry is in principle a private industry in the Philippines and the role of the government will be to set out fair and equitable rules and prepare appropriate market circumstance. In the past several years, however, 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. Indigenous refineries are relatively of small size and facing increasing difficulties in competition with large-scale refineries abroad. In addition, since investment in the secondary facilities is stagnant, they are losing competitive edge further.

Based on this background, we have set out the Reference Case assumptions without any increase of the refining capacity. However, as seen in Chapter 6, indigenous demand for petroleum products is expected to increase steadily and the operation of the indigenous refineries is already at a high rate. If the refining capacity remains at the current revel, even with certain quantity of petroleum product import,

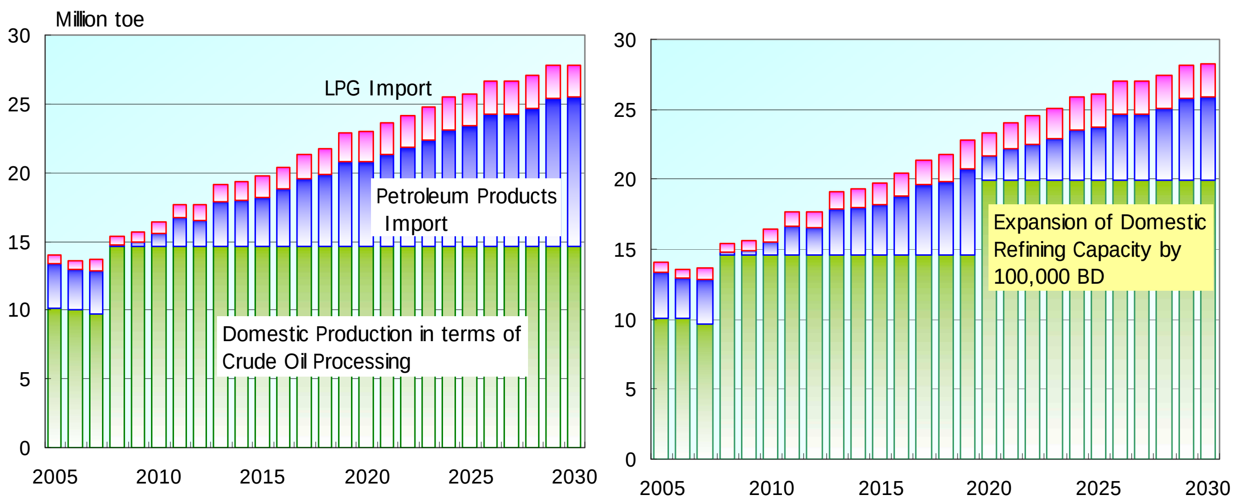


Figure 8.3-1 Expansion of Indigenous Refining Capacity

indigenous demand will exceed the refining capacity around 2010, and after then the supply/demand balance will require straight increase of product import.

Under the circumstance, let us consider an expansion of the indigenous refining capacity by 100,000 barrels per day as shown in the right chart of Figure 8.3-1. The red portion of the graph illustrates LPG import and should be neglected here, as the structure of the international LPG market is different. These charts indicate that expansion of the indigenous refining capacity may be considered by about 100,000 BD around 2015 through 2020, and another expansion may be required 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.

8.3.2 Supply of Natural Gas and LPG

History of natural gas supply in the Philippines is short. Nevertheless, the main gas field Malampaya is anticipated to start declining between 2015 and 2020. We are already coming to the timing to consider how to supplement it. At present there are three big gas-fired thermal power stations supplying electricity to the most important part of the country. We cannot afford to just idle these power generating and transmission facilities when gas production starts declining. 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. In the light of this fact, Figure 8.3-2 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.

Applying the current demand trend, supply/demand gap of these gases (LPG + natural gas) will start to expand around 2020. It is an important issue in the energy sector how to cope with this anticipation. 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, from the lessons of the efforts developing the Batman plan, we may need a great political initiative to construct the city gas grid in the central capital area. In addition, the global LNG market is not easing as predicted before but is anticipated to be tight at least until 2015, although there is a possibility that the market balance may change upon completion of the huge LNG capacity under construction in Qatar. At any rate, LNG is a business that requires long lead time, as insiders often chaff it as Long Negotiation Game, and we need to start preparation with sufficient time allowance in case LNG is preferred as the favorable goal.

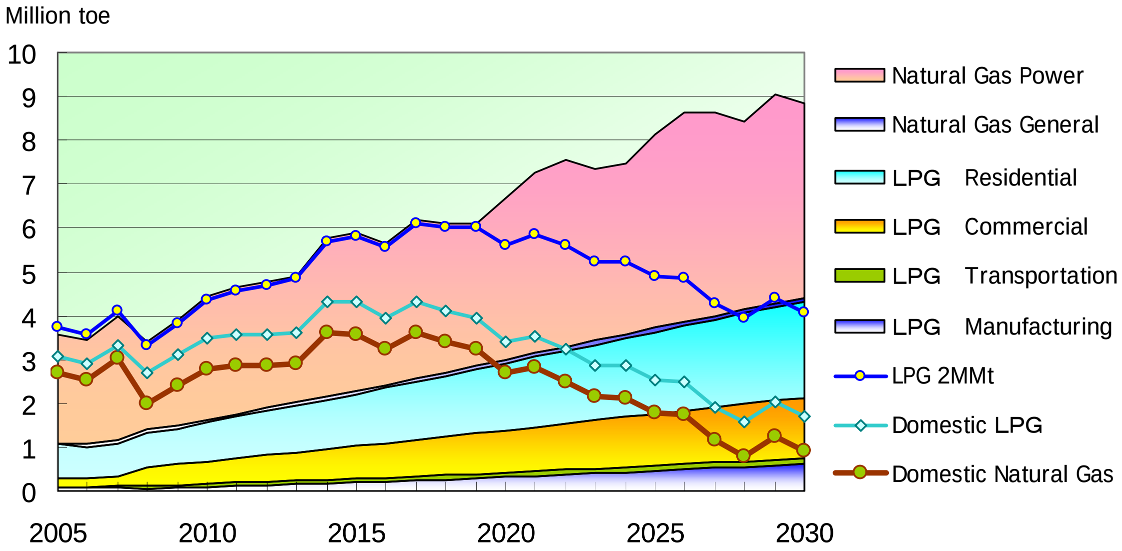


Figure 8.3-2 Supply / Demand Balance of Gas Energy

On the other hand, there is an observation that international market trend is changing. This is caused by the natural gas conversion in the large LPG consuming countries, and LPG has been pushed out from gas market in these countries. In Japan, the trend of LPG market erosion is temporally suspended because of the phenomenal LNG demand arising from shut down of nuclear power stations due to earthquake in Niigata Prefecture. However, LPG is being driven out by LNG as a basic trend. In China, the West-East gas pipeline was completed in 2004 and piped natural gas supply commenced in the Yangtze industrial delta including Shanghai. In 2006, LNG import started in Guangdong and started replacing LPG. In addition, the second Shaanjing gas pipeline is being developed absorbing demand in Shandong and Pan-Bohai regions. Consequently, LPG that had widely developed in major cities and surrounding areas is being replaced with natural gas rapidly. In addition, increase of natural gas production and refining capacity has have brought big increase of indigenous LPG production. Thus, Chinese LPG import started to decrease after peaking out in 2004. In another big LPG consuming country, India, large-scale natural gas field are being discovered one after another. Reflecting such development, LPG price in the international market is easing, relatively in its relation with crude oil price, 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.

8.3.3 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 8.3-3 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

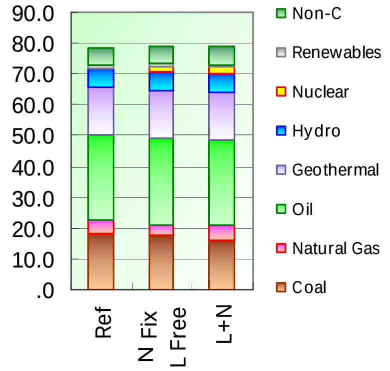


Figure 8.3-3 Change in Primary Energy Supply: Nuclear Introduction Case

Compared with the Reference Case, when nuclear power is introduced and LNG import is free, natural gas consumption will decrease first and coal consumption will also decrease slightly. Then, if we consider the LNG import of annual 3 million tons as a given condition, demand for coal will decrease consequently. As the size of nuclear power introduced here is relatively small, though 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.

8.3.4 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.

In comparison with this plan, we examined a case to increase biofuel blending ratio to 20% for both gasoline and diesel gas oil (E20/B20) and another ambitious case to replace 85% of gasoline with ethanol (E85/B20). Demands of gasoline and diesel gas oil in these cases are illustrated in Figure 8.3-4. In the Philippines where motor fuel demand shares substantial portion of the energy demand, 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 as shown in the chart. In view that those petroleum products are linked each other in the production process, the E85/B20 case requires a too extreme change in the petroleum products composition. In this consideration, it is preferable that biofuel introduction should be made to similar extents for both gasoline and diesel oil demands.

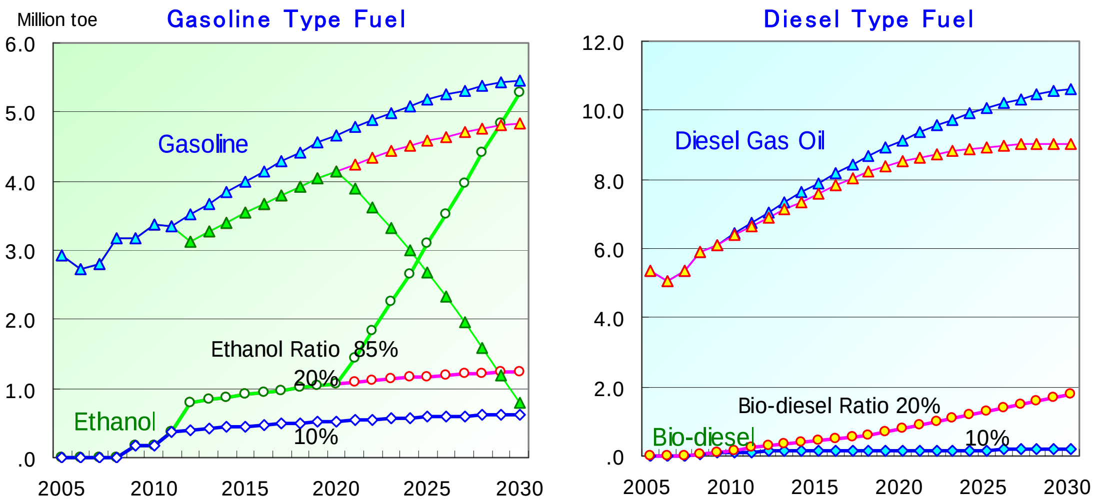


Figure 8.3-4 Introduction of Biofuel and Petroleum Demand

Table 8.3-1 Composition of Petroleum Products Demand excluding LPG

Case	Gasoline	Ethanol	Jet Fuel	Kerosene	Diesel	Bio-Diesel	Fuel Oil	Total
	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
Ref	5,463	622	2,490	0	9,492	178	2,075	20,320
E20/B20	4,840	1,245	2,490	0	7,888	1,782	2,075	20,320
E85/B20	795	5,290	2,490	0	7,888	1,782	2,075	20,320
Composition	%	%	%	%	%	%	%	%
Ref	27	3	12	0	47	1	10	100
E20/B20	24	6	12	0	39	9	10	100
E85/B20	4	26	12	0	39	9	10	100

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. As shown in Figure 8.3-5, we should assume this underlying trend in considering the biofuel production. Under the circumstance, 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 may be 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.

On the other hand, while CME production from coconuts oil for blending with diesel oil is already materialized as business in the Philippines, there are many issues that need technology development in the field of palm oil and Jatropha before moving to large-scale production. 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..

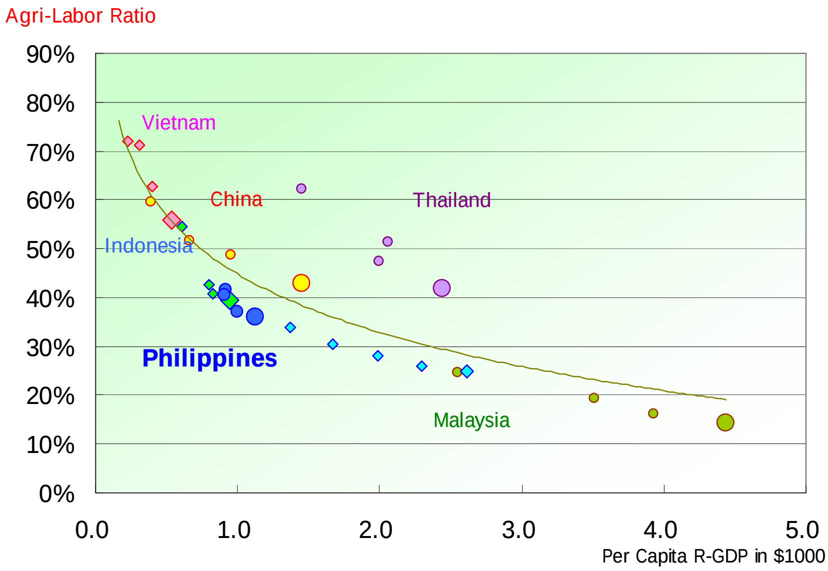


Figure 8.3-5 Agricultural Labor Ratio of ASEAN Countries

8.4 Important Issues to be considered in Energy Policy

As explained above, energy demand of the Philippines is expected to evolve moderately. Even so, in order to assure sustainable development of the country, it is necessary to think of the energy issues giving due consideration on the balance between the economic growth speed and energy demand increase, a long lead time necessary in preparing energy supply system, impact of high energy price on to the society, environmental burden to be incurred by consuming more energy, and so on. 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

As 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.

8.4.1 Energy Efficiency and Conservation

Energy is an essential material for daily life and industrial activities. However, 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. If the country would follow the current trend, 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 as estimated for 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 to the level of the latter case and an energy efficient society should be created. Measures to implement energy conservation will be discussed in the next chapter.

8.4.2 Indigenous Energy Development

Although the Philippines is not endowed with rich energy resources, as the world energy supply is moving toward tighter balance, 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.

Compared with 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 these non-fossil fuels as follows.

1) In considering introduction of nuclear energy, it is necessary to consider its economics as well as political condition within and outside of the country. As its 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) Among the renewable energies, in addition to the geothermal with firm record, biofuels and windmills may be promising sources.

With regard to biofuel, it is desirable to develop a kind of a Philippine Model to effectively utilize the favorable natural condition of the country and positively taking in the world technology development. It is also recommended to utilize the fund and resources provided by multilateral financial institutions and/or the international systems such as Clean Development Mechanism (CDM). It is necessary to pay due consideration on the fact that land policy and agricultural policy will be the keys to the successful development of biofuel as well.

As the Philippines being an archipelago country, it faces difficulties to take in electricity generated by wind power or geothermal in a large scale into a nationwide grid. It is necessary to investigate into and identify to what extent introduction of these renewable energies would be possible running a comprehensive study on the preferable power source composition and the grid structure based on long-term view point.

8.4.3 Securing Stable Energy Import and Reinforcement of Energy Security

As the energy demand increases, its import dependence would increase. Then, it is necessary to pay attention to the supply characteristics of each energy source; for example, in case of oil the international oil market is well developed but oil would be exposed to fierce price fluctuation, in case of natural gas a closed system is the basic structure and a long lead time and mutual trust between seller and buyer are the fundamental principles, greater geopolitical consideration is required for oil but it is less needed for coal, also greater consideration is needed on international political atmosphere for introduction of nuclear power, and so on. In case of supply by import that requires long haul transportation, economics of scale works to a substantial extent. In consideration on these elements, the following principles should be considered.

1) Energy diversification policy should be pursued with due attention on the supply characteristics of each energy
2) Based on the characteristics of each energy market, respective procurement strategies should be established giving particular consideration on required quality, environment and energy security in addition to economics. Then, it is also necessary to establish the country's presence in the international market and among import channels.
3) It is necessary to construct energy import infrastructure with careful investigation on the regional demand distribution and the applicable economics of scale.
4) It is necessary to establish an energy security measure to mitigate the impact of abrupt changes in the international market. Practically speaking, it is to materialize national strategic oil stockpiling taking account of the characteristics of oil in wider and easy use and convenience in storage and transportation.
5) The roles of the government and private sectors should be clearly defined and the private sector activities should be effectively promoted.

8.4.4 Construction of Reliable and Efficient Energy Supply System

Even after substantial efforts of energy conservation, energy consumption still increase by 1.7 fold by 2020 and 2.3-fold by 2030. In order to assure steady economic growth, it is necessary to structure a reliable and efficient energy supply system to certainly deliver necessary energies to the consumers. In construction of the large-scale energy infrastructure, huge amount of investment and a long lead-time is necessary from site selection to facility completion. From this viewpoint, it is desirable to strengthen the initiative of the government sector in the large-scale energy infrastructure projects taking account of the following principles.

1) With regard to construction of important energy infrastructure, it is necessary to clearly define the projects to be implemented by the government sector and those left for the private sector, considering their nature, social requirement and economics. The government projects should be identified with nationwide consensus and their progress should be reviewed periodically in the long-term energy plan.
2) The economics of scale works considerably in energy supply system. In view of this principle, a comprehensive plan to construct an efficient system in view of the long-term benefit should be proposed. Such plan could become the basis for public private partnership (PPP) and provide a guideline for the private sector projects.

3) Construction of energy system generally includes large projects that would give substantial impacts on environment and regional society. Therefore, in promoting them, it is necessary to prepare good coordination system to implement energy project development well harmonized with regional societies and stakeholders.

For example, how those projects such as refineries, LNG terminals, city gas grid, nuclear power and/or geothermal plants should be defined from the above view points? As it is desirable that many of them should be promoted by the private sector, it is needless to say that appropriate conditions must be prepared for the private sector to implement large-scale projects based on social consensus and with proper orientation of the government.

8.4.5 Rationalization of Energy Market to realize Reasonable and Appropriate Energy Prices

The energy sector of the Philippines is yet to develop sufficient power supply to support high economic growth. Unstable power supply system and the stranded city gas project are embarrassing obstacles when the economy aims at industrialization and modernization. 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, in the past experience of the world energy market liberalization, serious market failures have been experienced even in the United States and Europe, where political neglect of simple economic principles caused collapse of the energy supply systems elsewhere. It is extremely important to observe the simple economic principles in the course of setting out market rules. Then, the principles of the energy market policy may be summarized as follows.

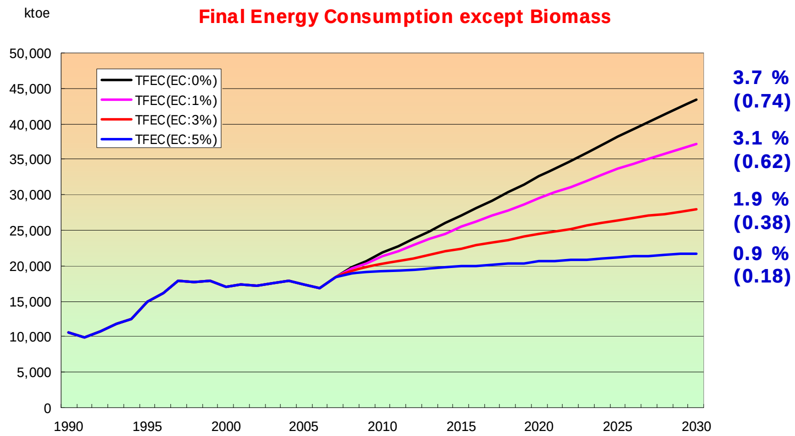
1) Clearly define the role of the government sector to set forth the market rule and that of the private sector as players, and set out fair and transparent transaction rules.
2) Liberate the energy market and promote participation of efficient players, while the government should reserve certain control on the energy market to protect national interest. Any entity to participate in the market should qualify against certain criteria on abilities to conduct safe and efficient business, financial capability, risk control ability, consideration on safety and environment, and so on.
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.

In the context of the above discussion, we will examine issues in individual sectors and the direction of the fundamental energy policy in the following chapters.

Chapter 9 Potential of Energy Conservation

9.1 Impact of Energy Conservation

In the present world, we face with big energy issues such as increasing CO_2 emission on a global scale and skyrocketing crude oil price. To cope with these issues, energy conservation is the most effective measure for curbing energy consumption while keeping economic growth. Thus, Energy Efficiency and Conservation Division of DOE at present has set a target to achieve 5% energy efficiency and conservation annually. The intension is ambitious, but this target looks too high and would not be realistic. Figure 9.1-1 shows projection of final energy consumption trend for different targets of energy conservation between annual 0 to 5%. If annual 5% energy conservation were achieved, final energy consumption in 2030 would remain almost at the same level of 2006. Energy conservation is a particularly favorable measure to strengthen energy security and alleviate global warming. Even so, in the Philippines where per capita energy consumption is at around 1/10 of that of Japan, it is difficult to imagine the situation that the countries would not virtually increase energy consumption in the coming 20 years.



(Note) Figures in ( ) are energy elasticities to GDP

Figure 9.1-1 Final Energy Consumption by Different EEC Targets (Annual 0 to 5%)

According to Japanese experiences, as a result of the strong energy conservation policy facing skyrocketing oil prices, energy consumption of the industry sector has remained at the same level of 1973 after the first oil crisis through today. However, energy conservation in the commercial, residential and transport sectors were relatively limited and energy demand in these sectors has evolved at almost same pace with GDP, or with GDP elasticities of slightly below 1.0. During the period of the 1980s and after when energy prices continued to be stagnant, the industrial sector acted with strong concern on energy cost while price effect faded out in the residential and commercial sectors and income effect had greater role on the energy consumption trends.

Based on the Japanese experiences as above, we will examine potential of energy conservation in the Philippines in this chapter.

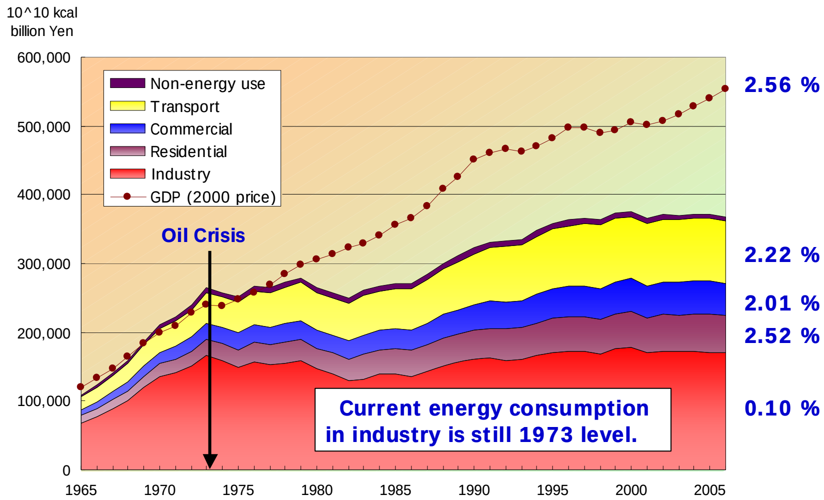


Figure 9.1-2 Trend of Final Energy Consumption in Japan after Oil Crisis

9.2 Industrial Sector

Energy demand of the industrial sector in Japan has been almost leveling off after the first oil crisis. In the days after World War II, Japanese industry had developed concentrating in the heavy industry that consumed a substantial quantity of energy. However, the industrial structure changed upon the oil crisis. The focus of Japanese industries shifted away from heavy industries toward high-value-added light industries such as car manufacturing and home electric appliances industries. Namely, Japanese industries have conserved energy consumption through combined effects of improving energy efficiency in individual sector and changes of industrial structure.

On the other hand, industries of the Philippines are developing concentrating on the light industries. Main three energy intensive industries such as cement, food processing and sugar are consuming more than 60% of the total energy consumption in the industrial sector. Improving energy efficiency in these industries, energy demand in the industrial sector can be saved substantially. According to information from a cement factory, unit energy consumption in the Philippines is about 20% higher than those observed in Japan. It seems that other industries also have a similar potential of energy conservation. Considering that the industrial sector of the Philippines may be consuming 10% more energy than Japanese firms on average from observations as above, it may be said that there is a potential of about annual 1% of energy conservation if they should catch up Japanese in 10 years.

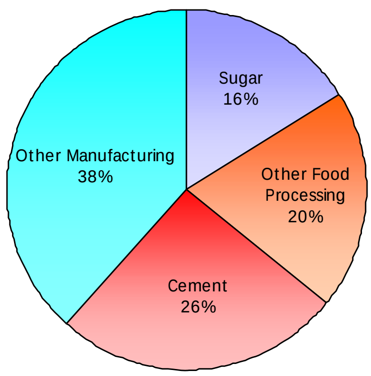


Figure 9.2-1 Share of Energy Consumption by Type of Industries (2006)

9.3 Commercial Sector

Energy demand of the commercial sector is mainly incurred for air-conditioning (cooling or warming) at buildings. In the Philippines, especially in Metro Manila area, construction of large shopping malls and tall office buildings is booming. Because of the tropical condition, it is quite natural that these buildings will consume a huge amount of energy for space cooling purpose.

According to calculation applying the 1992 Japanese energy conservation standard, 71% of the total heat coming from outside into a building during high summer season comes through windows. Most of the heat comes in as a form of sunshine. Therefore, shading sunshine is very important. Thus, sunshine shading and insulation are the two particular items of which standard have been strengthened in the next generation energy conservation standard. Appropriate measures are required in accordance with the direction of windows. In addition, double glass windows with insulating frames will work very effectively to keep out the heat; combined effects of them would raise the insulating efficiency triple. A new target of energy reduction for cooling purpose is set out in the revised energy conservation standard of 1999 to reduce energy consumption by 20% compared with the case former conservation standard on airtight and insulation was fully realized.

According to statistics, numbers of commercial buildings in the Philippines increased at an annual growth rate of 3.7% from 5,467 in 1990 to 14,086 in 2006. If the Philippines government implements energy conservation policy reducing 20% of cooling energy for new building, about 10% of cooling energy will be reduced in 2030, should growth rate of new building continue at the present level. Moreover, as old buildings will be demolished and replaced with new ones, cooling energy demand will be further reduced. Among others, efficiency improvement may be expected on business and electric appliances and thus we may be able to assume safely that there is a potential of annual 1% energy conservation in the commercial sector. In order to materialize EEC as explained here, it is necessary to implement measures under long-term, comprehensive policy including review of municipal plan, building codes and other relevant issues.

9.4 Residential Sector

At household, the current stock of low-efficiency electrical home appliances will be naturally replaced to the latest high-efficiency ones, and thus certain amount of energy conservation may automatically occur during the projection period. In order to estimate the extent of energy conservation in the household sector, we focused on three typical electrical appliances used in the households, namely, refrigerator, air conditioner and colored TV[29].

Firstly, to clarify the performance of the current appliances in the Philippines, statistics were collected from the Household Energy Consumption Survey 2004 (HECS 2004). In addition, the JICA study team

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[29] The reason why we selected these three appliances was that the total amount of energy consumption by these three appliances was in majority in households' electricity consumption, 51.2% as today's Japanese data: Refrigerator 16.1%, air conditioner 25.2% and colored TV 9.9%. Outlook of Power Supply and Demand, Agency for Natural Resources and Energy, 2003.

carried out a field survey to measure actual power consumption in Metro Manila area using clump meters as complements to insufficient data in HECS 2004. Then, data on two types of Japanese electrical appliances were referred to for estimating future transition of energy efficiency improvement in the Philippines since no suitable data were available in the Philippines. The stock-base data, which was based on the appliances on hand, were delivered from TEPCO survey in Japan, and new products data were cited from the catalogs on energy efficiency of electrical appliances compiled by the Energy Conservation Center of Japan. Although the two statistics of Japan were not strictly same in terms of definition of objective appliances, calculation conditions, sampling survey methods and so on, we conducted the estimation with these data to consider as much objective data as possible.

As the result of the survey, the chronological transition of energy efficiency of refrigerator, air conditioner and colored TV are shown in Figure 9.4-1 to 3, respectively. In every case, the average energy efficiency of appliances currently used in the Philippines is worse than that in Japan. It is needless to say that the new models on sale have much better efficiency than the stock-base appliances. Thus, the households in the Philippines, using low-efficient appliances at present, are susceptible to improve the energy efficiency as latest appliances will become popular. Regarding the energy efficiency improvement rate per year, the average efficiency improvement of stock-base refrigerator, air conditioner and colored TV in Japan were 1%, 2% and 0%, respectively, in this investigation. The reason that TV shows no improvements over the survey period is that the data includes TVs of various size and function, and recent high-functionality models tend to consume more power than conventional small-screen ones. On the other hand, focusing on the power consumption of new product TVs, data of them were collected on similar type products, energy efficiency has improved 2% per year on average. This indicates that energy efficiency improvement on TV sets has also been evolving on a certain pace.

Based on the above observations, we estimated that Filipino households as a whole have an energy conservation potential of 1% per year on average under the assumption that latest electrical appliances become widespread in future as was observed in the Japanese case.

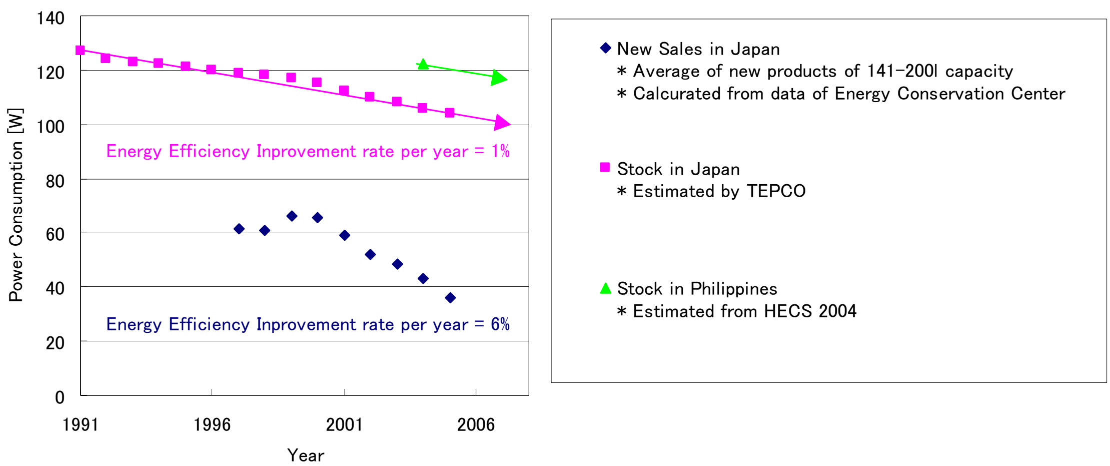


Figure 9.4-1 Chronological Transition of Energy Efficiency: Refrigerator

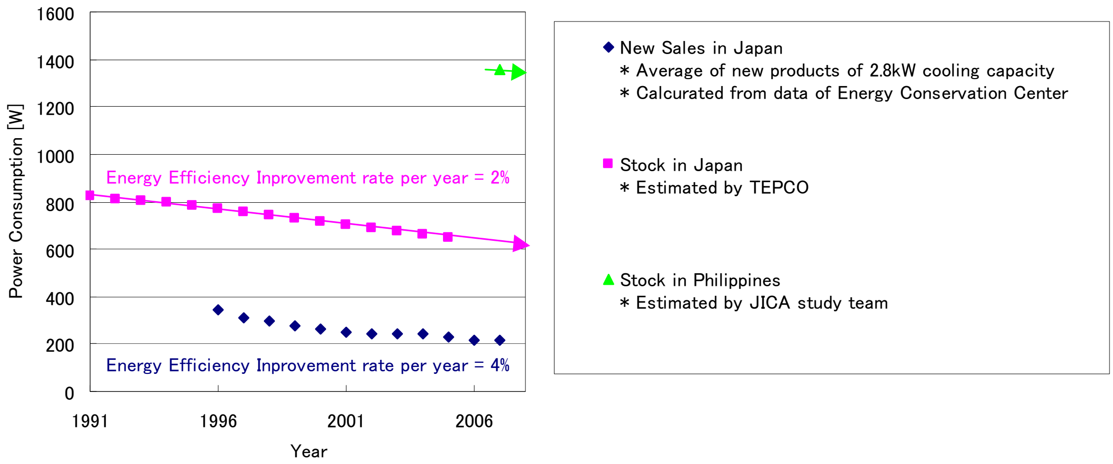


Figure 9.4-2 Chronological Transition of Energy Efficiency: Air Conditioner

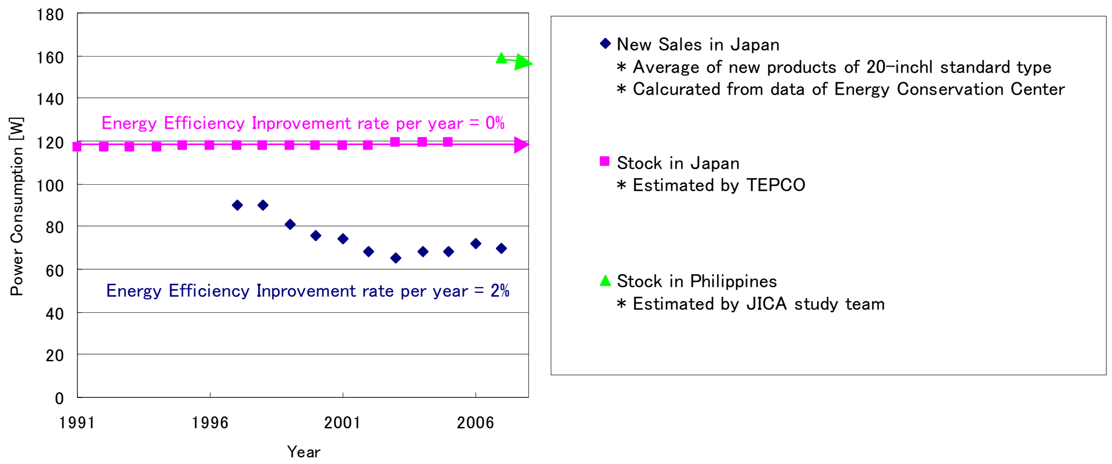


Figure 9.4-3 Chronological Transition of Energy Efficiency: Colored TV

9.5 Transport Sector

In the energy demand survey conducted under this study, we have included the transportation sector. Motor fuel consumption data were collected to some extent in the business bus and truck service sectors where survey by business entity was possible. However, regarding the privately owned passenger cars, utility vehicles and trucks, it was difficult to collect reliable data as their owners are not necessarily keeping records on fuel, though these categories consume substantial amount of motor fuels. In order to promote energy efficiency and conservation in particular, it is absolutely necessary to collect accurate data on vehicle fuel mileage that could be collated with the aggregate energy statistics. It is necessary to establish the system (laws and institutions on collection of energy statistics) to grasp the demand tendency more accurately in this manner. As an example of considering these elements, we would like to explain on a simple survey the JICA study team conducted by ourselves during missions in reference to Japanese experience. The outcome may indicate a direction of energy conservation promotion in the transportation sector.

Average fuel efficiency of the Japanese gasoline vehicles improved from 12.3 km/l in 1993 to 15.1 km/l in 2005. During this period, fuel efficiency improved by 22.8%, which was 1.7% per annum. Japan aims at the next target of fuel efficiency for all vehicles to improve it from 13.6 km/l in 2004 to 16.8 km/l in 2015. If the target is achieved, fuel efficiency will be improved by 23.5% over 11 years or at 1.9% per annum.

Figure 9.5-1 Target of Fuel Efficiency Improvement for All Vehicles

For example, if fuel efficiency of new vehicle is 10% higher than the existing vehicles on average, the total fuel consumption for all vehicles will be reduced at 0.3% per annum.

In Japan, waiting time for the traffic light accounts for 47% of total driving time in the city. This shows that a lot of fuel is consumed by engine idling.

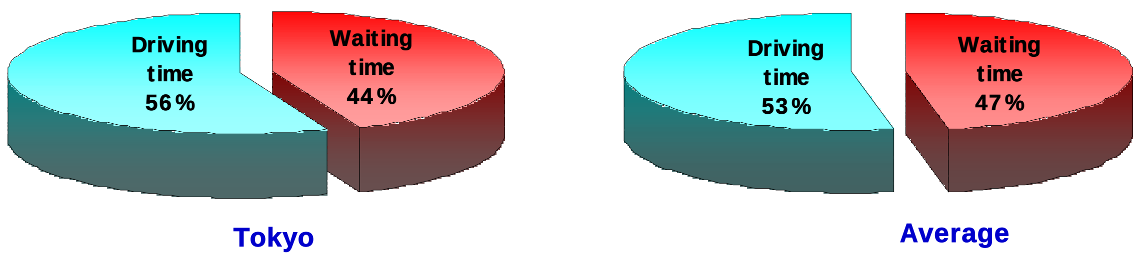


Figure 9.5-2 Share of Waiting Time for Traffic Light in City

On the other hand, according to the survey conducted by the JICA team, the average waiting time for traffic lights shares more than 30% of total driving time in the suburbs Manila area and the waiting time in the city center reaches 50% of the total traveling time. Actual speed excluding waiting time is about 30 km/hr and it is not an efficient driving speed. There looks substantial potential to reduce fuel consumption for road transportation eliminating traffic jam and installing idling stop devices.

Table 9.5-1 Waiting Time for Traffic Lights in Manila

	Route	Total time (min.)	Wait for traffic light (min.)	Distance (km)	Waiting rate (%)	Actual speed (km/hr)
26-May	Hotel-DOE	17.0	4.5	6.0	26.5	28.8
	JICA-Hotel	8.0	4.0		50.0	
27-May	Hotel-DOE	19.0	7.3	6.0	38.4	30.8
	DOE-Hotel	24.0	9.0	6.0	37.5	24.0
28-May	Hotel-DOE	20.5	5.5	6.0	26.8	24.0
	DOE-Hotel	21.0	7.8	6.0	36.9	27.2
2-Jun	Hotel-DOE	16.5	2.5	6.0	15.2	25.7
3-Jun	Hotel-DOE	20.0	7.5	6.0	37.5	28.8
4-Jun	Hotel-DOE	17.0	5.5	6.0	32.4	31.3
	DOE-Hotel	20.0	9.5	6.0	47.5	34.3
Total		183.0	63.1		34.5	

In addition to the above observation, automotive vehicles consume 75% of the transportation fuel in the Philippines, and except for the tiny railway service in the Manila area, almost 100% of land transportation is borne by automotive vehicles. In addition to improving vehicle mileage and traffic jam, introduction of large-scale traffic modal such as railway should be an important agenda to be examined for reduction of road transportation fuel. In addition to improving fuel efficiency and reducing traffic jam, modal shift to mass transport system can contribute to reduce fuel consumption substantially. Considering these measures, transport sector also has a potential of energy conservation of annual 1%; 0.3% by improving fuel efficiency, 0.3% by reducing traffic jam, and 0.3% by mass transport system.

9.6 Energy Conservation Effect to Final Energy Demand

Figure 9.6-1 shows the final energy demand before and after Energy Conservation when annual energy conservation rate of annual 1% is achieved in industry, commercial, residential, and transport sectors across the board. In the Reference case where annual 0.5% energy conservation is assumed, the final energy demand in 2030 will increase by 240% compared with 2005 level. However, in the EEC case of annual 1% energy conservation, the final energy demand will increase by 215%. Moreover, in the super EEC case of annual 1.5% energy conservation, the increase will be reduced to 194%.

In consideration of the great effect and potential of energy conservation, it is recommended that the Philippines should set up “Achievement of annual 1% Energy Conservation” as one of the energy policy goal and establish a practicable implementation plan of energy conservation that would substantially enhance the energy security of the country.

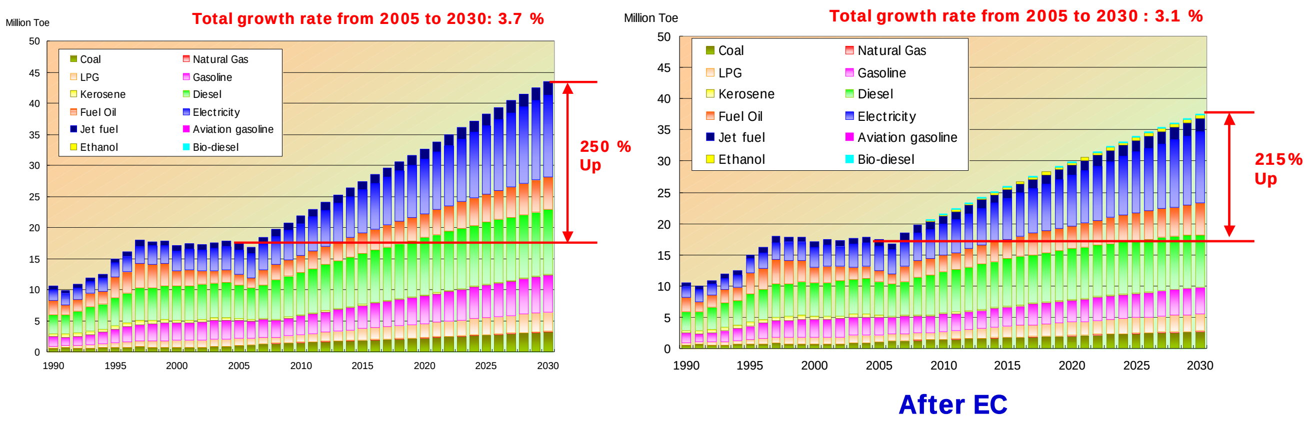


Figure 9.6-1 Final Energy Demand before / after Energy Conservation

Chapter 10 Outlook of Power Supply

10.1 Simulation of Power Supply Model

10.1.1 Objectives of Study

One of the main objectives of this study is to constitute an energy model in Philippines. As the frame work of this model has been illustrated before, it comprises a model which can forecast the energy demand based on the economic data, energy price trend and so on and a model which can optimize the supply combination to meet the energy demand.

When we focus on the power sector, thermal power plants, which are major players, are providing electricity as the secondary energy, on the other hand, geothermal, hydro power, nuclear power plants are provider of the primary energy. However, regarding the thermal power plants are main consumer of primary energy such as natural gas and coal and must enormously affect the national energy plan.

Consequently it's important to study on the optimal generation mixture of power no matter whether power plants provide the primary energy or not and we decided to implement the study on the supply model of the power sector as a sub-model.

10.1.2 Items of Study

To study on the optimal generation mixture with the screening curve method based on the bench mark price of energy (i.e. reference case price)

To implement sensitivity study on effects on the optimal generation mixture with energy price scenario based on the screening curve method

To study on the electricity price impacts when 2,000MW of GCC is introduced more until 2030, compared with the optimal generation mixture case, using PDPAT (Power Development Planning Assist Tool)

To study on the electricity price impacts when 1,000MW of Nuclear power is introduced during 2020 to 2030 with PDPAT

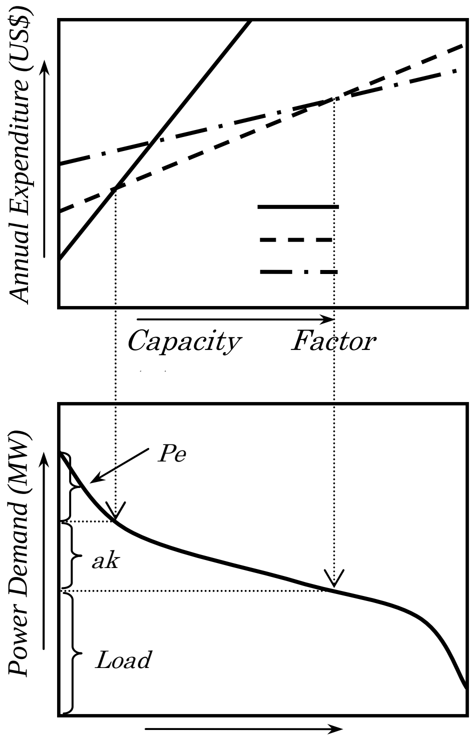
10.1.3 Methodology of Study

The study shall be carried out by the screening curve method and PDPAT. The chart below shows the idea of both methods.

Table 10.1-1 Screening Curve Method and PDPAT

【Screening Curve Method】

The right hand chart shows you the idea of the screening curve. It consists of an annual expenditure graph and a yearly duration curve of peak power demand.



The horizontal axis indicates the capacity factor and the vertical axis indicates the annual expenditure by each power plants. Consequently y intercept means the fixed costs and the gradient of line means the variable costs, which is almost equal with the fuel costs, respectively. For this example, in lower range of the capacity factor, oil fired thermal plants have the lowest annual expenditure and show the best economic performance. As the capacity factor increases, the economical advantage shifts to GCC and coal fired thermal plants.

Reflecting the capacity factor at the shifting point of the economical advantage, we can recognize which sort of power plants should meet which range of the power demand. And simultaneously we can obtain the most economical generation mix, so-called the best generation mix. For this example, the optimal generation mixture can be achieved by using oil fired thermal generation to supply peak load, which involves short periods of operation, coal fired thermal generation to supply base load, which involves long operating hours, and GCC to supply middle load, which is positioned midway between the two.

【PDPAT】

PDPAT which is an operation simulation software is developed by Tokyo Electric Power Company (TEPCO). It has a significant character that it can simulate some power systems operation interconnected among them. Consequently it must be very meaningful to use to study on the grid simulation of island country like Philippines.

The input data which PDPAT requires are as follows;

Daily Load Curve

Power Plant Data (Plant Capacity, Heat Rate Curve, Unite Capital Costs, Asset Life, AFC Capacity etc.)

Fuel Costs by Energy Type

Limitation of Fuel Provision, etc.

PDPAT can simulate load dispatch of power systems based on the input data and consequently calculates electricity generated and fuel costs consumed by each power plants. Furthermore it can output fixed costs and total power system costs.

It is possible for PDPAT to examine the optimal generation mixture if sensitivity studies on system costs are implemented under the various condition of generation mixture with it.

10.1.4 Assumption of Study

(1) Fuel Price

The fuel prices of oil, natural gas and coal which are required for the study on the optimal generation mixture are same as those which are required for the energy model. Since nuclear fuel price is not necessary for the model, however, for the power supply model it's required and so it has to be decided in this section.

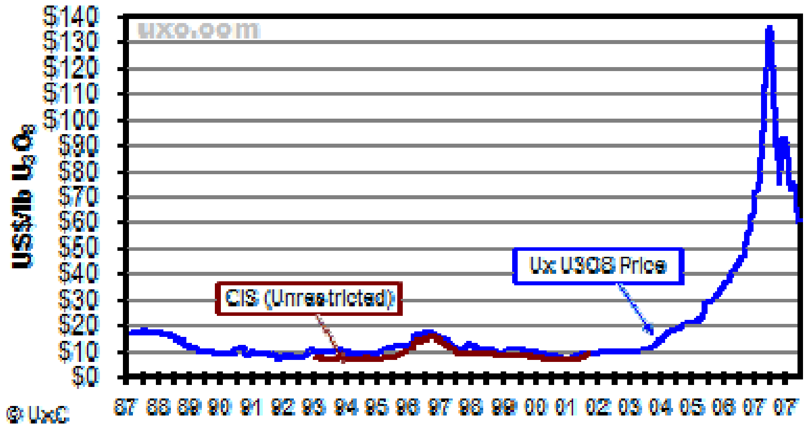
Figure 10.1-1 shows the spot price of uranium. The price had been stable in 10 US$/lb but it skyrocketed up to 130 US$/lb. in 2007. The reasons why it's hiked may be as follows;

The production of uranium ore had decreased because of a fire accident of an Australian mining industry in 2001, a leakage in a Canadian mine in 2003 and Namibia's cuts of production.

Western countries are becoming to anticipate that the overstock originated from Russian dismantled atomic bomb.

The US and China still have strong demand of uranium.

Uranium production is recovering after 2004 and the current price is falling down to about 50US$. Since the demand is however still strong, the current price level seems to be maintained. Consequently for this study, the price of 50 US$/lb$U_3O_8$ can be assumed.



Source: The Ux Consulting Company, LLC Web Site

Figure 10.1-1 Historical Uranium Prices

The nuclear fuel cycle cost which was calculated by the Federation of Electric Companies of Japan (FECJ) in December 2003 can be utilize for this study. The values are as follows;

Table 10.1-2 Component of Nuclear Fuel Cycle Cost

Nuclear Fuel Cycle Cost	1.65cent/kWh
<Front End>	0.74cent/kWh
Uranium Ore Cost, Concentration Cost and Conversion Cost	0.17cent/kWh
Enrichment	0.27cent/kWh
Reconversion, Fabrication Cost	0.29cent/kWh
<Reprocessing>	0.63cent/kWh
<Back End>	0.29cent/kWh
Interim Storage	0.03cent/kWh
Waste Disposal	0.25cent/kWh

(Note) 1$=100yen

Among these values, only costs of uranium ore, concentration and conversion should be adjusted because these costs are changing year by year. Taking account of uranium spot price, we've modified and the value below can be adopted.

Uranium Ore Cost, Concentration Cost and Conversion Cost	0.85cent/kWh

Consequently, total nuclear fuel cycle cost can be 2.32US$/kWh and each fuel cost can be set as the value indicated on Table 10.1-2.

Table 10.1-3 Fuel Prices

Year	Fuel Type	Unit	Reference	Low	Super High
2008	Crude Oil	US$/MMBtu	22.5	22.5	22.5
	Fuel Oil		25.8	25.8	25.8
	Diesel		30.8	30.8	30.8
	Natural Gas		13.3	13.3	13.3
	Coal		2.7	2.7	3.1
	Nuclear	Cent/kWh	2.3	2.3	2.3
2030	Crued Oil	US$/MMBtu	30	22.5	45
	Fuel Oil		36.1	28.4	51.5
	Diesel		46.8	39.7	60.8
	Natural Gas		20.4	15.3	30.6
	Coal		4.8	3.6	7.2
	Nuclear	Cent/kWh	2.3	2.3	2.3

(2) Plants' Characteristics

Table 10.1-3 shows power plants' characteristics by each type. The capital costs have been decided based on the information from newspapers and Japan Bank for International Cooperation (now it is integrated in new JICA). The equalized expenditure ratio has been calculated, only considering interest rate and depreciation. The heat efficiency can be obtained from name plate value of existing power plants in Philippines and catalog spec of some Japanese manufacturers.

Table 10.1-4 Plants' Characteristics

	Capital Costs (US$/kW)	Asset Life (year)	Expenditure Rate (%)	Heat Efficiency (%)
GCC	900.0	25.0	10.9	56.4
Coal	1,400.0	30.0	10.6	46.3
Oil ST	800.0	25.0	10.9	38.0
Oil GT	600.0	20.0	11.6	39.0
PSPP	900.0	50.0	10.1	N/A
Diesel	1,300.0	20.0	11.6	40.0
Geothermal	2,900.0	30.0	10.6	N/A
Wind	2,000.0	25.0	10.9	N/A
Conventional Hydro	2,500.0	50.0	10.1	N/A
Nuclear	3,000.0	35.0	10.3	N/A

(Note) Salvage Rate = 10% ; Interest Rate = 10%

Furthermore PDPAT requires heat rate curves by plant type. The curves can be decided in the manner as follow.

The heat rate curve has to be expressed as parabolic curve in PDPAT. Based on the value of heat balance shown in Table 10.1-4, the coefficient of curve can be obtain as shown in Table 10.1-5.

Table 10.1-5 Heat Balance by Plant Type

	Unite Capacity (MW)	% Load	Heat Efficiency (%)
Coal ST	500.0	1.0	46.3
		0.8	45.5
		0.5	43.9
GCC	500.0	1.0	56.4
		0.5	56.3
		0.2	54.0
Oil GT	100.0	1.0	39.0
		0.8	37.4
		0.5	34.4
Oil ST	100.0	1.0	38.0
		0.8	37.8
		0.5	36.8
Diesel	100.0	1.0	40.0
		0.8	38.0
		0.5	34.4

$$y = ax^2 + bx + c$$

y *: Inputted fuel (MCal)*

x *: Electric output (MW)*

Table 10.1-6 Coefficient of Heat Rate Curve

	Coefficient	Heat Efficiency (%)
Coal ST	a	0.1
	b	1,706.8
	c	59,501.0
GCC	a	0.1
	b	1,420.8
	c	18,654.0
Oil GT	a	0.5
	b	1,839.1
	c	31,859.0
Oil ST	a	1.5
	b	1,962.1
	c	14,955.0
Diesel	a	0.4
	b	1,736.8
	c	37,105.0

(3) Yearly Duration Curve of Power Demand

Yearly duration curve of power demand below can be made of data during 2002-2005.

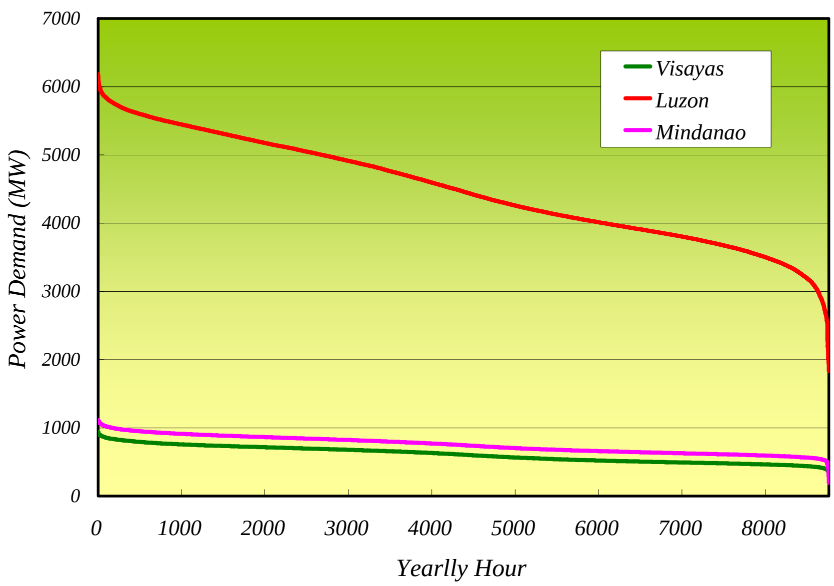


Figure 10.1-2 Yearly Duration Curve

(4) Demand Forecast & Reserve Margin Rate

Power Development Planning usually requires not only electricity consumption forecast but also power demand forecast. However, Chapter 6 presented only electricity demand. Consequently we shall assume the power demand will grow at the same rate of the electricity demand growth. Figure 10.1-3 shows the power demand forecasts.

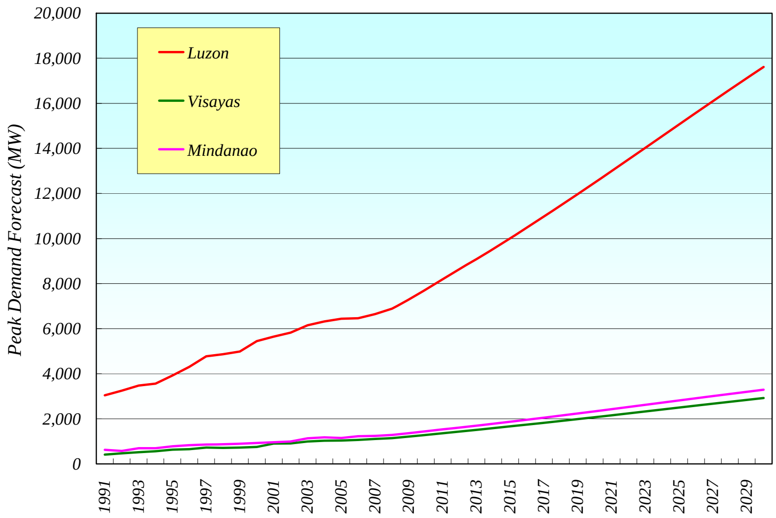


Figure 10.1-3 Power Demand Forecast

10.1.5 Result of Study

(1) Optimal Generation Mixture based on Fuel Price Scenario of Reference Case

Figure 10.1-4 shows the correlation between capacity factor and annual expenditure by plant type based on calculation with the reference case of fuel price scenario.

As a result, in more than 50% of capacity factor (so-called base demand), it is economical to develop and operate conventional hydro power plants, geothermal plants and coal fired thermal plants to meet the demand.   On the other hand, in less than 20% of capacity factor (so-called peak demand), it is economical to use PSPP (pumped starge power plant) to supply electricity and in middle range between the two (so-called middle load), GCC (gas combined cycle) is good.

The points revealed from the analysis regarding economical aspect are as follows;

i) Coal-fired thermal power plant

In range down to 20% of capacity factor, it is still economical to use coal fired thermal power plants to supply electricity. If liberalization is not restricted, much amount of this type of plants should be introduced in this country until 2030.

From the view point of system operation, this type of plants has some problem to meet middle load because it takes rather long time to be warmed up after the shutdown.   Practically, it may be realistic to combine with GCC plants to meet middle load.

ii) Conventional hydro power plant (run-of-river type)

Run-of-river hydro can be feasible if the capital costs are lower than 2,500US$/kW and it is expected to be operated in high capacity factor to some extent. So it should be promoted.

Based on “Guide on mini-hydropower development in the Philippines”, Philippines has hydro potential 5,400MW for which F/S has been implemented.   Under current condition that fossil fuel prices skyrocket, it’s required to re-study on economical, social and environmental effects of each hydro plan and promote them steadily from view points of national economics.

iii) Geothermal power plant

Geothermal power should be developed as its capital costs are kept less than 2,900US$/kW.

The potential of geothermal power is expected to be approximately 2,600MW and capacity of 1,200MW among them is recognized as very feasible site. So promoting the development is expected.

iv) Nuclear power plants

Based on the result it has been clarified find we cannot take any economical advantage from introduce of nuclear power and however, it can be more economical to operate nuclear to meet base load than GCC. So nuclear can be a good option for coal alternatives and needless to say for anti-CO_2 emission.

How the government will take counter-measure for the global warming issue will have effect on the nuclear power development.

v) PSPP

The result of analysis shows that it's efficient to use PSPP as peak power. When the capacity of coal-fired thermal power increase to some extent in near future, some amount of capacity of PSPP should be required to keep reliability of the grid.

vi)Wind power

Wind power plants can be feasible if it is operated for more than 30% in capacity factor. On the other hand, it has several problems that since its output depends on wind condition, the supply capacity output tends to be unstable and it cannot access the grid which is not fulfilled with adequate voltage. When the development tends to be prompted enormously, the technical issue like that should be examined.

Based on the result of the annual expenditure analysis, the optimal generation mixture can be acquired. Figure 10.1-4 shows that we can regard the power to meet the load which requires more than 50% of capacity factor as base power, the power to meet the load requiring less than 20% of capacity factor as peak power and the power between the two as middle power. Options for each power are as follows;

Base Power : Coal fired thermal, Run-of-river hydro, Geothermal, Nuclear power

Middle Power : GCC

Peak Power : PSPP(Pumped storage power plant, Reservoir type hydro, Oil GT, Diesel, Oil ST

Other : Wind power

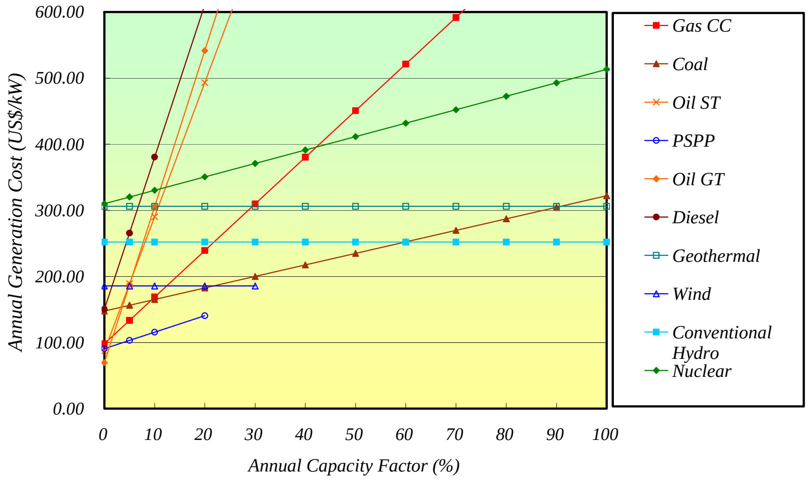


Figure 10.1-4 Annual Generation Expenditure Analysis

Figure 10.1-5~7 show duration curves of Luzon, Visayas, Mindanao to which peak power, middle power and base power are reflected. Table 10.1-6 summarizes the combination of each power capacity by region and in total of Philippines. As shown in table, the base power, the middle power and the peak power should account for 71%, 12% and 17% respectively. And it is the optimal generation mixture.

On the other hand, the portion of existing power plant capacity by power type is as shown in Table 10.1-7. Comparing this portion with the optimal generation mixture, we can say followings.

In each region, the peak power capacity in amount is introduced nearly twice as much as one required for constituting the optimal generation mix because they have a number of diesel power plants and oil GT in many islands. The peak power facilities portion more than necessary must forced the peak power plant to be operated to meet the middle load. it is supposed that this result in inefficient operation and higher electricity rate.

As Development of geothermal power plants has developed already in Visayas region already, the portion of base power capacity is adequate for the optimal mix. In Luzon and Mindanao, base power capacity is less than optimal amount. Furthermore, it has been clarified that coal fired thermal power plants are operate in too low capacity factor to control the facilities in efficiency. On the other hand GCC is utilized in very high capacity factor despite the fact it should be middle power essentially. This condition doesn’t represents the power plants may be operated economically.

Henceforth reasonable power plants such as coal fired thermal power, run-of-river hydro and geothermal power are expected to be developed to promote the optimal generation mix.

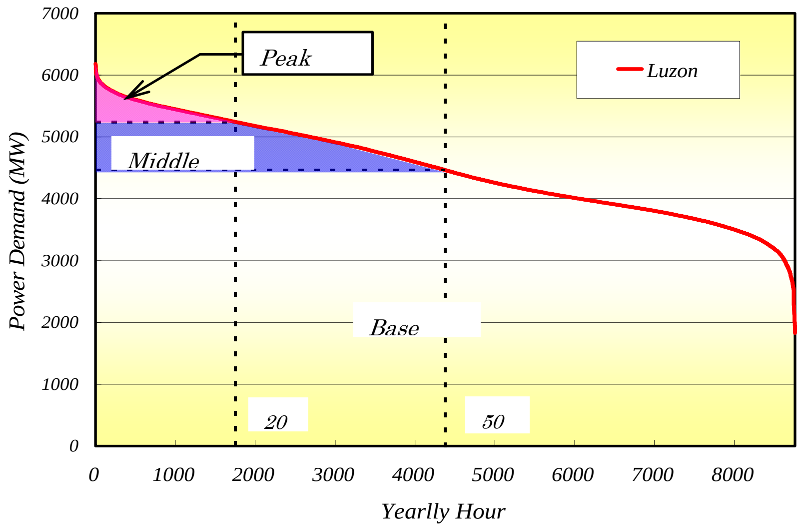


Figure 10.1-5 Duration Curve and Optimal Generation Mix in Luzon

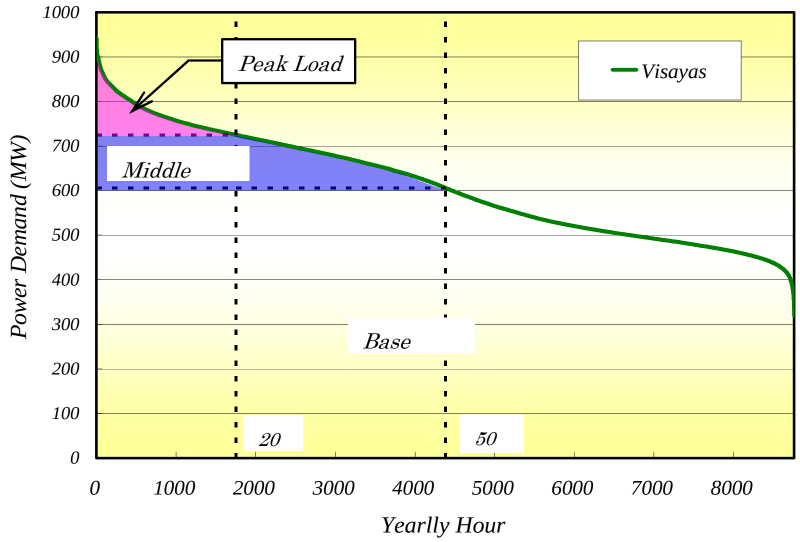


Figure 10.1-6 Duration Curve and Optimal Generation Mix in Visayas

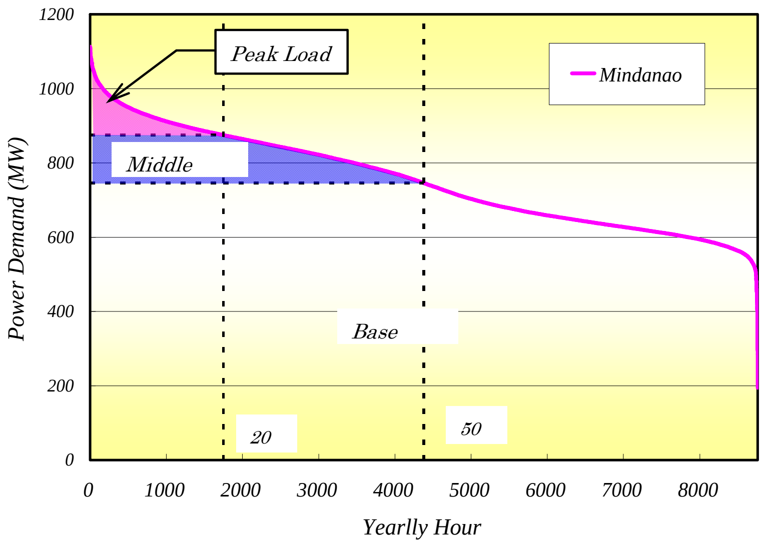


Figure 10.1-7 Duration Curve and Optimal Generation Mix in Mindanao

Table 10.1-7 Optimal Generation Mix

	Luzon	Visayas	Mindanao	All Philippines
Peak Load	15%	23%	21%	17%
Middle Load	13%	13%	12%	12%
Base Load	72%	64%	67%	71%

Table 10.1-8 Generation Mix of Existing Power Plants (as of 2007)

	Luzon	Visayas	Mindanao	All Philippines
Peak Load	36.70%	37.60%	40.30%	37.70%
Middle Load	22.80%	0%	0%	17.50%
Base Load	40.50%	62.40%	55.70%	44.80%

Taking account of the optimal generation mix acquired by screening curve method, we would like to make an example of power development planning.

First we shall calculate required capacity to be developed until 2030 in each region, Luzon,Visayas and Mindanao. In Figure 10.1-8~10 the blue colored line represents power demand forecast and the red colored line represents required total install capacity including reserve margin corresponding with 20% of reserve margin rate. The Green colored bar indicate the total capacity of the existing plants, hence it's made clear that the pale red bar indicates required capacity to be developed until 2030.

In Luzon new power should be installed after 2014, in Visayas and Mindanao new ones should be installed after 2010 as shown in the figures. The required capacities are 9,800MW, 1,900MW and 2,500MW in Luzon, Visayas and Mindanao respectively.

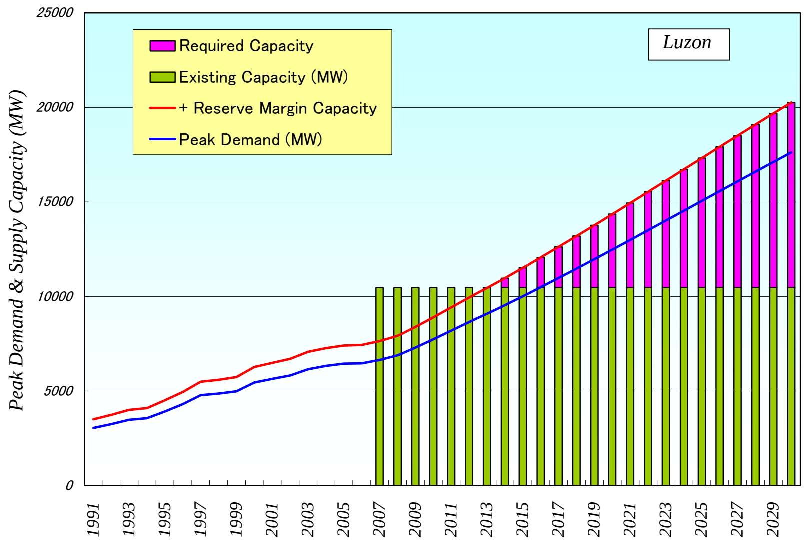


Figure 10.1-8 Required Capacity in Luzon

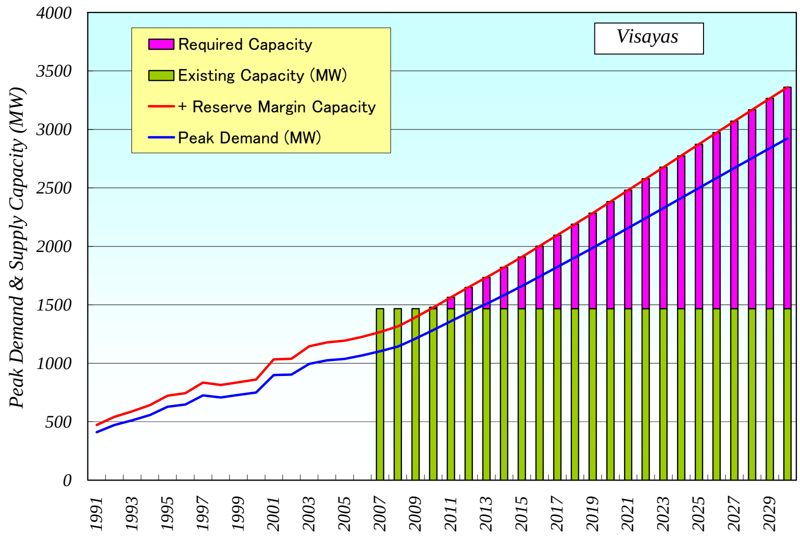


Figure 10.1-9 Required Capacity in Visayas

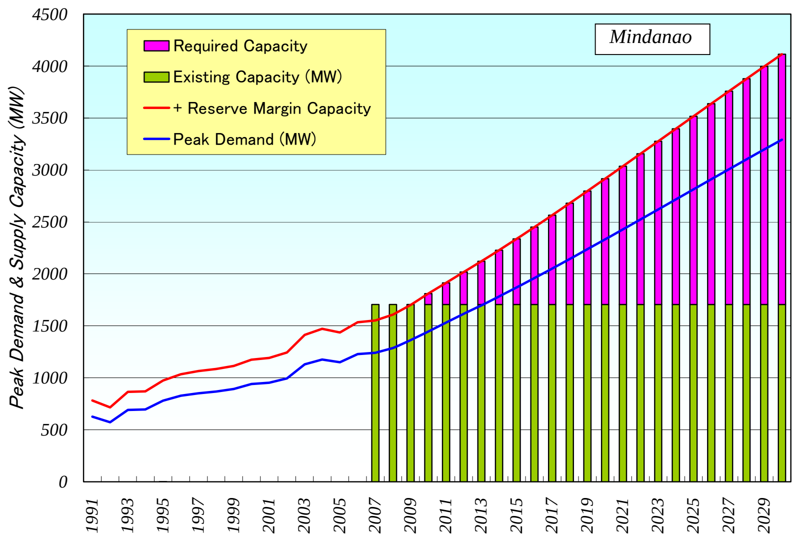


Figure 10.1-10 Required Capacity in Mindanao

Figure 10.1.11~13 show examples of power development plans which promote to the optimal generation mixture in Luzon, Visayas and Mindanao.

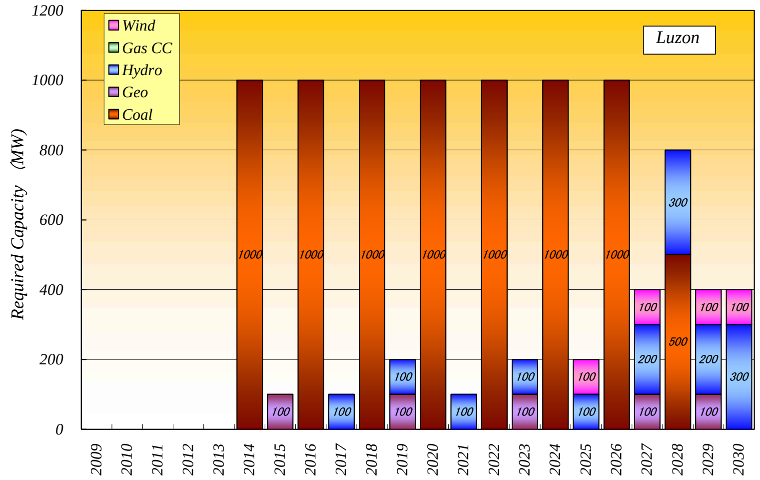


Figure 10.1-11 Power Development Mix in Luzon

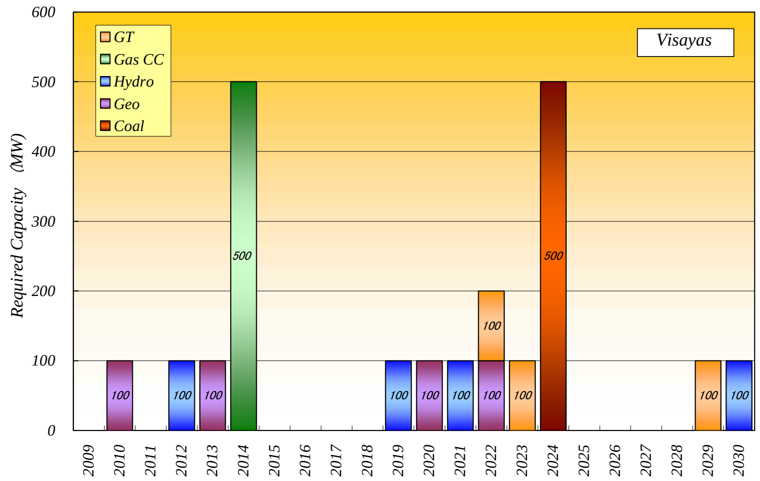


Figure 10.1-12 Power Development Mix in Visayas

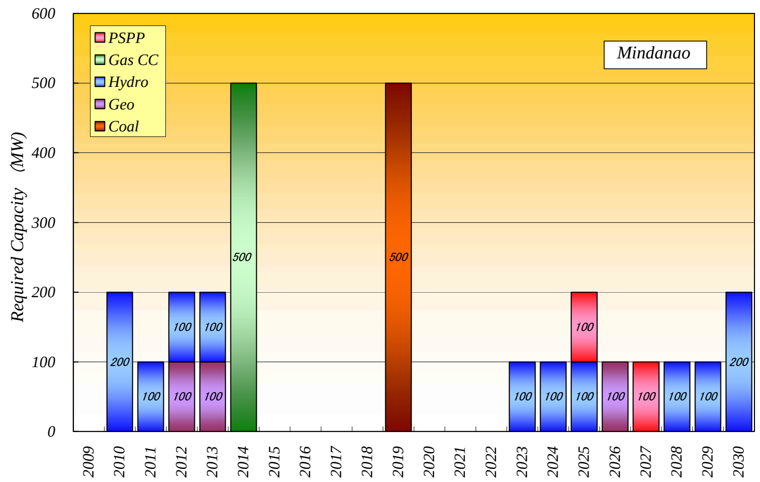


Figure 10.1-13 Power Development Mix in Mindanao

Table 10.1-8 shows the total required capacity to meet the power demand growth during 2009-2030 and promote the optimal generation mixture.

Table 10.1-9 Total Required Capacity

	Plant Type	Capacity(MW)
Base Supply	Coal-fired Thermal	8,500
	Geothermal	1,200
	Conventional Hydro	3,100
	Wind	400
Middle	GCC	1,000
Peak	PSPP	200
	Gas GT	300

(2) Scenario Case Study for Fuel Price

Figure 10.1-14 represents the correlation between annual capacity factor and annual generation costs based on the super high scenario and low scenario of fuel prices. The upper lines in the same colored one indicate the costs corresponded with the super high scenario and the lower ones indicate the cost costs corresponded with the low one. Conclusion which have be clarified from this study are as follows,

a) Nuclear Power shall be more economical than coal fired thermal power when the coal price hike up to the super high scenario. Under such a condition, nuclear power should be introduced into the optimal generation mixture.

b) In 2030 the fuel price level assumed for this study may make Gas CC and Oil GT development insignificant at any range of capacity factor.

c) Geothermal, conventional hydro and wind power plants which can generate a certain amount of electricity (i.e. 70% for geothermal, 50% for conventional hydro and 20% for wind in capacity

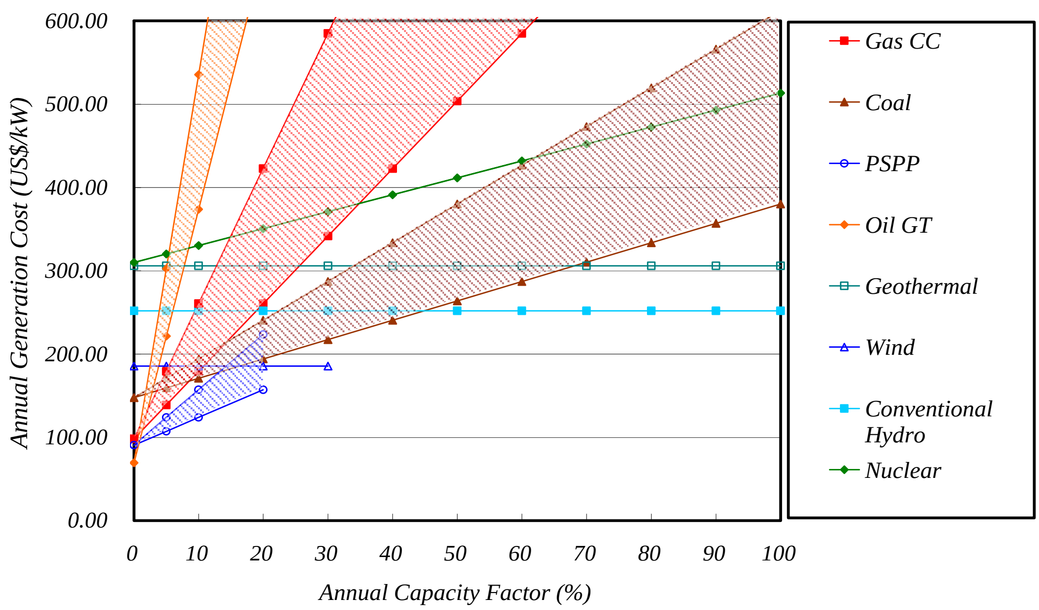


Figure 10.1-14 Annual Generation Costs with Various Fuel Price Scenario

factor) shall become more economical than coal fired thermal power plants in 2030.Consequently, if the fossil fuel prices hike up to some extent in the future, the power supply shown below should constitute the optimal generation mixture and provide electricity economically.

Base Supply Power	Nuclear, Geothermal
Base-Middle Supply Power	Coal-fired thermal, Conventional Hydro, Wind
Peak Supply Power	Pumped storage power hydro

(3) Sensitivity Study of GCC Introduction

Philippines has a plan that they will construct LNG tank base and start to import it. If they intend to utilize whole amount of that as fuel of GCC, the power plant of 3,000MW should be developed in total. The optimal generation mixture which is resulted from the study in Section one includes two 500MW GCC units. To satisfy the requirement, they have to introduce 2,000MW of GCC more, which is same as the reference case of the primary energy in Chapter 8.

To implement the sensitivity study with regard to economical effects, we shall assume that GCC of 2,000MW will be introduced in Luzon. Figure 10.1-15 shows the forecasted power development mix in each region.

We shall calculate the generation costs by PDPAT and compared them between the reference case and the optimal generation mixture case.

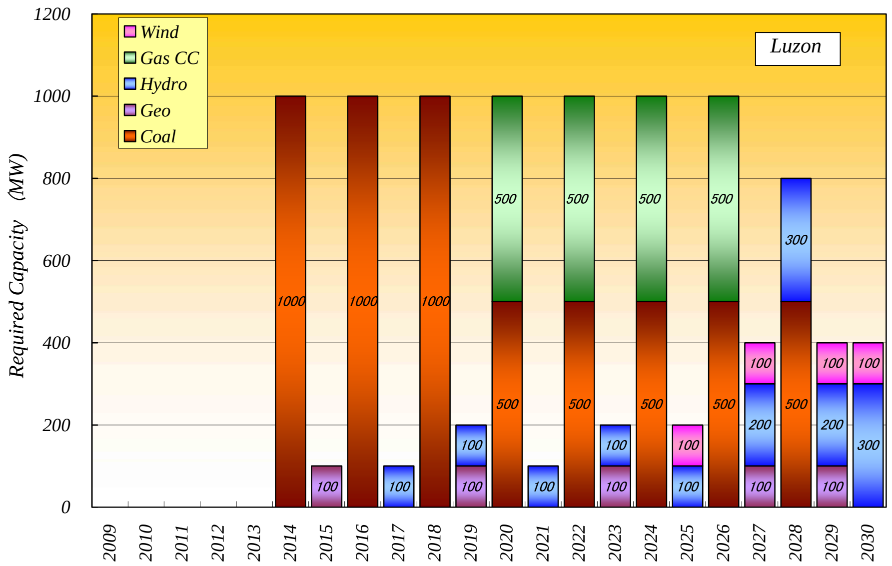


Figure 10.1-15 2,000MW GCC Introduction Case (Reference Case)

Figure 10.1-16 shows the correlation between the introduced capacity and the annual generation cost in 2030. When a GCC of 2,000MW is additionally introduced to the Optimal Case, the generation cost becomes approximately 7% higher compared with the optimal generation mix. When this applied to the Super-high-price Case, the annual generation cost becomes approximately 9% higher also.

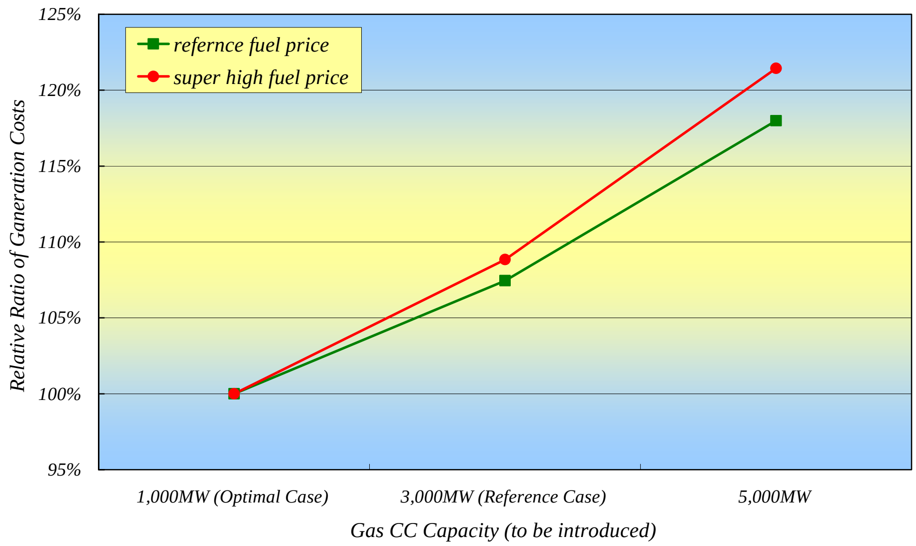


Figure 10.1-16 Correlation between GCC Introduction Capacity and Generation Costs

(4) Sensitivity Study of Nuclear Introduction

The Philippines constructed Bataan Nuclear Power Plant and abandoned as mentioned in Chapter 5. However under the circumstance that outage of power may occur in near future, they tend to develop a nuclear power plant again, taking account of the global warming issue.

To examine the condition in economical aspect, we shall calculate the generation costs by PDPAT and compared them between the nuclear introduction case and the optimal generation mixture case. Figure 10.1-17 shows the forecasted power development mix.

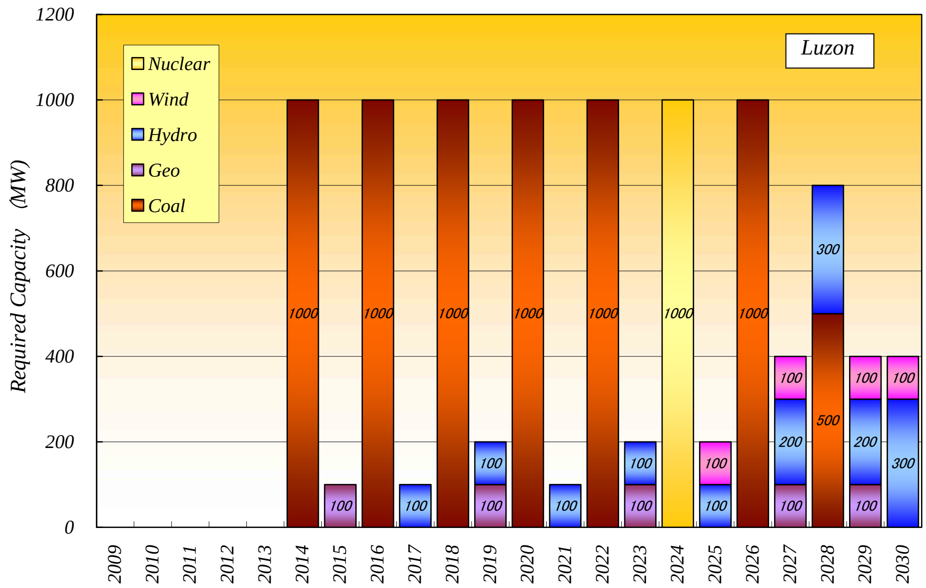


Figure 10.1-17 1,000MW Nuclear Introduction Case

Figure 10.1-18 shows the correlation between the introduced capacity and the annual generation cost in 2030. When a Nuclear Power Plant of 1,000MW is additionally introduced to the Optimal Case, the annual generation cost becomes about 2% higher compared with the optimal generation mix. When this is applied to the Super-high-price Case, the annual generation cost will be only 1% higher than cost of optimal generation mix. This result shows the nuclear introduction would not incur substantial rise in generation costs.

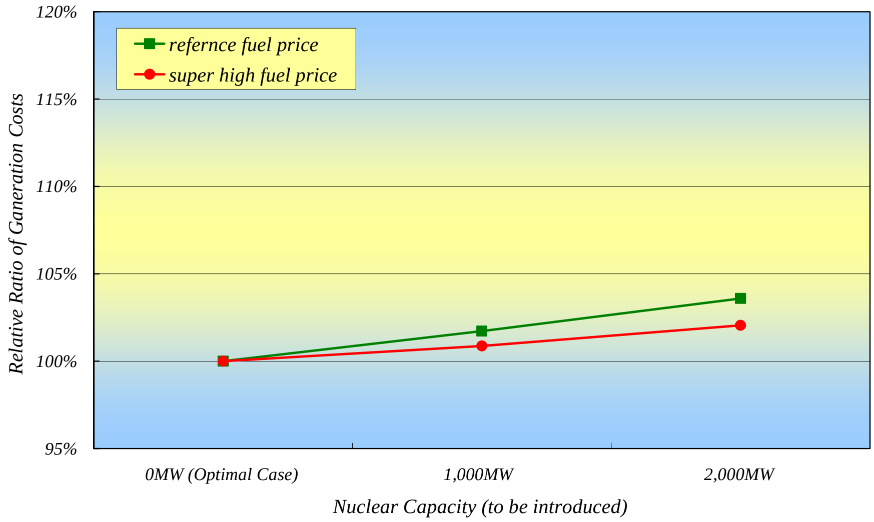


Figure 10.1-18 Correlation between Nuclear Introduction Capacity and Generation Cost

10.2 Surrounding and Implication of Power Sector

The important viewpoint of power development policy is to constitute the power supply system which can provide electricity in economical and reliable manner with conserving the global environment. From this viewpoint and the analysis implemented in Section 10.1 we like to clear some issues and make implication for the power sector policy.

10.2.1 Reliability of Power Supply

Based on this study for the demand and the supply taking account of reliability of power system, shortage of power supply may occur in Luzon in 2014 and in Visayas and Mindanao in 2010 respectively. Consequently urgent development of power plants should be required. However the Philippines has liberalized their power sector and the government cannot development the power by their own. Therefore the government should promote the development of subsidy, preferential tax and so on through legislating and preparing promotion act.

To ensure the reliability of the power supply, the grid's development and expansion are important factors. Especially the expansion of the grid in northern Luzon, the expansion of the interconnected line in Visayas and the development of the interconnected line between Mindanao-Leyte should be required and these development and expansion may also contribute promotion of development of geothermal, conventional hydro and wind power, which exist in each area.

It's important to make diversification of energy and procurement from the viewpoint of ensuring reliability of power supply in the broad sense for Philippines, which has high dependence on imported energy. Consequently it is essential for the country to push forward the development of not only oil, gas and coal-fired thermal power but also hydro and nuclear power.

10.2.2 Economical Power Supply System

To ensure economical power supply system, it's necessary to combine various power plants in appropriate portion, with examining the fixed cost, the fuel cost and the required capacity factor of each power plant. This study has clarified that the existing generation mixture is not optimum. Particularly total capacity ratio of coal-fired thermal power may be too low. On the other hand, total capacity ratio of GCC may be too high. The simulation by PDPAT has made clear that it's appropriate for GCC to be operated at about 50% in capacity factor but actually the power plants are run at the capacity factor of 70-80%. On the other hand, it's proper for Coal-fired thermal power to be operated at 70-80% in capacity factor but actually the power plants are run at the capacity factor of 40-50%. Consequently Philippines should make effort to modify the ratio of the capacity of each energy type.

When we assume the fuel price stabilize at the current level, Nuclear power cannot be introduced only from the viewpoint of economics. However if fossil fuel prices hike, it can be competitive, compared with coal, oil and gas. Therefore it's necessary to examine the fossil fuel prices carefully and anticipate it always.

Renewable energy such as Geothermal, Conventional Hydro and Wind Power that can generate a certain amount of electricity has competitiveness, compared with the fossil fuel energy. Consequently its development should be promoted as much as possible. However liberalization of power market may prevent private companies from investing to develop the renewable energy because the business can include various risks such as fluctuation of electricity generation, possibility of increment of investigation costs and long period of recovery of capital costs. To compensate the risks, government should be required to take measures of guarantee for the risks and implement some potential studies and master plans.

10.2.3 Action for Curbing Global Warming

In Philippines which has liberalized their power sector, power companies must develop coal-fired thermal power plants which have big merits in economic efficiency. There is a similar trend in other emerging countries and there is no doubt this matter has a negative impact to global warming issue. To curb global warming any more, the government should make every efforts to improve the efficiency of coal-fired thermal plants and introduce high efficient power plants. And to constitute efficient power supply system, it should legislate on the environment conservation act for their power sector and their energy saving act.

Nuclear power can be alternative option to coal-fired thermal power taking account of the economical efficiency and the global warming issue. Nuclear power can be regarded as sub-indigenous energy because the fuel life is very long and can be recycled. And this matter may contribute their energy security. Fortunately, they have construction site for expansion plan in Bataan Nuclear Power Plant that has a switchyard, transmission facilities and service road. And they may have a big advantage of development of a brand-new nuclear power plant. On the contrary there are many obstacles that they have to overcome such as legislation of related law, constitution of a developing and operating company and capacity building for operators.

Current soars of the fossil fuel are big tailwinds. However as mentioned earlier, to promote the renewable energy, the government' supports should be needed. Moreover the expansion of transmission system should be necessary. In Philippines they have a lot of potential sites of Wind power in the Northern Luzon and Palawan Island and many potential sites of Geothermal power in Visayas and Luzon, and good Hydro potential sites in Mindanao. The transmission systems in these areas are very weak or isolated. Therefore if the renewable power plants generate electricity, energy cannot be sent to consumers. Hence to promote their renewable energy, expansion of their transmission systems must be the top priority issue. The transmission company, TransCo has also been privatized. Under this circumstance, the government should make clear how they will keep relationship with TransCo and what measure they will take to expand their transmission system.

Chapter 11 Outlook of Primary Energy Supply

11.1 Outlook and Challenges of Oil and Gas Sector

Based on the analysis in the previous chapters, we will look into challenges anticipated in the oil and gas sector of the Philippines and consider possible measures to cope with them.

11.1.1 Issues and Challenges of Oil and Gas Sector

Major issues to be discussed on the future development of the oil and gas sector of the Philippines may be summarized as follows.

(1) Sufficiency of Indigenous Petroleum Products Supply

Table 11.1-1 shows the balance of indigenous production and consumption of petroleum products. At present, in addition to LPG, indigenous production of gasoline and middle distillates (Jet fuel and Diesel Gas Oil) are in short of the indigenous demand, and their import quantities are relatively large. Although the fuel oil production exceeds the indigenous demand, a substantial quantity is imported. It is inferred that this situation arises due to quality of indigenous fuel oil such that only high sulfur fuel oils are produced at indigenous refineries.

Table 11.1-1 Production/Consumption Balance of Petroleum Products

(Unit: thousand barrels)

Product	Production	Consumption	Balance		Import
			(Pro.-Cons.)	(vs. Cons.)	
LPG	3,864	10,931	**-7,067**	**-65%**	7,214
Gasoline	13,490	22,544	**-9,054**	**-40%**	9,500
Diesel Fuel/Gas Oil	26,942	39,058	**-12,116**	**-31%**	16,208
Aviation turbo/Jet A-1	7,186	9,984	**-2,798**	**-28%**	2,910
Industrial fuel oil	20,981	17,876	**3,105**	**17%**	4,668
Others	2,345	536	**1,809**	**338%**	545

Note: Others/ Asphalt, Naphtha, Solvents, Mixed Xylene and Waxes

Source: 2007 Philippine Statistical Yearbook

(2) Sulfur Content of Gasoline and Diesel Gas Oil

Specifications of motor fuels in the Philippines and Japan are shown in Table 11.1-2. Distillation ranges of these products are mostly same in both countries. However, sulfur contents remain at higher level of EURO-2 Standard in the Philippines though efforts are being made to lower them. Benzene content of gasoline is also high compared with the standard of Japan. These components of motor fuels are deemed as serious obstacles for exhaust gas cleaning system. The standard needs to be reviewed for improvement of air quality in metropolitan area as well as for efficient use of latest model vehicles equipped with sophisticated exhaust gas treatment system.

As petroleum products are widely traded among ASEAN and adjacent countries, it is desirable to consider a sort of regional technical standard, for example, ASEAN Standard. Such common standard will contribute to remove fake products, hindrances for trade and make it easier to accommodate products each other in case emergency response is required. It will also contribute to improve car engine efficiency, as many countries will be able to consider the issue on the same standard, then, since it is a big headache for international car makers to consider different fuel quality for one country and another in their efforts to cope with stricter environmental requirement as well as efficiency improvement. It is also desirable to consider quality standard of biofuels that are expected to increase substantially in Southeast Asian countries at the same time.

Table 11.1-2 Technical Standard of Motor Fuels in the Philippines and Japan

			Philippine		Japan	
Diesel					Less than	
	Density		0.820 - 0.860 kg/l @15.C		0.86	g/cm2
= >	**Sulfur**	Mass %, Max.	0.20	as of Jan, 2001	0.005	as of 2004
			0.05	as of Jan, 2004	0.001	as of 2007
	Cetane Index	Min.	50		45	
	Distillation	90% Recovery, < deg. C,	370		360 / 350/ 330	
					(by season, reasion)	
Gasoline					Less than	
	Density		0.783	kg/l @15.C	0.783	g/cm2
= >	**Sulfur**	Mass %, Max.	0.05		0.001	as of 2005
	Aromatics	%	45	as of Jan, 2000		
			35	as of Jan, 2003		
= >	**Benzene**	%	4	as of Jan, 2000	1	as of Jan, 2000
			2	as of Jan, 2003		
	Distillation	90% Recovery, < deg. C,	180		180	
		End Point	221		220	

Source: DOE, Petron Basic Line: Fuels Lubricants Related Specifications, JIS Handbook

(3) Crude Oil Import

The Philippines depends upon import for most of its crude oil supply being endowed very small quantity of current indigenous crude oil production. Oil exploration efforts in the country are relatively stagnant without very promising potential. This tendency would not change for the time being unless sizable oil discovery were made. Among the imported crude oils, share of the Middle East crude oils exceed 90% of the total import, and this trend may continue in future. Given these conditions, it is necessary to consider due measures on energy security as well as product quality improvement.

Table 11.1-3 Crude Oil Import Sources

(Unit: thousand barrels)

Source	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Imported	119,084	128,940	116,596	117,592	113,633	111,454	93,871	91,309	73,066	77,637	78,097
Domestic	721	176	298	191	134	175	251	162	119	226	164
Imported (%)	(99.4%)	(99.9%)	(99.7%)	(99.8%)	(99.9%)	(99.8%)	(99.7%)	(99.8%)	(99.8%)	(99.7%)	(99.8%)
Domestic (%)	(0.6%)	(0.1%)	(0.3%)	(0.2%)	(0.1%)	(0.2%)	(0.3%)	(0.2%)	(0.2%)	(0.3%)	(0.2%)
Total	119,805	129,116	116,894	117,783	113,767	111,629	94,122	91,471	73,185	77,863	78,261

Note: Details may not add up to totals due to rounding,
Source: Department of Energy,

(4) Platform for natural Gas Development

In the Philippines, natural gas is used mostly for power generation and only a very tiny quantity is used in other sectors such as CNG (compressed natural gas) to replace motor fuel and industrial fuel/feedstock. This is merely because gas transmission line to the demand center is not available. While the Batman gas pipeline system has been proposed with one route from the Batangas shore terminal of the Malampaya gas connecting to Metro Manila area and another from an LNG terminal proposed on the Bataan peninsula as shown in Figure 5.1-3, there has been no material progress of the project. Natural gas utilization has not been developed to the stage of forming a city gas grid yet, and the creation and development of natural gas market in the Philippines is not past the conceptual stage.

It is necessary to secure certain amount of gas demand in order to proceed with a city gas grid plan. In this regard, it is conceivable that introduction of natural gas in the Philippines will bring various benefits, for example those direct effects such as improvement of environment at offices and households with supply of cleaner energy and improvement of energy efficiency applying co-generation. There will be additional benefits that it will strengthen energy security through energy diversification and reduce greenhouse gas emission.

In developing natural gas demand, in addition to search for new demand, conversion from the existing fuels is also promising. Natural gas demand for the first category may include conversion from biomass or LPG at offices and households, co-generation and gas-driven air-conditioner, and CNG driven vehicles. Those for the second category of fuel conversion at existing facilities may be those to aim at change of fuel from coal and/or oil at power stations and industrial boilers. It is often observed that the issue if such introduction of natural gas is beneficial in rationalizing the national energy system closely relates to regulation on fuel quality for better environment, energy demand structure, status of gas utilization technology and potential of technology deployment. It is desirable to conduct a comprehensive study on these points, and then, once natural gas development is proven to be beneficial, firm and proper development plan should be implemented with due consideration on the construction of efficient infrastructure system.

11.1.2 Policy Objectives for Oil and Gas Sector

Major policy objectives to be considered in the oil and gas sector may be, in the oil sector, securing stable supply and improving product quality, and in the gas sector, environment improvement and energy diversification.

(1) Stable Oil Supply

Supply security of oil should be given first priority to consider. In particular, it is deemed necessary to strengthen the relationship with oil exporting countries such as the Middle East, and the desirable form of relationship should be comprehensive one with wide coverage beyond the general relationship of seller and buyer of oil. As the position of SaudiAramco as an investor in Petron is changing, it is hoped that cooperative relationship should be maintained. It is generally conceivable to take direct means such as investment in upstream exploration and/or joint venture refineries in oil producing/exporting countries, for example in the Middle East. Considering the present global circumstance, however, workforce secondment and investment in surrounding businesses may also be effective objectives.

(2) Strategic Petroleum Stockpiling

Since the Philippines is already a net oil importing country, national strategic petroleum stockpiling system should be established. In the system, due consideration should be paid on the elements such as combination of crude oil and petroleum products, location of the terminal and indigenous refineries and linkage with logistic systems. It is also important to consider cooperation within ASEAN and/or ASEAN+3 countries including accommodation system in case of emergency.

(3) Secondary Refining Facilities

Although penetration of biofuel may alleviate demand growth of petroleum products such as gasoline and diesel gas oil to some extent, the demands are apparently on the increasing trend. Considering the current refinery composition, quality of prevailing petroleum products, response to increasing demand and tighter environment regulation, refineries in the Philippines are in short of secondary facilities such as hydro-desulphurization and hydro-cracking facilities and accompanying hydrogen plants and sulfur recovery plants. Assuming that the quality of future import crude oil may tend to be high sulfur and heavy, to receive these crude oils and produce gasoline and diesel gas oil with maximum yields, it is necessary to install or expand secondary facilities. In particular, reduction of sulfur content is essential in the trend of upgrading motor fuel quality.

In view of the world crude oil market trend, it is necessary to focus on the following points in examining the future refinery plan.

-Quality constraints of crude oil, namely, API degree and sulfur content

-Price differentials among different grades of crude oil

-Economics of refinery business

In addition, unification of product standard such as gasoline and diesel oil is important in promoting energy conservation and environment protection. The current standard is set at EURO-2 level aiming at EURO-3 or EURO-4 in future. It will be appropriate to set forth the new standard taking account of the global trend considering ASEAN standard or Southeast Asian standard.[30] Setting out common product standard with Asian countries, it is possible to reduce constraints on export/import and make it easier to accommodate products in case of emergency.

(4) Taxation on Petroleum Products

It is an urgent issue to secure sufficient fund for construction of energy infrastructure platform such as oil stockpiling base, natural gas pipeline system, importing ports for fuel, road for transportation and delivery and so on. Taxation on automotive energy such as gasoline and diesel oil, though it requires highly political decision considering social impact, will be considered as an important measure to manage necessary investment funds on energy facilities under control of DOE or appropriate authority.

(5) Natural Gas Pipeline and LNG

Development of natural gas use is highly effective in improving environment as well as energy security curbing oil demand and import. Considering the benefits of the clean and convenient energy for use, social needs of natural gas development are great and construction of natural gas pipeline grid to this end is an urgent issue. However, multiple pipeline projects proposed to link the shore terminal of the Malampaya gas at Batangas and Metro Manila have made no substantial progress to date.

In promoting this plan, it is necessary to develop city gas demand other than those for power generation purpose and integrate them into a gas market. Construction of natural gas grid is a highly capital intensive business. In case of a green field project, a general approach is that, with anchor demand for power generation, a fundamental grid should be formed incorporating large and medium sized users available along the pipeline route. In this regard, natural gas use for power generation should be considered not only based upon its economic as power source but also overall benefits to introduce natural gas with a comprehensive plan from a viewpoint of regional and national development. The government sector is requested to take up important role to prepare proper laws and regulations and administrative actions for construction and expansion of pipelines, such as right of way.

As energy to be used at fixed facilities such as factories and at home, electricity and gas are popular as they are clean and easy to use. As the gas supply system is not available in the Philippines, it is desirable to construct, especially in Metro Manila area, a natural gas delivery system. As a middle-long-term issue, taking account of depleting indigenous gas supply, it is necessary to consider introduction of LNG and start preparatory work on selection of source, establishment of procurement channel and delivery method, construction of receiving terminal and delivery pipelines, identification of core users and other important elements.

(6) Public Authority to Construct Energy platform

Energy infrastructure projects are generally less economic while requiring huge fund, and therefore they

[30] Japan started sulfur free (less than 10 ppm) on both gasoline and diesel oil since January 2005, and Korea will follow shortly. China is behind them currently aiming at EURO-3 and EURO-4. It is technically proven that low-sulfurization contributes to prevention of catalyst deterioration at exhaust gas treatment system and improvement of mileage.

would not make good progress just opening doors to the private sector. From this observation, it is recommended to create an authority that will be in charge of building the national energy platform of the Philippines, implementing those projects with high social requirement such as national oil stockpiling to enhance energy security and trunk gas pipeline system as an important energy infrastructure. Taking this approach, it is important to carefully limit direct involvement of government arms to a minimum extent. If government involvement is inevitable, we should set up a clear plan to set out the schedule to transfer the business to a third sector or the private sector in due course and take every measure to curb expansion of expense. It is desirable to list up potential projects that require governmental promotion and prepare laws and institutions to set up implementing bodies. Periodical review and audit are another important system after establishment of these organizations.

(7) Natural Gas Technologies

For development of natural gas use, it is necessary to promote introduction and deployment of new technologies at the potential users such as co-generation system, gas-driven air conditioner, and fuel cells. These activities will contribute to exploring potential gas demand for market expansion, and in turn overall energy efficiency improvement, reduction of electricity demand and alleviation of load fluctuation, and diversification of primary energy supply. Some assistance systems for gas introduction to residential and commercial sector will further enhance market development.

11.2 Outlook and Challenges of Coal Sector

11.2.1 Issues and Challenges of Coal sector

(1) Demand Side of Coal

The coal quality in the Philippines has characters such as low heat value, low fuel ratio, high sulphur, and high alkali content in ash, etc. The Semirara coal is especially high in ash alkali content. If Semirara coal is singly burned in a boiler for power generator in a cement kiln, it tends to cause fouling and related troubles. Also, the Semirara coal is apt to absorb moisture, and cause troubles during handling. Accordingly, the Semirara coal is singly burned only in some of the coal-fired units in the Calaca and Toledo power stations, while other plants are using it at the maximum ratio of 20% in a mixed combustion with imported steaming coal. This situation is one of the reasons to restrict the consumption of indigenous coal, requiring technologies to enhance coal preparation or introduction of coal refining.

However, if the boiler is of a fluid bed type, it is possible to even burn 100% indigenous coal without a problem as mentioned above. It is therefore vital to carefully examine the boiler model and the specifications of purchased coal at the time of a boiler introduction.

As for specifications of coal-fired power stations in the Philippines, the older plants are designed for burning indigenous coal, and newer ones are designed for imported coal. Since heat value of indigenous coal is lower than imported coal, indigenous coal cannot be burnt efficiently and in large enough quantity in the newer boilers designed for imported coal, creating another reason restricting the indigenous coal consumption. In addition to the above-mentioned problems, the installed capacity of boilers for power generation is generally small at approximately 100MW or lower, which is also one of the factors for further reducing the thermal efficiency. It is required to ensure a reduction of coal consumption and CO_2 emission by reducing specific coal consumption with improved thermal efficiency and larger sized boilers for power generation, as well as by promoting advanced clean coal technologies.

(2) Supply Side of Coal

For the coal demand that is projected to grow more than 3 times from now until 2030, it is required to secure coal supplies that are stable both in quality and quantity.

Semirara Mining Corporation has been exporting coal since 2007, and has a plan to expand the exports up to about 1.5 million tons in 2008. Since imported coal price is drastically increasing with the substantial rise in FOB coal price and ocean transport cost, it would contribute to realize energy conservation and cost-saving if export coal is diverted to indigenous consumers.

To review steaming coal markets in Asia and Pacific region, while coal importing countries are steadily increasing coal demand, major coal exporting countries such as Australia and Indonesia are experiencing reduced supply capability due to bad weather or limited port facilities. The resultant tight supply and demand situation is causing the coal price to take a sharp upward trend. Meanwhile, National Power Corporation is purchasing 50% of its steaming coal requirement through long-term contracts and the other 50% by competitive bidding. However, they have no bargaining power against coal suppliers because the volume of coal purchase is not sizable enough. The purchasing price of Australian steaming coal for the coal-fired Masinloc Power Station has more than doubled from US$80/ton (6,322 kcal/kg, GAR) for the second quarter 2007 delivery to US$182.5/ton (6,322 kcal/kg, GAR) for the April 2008 delivery. Meanwhile, steaming coal spot FOB price (6,322 kcal/kg, GAR) of Newcastle in Australia rose from US$51/ton in January 2007 to US$190/ton at the beginning of July 2008. As escalation of global coal market price has an impact on a stable supply of coal in the Philippines, it should become necessary to develop and secure interests in overseas coal mines by joint effort of the public and private sectors.

11.2.2 Countermeasures on Coal Sector

Given the needs to supply coal stably for consumers in the Philippines including coal-fired power generation that will increase steadily toward the future, and also to reduce economic losses caused by exporting cheaper indigenous coal and importing expensive overseas coal, it is most effective and suitable to utilize indigenous coal resources existing in own country. In the Philippines, coal supply in 2030 is estimated at 17,968 ktoe, of which 28% will be indigenous coal and 72% import coal. It means that most of coal supply in the Philippines is estimated to depend on imports. For expanding coal supply, it is necessary to increase indigenous coal production as well as imports of overseas coal. On the other hand, since the coal consumption always accompanies the issues of CO_2 emission, it is required to reduce specific coal consumption in parallel with expanding coal supplies.

Possible countermeasures for coal sector are described as follows:

(1) Measures for Stable Coal Supply:

- To provide tax incentives to expanding indigenous coal supplies for indigenous coal developers.
- To promote development of overseas coal mines and acquisition of interests by private sector companies either jointly with the government and or alone for securing stable overseas coal supply. Also to provide low-interest financing and tax benefits to development and acquisition of overseas coal mines.
- To promote development and utilization of gas such as coal bed methane in the areas that can not produce coal economically.

(2) Measures for Reduction of Specific Coal Consumption and CO_2 Emission

- To promote introduction and diffusion of clean coal technologies by strengthening the core organization.
- To research possible introduction and to actively introduce and diffuse clean coal technologies. In addition, to ensure cooperative research with developed countries, and to invite demonstration projects regarding on-going research and development activities for clean coal technologies.
- Concerning boilers for power generation, to improve thermal efficiency by scaling up and by introducing boiler types suitable for coal type employed, such as fluid bed type for indigenous coal and high efficiency type for imported coal.
- To expand coal preparation and to introduce updated coal preparation technologies for improving recovery ratio and heat value on indigenous coal.
- To introduce desulphurization and dealkalization technologies for expanding indigenous coal demand for power generation.

11.3 Renewable Energy Sector

11.3.1 Issues and Challenges of Renewable Energies

As renewable energies are widely used for electricity supply, we will mainly discuss in this section on the use of those originating agricultural products as motor fuel replacing gasoline and diesel gas oil.

(1) Supply Potential of Biofuel

Typical energy crops as the source of ethanol for blending with gasoline are sugar cane, corn, beat, and wheat, and those as source of fatty acid ester are oil palm, corn, soybean, rapeseed and Jatropha. Considering the favorable climate, vast unutilized lands and sufficient labor force available in the Philippines, agriculture of farming the above crops has great potential. It is also meaningful to enhance energy independence as the national goal.

At present, it is not certain to what extent land is available for growing energy-oriented crops after reservation for food production, that is, to what extent we can expect production of biofuel. Food-fuel competition may be anticipated, though to a limited extent. It is desirable if we could discover crops that grow in the wasteland not suitable for food production. Present production scale of biofuel is still small, and we need to develop studies to enable large-scale production with commerciality.

As discussed in Sections 7.4.4 and 7.4.5, when blending ratios of biofuel into gasoline and diesel oil are raised extremely, it will give serious impact on petroleum products production at refineries as their yields are linked each other. It is also necessary to pay due attention on the refinery operation and keep biofuel blending ratio at a balanced level.

(2) Review and Support of Projects

It is a meaningful and realistic option to promote biofuel in the Philippines. Observing the development, however, the Jatropha roadmap program by PNOC-AFC was just launched in 2006 and the history of CME Biodiesel is less than 10 years. With this short history, we are not free from uncertainties for their long-term outlook. We need to review their progress periodically and continue technology research and development.

Molecular weight distribution of various biofuels is shown in Figure 11.3-1. Among the proposed biofuels, only CME has a molecular weight distribution of C8 to C18, which is similar to that of diesel oil produced from mineral oil. Those distributions of other biofuels such as Jatropha and soybean are relatively concentrating on the heavier and narrower range. As the biofuel blending ratio goes up, influences on the fuel burning stability and engine performance need to be carefully investigated.

To materialize large-scale introduction of biofuel, we need to carry out various studies for optimized plan covering biofuel production, blending with petroleum products produced at refineries, rational logistic and delivery plan considering location of the blending system and market.

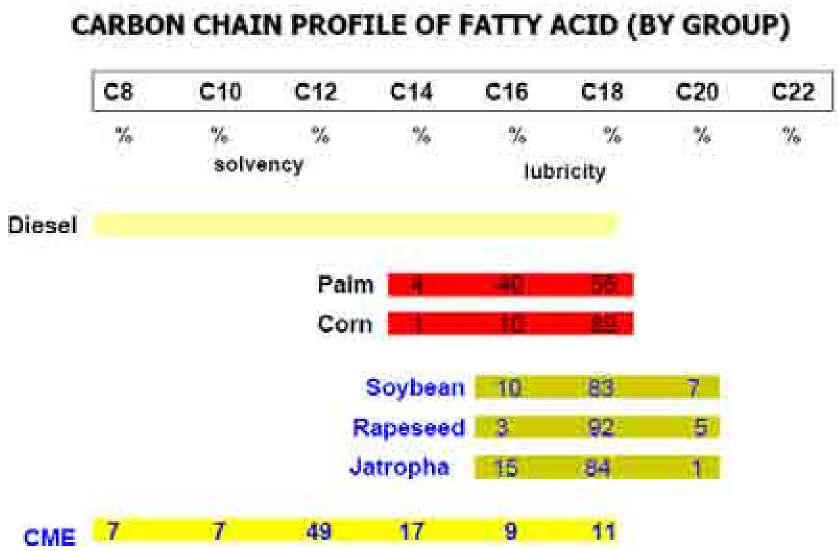


Figure 11.3-1 Molecular Weight Distributions of Biofuels

11.3.2 Policy Objectives for Renewable Energy Development

In the Philippines, geothermal energy is an established sector and our objective there is to realize wider, large-scale utilization as much as possible.

In other areas, promotion of biofuel seems most attractive option for the Philippines in view of the climate, available land, work force and the government policy. Biofuels will surely develop new phase of the agriculture sector and supply substantial quantity of alternative transport fuel. We can also identify its favorable effects on energy diversification, air quality improvement reducing SOx, mitigation of global warming issue, provision of driving power for agricultural development. However, supply of any single crop is not sufficient for the country's requirement and a sort of good combination need to be studied.

(1) Large-Scale Production at Affordable Cost

It is necessary to realize competitive price of biofuel for development of its market establishing large-scale production system of energy crops and efficient gathering system.

For production of them, it is desirable to utilize wasteland or hilly areas for production of energy crops in order to avoid competition with food production. Jatropha project being promoted by PNOC-AFC aims at growing the crop under the condition where it is difficult to cultivate food crops.

On the other hand, considering that the sugar industry, one of the peculiar industries in the Philippines, has been on the declining trend, substantial portion of sugar cane production may be diverted from sugar production to biofuel production. In addition to identifying the extent of this possibility, it is essential to confirm the potential land available for biofuel production. Stating with collaboration of various government offices in charge of agriculture and environment, regional government and stakeholders, thorough study and periodical review should be conducted on this fundamental aspect.

(2) Collaboration of Stakeholders

For the future development of the biofuel market, mutual alliance/collaboration between feedstock producer and fuel processor, and/or among stakeholders are indispensable. For example, suppliers as seller of feedstock need reliable off-taker as buyer who would assure purchase of certain quantity of crop over a long period, and processors need stable supply that should fulfil the requirement at their plants. Thus, it is necessary to create some standard contract that shall assure stable transaction for long-term taking account of those aspects peculiar to biofuel trade such as impact of weather and natural disaster. For example, it can be a modified take-or-pay contract or option contract with certain flexibility. Principles to be included in the standard contract should be applicable not only to the transaction between entrepreneurs (B-to-B contract) but also to arrangements among governments (G-to-G arrangement).

Then, it is on the supply side of the feedstock crops where many uncertainties would exist. In the early stage of a biofuel project, we need to secure and develop vast land, bring in substantial work force and establish efficient production system that would require huge amount of capital investment. We need to solve those issues step by step who should and how to mobilize or procure these resources, who should assure it, and who should take risk at various stages of the project. Since the business is closely related to land and agriculture where various traditional fetters work, these issues could not be solved simply applying business rules. For its promotion, social consensus and strong political leadership are necessary. To this end, it is at first necessary to create a model project that will demonstrate the value of biofuel to the society and also serve to identify problems to be improved.

For the smooth trade or accommodation of biofuel, it is desirable to set out common fuel specifications for biofuels among regional countries.

Considering the above issues, it is desirable to share among stakeholders those various problems anticipated in the course of developing biofuel and exchange transparent discussion among them to conquer them. History of biofuel is short, its market is still in incubation stage and there exist many uncertainties on the technical as well as economic aspects. In order to solve issues and develop biofuels as effective alternative fuels, it will be useful to promote technical research and information exchange among stakeholders relating to issues such as continued monitoring of engine performance, investigation of compatibility with traditional mineral oil based products, improvement of exhaust gas emission quality and so on.

(3) Electricity Supply by Renewables

In general, scale of power supply by renewable energy is not so big, and it is positioned as distributed type power source rather than centralized one. However, the Philippines are proud of the geothermal resource utilization ranked as the world 2^{nd}, which already possesses capability to supply to the core grid and further potential for development. Since major geothermal resources are mal-distributed in Leyte or Luzon and electricity markets are scattered over islands, transmission lines to major demand areas play an important role. As the recent deregulation of the electricity market has activated investments in power generation sector, it is not necessarily a desirable system for development of renewable energies. In particular, when we consider introduction of parasite type power sources such as windmill and PV, sufficiency of the transmission/delivery sector capability is questionable.

Promoting development of power supply by renewable energies, geothermal being ranked as the most promising source and other sources such as wind, hydro and solar energies, it is necessary to review the existing power market design focusing on the role of the transmission system, not to mention power storage technologies to be developed in future.

Chapter12 Regional Energy Plan in the Philippine Energy Plan 2006

12.1 Classification of Regions

This report includes 13 regions (exactly saying 14) plus 2 special regions, which has four - six provinces, as follows:

Region 1: Ilocos Region
Region 2: Cagayan Region
Region 3: Central Luzon Region
CAR: Cordillera Administrative Region
Region 4-A: Calabarzon Region
Region 4-B: Minaropa Region
Region 5: Bicol Region
Region 6: Western Visayas Region
Region 7: Central Visayas Region
Region 8: Eastern Visayas Region
Region 9: Zamboanga Peninsula Region
Region 10: Northern Mindanao Region
Region 11: Davao Region
Region 12: Soccsksargen Region
Region 13: Caraga Region
ARMM: Autonomous Region in Muslim Mindanao

Each region has no local head like Governor or Mayor. It is required institutional system for them to make unified idea for development, etc. to discuss with the central government. There is no such a system in Japan, too. But there is prefecture (something like province in the Philippines), which has authority and responsibility to make development plan, etc. respectively.

12.2 Structure of Regional Energy Profile

Energy profile of each region refers to following items.

At a Glance: Socio-economic profile
A. Energy Situationer
A.1 Energy Resources
A.2 Downstream Facilities
A.3 Power and Electrification
A.4 Benefits to Host Communities
B. Energy Demand Forecast
C. Sectoral Plans and Targets

Table 12.1-1 Composition of Regional Energy Profile

Region	Region 1 Ilcos	Region 2 Cagayan Valley	Region 3 Central Luzon	CAR	Region 4A Calabarzon	Region 4B Mimaropa	Region 5 Bicol	**Region 6 Western Visayas**
At a Glance	○	○	○	○	○	○	○	●
Sosio-Economic Profile	○	○	○	○	○	○	○	●
A. Energy Situationer	○	○	○	○	○	○	○	●
A.1 Energy Resources	○	○	○	○	○	○	○	●
a. Geothermal	○	○	○	○	○	○	○	●
b. Hydropower	○	○	○	○	○	○	○	●
c. Wind	○	○	○	○	○	○		●
d. Ocean								
e. Solar								
f. Coal		○			○	○		
g. Oil and Gas						○		
h. Other Energy Sources	○	○					○	●
A.2 Downstream Facilities	○	○	○	○	○	○	○	●
A.3 Power and Electrification	○	○	○	○	○	○	○	●
A.4 Benefits to Host Communities	○	○	○	○	○	○	○	●
B. Energy Demand Forecast	○	○	○	○	○	○	○	●
Residential	○	○	○	○	○	○	○	●
Transport	○	○	○	○	○	○	○	●
Industrial	○	○	○	○	○	○	○	●
Commercial	○	○	○	○	○	○	○	●
Agricultural	○	○	○	○	○	○	○	●
C. Sectoral Plan and Targets	○	○	○	○	○	○	○	●
c.1 Power Development Plan	○		○	○	○	○	○	●
c.2 Transmission Development Plan	○	○	○	○	○	○	○	●
c.3 Distribution Development Plan	○	○	○	○	○	○	○	●
c.4 Expand Rural Electrification	○	○	○	○	○	○	○	●
c.5 Energy Resource Development	○	○	○	○	○	○	○	●
Geothermal	○	○	○	○	○	○	○	●
Hydropower	○	○	○	○	○	○	○	●
Solar					○			●
Biomass			○				○	●
Wind	○		○		○	○	○	●
Natural Gas					○			●
Coal							○	●
Oil and Gas						○		
c.6 Downstream Sector Development			○					
Natural Gas								
Coal								

Region	Region 7 Central Visayas	Region 8 Eastern Visayas	Region 9 Zamboa ngaPeni nsula	Region 10 Northern Mindana o	Region 11 Dabao	Region 12 Soccsk sargen	Region 13 Caraga	ARMM
At a Glance	○	○	○	○	○	○	○	○
Sosio-Economic Profile	○	○	○	○	○	○	○	○
A. Energy Situationer	○	○	○	○	○	○	○	○
A.1 Energy Resources	○	○	○	○	○	○	○	○
a. Geothermal	○	○	○	○	○	○	○	○
b. Hydropower	○	○	○	○	○	○	○	○
c. Wind	○	○	○	○	○	○	○	○
d. Ocean		○						
e. Solar							○	
f. Coal	○	○	○	○				
g. Oil and Gas								
h. Other Energy Sources						○	○	○
A.2 Downstream Facilities	○	○	○	○	○	○	○	○
A.3 Power and Electrification	○	○	○	○	○	○	○	○
A.4 Benefits to Host Communities	○	○	○	○	○	○	○	○
B. Energy Demand Forecast	○	○	○	○	○	○	○	○
Residential	○	○	○	○	○	○	○	○
Transport	○	○	○	○	○	○	○	○
Industrial	○	○	○	○	○	○	○	○
Commercial	○	○	○	○	○	○	○	○
Agricultural	○	○	○	○	○	○	○	○
C. Sectoral Plan and Targets	○	○	○	○	○	○	○	○
c.1 Power Development Plan	○	○	○	○	○	○	○	○
c.2 Transmission Development Plan	○	○	○	○	○	○	○	○
c.3 Distribution Development Plan	○	○	○	○	○	○	○	○
c.4 Expand Rural Electrification	○	○	○	○	○	○	○	○
c.5 Energy Resource Development	○	○	○	○	○	○	○	○
Geothermal	○	○	○		○	○		
Hydropower		○	○	○	○	○	○	○
Solar								
Biomass								
Wind							○	
Natural Gas	○					○		
Coal	○		○			○	○	
Oil and Gas								
c.6 Downstream Sector Development	○				○			
Natural Gas	○				○			
Coal	○							

Distribution Development Plan

Expand Regional Electrification Plan

Energy Resource Development

(1) “At a Glance: Socio-economic Profile”

In this part, socio-economic profile of each region is explained based on the data supplied by National Statistical Coordination Board (NSCB).

(Comment by JICA Team)

Except the case where any specific investigation is required, it would not be necessary to visit any region for research work, since most of data are available from NSCB.

(2) “A. Energy Situationer”

In the Regional Energy Profile 2006, “Energy Situationer” is composed of following 4 items; Energy Resources, Downstream Facilities, Power and Electrification and Benefits to Host Communities. They differ much among regions reflecting characteristics of each region.

(3) “A.1 Energy Resources”

Eight kinds of energy resources are listed in this part; Geothermal, Hydropower, Wind, Ocean, Solar, Coal, Oil and Gas and Other Energy Sources. Main energy sources commonly available in most regions are Geothermal, Hydropower and Wind. Coal, Oil and Gas resource development is limited in specific regions where such energy resources are available.

(4) “A.2 Downstream Facilities”

For downstream facilities, refineries, oil depots, LPG refilling plants and gasoline stations are listed. In addition, coal and gas terminals are also shown for some regions.

(Comment by JICA Team)

Data are available from PNOC and DOE easily.

(5) “A.3 Power and Electrification”

Installed capacity, electricity profile and status of energization in each region are shown in this part.

(Comment by JICA Team)

Data are available from NPC.

(6) “A.4 Benefits to Host Communities”

In this part, financial benefit to the host community is described. Basically, the fund for EF (electrification), DLF (development and livelihood) and RWMHEEF (reforestation, watershed management, health and/or environmental enhancement) projects are shown in the common table format.

(7) "B. Energy Demand Forecast"

Energy demand of each region by energy sector such as residential, transport, industrial, commercial and agricultural is forecasted. Energy consumption by energy source in each region is also estimated. Table in this part is indicated with almost same format. Looking into them in detail, however, some renewable energy sources are classified as "Other Renewables". Therefore, regional data do not necessarily add up to the national total.

(Comment by JICA Team)

Aggregation of regional balance tables shown in the regional energy plans does not meet the national energy balance table. It is desirable that they are consistent each other, though the regional plan is aimed to explain regional energy characteristics.

(8) "C. Sectoral Plans and Targets"

In this part, since data is available from development plans of NPC on power generation, transmission and distribution systems as well as expanded regional electrification plans, they can be used to compile plans and targets. On energy resource development, development plans during the planning period are explained. They are supposed to meet the requirement of national and regional energy demand.

12.3 Energy Situation of Region 6 (Western Visayas) as a Pilot Area

(1) Socio-economic position of Region 6

Population of Region 6 is 6,208,733 and the third largest in the Philippines after Region 4-A and Region 3, with 9,320,629 and 8,204,724 respectively. The land area accounts for 20,158 km^2, or the 7^{th} largest in the country. The Region is also in the fifth position in terms of the population density and in the third position in terms of GRDP (Gross Regional Indigenous Production) after the Region 4-A and Region 6. All in all, Region 6 is the third largest economic region in the Philippines.

(2) Energy resources in Region 6

Energy resources in Region 6 are mainly composed of renewable energies such as Geothermal, Hydropower and Wind and the exploration, development and production of a prospective coal area is offered under the 2005 PECR. According to the PNP2006, indicative capacity additions of these renewable energies are as follows:

Geothermal; 73MW or 10.0% of the total 750MW in the Philippines

Hydropower; 44MW or 1.7% of total 2603.5MW in the Philippines

Wind; 80MW or 23.2% of total 345MW in the Philippines

Biomass; 50MW

As shown above, this region has rich indicative renewable energy sources except for hydro and biomass energy source.

(3) Energy demand in Region 6

Energy consumption in the region in 2005 was 11.04 MMBFOE (million barrels of fuel oil equivalent) or 1.6Mtoe (million ton of oil equivalent) and accounted for 6.7% of the total energy consumption in the Philippines of 165.3 MMBFOE (24 Mtoe). Considering that share of population and GRDP of the region are 9.3% and 10.5%, respectively, its energy consumption share at 6.7% indicates that the region is relatively less energy intensive.

Energy consumption structure of the region is highlighted as follows:

* Among energy consuming sectors, industry sector consumes the largest quantity at a share of 39% followed by residential sector at 28% and transport sector at 25%. By energy source, biomass supplies the largest quantity at a share of 54% followed by oil and oil products at 42% and electricity at 4%.

* Compared with the national average, the share of industry sector and agriculture sector are higher and all the other sectors are lower in the region.

* On energy sources, the share of biomass has a higher share and all the other sources have a lower share than the national average.

Region 6 is one of the active economic and energy consuming regions of the Philippines but it has characteristics that main energy source is biomass production. Main industry in the region is agriculture such as rice, corn and sugar and fish industry. This industrial structure explains that biomass energy consumption is large in the region. Also mining industry such as copper, gold and silver is other main industry in the region.

Table 12.3-1 Energy Demand Forecast of Region 6

	Region VI Western Viasayas				Share(%)			
	2005	2006	2010	2014	2005	2006	2010	2014
Grand Total	11.05	11.40	13.38	15.74	100.0	100.0	100.0	100.0
Oil & Oil Products	4.67	4.81	5.78	6.70	42.3	42.2	43.2	42.6
Ntural Gas	-	-	-	0.11	-	-	-	0.7
Biomass	5.94	6.13	7.01	8.13	53.8	53.8	52.4	51.7
Electricity	0.44	0.46	0.59	0.80	4.0	4.0	4.4	5.1
Industry	4.32	4.51	5.56	6.90	100.0	100.0	100.0	100.0
Oil & Oil Products	0.84	0.83	0.94	1.04	19.4	18.4	16.9	15.1
Ntural Gas	-	-	-	0.05	-	-	-	0.7
Biomass	3.41	3.61	4.54	5.71	78.9	80.0	81.7	82.8
Electricity	0.07	0.07	0.08	0.10	1.6	1.6	1.4	1.4
Commercial	0.46	0.47	0.64	0.87	100.0	100.0	100.0	100.0
Oil & Oil Products	0.27	0.27	0.38	0.53	58.7	57.4	59.4	60.9
Ntural Gas	-	-	-	-	-	-	-	-
Biomass	0.04	0.04	0.05	0.05	8.7	8.5	7.8	5.7
Electricity	0.15	0.16	0.21	0.29	32.6	34.0	32.8	33.3
Residential	3.14	3.13	3.21	3.33	100.0	100.0	100.0	100.0
Oil & Oil Products	0.43	0.42	0.49	0.55	13.7	13.4	15.3	16.5
Ntural Gas	-	-	-	-	-	-	-	-
Biomass	2.49	2.48	2.42	2.37	79.3	79.2	75.4	71.2
Electricity	0.22	0.23	0.30	0.41	7.0	7.3	9.3	12.3
Transport	2.75	2.90	3.54	4.18	100.0	100.0	100.0	100.0
Oil & Oil Products	2.75	2.90	3.54	4.12	100.0	100.0	100.0	98.6
Ntural Gas	-	-	-	0.06	-	-	-	1.4
Agriculture	0.38	0.39	0.43	0.46	100.0	100.0	100.0	100.0
Oil & Oil Products	0.38	0.39	0.43	0.46	100.0	100.0	100.0	100.0

Table 12.3-2 Energy Demand Forecast of the Philippines

	Total				Total				2005 Share	
	2005	2006	2010	2014	2005	2006	2010	2014	Total	Region 6
Grand Total	122.07	124.91	141.23	160.15	100.0	100.0	100.0	100.0	100.0	100.0
Oil & Oil Products	55.89	57.23	67.56	78.40	45.8	45.8	47.8	49.0	45.8	42.3
Ntural Gas	0.26	0.54	0.87	1.22	0.2	0.4	0.6	0.8	0.2	-
Coal	6.65	6.71	7.04	7.38	5.4	5.4	5.0	4.6	5.4	-
Biomass	46.98	47.40	49.46	52.22	38.5	37.9	35.0	32.6	38.5	53.8
Other Renewables	0.07	0.08	0.08	0.08	0.1	0.1	0.1	0.0	0.1	-
Electricity	12.22	12.95	16.22	20.85	10.0	10.4	11.5	13.0	10.0	4.0
Industry	29.27	29.78	34.93	41.42	100.0	100.0	100.0	100.0	24.0	39.1
Oil & Oil Products	8.95	8.41	9.77	11.53	30.6	28.2	28.0	27.8	7.3	7.6
Ntural Gas	0.24	0.48	0.59	0.67	0.8	1.6	1.7	1.6	0.2	-
Coal	6.65	6.71	7.04	7.38	22.7	22.5	20.2	17.8	5.4	-
Biomass	9.74	10.33	12.99	16.33	33.3	34.7	37.2	39.4	8.0	30.9
Other Renewables	0.01	0.01	0.01	0.01	0.0	0.0	0.0	0.0	0.0	-
Electricity	3.68	3.84	4.53	5.50	12.6	12.9	13.0	13.3	3.0	0.6
Commercial	7.54	7.89	10.03	12.83	100.0	100.0	100.0	100.0	6.2	4.2
Oil & Oil Products	2.86	2.96	3.93	5.16	37.9	37.5	39.2	40.2	2.3	2.4
Biomass	1.47	1.51	1.75	2.01	19.5	19.1	17.4	15.7	1.2	0.4
Other Renewables	0.01	0.01	0.01	0.01	0.1	0.1	0.1	0.1	0.0	-
Electricity	3.20	3.41	4.34	5.65	42.4	43.2	43.3	44.0	2.6	1.4
Residential	46.20	46.54	48.11	50.41	100.0	100.0	100.0	100.0	37.8	28.4
Oil & Oil Products	5.07	5.25	6.01	6.80	11.0	11.3	12.5	13.5	4.2	3.9
Biomass	35.77	35.56	34.72	33.88	77.4	76.4	72.2	67.2	29.3	22.5
Other Renewables	0.02	0.03	0.03	0.03	0.0	0.1	0.1	0.1	0.0	-
Electricity	5.34	5.70	7.35	9.70	11.6	12.2	15.3	19.2	4.4	2.0
Transport	36.49	38.07	45.23	52.31	100.0	100.0	100.0	100.0	29.9	24.9
Oil & Oil Products	36.47	38.01	44.95	51.76	99.9	99.8	99.4	98.9	29.9	24.9
Ntural Gas	0.02	0.06	0.28	0.55	0.1	0.2	0.6	1.1	0.0	-
Agriculture	2.57	2.63	2.93	3.18	100.0	100.0	100.0	100.0	2.1	3.4
Oil & Oil Products	2.54	2.60	2.90	3.15	98.8	98.9	99.0	99.1	2.1	3.4
Other Renewables	0.03	0.03	0.03	0.03	1.2	1.1	1.0	0.9	0.0	-

12.4 Recommendations for formulation of the Regional Energy Plan of Region 6

12.4.1 Objectives of Regional Energy Plan

Objectives of compiling Regional Energy Plan may be summarized as follows.

1) To set out targets of the energy related policies in a region, which are consistent with the national energy policies and targets.

In considering this, the national energy policy and targets are as follows:

a) Energy policy well recognizing the international trend and standard

(1) 3E (consistency among energy, economy and environment issues)

(2) 3S (stable, secured and sustainable supply of energy)

b) Energy Policy based on the specific Philippine Energy Situation

(3) Energy conservation in all energy consuming sectors with continued consciousness by people plus technology progress on energy production and consumption

(4) Stable supply of energy at reasonable prices

(5) Energy independence of 60% to be attained by indigenous energy supply increase in addition to energy conservation, in particular through development of fossil resources, nuclear energy and renewable energies whichever is available.

Then, the regional energy policy targets of Region 3 may be as follows:

1) Stable energy supply at reasonable prices

2) Energy conservation to reduce energy consumption and costs in the region

3) Development of energy resources, especially wind energy in the region

4) Preservation of the living environment of the residents in the region

2) To identify energy related issues and challenges in the region in reasonable and scientific way of thinking.

After identifying issues and challenges, in formulating measures to cope with them, it is necessary to adjust the national targets of energy policy and the local requirements on the next step. To exercise measures toward the national energy targets, it is necessary to discuss thoroughly on what kind of proposals the central government can offer to the region and, in return, what kind of proposals with what kind of conditions the regional government can accept. Procedure on such discussion must be set out simple and clear so as not to waste time.

3) To evaluate the energy resources, if any, in the region and consider exploration and development.

Through evaluation of natural resources proper information could be provided for the stakeholders such as governments and private companies considering investment in the region. Central and local Governments may draw up development plans based on such evaluations. They should also open such information widely to the private companies to invite them in to the region. Publication of regional energy plan or any other information about energy development is important in promoting energy projects in the region inviting private sector investments.

4) To illustrate visions on the future economic, industrial and demographic structure of the region.

In the Philippine Energy Plan 2006, five sectors namely industry, commercial, residential, transport and agriculture are analyzed individually. To grasp the direction of the regional energy development, it is very important to evaluate sectors, in which energy consumption would increase or decrease in future, as they may be different from the national average pattern. For example, if the transportation sector increases rapidly, petroleum products consumption will increase rapidly, too. If the residential sector increases rapidly, modern household energy consumption such as electricity and LPG demand will increase rapidly, and so on.

Industrial structure also gives a great impact on energy consumption. For example, if heavy and energy intensive industries share a substantial part of the regions' industry, the region's energy consumption tends to be intensive than other areas where heavy industry has not developed. However, the Philippine economy is not composed of heavy and energy intensive industries such as iron, chemical, paper and ceramics industry. Thus, share of the heavy industry, if any, gives a big influence to the energy consumption in a specific region, although the apparent differences in terms of energy intensity caused by industrial structure would not be very large in the country.

Demographic structure is a factor not to be forgotten in considering energy consumption; ratio of urban and rural population gives a big impact. Energy consumption in an area with higher share of urban population may be larger than the area with less urban population, with certain impact on the energy intensity, since urban residents tend to consume more energy than rural residents. Regional urbanization or break up of agricultural society would influence energy consumption to a considerable extent. If urban population in the region increases fast, modern energy consumption may increase rapidly.

12.4.2 Contents of Regional Energy Plan

Contents of the regional energy plan may be maintained basically same as the last one, to which some topics or analysis may be added. Candidate items to be considered in the regional energy plan of Region 6, may be as follows:

1) Socio-economic development plan in the region, if possible, at first referring to discussion on economy, industry and geographical structure.

In region 6, following "Long-term Development Vision" is indicated: "An ecologically-balanced, gender-responsive, healthy, progressive and peaceful Western Visayas Region, with a globally competitive economy and empowered citizenry". It is important to show it clearly to attract investors.

2) Future development plans of economic zones

It is required to explain present situation, future plan and energy related topics on the following economic zones:

Amigo Mall
Bacolod IT Park
Boracay Eco-Village Resort Tourism Economic Zone
Monfort IT Building
Robinsons Place Iloilo
San Carlos Economic Zone
SMCI IT Center
The Block IT Park

3) Renewable energy resources by site

With recent abrupt energy price hike and potential technology development, circumstance and conditions for renewable energy development are changing fast. It would be appropriate to reinvestigate into regional renewable energy potential and evaluate development feasibility on prospective ones.

12.4.3 Proposed Outline of Regional Energy Plan (an example)

The JICA team understands that the current regional energy plan sufficiently explains necessary factors. For future improvement, format and contents of the regional energy plan may be re-examined, which would be a summary appropriately reduced from the full list of the contents such as below:

Chapter 1 Socio-economic Profile: brief description of the current situation of the region

1.1 Geographic, demographic and economic/industrial features

1.2 Existing energy facilities and resources

Chapter 2 Plan and Assumptions

2.1 GDP, if available, by sector

2.2 Population

2.3 Industrial, Commercial and Residential Development Plans

Chapter 3 Energy Demand Projections

3.1 Demand forecast by sector

3.2 Demand forecast by energy

Chapter 4 Sectoral Plans and Programs; how to meet demand

4.1 Development of local resources; this should include an economic evaluation of the resources

4.2 Improvement/expansion of local infrastructure

Chapter 5 Regional Energy Program

5.1 Economic aspects

5.1.1 Investment requirements

5.1.2 Job creation potential

5.1.3 Benefits to host communities

5.2 Demand side elements, i.e. rational use and energy efficiency

5.3 Supply side elements, i.e. development of local energy resources

5.4 Environmental elements, i.e. possibility and reduction of environmental pollution

12.4.4 Reference: Process for Making REP

According to explanation by DOE, Regional Energy Planning Process is as follows:

i) Legal basis (Administrative Order No. 38)

"Providing for the Institutional Strengthening of the DOE by redefining the functions and services of its bureaus, service units and offices"

ii) Basic activities

Linking up with NEDA as the country's over-all body and secretariat to the Regional Development Council (RDC)

Conduct of briefing orientation with concerned stakeholders (energy agencies, Government offices, Non-government Organizations, LGUs)

iii) Regional Workshop (selecting 4-5regions among 16 regions in a year)

At the regional workshop, following items will be presented to and discussed with local stakeholders.

Matching Demand with Supply

Demand Forecasting

Resource Assessment

Identification of Challenges and Gaps

Program/Project Identification

Legislative Agenda

Local Stakeholders Involvement

In addition, at the Multi Sectoral Regional Dialogue entitled “Climate Change, Energy & Development Planning” on 6th June in Iloilo City, following information on the Regional Development Plan was acquired.

1) Economic Activity:

Industry and services sectors grew highly. On the other hand, agriculture sector decreased contribution to economy, but fast growth in last 3 years. This trend will continue in the future.

2) Main agricultural and fishery production:

2 million MT rice: 3rd only to Central Luzon and Cagayan Valley

13.5 million MT of sugar cane: the country’s largest producer

55,000 metric tons of mango: 3rd largest producer

Livestock and Poultry Production (2007)

Carabao: 19,200 MT LW: highest producer

Hog: 159,000metric tons: 3rd

Cattle: 18,800 metric tons: 5th

Fishery Production (2007)

Commercial: 113,000 metric tons: 3rd biggest producer

3) Mineral Resources:

Deposits of copper, gold and massive sulphide and chromites

Abundant non-metallic minerals: coal, guano, phosphate, dolomite, silica and marble

4) Industrial Development Plan in the future

More investments in sub-regional growth centers like the San Carlos City industrial park, Kabankalan and Bacolod Cities

Construction will boom in the 54-ha site of old Iloilo Airport and in surrounding areas of New Iloilo and Bacolod Airports

Mining will also boom especially in Antique with current oil exploration around Maninquin, Culasi and in other small scale mineral areas in Iloilo and Negros Occidental and so on.