Energy Requirements and Export Potentials in Indonesia

Atsushi FUKUSHIMA
General Manager, International Cooperation Department

1. Introduction

This paper is a revised draft presented at the "The 3rd Biannual International Conference and Exhibition on Energy 2002," held in Gadjah Mada University, Yogyakarta, Indonesia on 29 and 30 July, 2002.

In this paper, simulation studies are carried out by use of a simple model, which was specially built by an econometric method for the purposes of analyzing energy demand structure and forecasting domestic energy requirements in the future. This simulation study focuses on domestic energy requirements and export potentials targeting the year 2015.

The applied model includes (1) the final energy demand sector comprising the agricultural, industrial, residential and commercial sectors, (2) the energy conversion sector (electric power, oil refinery, transfer, and extraction sectors), and (3) the indigenous production, export and import sectors. Regarding the simulation results, it is estimated that Indonesia may change from a net exporter to a net importer of crude oil around 2010, although it will retain the status of an overall net energy exporter.

2. Historical Trends of Energy Supply and Demand

2.1 Current Situation

According to the annual report "Statistik dan Informasi Ketennagalistrik dan Energi" by DGEEU (Directorate General of Electricity and Energy Utilization, Ministry of Energy and Mineral Resources), the Primary Energy Requirement (PER) in 1999/2000 was 86,461.3 thousand tons of oil equivalent (ktoe) comprising 49,667.8 ktoe of oil (share of 58%), 23,224.8 ktoe of natural gas (27%), 8,882.8 toe of coal (10%), 3,690.8 ktoe of hydropower (4%) and 995.0 ktoe of geothermal (1%).

The Final Energy Consumption (FEC) in 1999/2000 was 55,951.6 ktoe, consisting of 20,231.8 ktoe for the industrial sector (36%), 21,142.9 ktoe for the transportation sector (38%) and 14,575.5 ktoe for the residential sector (26%). As for the final energy consumption

structure in 1999/2000, oil accounts for 75 % (41,863.5 ktoe), natural gas for 8 % (4,687.2 ktoe), coal for 4 % (2,215.7 ktoe), and electricity for 11 % (6136.1 ktoe).

Figure 2.1 PER Structure in 1999/2000

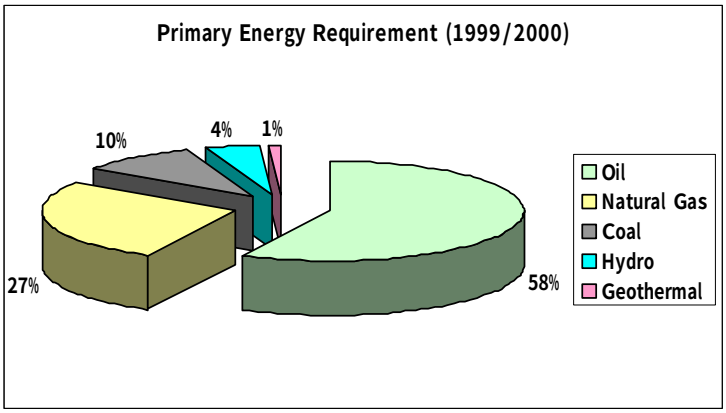
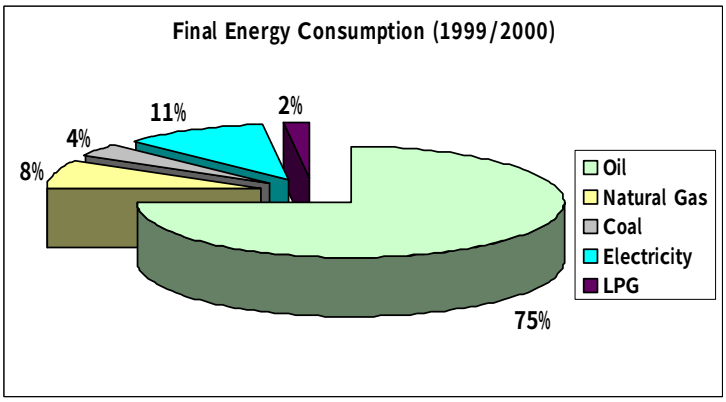


Figure 2.2 FEC Structure in 1999/2000

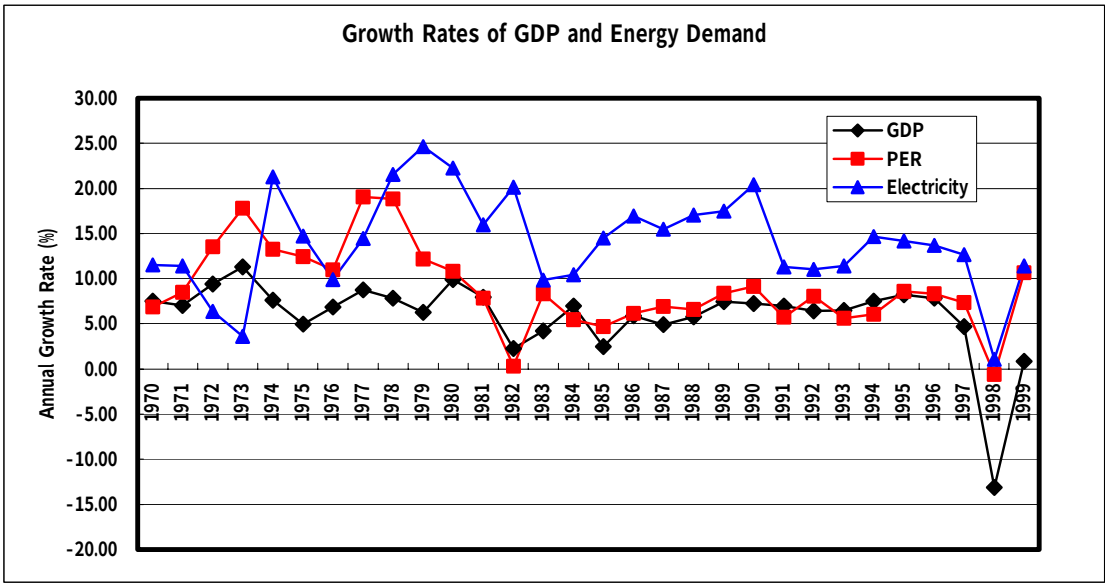


2.2 Economic Activities and Energy Demand

Figure 2.3 shows the historical trends between economy and energy in Indonesia. In the Figure, the polygonal line indicates the annual average growth rates (%) of GDP, Primary Energy Requirement ("PER" in the Figure), and Electricity Consumption ("Electricity" in the Figure), respectively.

As shown in the Figure, the primary energy requirement maintained a stable relationship with the GDP growth rate during the period 1984/85–1997/98. From 1998/99, these energy indicators decreased drastically, under the influence of the negative (-) growth of GDP. From 1999/00 onward, the recovery of GDP growth pushed up the energy growth rates.

Figure 2.3 Historical Trends of GDP and Energy Indicators

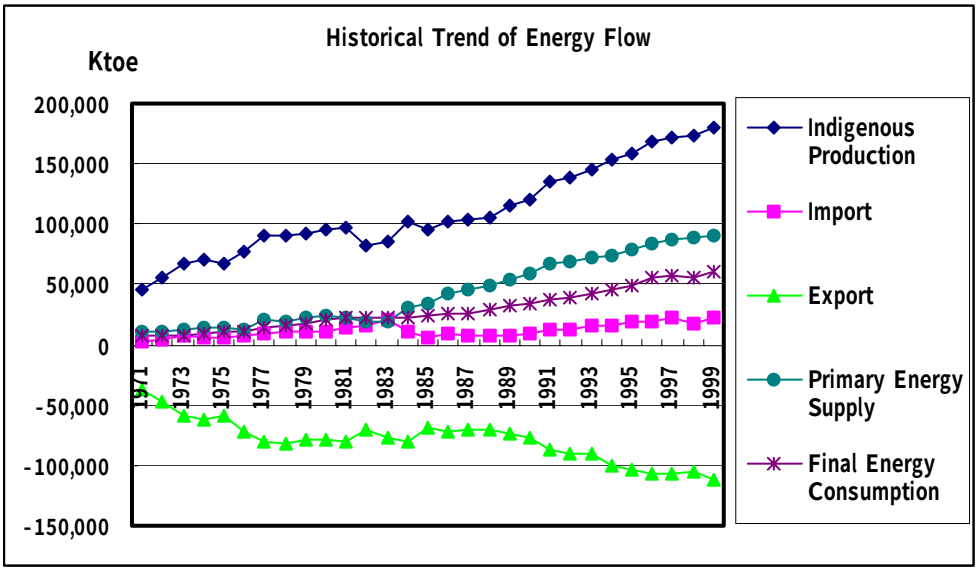


(Source) IMF, DGEEU

2.3 Energy Supply and Demand

Figure 2.4 shows the historical trends of energy supply/demand (commercial energy) from energy production to final energy consumption. Since the latter half of the 1990s, primary energy production has tended to progress increasingly. On the other hand, the energy imports have also increased with crude oil imports for refineries and secondary energy imports such as diesel oil, kerosene and gasoline.

Figure 2.4 Historical Trends of Energy Supply and Demand in Indonesia



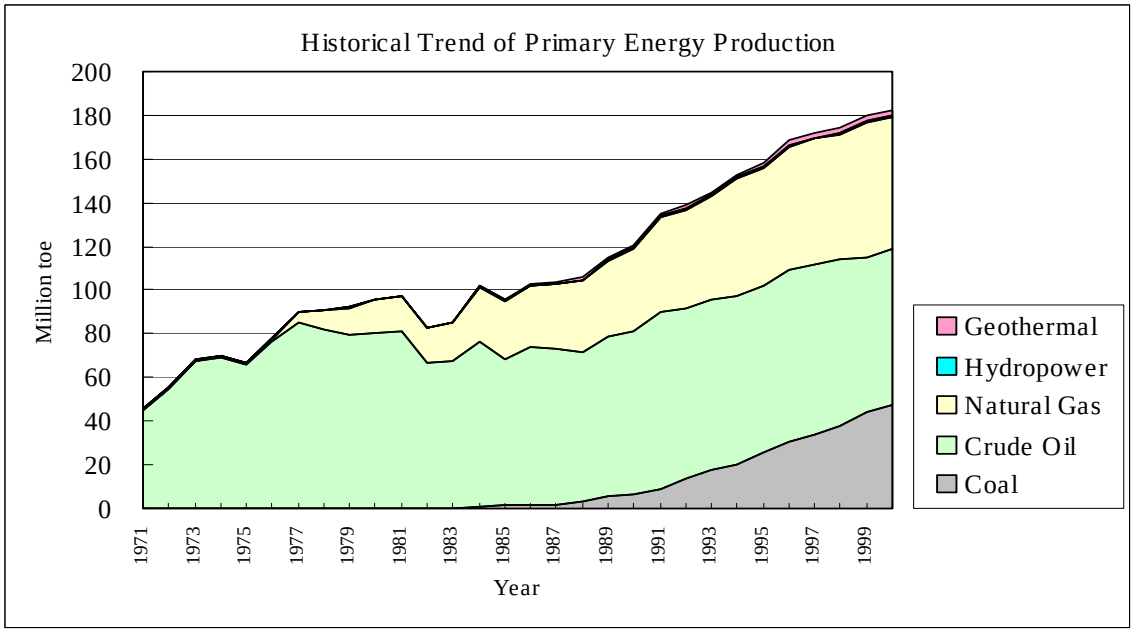
(Source) IEA, “Energy Balances of Non-OECD Countries, 2001”

Regarding exports and imports of crude oil, Indonesia earns hard currency by the export of high-quality crude oil and meets its domestic demand by the import of comparatively low priced crude oil for throughput to refineries.

2.4 Energy Production

Figure 2.5 shows the specific historical trends of the indigenous energy production indicated in Figure 2.4. As shown in the Figure, coal and natural gas have been expanding their share throughout the 1990s.

Figure 2.5 Historical Trend of Primary Energy Production by Energy Carrier



(Source) IEA, "Energy Balances of Non-OECD Countries, 2001"

3. Model Structure Applied for this Simulation Study

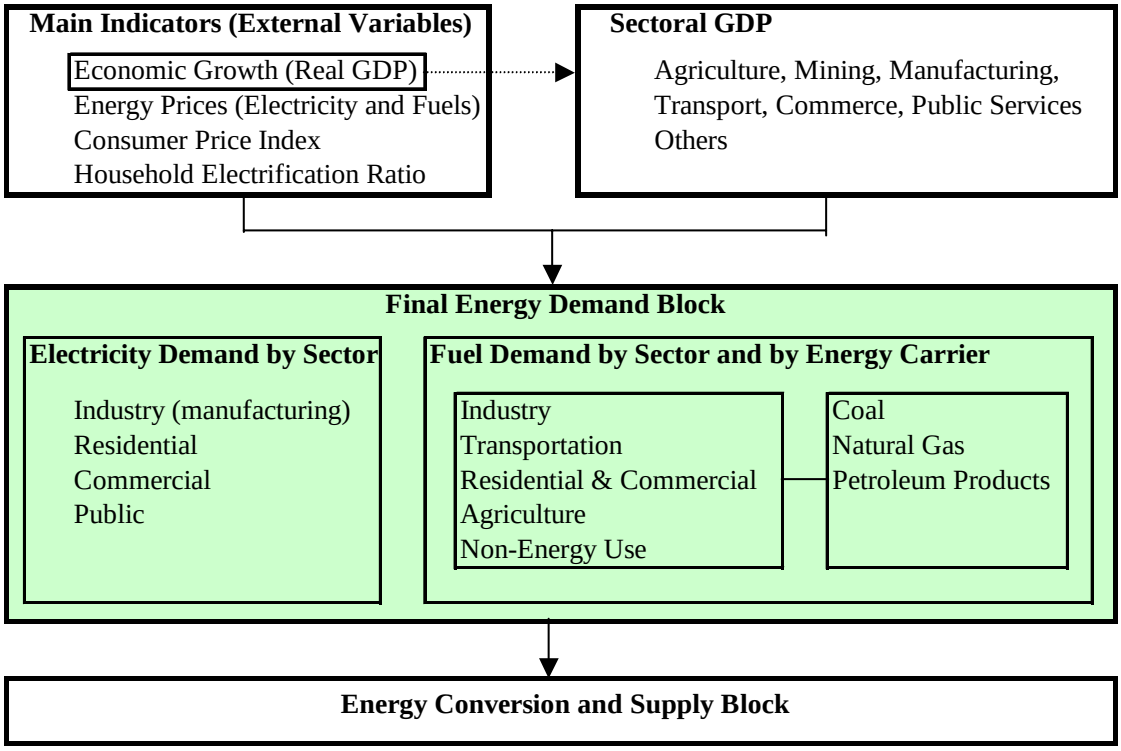
The model consists of (1) a final energy demand-forecasting block and (2) an energy conversion and supply block.

3.1 Final Energy Demand Forecasting-Block

Figure 3.1 shows the framework of the final energy demand-forecasting block. In this case, macro indicators as external variables consist of (1) economic growth, (2) energy prices including electricity and fuels, (3) consumer price index, and (4) household electrification. Sectoral GDP components are generated internally as the trends of economic structure shift.

The final energy demand block comprising each sector creates system equations by energy carrier such as electricity, natural gas and petroleum products (kerosene, LPG, gasoline, diesel oil, fuel oil etc.) and calculates the fuel total and sector total. The demand function is estimated by regression analysis in each energy demand for agriculture, manufacturing, transportation, residential/commercial, government/public utilities (others) and non-energy sectors. The final energy demand total is obtained by sector and by energy source.

Figure 3.1 Framework of Final Energy Demand Forecasting Block



3.2 Energy Conversion and Supply Block

(1) Electricity Sector

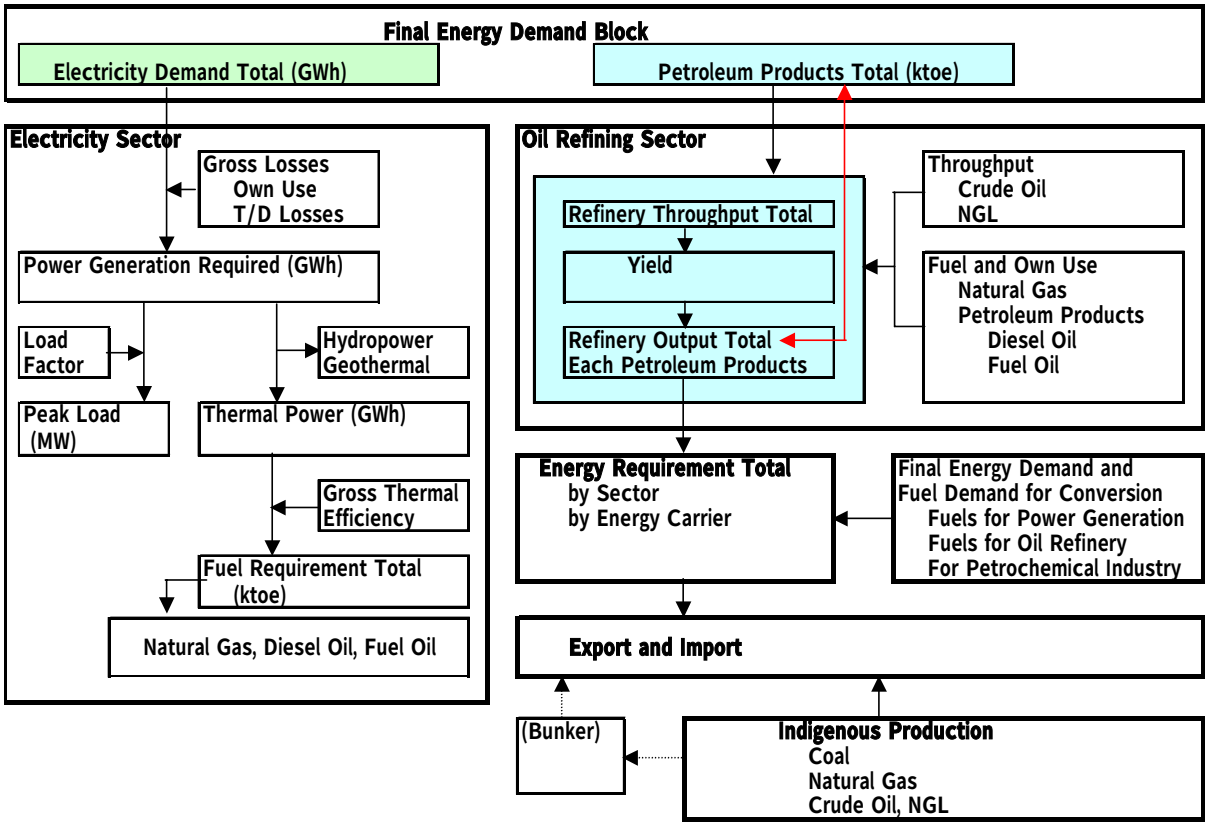
As shown in Figure 3.2, the forecast total electricity demand is received from the final energy demand-forecasting block. After adding transmission /distribution (T/D) losses and own use (in-plant use), the required electric power generation is calculated. Thermal power generation is obtained by subtracting hydropower and geothermal generation from the total. Total and specific fuel demands are obtained by use of thermal efficiency and fuel share function.

From a technical point of view, the gross losses, thermal efficiency and load factor can be input as external variables. In this simulation, however, these variables are set as internal variables.

(2) Oil Refinery Sector

Figure 3.2 shows the framework of the oil refinery sector. As shown in the Figure, the benchmark of oil refineries operation is assumed to meet the total demand for domestic petroleum products, and the demand for petroleum products is received from the final energy demand forecasting-block. Firstly, total products of refineries (output) are projected based on the past trend of refineries output and its total domestic demand. After determination of the refineries' output, the required amounts of throughput and fuels are calculated. The output of refineries (petroleum products) is obtained by use of each yield for products.

Figure 3.2 Framework of Energy Conversion and Supply Block



(3) Energy Supply and Export/Import

In general, the production of crude oil, natural gas and electric power (especially hydropower) can be handled as exogenous (external) variables based on a national development plan. In this model, however, the indigenous production of primary energy (crude oil natural gas and coal) is assumed to increase or remain with its historical trend. The purpose of energy supply is to meet the domestic demand, and the concept of net export/import is introduced to avoid a mismatch between supply and demand (especially export and import). The balancing of petroleum products is also taken into consideration in the export/import.

4. Data Source and Scenario for Model Simulation

(1) Data Source

Time series data applied or referred to for the model building are as follows;

Population (1980-2000)	BPS
GDP (1982-2000)	ADB & BPS
GDP Deflator (1980-2000)	IMF
CPI, WPI (1980-2001)	IMF
Electricity Prices (1980-2001)	DGEEU & PLN
Fuel Prices (1980-2001)	MIGAS
Electricity Consumption (1980-2001)	DGEEU & PLN
Fuel Consumption (1980-1999)	IEA
Refinery Input/Output (1980-2000)	IEA & MIGAS
Primary Energy Production (1980-2001)	IEA, MIGAS & BP
Energy Export and Import (1980-1999)	IEA

(2) Scenario

Electricity prices are set to be 6-7 cent/kWh in 2005 and fuel prices are set to be international prices corresponding to Singapore in 2004. Afterwards, these prices increase with inflation (consumer price index), and the inflation is set at between 10% and 7%. Household electrification ratio in the residential sector increases from 53% in 2000 to 83% in 2015 at the average growth rate of 3%.

As for GDP growth, two (2) scenarios—low case and high case—are prepared as shown in Table 4.1. The low case is set as BAU (business as usual) or Base scenario in this study. The high case is a more ambitious scenario.

Table 4.1 GDP Scenarios for Simulation

(unit: %)

	2001	02	03	04	05	06	07	08	09	10	11	12	13	14	2015
Low	3.4	3.7			4.2			4.4	4.5						
High	3.4	4.5				5.0					5.5				

5. Simulation Results

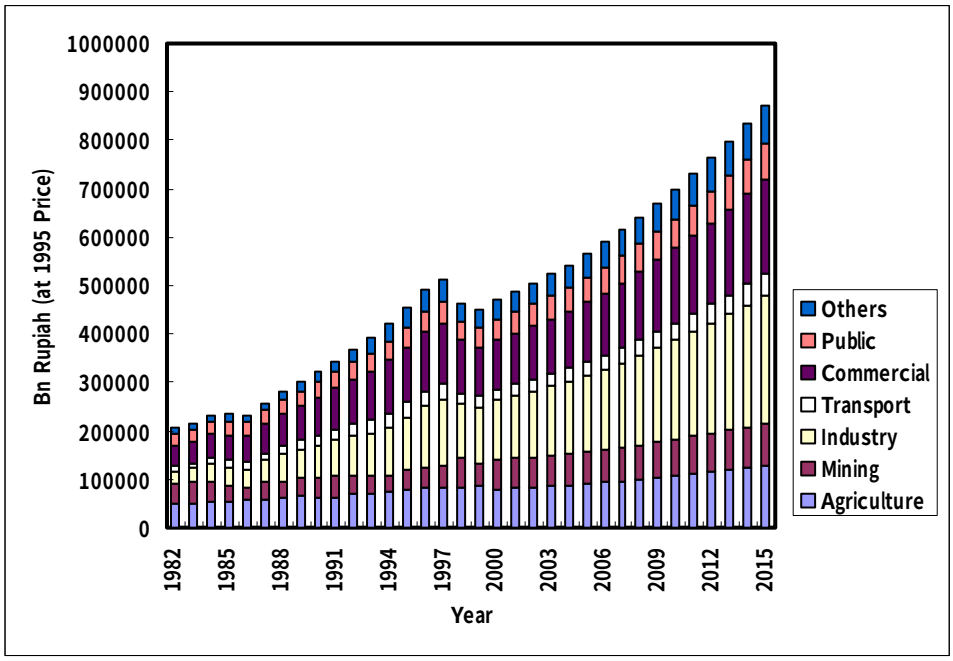
5.1 GDP Structure

This model can handle the structural change of economic activities. Figures 5.1 and Table 5.1 show the historical trends and projections of the real GDP (at 1995 constant price) with its factor cost components. In the Figure, the "industry" sector corresponds to the manufacturing industries, the "commercial" sector corresponds to the restaurants and hotels, banking and other finance intermediaries, and the "public" sector corresponds to the public administration and defense and public services.

During the economic crisis in 1998 and 1999, the real GDP recorded negative (-) 10.1 % and (-) 2.6 % growth respectively. Afterwards, although the economy began to recover, to date the real GDP has still not reached the level of 1995-1997. The GDP growth rate recorded 4.7 % in the year 2000 and 3.4 % in 2001.

The industrial sector has expanded its share from 15.8 % in 1985 to 26 % in 2000. On the other hand, the mining and agricultural sectors have decreased their share in the GDP total. In a period of economic crisis, the share of the industrial and commercial sectors decreases; on the other hand, the share of the mining and agricultural sectors increases. This implies that the mining and agricultural sectors did not suffer greatly from the impact of the 1998 economic crisis.

Figure 5.1 Trends and Projection of GDP Component



The share of GDP component for the future is projected by using its historical trend (logarithmic trend) as shown in Table 5.1.

Table 5.1 Share of each GDP Component (Unit: %)

	1985	1990	1995	2000	2005	2010	2015
Agriculture	22.9	19.4	17.1	16.9	16.0	15.2	14.6
Mining	13.8	12.2	8.8	12.9	11.8	10.9	10.1
Industry	15.8	20.7	24.1	26.0	27.7	29.1	30.3
Transport	6.2	6.3	6.8	5.0	5.1	5.1	5.2
Commercial	22.1	24.8	25.3	21.4	21.7	22.0	22.3
Public	12.1	10.4	9.0	9.4	9.1	8.8	8.5
Others	7.0	6.3	8.8	8.3	8.6	8.9	9.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

As for the annual average growth rates during 2001 –2015, the industrial sector is expected to grow at 5.3 %, the commercial sector at 4.5 %, the transport sector at 4.4 %, the agricultural sector at 3.2 %, the mining sector at 2.5 %, the public sector at 3.5 % and the others sector at 4.8 %.

5.2 Energy Supply and Demand

(1) Primary Energy Requirement

Table 5.2 shows the primary energy requirement by energy source, summarizing the simulation results over a five span. According to the simulation results targeting the year 2015, the energy requirement total is expected to rise at the average growth rates of 3.8 % in the low case, and respectively, 4.4 % in the high case in the period from 2000 to 2015. In the low case, the total energy requirement will increase from 87.88 million toe in 1999, to 108.28 million toe in 2005 at an average growth rate of 3.5 %, to 130.62 million toe in 2010 (at 3.8 % growth), and to 159.90 million toe in 2015 (at 4.1 % growth). In the high case, the total energy requirement is expected to rise to 110.15 million toe in 2005 (at 3.8 % growth), to 136.27 million toe (at 4.3 % growth), and to 173.89 million toe (at 5.0 % growth).

At present, the main energy source is oil, accounting for about 57 % of the total. Natural gas accounts for about 31 % and coal accounts for about 10 %. The highest growth will be coal, followed by natural gas and oil in both the low and high cases. The share of oil will decrease slightly from the 57 % level in 1999 to about 52-53 % in 2010. On the other hand, coal will expand its share from 10 % in 1999 to 16-17 % in 2010.

(2) Final Energy Consumption

Table 5.3 also shows the forecast final energy consumption by sector and by energy source. The final energy demand is expected to rise at the average growth rates of 3.8 % in the low case

and 4.4 % in the high case, respectively, in the period from 2000 to 2015. In the low case, the final energy consumption will increase from 56.99 million toe in 1999, to 70.57 million toe in 2005 at an average growth rate of 3.6 %, to 84.82 million toe in 2010 (at 3.7 % growth), and to 103.36 million toe in 2015 (at 4.0 % growth). In the high case, the final energy consumption is expected to rise to 71.86 million toe in 2005 (at 3.9 % growth), to 88.70 million toe (at 4.3 % growth), and to 112.68 million toe (at 4.9 % growth).

Looking at the demand by sector, the industrial sector expands its share from about 35 % in 1999 to about 39 % in 2015 as shown in Table 5.3. The transportation and residential/commercial sectors will slightly decrease their shares, however, and will remain as the main energy consuming sectors. The biggest energy source is petroleum products, accounting for about 74 % of the total demand. Natural gas accounts for about 13 % and coal accounts for about 3 %. The share of petroleum products will remain at over 70 %, while electricity will expand its share from about 11.5% to about 17-18 % until 2015 (at the average growth rate of 6.6 % in the low case and 7.6 % in the high case).

(3) Power Generation and Consumption

Table 5.4 shows the forecast power demand and generation. Electricity demand and generation will also increase at a 6.6 % (and 6.9 % in generation) growth rate in the low case and 7.6 % (and 7.5 %) in the high case during the same period mentioned above. Figure 5.2 shows the forecast electricity demand of the low case (Bar Graph) and the high case (Polygonal Graph).

In the low case, the power demand will increase from 84 TWh in 2001 to 145.5 TWh in 2010 and to 204.8 TWh in 2015 (up 6.6 % per year during 2001-2015). Demand for the industrial (manufacturing) sector is likely to increase from 35.5 TWh in 2001 to 70.3 TWh in 2010 and to 104.1 TWh in 2015 (up 8.0 %). Demand for the commercial sector is projected to climb from 10.9 TWh in 2001 to 21.1 TWh in 2010 and to 31.5 TWh by 2015 (up 7.9 % per year). Demand for the residential sector will increase from 33.2 TWh (2001) to 47.5 TWh (2010) and to 60.4 TWh in 2015 (up 4.4 % per year). The public sector demand will increase from 4.4 TWh (2001) to 6.7 TWh and to 8.7 TWh in 2015 at the average growth rate of 5.0 %.

Thermal power generation will continue to expand its share from about 86 % in 1999 to about 92 –93 % in 2010, as shown in Table 5.4. On the other hand, hydro and geothermal generation will decrease its share relatively.

Table 5.2 Primary Energy Requirement (unit: thousand toe)

	Actual				Forecast (Low Case)						Forecast (High Case)					
	1990	Share	1999	Share	2005	Share	2010	Share	2015	Share	2005	Share	2010	Share	2015	Share
Coal	3,921	6.7%	9,001	10.2%	13,063	12.1%	18,369	14.1%	25,952	16.2%	13,500	12.3%	19,754	14.5%	29,721	17.1%
(Growth rate)			9.7%		6.4%		7.1%		7.2%		7.0%		7.9%		8.5%	
Natural Gas	13,140	22.5%	27,440	31.2%	32,988	30.5%	39,529	30.3%	48,012	30.0%	33,373	30.3%	40,741	29.9%	51,277	29.5%
(Growth rate)			8.5%		3.1%		3.7%		4.0%		3.3%		4.1%		4.7%	
Crude Oil & NGL	40,672	69.7%	50,394	57.3%	60,976	56.3%	71,216	54.5%	84,185	52.6%	62,019	56.3%	74,278	54.5%	91,147	52.4%
(Growth rate)			2.4%		3.2%		3.2%		3.4%		3.5%		3.7%		4.2%	
Hydropowrer	488	0.8%	806	0.9%	963	0.9%	1143	0.9%	1322	0.8%	963	0.9%	1143	0.8%	1322	0.8%
(Growth rate)			5.7%		3.0%		3.5%		3.0%		3.0%		3.5%		3.0%	
Geothermal	97	0.2%	235	0.3%	293	0.3%	359	0.3%	425	0.3%	293	0.3%	359	0.3%	425	0.2%
(Growth rate)			10.3%		3.8%		4.1%		3.4%		3.8%		4.1%		3.4%	
Total	58,318	100%	87,875	100%	108,284	100%	130,616	100%	159,897	100%	110,148	100%	136,274	100%	173,891	100%
(Growth rate)			4.7%		3.5%		3.8%		4.1%		3.8%		4.3%		5.0%	

Table 5.3 Final Energy Consumption (unit: thousand toe)

	Actual				Forecast (Low Case)						Forecast (High Case)					
	1990	Share	1999	Share	2005	Share	2010	Share	2015	Share	2005	Share	2010	Share	2015	Share
by Sector																
Industry	12,953	37.6%	19,725	34.6%	26,077	37.0%	32,191	38.0%	40,181	38.9%	26,492	36.9%	33,554	37.8%	43,753	38.8%
Transport	11,366	33.0%	19,897	34.9%	22,626	32.1%	26,909	31.7%	32,472	31.4%	23,194	32.3%	28,501	32.1%	36,012	32.0%
Residential/Commerc	8,375	24.3%	14,892	26.1%	18,893	26.8%	22,182	26.2%	26,598	25.7%	19,207	26.7%	23,108	26.1%	28,806	25.6%
Agriculture	992	2.9%	1,784	3.1%	2,209	3.1%	2,563	3.0%	2,917	2.8%	2,209	3.1%	2,563	2.9%	2,917	2.6%
Non-specified	779	2.3%	692	1.2%	999	1.4%	1,255	1.5%	1,511	1.5%	999	1.4%	1,255	1.4%	1,511	1.3%
by Source																
Coal	1,109	3.2%	1,850	3.2%	2,379	3.4%	3,125	3.7%	4,085	4.0%	2,445	3.4%	3,317	3.7%	4,556	4.0%
Natural Gas	5,452	15.8%	7,097	12.5%	8,224	11.7%	9,353	11.0%	10,673	10.3%	8,282	11.5%	9,521	10.7%	11,082	9.8%
Petroleum Products	25,519	74.0%	41,908	73.5%	51,017	72.3%	59,827	70.5%	70,991	68.7%	51,916	72.2%	62,469	70.4%	76,998	68.3%
Electricity	2,386	6.9%	6,135	10.8%	8,945	12.7%	12,516	14.8%	17,611	17.0%	9,219	12.8%	13,396	15.1%	20,044	17.8%
(Growth rate)			11.1%		6.5%		6.9%		7.1%		7.0%		7.8%		8.4%	
Total	34,466	100%	56,990	100%	70,565	100%	84,822	100%	103,360	100%	71,863	100%	88,703	100%	112,680	100%
(Growth rate)			5.7%		3.6%		3.7%		4.0%		3.9%		4.3%		4.9%	

Table 5.4 Power Generation and Consumption (unit: GWh)

	Actual				Forecast (Low Case)						Forecast (High Case)					
	1990		1999		2005		2010		2015		2005		2010		2015	
		Share		Share		Share		Share		Share		Share		Share		Share
Power Generation	34,879	100%	84,776	100%	123,204	100%	172,396	100%	242,564	100%	126,973	100%	184,517	100%	276,079	100%
(Growth rate)			10.4%		6.4%		7.0%		7.1%		7.0%		7.8%		8.4%	
Thermal power	28,078	80.5%	72,678	85.7%	108,592	88.1%	154,932	89.9%	222,247	91.6%	112,362	88.5%	167,053	90.5%	255,762	92.6%
Hydro power	5,675	16.3%	9,370	11.1%	11,199	9.1%	13,288	7.7%	15,377	6.3%	11,199	8.8%	13,288	7.2%	15,377	5.6%
Geothermal power	1,125	3.2%	2,728	3.2%	3,412	2.8%	4,176	2.4%	4,940	2.0%	3,412	2.7%	4,176	2.3%	4,940	1.8%
Power consumption	27,741	100%	71,332	100%	104,017	100%	145,539	100%	204,779	100%	107,199	100%	155,771	100%	233,074	100%
			11.1%		6.5%		6.9%		7.1%		7.0%		7.8%		8.4%	
Industry	14,166	51.1%	31,338	43.9%	47,251	45.4%	70,272	48.3%	104,115	50.8%	49,139	45.8%	76,536	49.1%	121,855	52.3%
Commercial	2,328	8.4%	9,330	13.1%	14,276	13.7%	21,124	14.5%	31,507	15.4%	14,931	13.9%	23,294	15.0%	37,728	16.2%
Residential	9,004	32.5%	26,875	37.7%	37,309	35.9%	47,474	32.6%	60,442	29.5%	37,755	35.2%	48,721	31.3%	63,400	27.2%
Public	2,244	8.1%	3,789	5.3%	5,181	5.0%	6,668	4.6%	8,715	4.3%	5,374	5.0%	7,221	4.6%	10,091	4.3%

Table 5.5 Petroleum Products Demand (unit: thousand toe)

	Actual				Forecast (Low Case)						Forecast (High Case)					
	1990		1999		2005		2010		2015		2005		2010		2015	
		Share		Share		Share		Share		Share		Share		Share		Share
Total	30,934	100%	46,890	100%	58,288	100%	69,681	100%	84,521	100%	59,401	100%	73,000	100%	92,354	100%
(Growth rate)			4.7%		3.7%		3.6%		3.9%		4.0%		4.2%		4.8%	
LPG	347	1.1%	705	1.5%	973	1.7%	1,273	1.8%	1,651	2.0%	1,015	1.7%	1,384	1.9%	1,902	2.1%
Gasoline	5,015	16.2%	9,524	20.3%	10,834	18.6%	12,528	18.0%	14,646	17.3%	11,108	18.7%	13,234	18.1%	16,210	17.6%
Jet Fuel	952	3.1%	461	1.0%	778	1.3%	1,107	1.6%	1,512	1.8%	778	1.3%	1,107	1.5%	1,512	1.6%
Kerosene	6,667	21.6%	10,145	21.6%	12,084	20.7%	13,195	18.9%	14,763	17.5%	12,247	20.6%	13,669	18.7%	15,814	17.1%
Diesel Oil	11,818	38.2%	18,722	39.9%	24,495	42.0%	30,210	43.4%	37,748	44.7%	24,994	42.1%	31,798	43.6%	41,585	45.0%
Fuel Oil	4,916	15.9%	6,451	13.8%	7,888	13.5%	9,833	14.1%	12,371	14.6%	8,022	13.5%	10,274	14.1%	13,501	14.6%
Naphtha	440	1.4%	190	0.4%	238	0.4%	279	0.4%	319	0.4%	238	0.4%	279	0.4%	319	0.3%
Others	779	2.5%	692	1.5%	999	1.7%	1,255	1.8%	1,511	1.8%	999	1.7%	1,255	1.7%	1,511	1.6%

Figure 5.2 Electricity Demand by Sector

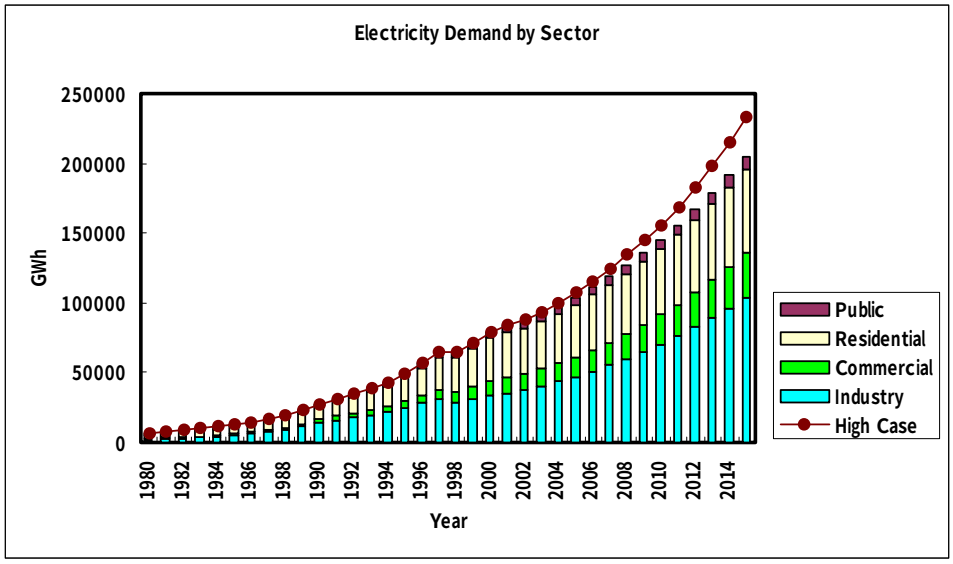


Figure 5.3 Peak Load

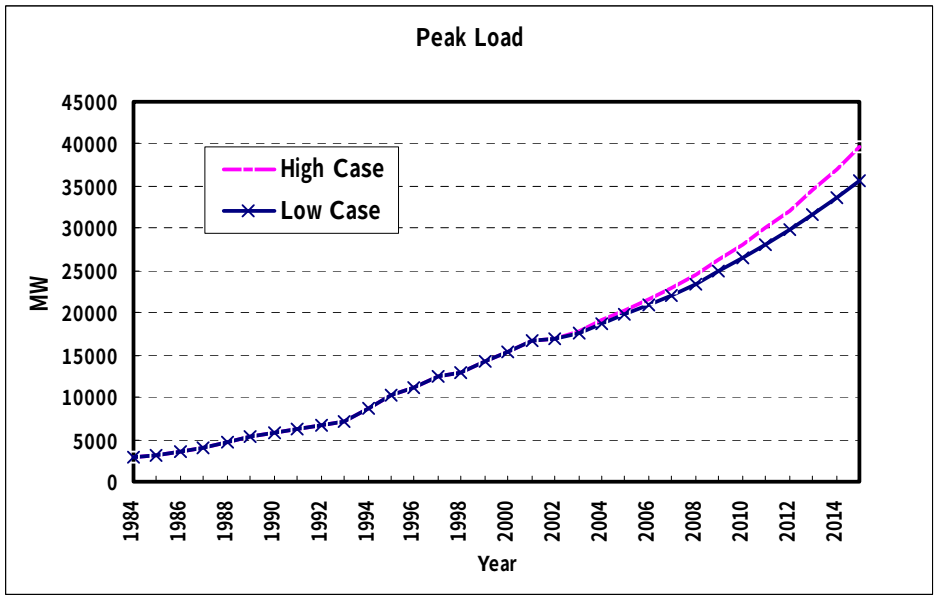


Figure 5.3 shows the historical trend and forecast result of peak load in Indonesia. In the low case, the peak load will increase from 15.32 GW in 2000, to 19.74 GW in 2005, to 26.46 GW in 2010, and to 35.68 GW in 2015 at the average growth rate of 5.8 %. In the high case, the peak load is expected to rise to 20.23 GW in 2005, to 27.96 GW, and to 39.68 GW at the average growth rate of 6.6 %.

(4) Petroleum Products Demand

Looking at petroleum products shown in Table 5.5, diesel oil, gasoline, kerosene and fuel oil

will retain the major part in order to meet domestic demand. The biggest share is diesel oil, which accounts for about 40 % in 1999 and will expand to about 45 % in 2015. The share of gasoline and kerosene is expected to be slightly less in the future. The highest growth is 7.7 % for jet fuel, followed by 5.5 % for LPG and 4.5 % for diesel oil.

(5) Production, Export and Import

Figure 5.3 shows the actual values and the projected results of the primary energy production in the period from 2000 to 2015. Each projection is assumed by use of gross trend or linear trend. Crude oil production remains at the current production level of about 70-72 million toe. Natural gas production is likely to increase from 60.5 million toe in 2000 to 73.5 million toe in 2005, to 86.5 million toe in 2010, and to 99.4 million toe in 2015 at the average growth rate of 3.4 % per year. Coal production is expected to increase from 52.3 million toe in 2001 to 62.5 million toe in 2005, to 75.1 million toe in 2010, and to 87.8 million toe in 2015 with a 3.8 % growth rate.

Figure 5.3 Indigenous Production of Primary Energy

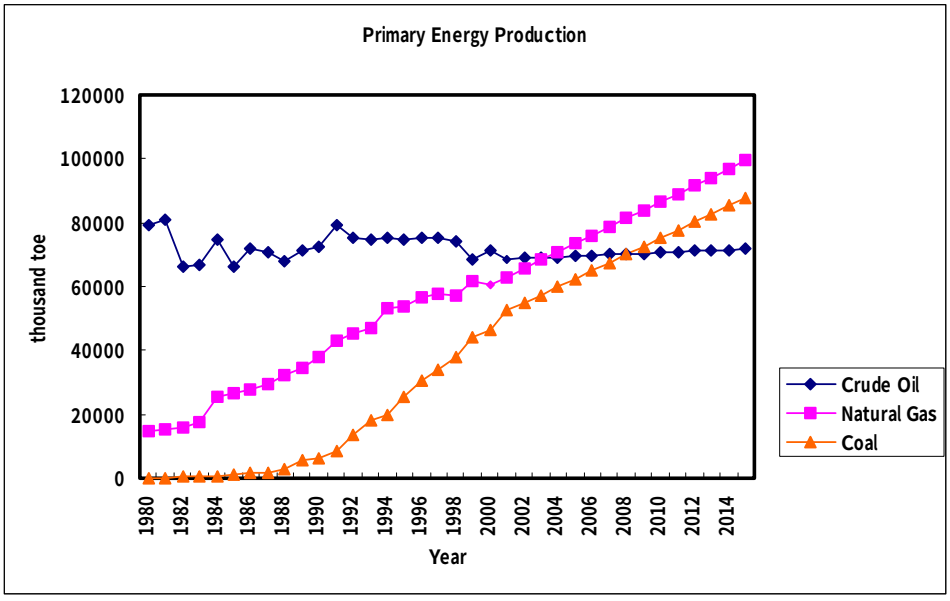


Figure 5.4 shows the historical trends and the projected results of the export/import of crude oil in the period from 2000 to2015. In the Figure, the negative (- side) values mean export, and the positive values (+ side) mean import, while the Figure also shows the net export/import value of the high case in addition to the low case. At present, Indonesia is a net exporter of crude oil. According to simulation results, it is estimated that Indonesia may change to a net importer of crude oil around the year 2010 (2011 in the low case, 2010 in the high case). In 2015, Indonesia requires a net crude oil import of 10.5 million toe (in the low case) or 17.5 million toe (in the high case).

Figure 5.5 shows the net values of primary energy export and import in the low case until 2015. Crude oil will change to a net import, while natural gas and coal will keep the net export balance between indigenous production and domestic demand. National gas maintains its export potential of 51.4 million toe in the low case and of 48.1 million toe in the high case. Coal also maintains its export potential of 61.8 million toe in the low case and of 58.1 million toe in the high case

Figure 5.4 Export and Import of Crude Oil

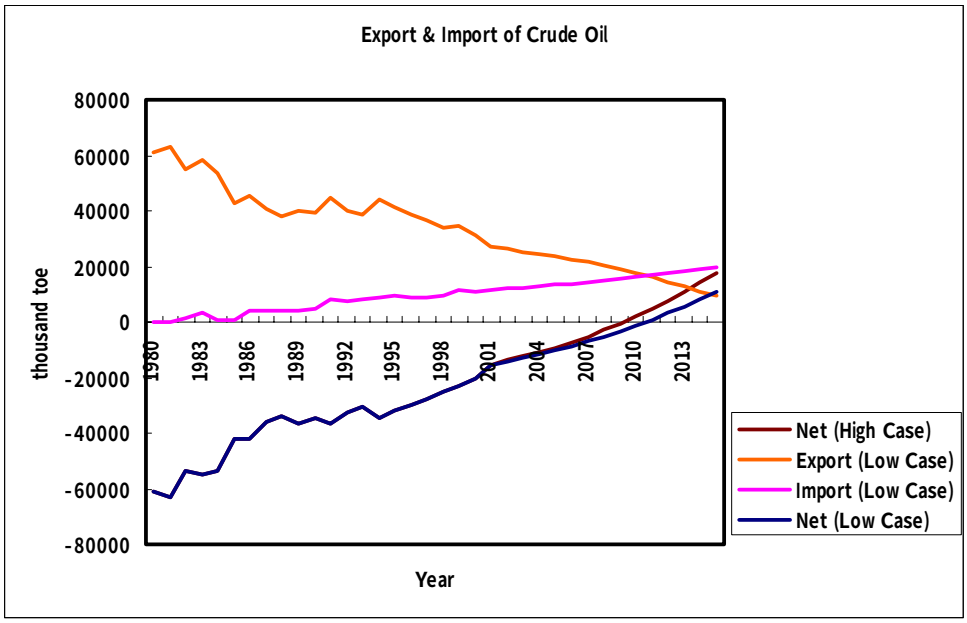
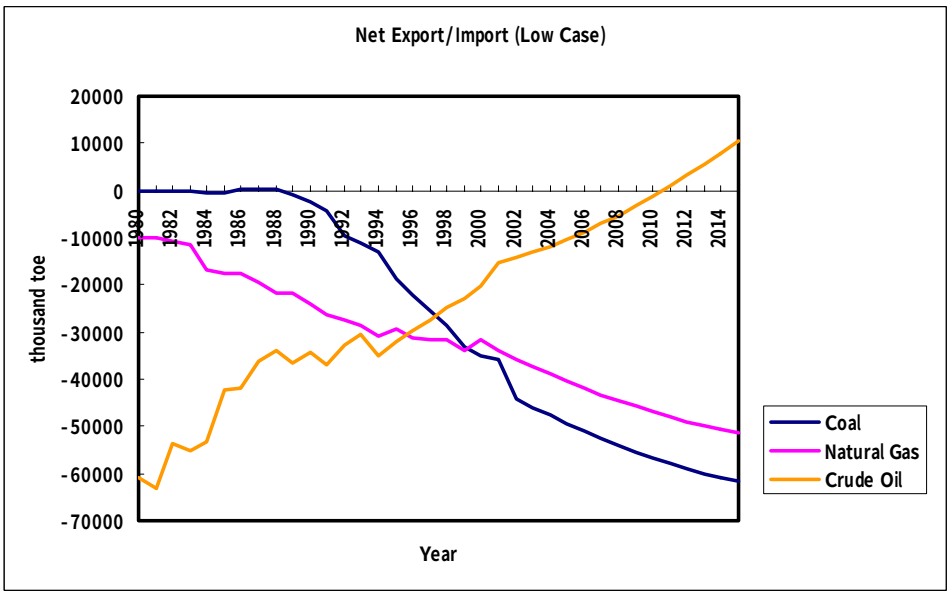


Figure 5.5 Net Export/Import of Primary Energy



6. Primary Energy Resources

6.1 Resources and Reserves

Table 6.1 shows the regional distribution of oil and natural gas reserves (by MIGAS). Much of Indonesia's proven oil reserve base is located onshore. Central Sumatra, where the Duri and Minas oil fields are located, is the country's largest oil producing province. Other significant oil fields under development or in production are located in accessible areas such as offshore from northwestern Java, East Kalimantan, and the Natuna Sea.

Table 6.1 Distribution of Hydrocarbon Reserves

	Oil (million bbl)			Natural Gas (TSCF)		
Location	Proven	Potential	Total	Proven	Potential	Total
Aceh	53.3	19.7	73.0	4.1	6.7	10.8
North Sumatra	162.1	59.5	221.6	1.2	0.3	1.5
Natuna	127.0	180.2	307.2	30.5	19.0	49.5
Central Sumatra	2,732.0	2,973.1	5,705.1	0.3	1.0	1.3
South Sumatra	428.6	319.8	748.4	6.3	3.8	10.1
West Java	621.9	487.4	1,109.4	4.5	2.3	6.7
East Java	232.2	91.7	323.9	2.8	3.1	5.9
East Kalimantan	760.9	475.9	1,236.7	27.7	20.1	47.8
South Sulawesi	-	-	-	0.7	0.2	0.9
Irian Jaya	85.3	15.7	101.0	14.5	9.4	23.9
Total	**5,203.2**	**4,623.1**	**9,826.3**	**92.5**	**65.8**	**158.3**

(Source) MIGAS, January 1, 1999

MIGAS estimates gas reserves of 158.3 trillion standard cubic feet (TSCF) or about 27 billion barrels of oil equivalent, of which 92.5 TSCF are proven and 65.8 TSCF are probable (See Table 6.1). This corresponds to around three times of Indonesia’s oil reserves, and can supply the country for 50 years at the current production rate. Over 71 percent of natural gas reserves are located offshore. Of these, the largest reserve is Natuna Island accounting for the share of 33.3 percent, followed by East Kalimantan (30.2 percent), Irian Jaya (15.1 percent), Aceh (6.8 percent) and South Sumatra (6.4 percent). The discoveries by Arco, now BP, in the Wiriagar and Berau gas fields located offshore from Irian Jaya are expected to be one of the most promising finds of late.

Meanwhile, the Directorate of Mineral and Coal Enterprises (DOC), Ministry of Energy and Mineral Resources has identified 38.8 billion tones of coal deposits, of which 11.5 billion tones are classified as measured resources and 27.3 billion tones as indicated, inferred and hypothetical resources, and 5.4 billion tones are classified as commercially exploitable reserves

(See Figure 6.2). The major coal resource areas are Kalimantan and Sumatra, estimated at 21.1 billion tones and 17.8 billion tones, respectively.

Table 6.2 Indonesian Coal Resources

Company (Million tones)	Resources			Mineable Reserves
	Measured	Indicated	Total	
PTBA	1,902	4,657	6,559	2,804
Contractors	8,998	22,185	31,183	2,054
Others	584	442	1,026	504
TOTAL	11,484	27,284	38,768	5,362

(Source) Directorate of Mineral and Coal Enterprises

Coal deposits in Sumatra are located largely in the area surrounding Tanjung Enim, South Sumatra. These deposits are mined by a state-owned coal company, Perusahaan Tambang Batubara Bukit Asam (PTBA). Kalimantan has high-quality coal deposits. Coal contractors operating in Kalimantan have the rights to exploit a total of 6.5 billion tones of the measured reserves. Kaltim Prima Coal possesses the largest measured reserves, estimated at 1.3 billion tones, followed by Arutmin Indonesia and Adaro Indonesia with one billion tones each.

6.2 Exploration

Indonesia's recent oil production has remained relatively flat as a result of the introduction of crude streams from new and smaller fields, which has helped to compensate for declines at many of the country's mature oil fields. To meet its goal of oil production, Indonesia has stepped up efforts to conclude new oil exploration contracts. The majority of Indonesia's producing oil fields are located in the central and western sections of the country. Therefore, the focus of new exploration has been on the frontier regions, particularly in eastern Indonesia. Sizable, but as yet unproven, reserves may exist in the numerous, geologically complex, pre-tertiary basins located in eastern Indonesia. These regions are much more remote and the terrain more difficult to explore than areas of western and central Indonesia.

Indonesia oil and gas resources are buried underneath sixties’ (60) Tertiary sedimentary basins, covering an area of more than two millions square kilometers. So far thirty-six (36) basins have been explored in detail (by MIGAS). The Government has placed increased emphasis on developing oil reserves in remote locations, such as Papua, where proven reserves are estimated at 85 million barrels.

7. Conclusion

According to the simulation results targeting the year 2015, the domestic energy demand is expected to increase at the average growth rates of 3.8 % in the low case scenario (GDP growth rates of 3.7%-4.5%), and of 4.4 % in the high case scenario (GDP growth rates of 4.5%-5.5%) in the period from 2000 to 2015. Electricity demand will increase at a 6.6 % growth rate in the low case and 7.6 % in the high case during the same period mentioned above.

In case the primary energy production increases/remains continues to maintain its historical trend, Indonesia will retain totally its status of a net energy exporter, but will transit from net exporter to net importer of crude oil in about 2010. Fuel shift from oil to natural gas, rational use of energy and exploration for oil are considered to be crucial matters for the country's sustainable development.

Data published by MIGAS show that Indonesia has crude oil proven reserves of 5.2 billion bbl (barrels), natural gas proven reserves of 92.5 trillion standard cubic feet, and coal reserves of about 5.3 billion tones. The reserved/production (R/P) ratio is estimated at about 10 for oil, about 50 for natural gas and about 80 for coal. Despite its significant gas reserves and its status as the world's largest exporter of liquefied natural gas (LNG), Indonesia still depends on oil for about 50% of its energy needs.

Indonesia, one of the most energy-resource rich of the ASEAN countries, has made a drastic turnaround in its second long-term national plan. The second long-term plan (LTD-2, 1994/95-2018/19) revealed that (1) Indonesia is not necessarily rich in energy resources, (2) fossil fuel resources need to be earmarked for exports, and are also positioned as fuels and materials necessary for manufacturing products, and (3) energy prices must be set to reflect the economic values. LTD-2 states that the goal of energy development is to increase the added value of Indonesia as a whole and to ensure the country's energy security and elasticity.

Energy policies related to (1) energy intensification, (2) energy diversification, (3) energy conservation, (4) energy pricing and (5) environment protection are emphasized in the LTD-2 as significant and valuable at present. This model study does not involve energy policy targets or constraints such as power capacity and refinery expansion. It is expected that integrated national energy policies will be established with concrete plans and policy targets covering the entire field of energy supply and demand.

Contact: ieej-info@tky.ieej.or.jp