Project Study on Comprehensive Technical Cooperation in the Field of Energy in Indonesia

Final Report

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Preface

JICA has conducted a wide range of technical cooperation projects on the Indonesian energy sector in the areas such as JICA Expert dispatch, development study, technical cooperation project and acceptance of trainees. These projects have led both soft loan projects and grant-aid projects and contributed to the development of the economical and social infrastructure.

The foundational consolidation of technical data, technical transfer and human resource development was implemented through previous technical cooperation projects, consequently, certain technological competencies have already been established in Indonesia. However, in recent years, the circumstances in the Indonesian energy sector have changed dramatically and various difficult issues have emerged. The energy policy, based on abundant oil reserve, has been unsuccessful and oil amount of import exceeded that of export in 2004, thus, effective policy changes are urgently required. The Indonesian energy sector should promote the establishment of a practical energy policy and institutions to achieve sustainable development. The installation of a fair and highly transparent energy sector is essential. At the same time, the structural reform of the energy sector and decentralization policy should not adversely affect the socio-economic infrastructure environment, particularly with regard to rural development.

Based on these circumstances, it can be said that the methods of JICA's technical cooperation projects are now in a phase of diversification. The most appropriate form and method of cooperation should be presented by identifying various requirements for technical assistance, then on assessment, the projects which meet each requirement should be actively proposed. In addition to the previous assistance, a comprehensive approach that includes policy planning, institutional arrangement and human resource development are necessary.

This study assesses the difficulties in each field of the Indonesian energy sector and proposes effective practical cooperation programs for the future. Specific recommendations for cooperation projects are also presented.

This report aims to contribute to the establishment of a technical cooperation plan in the Indonesian energy sector. This study was sponsored by JICA and implemented through the study team consist of Chubu Electric Power Co., Inc and Nippon Koei Co., Ltd. However, the contents of the report are based on the investigation and the analysis of the study team involved and do not necessarily represent the views of JICA.

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List of Abbreviations

Abbreviations	Nomenclature
ADB	Asian Development Bank
ADO	Automotive Diesel Oil
BAKOREN	Badan Koordinasi Energi Nasional
BAPPEDA	Badan Perencanaan Pembangunan Daerah
BAPPENAS	Badan Perencanaan Pembangunan Nasional
BOO	Build Operate Own
BP	British Petroleum
BPH-MIGAS	Badan Pengatur Hilir MIGAS
BP-MIGAS	Badan Pelaksana MIGAS
BPPT	Badan Pengkajian dan Penerapan Teknologi
CBM	Coal-Bed Methane
CCT	Clean Coal Technologies
CDM	Clean Development Mechanism
CFBC	Circulating Fluidized Bed Combustion
CNG	Compressed Natural Gas
CSR	Corporate Social Responsibility
CWM	Coal Water Mixture
DGEEU	Directorate General of Electricity and Energy Utilization
DMCE	Director of Mineral and Coal Enterprise
DMCT	Directorate of Mineral and Coal Techniques
DME	Dimethyl Ether
DSM	Demand Side Management
EIA	Environmental Impact Assessment
EOR	Enhanced Oil Recovery
ESCO	Energy Service Company
FO	Fuel Oil used by local transportation companies and Indonesia's state electricity company PLN
GDP	Gross Domestic Product
GEF	Global Environment Facility
GT	Gas Turbine
GTAP	Global Trade Analysis Project
GTL	Gas To Liquid
HSD	High Speed Diesel Oil
IDO	Industrial Diesel Oil
IEA	International Energy Agency

Abbreviations	Nomenclature
IPP	Independent Power Producer
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
KLP	Keputusan Limit Penjaminan
KONEBA	Konservasi Energi Abadi (Persero)
KP	Kuasa Pertambangan
KUD	Koperasi Unit Desa
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MEMR	Ministry of Energy and Mineral Resources
MIGAS	Directorate General of Oil and Gas
MOC	Ministry of Cooperative
MOU	Memorandom Of Understanding
MSOE	Ministry of State Owned Enterprises
NEDO	New Energy and Industrial Technology Development Organization
NGL	Natural Gas Liquid
OECF	Overseas Economic Cooperation Fund
OPEC	Organization of the Petroleum Exporting Countries
P3B	Pusat Pengaturan dan Pendistribusian Beban
PBS	Palli Bidyut Samity
PERTAMINA	Perusahaan Pertambangan Minyak dan Gas Bumi Negara
PGN	Perusahaan Gas Nagara
PKUK	Pemegang Kuasa Usaha Ketenagalistrikan
PLN	Perusahaan Listric Negara PERSERO
PPA	Power Purchase Agreement
PPP	Public Plivate Partnership
PSC	Production Sharing Contracts
PSS/E	Power System Simulator for Engineering
PTA	Performance Target Agreement
PTBA	Perusahaan Tambang Batubara Bukit Asam
PTE	Panitian Tenis Energi
REB	Rural Electrification Board
Renja-SKPD	Renja Satuan Kerja Perangkat Daerah
Renstra-SKPD	Rencana Strategis Satuan Kerja Perangkat Daerah
RKPD	Rencana Kerja Pemereintah Daerah
RPJMD	Rencana Pembangunan Jangka Menengah Daerah

Abbreviations	Nomenclature
RPJPD	Rencana Pembangunan Jangka Panjang Daerah
RPS	Renewable Portfolio Standard
RUKD	Rencana Umum Kelistrikan Daerah
RUKN	Rencana Umum Ketenagalistrikan Nasional
RUPTL	Rencana Usaha Penyediaan Tenaga Listrik
SHS	Solar Home System
SSWJ	South Sumatra-West Java gas pipeline project
TekMIRA	Teknologi Mineral dan Batubara
TOR	Terms of Reference
UBC	Upgraded Brown Coal
USAID	U.S. Agency for International Development
WASP	Wien Automatic Simulation Program
WB	World Bank

Chapter 1 Introduction

1.1 Background

The energy sector in Indonesia has confronted several difficulties, such as the deficiency of oil and natural gas, the poor reliability of electricity supply, the slow development of electricity infrastructure and delay in the introduction of systematic power conservation to reduce energy consumption.

In Java and Bali, electricity supply is insecure and P3B balances supply and demand by load shedding. The shut down of generating facilities due to fuel shortage and the load limitation of alternative fuels could result in severe undersupply issues. Comprehensive approaches, considering the supply and demand of primary energy, are needed to improve the circumstances.

The fuel shortage results from both an inadequate national oil reserve, which could be exhausted in 10 years and from the elevation of the international oil price. At the same time, natural gas fields located along coastal lines have gradually been exhausted and sometimes high-speed diesel oil is applied as an alternative fuel for natural gas fueled turbines.

To cope with the shortages of oil and natural gas, the Indonesian government promoted the utilization of coal, however, it is often the case that the use of coal, behaves differently to the specified fuel, and may cause trouble in boilers.

At the same time, stable supply of electricity concerns human security. Indonesia experienced civil unrest and protest demonstrations against previous increases in the price of petrochemical products and the riots resulted in immense harm to the population. The incidents showed that the disturbance in energy security may directly threat the livelihoods of citizens. Presently, the Indonesian government has increased grant money to cope with the recent elevation of the international oil price. The expansion leads to a budget deficit, which requires a phased increase in the price of petrochemical products. In response to this, regular protest rallies are held indicating the growing underlying social instability. Also, the livelihood of citizens is directly affected by energy supply in terms of regional and village development. Achieving a stable energy supply would: allow people to avoid the need to collect wood for fuel; vitalize economic activity; improve productivity towards alleviating poverty; and develop accessibility to essential elements for human life, such as healthcare, food and clean water.

JICA has conducted various technical cooperation projects in diverse areas in the Indonesian energy sector, such as renewable energy, coal and energy conservation. However, a simple approach, such as an improvement and increase in facilities and maintenance, is not enough to cope with the poor reliability of electricity supply. A comprehensive approach, including stable primary energy supply, quality improvement and demand restraint, is required and a synergistic strategy should be derived. At the same time, cooperation with other sectors that are focusing on energy security, regional development and poverty reduction from the viewpoint of citizen's security is expected.

The study examines the current conditions and difficulties in each field to conduct effective cooperation projects in the Indonesian energy sector. Then the study presents the guideline on synergistic cooperation among sectors to highlight key issues. At the same time, the study examines the cooperation program aimed at regional and village development and proposes a cooperation program which relates to citizen's security and poverty reduction.

1.2 Objective

The Study consists of the following two objectives:

1. To present a practical and comprehensive cooperation program on the Indonesian energy sector. The collective difficulties in the Indonesian energy sector and previous JICA projects on the sector should be analyzed and an effective guideline for cooperation projects should be organized.

2. To propose a cooperation program which contributes to regional development. The current conditions of regional and village development in Indonesia should be analyzed and the expected role of the energy sector from the viewpoint of citizen's security and poverty reduction should be clarified.

1.3 Research Zone

Throughout Indonesia. Field studies on regional and village development were deployed in Lombok islands based on advanced study in Japan.

1.4 JICA Study Team

Member	Field
Mr. Yoshitaka Saito	Team Leader / Cooperation Program in Energy Sector
Mr. Tomoyuki Inoue	Supply - Demand Plan for Oil, Natural Gas, and Coal
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Mr. Tsutomu Mori	Supply - Demand Plan for Energy / Energy Conservation
Mr. Naoya Azegami	Local Development / Rural Development

Chapter 2　Current situation of Indonesian energy sector

2.1 Current Situation and Issues of Primary Energy Balance

2.1.1 Energy Resources

It has hitherto been believed that Indonesia has great fossil energy resources such as oil, coal and natural gas. However it is currently considered that Indonesian energy resources are limited, and in particular that crude oil resources will be used up within ten years. This section gives the latest report on primary energy resources in Indonesian.

(1) Oil

Table 2.1.1 shows the crude oil reserves changes from the 2004 statistics of BP Amoco. The crude oil reserves are estimated to have been 4.4 billion bbl at the end of 2003, which accounts for 0.4% of the world's crude oil reserves and 9.2% of those of Asian Pacific countries. R/P, which shows the ratio between reserves and production, is 10.3, meaning that Indonesia crude oil will be consumed within 10.3 years if no additional reserves are found in the future. As the world ratio shown by the following table is 41.0, Indonesia crude oil reserves will be exhausted earlier than those of the other countries.

Table 2.1.1　Crude Oil Reserves in 2003

Proved Reserves	At the end of 1983	At the end of 1993	At the end of 2002	At the end of 2003			
	Billion barrels	billion barrels	billion barrels	billion barrels	billion tones	Share	R/P ratio
Indonesia	**10.1**	**5.2**	**4.7**	**4.4(A)**	**0.6**	**100.0 %**	**10.3**
Asia Pacific Total	39.0	52.0	47.5	47.7(B)	6.4	9.2%(A/B).	16.6
World Total	723.0	1,023.6	1,146.3	1,147.7(C)	156.7	0.4 %(A/C)	41.0

・R/P ratio = reserves / production in current year.

・Sources ：BP 2004 Statistical Review of World Energy

Table 2.1.2 shows the crude oil and natural gas reserves by region. Most of Indonesia's crude oil reserves are located onshore. The big oil reserves such as the Duri and Minas oil fields in Central Sumatra are the greatest oil production area in Indonesia. The other areas, namely the North-west of Java, East Kalimantan and the sea near Natuna, also have comparatively large oil reserves. These areas are located with easy access to transportation.

Table 2.1.2　Distribution of Oil and Gas Reserves

	Oil (million bbl)			Natural Gas (TSCF)		
Location	Proven	Potential	Total	Proven	Potential	Total
Aceh	147.9	38.5	186.4	3.2	6.5	9.7(5.5%)
North Sumatra	109.2	33.6	142.8	0.8	0.3	1.1(0.6%)
Natuna	169.3	238.2	407.5	31.8	23.0	54.8(31.0%)
Central Sumatra	2,263.8	3,098.7	5,362.5	2.8	6.7	9.5(5.4%)
South Sumatra	426.6	285.4	711.8	7.6	13.6	21.2(12.0%)
West Java	468.6	527.1	1,175.7	4.1	3.1	7.2(4.0%)
E/C Java	170.1	79.1	249.2	2.0	2.3	4.3(2.4%)
E/S Kalimantan	637.8	605.9	1,243.7	26.0	22.7	48.7(27.6%)
South Sulawesi	10.2	0	10.2	0.4	0.2	0.6(0.0%)
Irian Jaya/Maluku	138.4	118.4	256.8	11.7	7.9	19.6(11.1%)
Total	**4,721.8**	**5,024.6**	**9,746.4**	**90.3**	**86.3**	**176.6(100.0%)**

The name of Irian Jaya was changed to "Papua" in Jan 2000

Sources：MEMR-MIGAS, January 1, 2002

Table 2.1.3 shows the oil and gas resources and reserves by location (Onshore and offshore) in Indonesia.

Table 2.1.3 Resources and Reserves of Oil and Gas

	Oil (billion bbl)	Gas (TSCF)
Reserves		
Onshore	7.3	71.8
Offshore	2.4	104.8
Total	**9.7**	**176.6**
Resources		
Onshore	84.3	110.0
Offshore	53.4	185.3
Total	**137.7**	**295.3**

Sources：MEMR-MIGAS, January 1, 2002

(2) Natural gas

Table 2.1.4 shows the changes of natural gas reserves in Indonesia from 2004 (statistics edited by BP Amoco). According to Table 2.1.4, natural gas reserves at the end of 2003 are estimated to be 84.9Tscf, which is a 1.4% share of the world's natural gas reserves and a 17.8% share of those of the Asian Pacific countries. Since the R/P ratio is 45, these will be consumed within around 50 years if natural gas consumption continues at the present level. Meanwhile, the Indonesian government estimates that natural gas reserves are 176.6Tscf(Table 2.1.3), and proved reserves were 84.9Tscf (Table 2.1.4) in 2003.

By regional reserves, Natuna has the biggest reserves in the Table 2.1.2 with a share of 31%, followed by East Kalimantan with 28% and South Sumatra with 12%. Approximate 60% of the natural gas reserves in Indonesia are located offshore.

Table 2.1.4 Natural Gas Reserves in Indonesia

Proved Reserves	At the end of 1983	At the end of 1993	At the end of 2002	At the end of 2003			
	Trillion cubic meters	Trillion cubic meters	Trillion cubic meters	Trillion cubic meters	TSCF	Share of Indonesia	R/P ratio
Indonesia	**1.40**	**1.83**	**2.48**	**2.41**	**84.9(A)**	**100%**	**45.0**
Asia Pacific Total	5.95	8.73	13.38	13.47	475.6(B)	17.8 %(A/B)	43.4
World Total	92.68	141.08	175.15	175.78	6,204.8(C)	1.4 %(A/C)	67.1

Sources ：BP 2004 Statistical Review of World Energy

(3)Coal

According to the "BP Statistical Review of World Energy 2005", the coal reserves were 4.97 billion ton at the end of 2004, representing a share of 0.5% in the world and a 1.6% share in the Asian Pacific countries. As the R/P is 38, it will be possible to produce Indonesia coal for the next 50 years. According to the Directorate of Mineral and Coal Enterprises in MEMR, coal resources reach 57.8 billion tons, proved reserves are 12.5 billion tons, estimated reserves are 20.5 billion tons and recoverable reserves are 7.0 billion tons.

Table 2.1.5 Coal Reserves in Indonesia

Reserves at the end of 2004 Million tones	Anthracite and Bituminous	Sub-bituminous and Lignite	Total	Share of Indonesia	R/P ratio
Indonesia	**740**	**4,228**	**4,968(A)**		**38**
Asia Pacific Total	211,895	96,695	308,590(B)	1.6%(A/B)	102
World Total	478,771	430,293	909,064(C)	0.5%(A/C)	164

Sources：BP Statistical Review of World Energy2005

Table 2.1.6 shows the regional reserves. The main coal fields are located in Sumatra and Kalimantan provinces. The coal reserves of these provinces are 27.4 billion tons and 30.2 billion tons, respectively.

Table 2.1.6 Coal Reserves by Region （Million tons）

	Proved reserves	Estimated reserves	Resources	%	Recoverable reserves
Sumatra	2,755	20,046	27,392	47.4	2,735
Java	0	0	15	0	0
Kalimantan	9,690	487	30,169	52.2	4,246
Sulawesi	21	0	134	0.2	0
Papua	0	0	138	0.2	0
Others	0	1	0	0	0
Total	12,466	20,534	57,848	100	6,982

Sources：Directorate of Mineral and Coal Enterprises “Indonesia Coal book Statistics 2004/2005

Table 2.1.7 shows the coal resources, coverable reserves and coal production by mining right honor. Most of the coal fields are located around Tanjung Enim in South Sumatra province, which is mined by a company named Perusahaan Tambang Batubara Bukit Asam (PTBA) established by the Government. In Kalimantan, the biggest coal mining company is Kaltim Prima Company that has coal mining rights for 130 million tons. Next are Arutmin Indonesia and Adaro Indonesia, companies which have coal mining rights for 100 million tons, respectively.

Table 2.1.7 Coal Resources in Indonesia（Million tons）

Companies Generation	Resources			Recoverable	Production 2002	R/P
	Proved	Estimated	Total			
PTBA	1,902	4,657	6,559	2,804	9.5	295
First generation	4,510	9,320	13,830	1,792	76.6	23
Second Generation	599	1,639	2,238	260	7.4	35
Third generation	3,963	11,244	15,207	433	3.0	144
KP Holders	594	447	1,041	79	6.8	12
Total	11,568	27,307	38,875	5,368	103.3	52

Source：Directorate of Mineral and Coal Enterprises “Indonesian Coal Statistics 2003”

(4) Hydropower

Tables 2.1.8 and 2.1.9 show the potential of hydropower in Indonesia. The total potential is 75,000MW (maximum). However, most of the potential is located in Sumatra, Kalimantan and the outer islands. According to the national energy policy, the development of hydropower needs to be

promoted as an oil-substituting energy. The government is planning to implement optimum development of the water resources around Java islands and promote sustainable development in rural areas. As it is considered that small and micro hydro can contribute to the economic development of rural areas in cases where the economy is depressed, the government has decided to give incentives for the development of hydropower resources. However, the details of such incentives have not yet been announced.

Table 2.1.8 Hydropower Potential in Indonesia

Regions	Number of sites	Capacity（MW）	Energy (GWh)
Sumatra	447	15,587	84,110
Java-Bali	120	4,200	18,042
Kalimantan	160	21,581	107,202
Sulawesi	105	10,183	52,952
Papua	205	22,371	133,759
NTB-NTT	120	624	3,287
Maluku	53	430	2,292
Total	1210	74,976	401,644

Source：Potensi Hidro Indonesia,PLN,2003

Table 2.1.9 Mini/Micro Hydropower Potential and Capacities (kW) in Indonesia

Region	Potential		Installed capacity					
			PLN		DJLPE		Others	
	Number	Capacity	Number	Capacity	Number	Capacity	Number	Capacity
Sumatra	146	116,912	60	51,337	24	774	100	1,247
Java-Bali	2	6,472	51	34,022	27	916	29	811
Kalimantan	48	243,783	3	400	13	399	0	0
Sulawesi	117	63,913	92	98,676	5	95	26	392
Papua	36	9,763	9	2,893	10	213	4	70
NTB-NTT	124	264,450	11	11,523	6	235	4	53
Maluku	6	2,337	2	1,103	1	15	0	0
Total	479	707,630	228	199,956	86	2,647	163	2,572

Source: The Indonesian Electric Power Business Directory 2004

(5) Geothermal

Table 2.1.10 shows geothermal potential in Indonesia. The geothermal resources are as high as 27GW for the country as a whole, where many volcanoes exist in Indonesia. The geothermal resources are expected by the Government to be used as an oil-substituting energy. Most of the geothermal resources are located in Java and Sumatra islands.

Table 2.1.10 Geothermal Potential in Indonesia (MW)

Region	Potential	Probable	Proven	Resources	Installed
Sumatra	5,419	15	499	14,071	2
Java-Bali	3,088	603	1,727	9,329	785
NTB-NTT	631		14	1,233	
Sulawesi	632	110	65	1,932	
Maluku	142			534	20
Papua				50	
Kalimantan				50	
Total	9,912	728	2,305	27,189	807

Source: MEMR, DGGMR (as of 2005)

The installed geothermal capacity in Indonesia is 807MW in total, and the number of the sites is seven. Most of the geothermal units are connected to the Java grid network. Geothermal development

was monopolized by PERTAMINA during years in the past, but since 2000 it has been possible for private companies to develop geothermal power plants. PERTAMINA operates geothermal plants in Kamojang, Sibayak, Lahendong and other areas.

Table 2.1.11 Installed Geothermal Units in Indonesia（MW）

Names	Total
Kamojang	140 (3unit)
Sibayak	2 (1 unit)
Darajat	145 (2unit)
Gunung Salak	330 (6unit)
Wayang Windu	110 (1unit)
Dieng	60 (1 unit)
Lahendong	20 (1 unit)
TOTAL	807

Source: MEMR, DGGMR (as of 2005)

2.1.2 Energy Balance

(1) Comprehensive energy balance

Table 2.1.12 shows the primary energy supply changes in Indonesia. In the 1990s, primary energy production and exports were pursued increasingly in Indonesia, although at the same time there was an increase in imports of crude oil for domestic oil refineries and secondary oil products such as diesel, gasoline and kerosene. The table shows clearly that the Government has the intention of exporting high-quality crude oil in order to earn foreign currency, and of importing comparatively cheaper crude oil for domestic use.

Table 2.1.12 Changes of Primary Energy Supply (1,000kTOE)

Items	1990	1995	2000	2001	2002	2003
Domestic production	161.3	207.5	226.8	232.6	240.9	250.0
Import	10.2	18.8	23.7	27.8	31.7	33.4
Export	-76.1	-100.2	-107.7	-110.7	-116.4	-121.4
International marines	-0.5	-0.4	-0.1	0	-0.2	-0.4
Supply total	94.8	125.7	142.7	149.6	156.1	161.6

Supply total in the above table is Primary energy supply total

Sources：IEA, “Energy Balances of Non-OECD Countries,”

Tables 2.1.13 and 2.1.14 show the changes of primary energy production and contributions. Since 2000, production of coal, natural gas and thermal power has been increasing. However, crude oil and NGL have been decreasing during this period. Regarding energy production contribution in 2003, oil is 24% (53% in1986), gas is 28% (21% in 1986), coal is 28% (1% in 1986) and others are 2.5% (0.5% in 1986). The oil contribution in 2003 declined by 29 points as compared with 1986. Coal contribution in 2003 increased by 27points as compared with 1986. Gas contribution in 2003 increased by 7 points as compared with 1986. It is clear that energy production in Indonesia is shifting from oil to coal and gas.

Table 2.1.13 Changes of Primary Energy (1,000kTOE)

Items	1986	1990	1995	2000	2001	2002	2003
Coal	1.6	6.4	25.3	47.1	56.9	63.6	70.9
Renewable	33.2	37.3	40.3	41.1	41.7	42.9	43.5
Natural gas	28.0	42.6	58.6	63.0	60.8	65.9	68.9
Crude oil	71.8	64.7	72.5	64.4	61.1	56.4	53.8
NGL	0.6	8.6	8.2	6.2	5.9	5.9	5.6
Hydro	0.5	0.6	0.7	0.9	1.0	0.9	0.8
Geothermal	0.2	0.9	1.9	4.2	5.2	5.4	5.4
Production total	135.8	161.3	207.5	226.8	232.6	240.9	250.0

Sources：IEA, “Energy Balances of Non-OECD Countries,”

Table 2.1.14 Production Contribution of Primary Energies (%)

Items	**1986**	**1990**	**1995**	**2000**	**2001**	**2002**	**2003**
Coal	1.2	4.0	12.2	20.8	24.5	26.4	28.4
Renewable	24.4	23.1	19.4	18.1	17.9	17.8	17.4
Natural gas	20.6	26.4	28.2	27.8	26.1	27.4	27.6
Crude oil	52.9	40.1	34.9	28.4	26.3	23.4	21.5
NGL	0.4	5.3	4.0	2.7	2.5	2.4	2.2
Hydro	0.4	0.4	0.3	0.4	0.4	0.4	0.3
Geothermal	0.1	0.6	0.9	1.9	2.2	2.2	2.2
Production total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sources：IEA, “Energy Balances of Non-OECD Countries,”

(2) Energy production by energy

■ **Oil and gas**

In Indonesia, the energy production of the main oil and gas companies with the exception of Exspan, Exxon Mobil and Kodeco is in decline owing to the fact that no new oil or gas reserves have been discovered. The exploration of new oil and gas reserves are now concentrated in a small area of offshore reserves in Sumatra, Java and Kalimantan. Tables 2.1.15 to 2.1.18 show the actual oil and gas production by company. Tables 2.1.19 and 2.1.20 show the current situations of the main oil and gas wells and oil refinery plants. The average oil production declined by 25% from 1.5 million bbl/day in 1999 to 1.13 million bbl/day in 2004. According to MEMR-MIGAS, the crude oil production will be recovered to 1.30 million bbl/day up to 2009. Meanwhile, the production of natural gas increased by 20% from 3.0 Tscf in 1999 to 3.6 Tscf in 2004.

Table 2.1.15 Changes of Oil Production by Oil Company (1,000 bbl/day)

Company	1980	1999	2000	2001	2002	2003	2004	Shares%
Caltex	760.5	746.0	705.9	643.2	577.3			46.1
CNOOC	82.2	140.1	126.6	125.7	114.9			9.2
Exspan	38.9	37.5	67.2	77.0	85.5			6.8
Total	198.8	81.2	85.5	90.0	79.8			6.4
Conco Philips	25.5	109.5	87.9	83.2	69.3			5.5
Unocal	108.8	63.9	59.4	59.3	56.2			4.5
BP	133.8	71.5	62.6	50.8	46.5			3.7
Petrochina	60.3	41.6	37.6	45.8	42.4			3.4
Pertamina	81.7	44.2	46.3	45.1	40.1			3.2
Vico	23.3	54.7	48.4	40.8	36.2			2.9
Kondur Pet		16.9	14.9	13.8	11.1			0.9
Talisman		20.0	14.6	13.8	12.7			1.0
Exxon Mobil	61.3	42.3	28.2	13.4	25.3			2.0
Husky/Sea Union		6.8	6.2	6.0	5.6			0.4
Kodeco		1.8	4.2	6.5	13.5			1.1
Perkasa Equatorial		2.7	3.1	5.3	5.5			0.4
Premier Oil/Amoseas		2.7	3.1	5.3	5.5			0.4
Total	**1,576.0**	**1,500.3**	**1,414.1**	**1,344.0**	**1,251.5**	**1,183**	**1,126**	**100.0**

Note: the total includes other companies' productions

Source: Petroleum Report Indonesia 2003 by American Embassy in Jakarta

Table 2.1.16 Changes of Natural Gas Production by Gas Company (Billion scf)

Company	1998	1999	2000	2001	2002	2003	2004	Shares%
Total	604.4	684.5	841.4	880.2	835.0			27.4
Exxon Mobil	921.8	794.2	458.9	268.1	557.8			18.3
Vico	456.9	477.4	452.5	464.0	439.0			14.4
BP	284.8	298.3	293.0	295.0	272.1			8.9
Pertamina	270.3	259.1	285.7	276.8	258.0			8.5
Gulf Resources	75.8	166.4	165.2	163.8	N/A			5.4
Unocal	143.8	162.9	166.3	159.3	149.3			4.9
ConocoPhilips	14.2	8.7	20.9	41.3	233.4			7.7
Petrochina/Devon Ener.	17.6	20.1	30.9	45.1	58.6			1.9
Caltex	57.0	68.3	57.8	50.3	45.7			1.5
Expan	35.7	35.1	33.1	41.0	41.9			1.4
Premier/Amoseas	16.3	16.5	12.6	29.2	40.4			1.3
CNOOC/YPF/Maxus	26.3	24.4	24.9	27.6	27.3			0.9
Kodeco	7.1	10.1	12.4	11.0	23.6			0.8
Talisman	8.5	6.9	5.8	7.7	14.0			0.5
Energy Equity/Amerada	5.9	6.7	8.1	8.5	9.7			0.3
Lapindo	0.5	1.3	2.8	4.2	7.7			0.3
SeaUnion/Husky	9.7	8.1	7.9	7.5	7.5			0.2
Hed Ind./citra Patenindo	4.7	5.4	6.6	5.8	5.0			0.2
Japex	7.2	6.8	6.4	5.1	3.5			0.1
Oteher	10.5	7.5	8.3	24.0	12.6			0.4
Total	**2,978.9**	**3,068.3**	**2,901.4**	**2,807.2**	**3,041.9**	**3,208**	**3,619**	**100.0**

Source Petroleum Report Indonesia 2003 by American Embassy in Jakarta

Table 2.1.17 Production and Export of LNG (Unit:1,000 tons)

	1998	1999	2000	2001	2002	2003	Shares%
Production							
PT. Arun	10,845	11,417	6,706	3,000	6,243		23.8
PT Badak	16,335	18,396	20,615	21,344	19,942		76.2
Total	27,180	29,813	27,321	24,344	26,185		100.0
Export							
PT. Arun	10,763	11,089	6,747	2,823	6,250		23.8
PT Badak	162,121	17,867	20,243	21,060	19,965		76.2
Total	26,974	28,956	26,990	23,883	26,215	26,680	100.0

Source Petroleum Report Indonesia 2003 by American Embassy in Jakarta

Table 2.1.18 Directions of LNG Export (Unit: million tons)

Countries		Contract	Volume	Fields
Japan	Kansai	1977-2010	2.56	Arun/Badak
		1983-2011	0.91	Badak
		1997-1999	0.06	Badak
	Chubu	1997-2010	2.14	Arun/Badak
		1983-2011	1.70	Badak
		1997		Badak
	Kyushu	1977-2010	1.55	Arun/Badak
	Osaka gas	1977-2010	1.30	Arun/Badak
		1983-2011	0.45	Badak
		1994-2013	1.27	Badak
		1996-2015	0.07	Badak
		1997-1999	0.11	Badak
	Nippon Steel	1977-2010	0.54	Arun/Badak
		1996		Badak
		1997-1999	0.17	Arun/Badak
	Toho gas	1977-2010	0.06	Arun/Badak
		1983-2011	0.57	Badak
		1994-2013	0.11	Badak
		1997		Badak
	Tohoku	1984-2004	3.00	Arun
		2005-2009	0.83	Arun
	Tepco	1984-2004	0.51	Arun
		2005-2009	0.13	Arun
	Tokyo gas	1994-2013	0.92	Badak
	Hiroshima gas	1996-2015	0.08	Badak
	Nippon gas	1996-2015	0.05	Badak
	Total		18.23	
Korea	Korea gas	1986-2007	2.28	Arun
		1994-2014	2.05	Arun/Badak
		1998-2017	1.02	
		1995-1999	1.53	Badak
		1996-1999	1.30	Badak
		1998		Badak
	Total		8.19	
Taiwan	CPC	1990-2009	1.57	Badak
		1998-2017	0.75	Badak
		1998		Badak
	Total		3.05	
Total			29.46	

Source: Petroleum Report Indonesia 2003 by American Embassy in Jakarta

Table 2.1.19 Oil Fields of PERTAMINA

Region	Oil field name
South Aceh (NAD)	Rantau
Central Sumatra (RIAU)	Minas Duri
South Sumatra	Tl.Akar Ramba Jene
West Java	Jatibarang Cemara Arjuna Arimbl Widuri
East Java	Poleng Camar Kawengan
South Kalimantan	Tanjung
East Kalimantan	Attaka Bekapai
Maluku	Bula
Papua	Klamono Sele Linda Cendrawasih Walio Kasim Salawati

Source: : PERTAMINA publications in 2005

Table 2. 1. 20 Oil Refineries of PERTAMINA

Oil refinery names	Area	Capacity（Barrel stream day）
Pangakalan Brandan	North Sumatra	5,000
Dumai	Central Sumatra	170,000
Plaju	South Sumatra	124,000
Cilacap	Central Java	348,000
Balikpapan	East Kalimantan	260,000
Balongan	West Java	125,000
Sorong	Papua	950
Total		1,041,000

Source: ：PERTAMINA Brochure 2005

The government is placing emphasis on the development of new oil and gas fields as well as improvement of existing fields in order to prevent a decrease in oil and gas production. Large amounts of capital funds are required for development. The government has also introduced the Production Share Contract System for the purpose of introducing foreign companies' funds. Indonesia has developed more than 22 basins in a total of 60 basins by using the PSC system. Most of the developed basins are located in Western Indonesia. As a result, most of the oil and gas fields are located onshore and offshore in East and West Java, Central Sumatra and Kalimantan.

＜Reference＞ Government share by Production Share Contract(PSC)

Oil revenue

Government 65%	Contractors 35%

① The government share (65%) is divided into Central Government (85%) and Local government (15%).
② The operation cost are owned by the proportion of the shares
③ Local companies can participate in the business with the following investment ratio.
Local company：10%、Foreign company：45%、 PERTAMINA：45%
④ Contractors' shares of PSC are 35% in total. The earnings are distributed to contractors by the contractor investment shares.
⑤ The government's current oil production share is 85%, and the contractors' share is 15%.
⑥ The government's current gas production share is 70%, and the contractors' share is 30%.
⑦ From 2002, the government's oil and gas production share changed to 65%, and the contractors' share changed to 35%.

However, the recent new exploration sites are located in eastern Indonesia. There is a possibility that the new oil and gas fields will be discovered in the third sea basin in Eastern Indonesia. The Government is placing emphasis on exploring new oil and gas fields with 8.5 million bbl in remote area such as Papua. Table 2.1.21 and Table 2.1.22 show recent exploration and exploitation of new oil and gas fields.

Table 2.1.21 Numbers of New Oil and Gas Fields

		Oil	Gas	Dry	Total	Success ratio(%)
1998	Wildcat	16	5	48	69	30.0
	Appraisal	32	22	22	76	71.0
	Total	**48**	**27**	**70**	**145**	**52.0**
1999	Wildcat	10	9	27	46	41.3
	Appraisal	18	13	12	43	72.1
	Total	**28**	**22**	**39**	**89**	**56.2**
2000	Wildcat	19	15	32	66	50.0
	Appraisal	7	3	6	16	62.5
	Total	**26**	**18**	**38**	**82**	**52.4**
2001	Wildcat	11	6	30	47	36.2
	Appraisal	15	6	11	32	66.7
	Total	**26**	**12**	**41**	**79**	**48.1**
2002	Wildcat	5	10	18	33	45.5
	Appraisal	7	7	6	20	70.0
	Total	**12**	**17**	**24**	**53**	**54.7**

Sources：MEMR-MIGAS Wildcat: trial well、Appraisal：evaluation well
Dry: In new oil and natural gas fields, oil and gas reserves are extremely small

Table 2.1.22 Numbers of Oil and Gas Wells Exploration and Exploitation

	PERTAMINA	Onshore (PSC/TAC/JOB)	Offshore (PSC/TAC/JOB)	Total
1996	36	766	112	914
1997	44	702	145	891
1998	20	594	218	832
1999	32	629	186	847
2000	65	743	141	949
2001	61	657	197	915
2002	71	568	97	736

PSC: Production Share Contracts TAC: Technical Assistance Contracts JOB: Joint Operation Bodies
Source：MEMR-MIGAS

Table 2.1.23 shows the names of the main gas fields. The gas fields in Java islands have recently been decreasing their production. A new gas pipeline from South Sumatra to Java is now being planned, by means of which natural gas will be transported from South Sumatra to Java islands.

Table 2.1.23 Main Gas Fields and Equipment

Main Gas fields	Sumatra: Arun, Alur Siwah, Kuala Langsa, Musi, South Lho Sukon, Wampu East Kalimantan: Attaka, Badak, Bekapai, Handil, Mutiara, Nilam, Semberah, Tunu Natuna Sea: Natuna Java: Pagerungan, Terang/Sirasun Papua: Tangguh
LNG base	Aceh:Arun, Kalimantan: Bontang Papua: Tangguh
Gas Transmission Pipe line	South Sumatra ---West Java Phase 1 445km 250-550mmscfd 2006 Start South Sumatra ---West Java Phase 2 649km 400-600mmscfd 2007 Start Duri---Medan 521km 250-350mmscfd 2008 Start East Kalimantan ---Central Java 619km 700-1100mmscfd 2011 Start East Java – West Java 700km 500-700mmscfd 2011 Start
Gas Distribution Pipe line	Bontam 120km 125mmscfd 2004 Start Batam 155km 300mmscfd 2009 Start Pekanbaru 253km 50mmscfd 2009 Start Jambi 44km 50mmscfd 2009 Start Lampung 180km 100mmscfd 2011 Start Banten/West Java 660km 100mmscfd 2009 Start Semarang Central Java 200ｋｍ 150 mmscfd 2013 Start

Source: brochures of PERTAMINA and PGN

Figure 2.1.1 published by BP-MIGAS shows the exploration areas for oil and gas fields. In coming years, exploration is expected to shift from locations near the big cities such as Jakarta and Bali to the remote and rural areas including Papua province.

Source： MEMR-MIGAS

Figure 2.1.1 Exploration Area for Oil and Gas Fields

■ Coal production

Table 2.1.24 shows the changes of coal production in Indonesia. Future coal production will be increased drastically more than the production level of 2003, with coal exports to East Asia and India. The Government is giving first priority to additional coal production by private companies. The Clough group established by Australia received a rehabilitation order to improve coal mines in East Kalimantan. Regarding coal development by other big company, Australia's Broken Hill Proprietary BHP is interested in coal development in Indonesia.

Table 2.1.24 Changes of Coal Production

Production Million toe	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	Growth 02/95	Share in 2002
Indonesia	**6.4**	**25.5**	**31.0**	**33.7**	**37.1**	**40.1**	**47.1**	**56.9**	**63.6**	**70.9**	**13.9%**	**100%**
Asia Pacific Total	815	978	1,040	1,031	999	884	947	996 (Est.)	1,078 (Est.)		1.4%	5.9%
World Total	2,269	2,221	2,286	2,290	2,239	2,104	2,331	2,310	2,402		1.1%	2.6%

Source：BP Amoco 2001, and Mineral and Coal Statistics 2005

(3) Energy import

The Indonesia, which is the only Asian member country of OPEC, has the policy to export high-quality crude oil produced in the country and to import lower-quality crude oil. Table 2.1.25 shows the imports of primary energies. The import of crude oil and petroleum products has been increasing since 1986. It is believed that this trend of import will continue in the future. Indonesia was previously importing crude oil from Malaysia and China and petroleum products from Korea. In 2003, Indonesia exported 458,000 bbl/day of crude oil and imported 363,000 bbl/day of oil and petroleum products. In March 2004, Indonesia exported 448,000 bbl/day of crude oil and imported 484,000 bbl/day. As from March 2004, Indonesia shifted from being a net oil exporting country to a net oil importing country. This phenomenon means that Indonesia has to enhance its stocks of petroleum products and crude oil. In the past years, the stock level has been more than 20 days for petroleum products.

Table 2.1.25 Import of Primary Energies and Petroleum Products (Unit: kTOE)

Items	1986	1990	1995	2000	2001	2002	2003
Coal	782	461	391	0	0	0	0
Crude oil	3,861	6,321	9,459	11,073	15,628	17,188	17,883
Jet fuel	379	397	370	298	226	156	84
Gasoline	0	125	1,543	1,463	1,777	2,326	3,211
Kerosene	0	896	1,175	2,207	2,072	2,308	1,913
Diesel	562	1,916	4,474	6,543	6,876	8,409	7,923
Fuel oil	2,943	348	1,229	1,833	1,057	1,117	1,347
Import total	8,527	10,464	18,641	23,417	27,636	31,504	32,361

Sources：IEA, “Energy Balances of Non-OECD Countries”

(4) Energy export

Table 2.1.26 shows the export of primary energy in Indonesia. Indonesia exports main primary energies such as crude oil, natural gas and coal, and is the biggest primary energy exporting country in South East Asia.

Table 2.1.27 shows oil exports and values. Indonesia’s oil export in 2002 amounted to 220 million bbl and US$4.9 billion. However, there has been a decline since 1997 together with an increase in domestic demand. The directions of crude oil export are Japan (34.3%), China (45.55%), USA (6.50%), South Korea (17.22%), Australia (9.45%) and others (14.52%).

Table 2.1.26 Export of Primary Energies and Petroleum Products (Unit: kTOE)

Items	1986	1990	1995	2000	2001	2002	2003
Coal	579	2,989	19,261	35,294	40,148	45,619	52,078
Renewable	26	50	104	106	106	106	106
Natural gas	17,761	24,146	29,180	31,744	28,878	32,885	33,465
Crude oil	45,640	34,384	35,260	27,035	29,971	25,742	22,626
NGL	0	3,711	4,377	2,622	2,334	2,911	2,956
LPG	683	2,940	2,839	1,476	1,678	1,433	1,251
Fuel oil	5,035	5,940	7,957	7,080	5,180	5,650	5,400
Naphtha	1,946	1,896	844	1,441	1,701	1,390	2,367
Export total	71,995	76,144	100,152	107,688	110,747	116,365	120,249

Source：IEA, “Energy Balances of Non-OECD Countries”

Table 2.1.27 Crude Oil Export and Value

	Export（1,000bbl）	Export value（Mill$）	Price（$/bbl）
1991	330,495	6,378	19.3
1992	293,069	5,410	18.5
1993	283,280	4,795	17.0
1994	323,976	5,071	15.7
1995	301,810	5,148	17.1
1996	283,740	5,712	20.1
1997	289,093	5,480	19.0
1998	280,364	3,445	12.3
1999	285,400	4,950	17.3
2000	223,500	6,283	28.1
2001	241,612	5,650	27.0～28.9
2002	217,274	4,929	26.7～27.9
2003	192,468		

Sources: Petroleum Report Indonesia 2002-2003 by US embassy in Jakarta
IEA non-OECD countries 2005

Table 2.1.28 shows natural gas exportation and its values. Since natural gas was first exported in 1977, natural gas has been the main energy for acquiring foreign currencies in Indonesia. Export from 1995 to 2002 increased by 2.1% per year in the average growth rate, and since 2000 the natural gas export has remained at the level of 26 million tons.

Table 2.1.28 Natural Gas Export and Value

	LPG			LNG		
	Export (1,000 t)	Value (Million $)	Price ($/ton)	Export (1,000 t)	Value (Million $)	Price ($/mmBtu)
1995	2,511	471.1	187	24,941	3,856	3.00
1996	2,712	547.9	202	26,552	4,730	3.45
1997	2,133	516.2	242	26,891	4,732	3.41
1998	1,761	257.1	146	26,891	3,390	2.44
1999	1,745	339.2	260	29,108	4,489	2.99
2000	1,306	393.7	301	26,990	6,802	4.15
2001	1,484	388.6	262	23,883	5,375	4.34
2002	1,269	411.5	324	26,215	5,595	4.11
2003	1,107			26,680		

Sources: Petroleum Report Indonesia 2002-2003 edited by US embassy in Jakarta
LNG: mmBtu=0.01938t

Table 2.1.29 shows coal exports in Indonesia. Indonesian export of coal, which is low in sulfur

content, has increased since 1990 and, in particular, the growth rates have been kept at the level of 9～14％ since 2000. The coal export in 1999 was 54 million tons, and this was increased to the level of 93 million tons in 2004, meaning that the increase rate in 2004 was 1.7 times that of 1999. 60 million tons from the total coal exports go to Asian countries such as Japan (13 million tons), Taiwan (10 million tons), Malaysia (5 million tons) and South Korea (4.5 million tons). The remainder is exported to the EU (10 million tons) and USA (2.6 million tons).

Table 2.1.29 Changes of Coal Export in Indonesia (Unit: 1,000tons)

	1999	2000	2001	2002	2003	2004	2004/1999
Coal export	53,945	57,244	64,304	73,443	85,306	92,710	
Growth rate	－	7.0%	14.1%	14.8%	12.0%	8.7%	11.4%

Sources: Indonesia Mineral and Coal Statistics 2005 by Directorate of Mineral and Coal Enterprises

(5) Final energy consumption by energy

Table 2.1.30 shows final consumption of primary energies and petroleum products. In 2002, 36% of final energies are renewable energies; those are mainly woods and charcoal. And most of the woods and charcoal are used in households as residential use. The petroleum product consumption rate in commercial energies was 73% in 1986 and 64% in 2002. Although the rate decreased from 1986 to 2002, the contribution of petroleum products for final consumption in Indonesia is still high.

Table 2.1.30 Final Consumption of Primary Energies and Petroleum Products (Unit: kTOE)

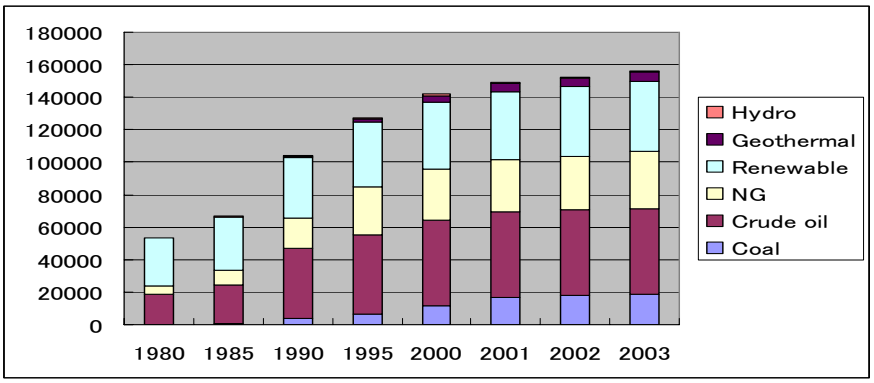
Energies	1986	1990	1995	2000	2001	2002	2003
Coal	223	590	1,469	5,345	5,286	5,667	5,852
Renewable	30,807	34,488	37,087	39,488	40,010	41,244	41,755
Natural gas	5,375	5,250	7,793	11,949	11,185	12,881	13,047
LPG	133	164	484	884	716	940	
Gasoline	3,526	5,015	7,250	7,800	10,301	10,834	
Jet fuel	511	950	1,480	1,576	1,653	1,358	
Kerosene	5,889	6,668	7,856	10,579	10,444	9,933	47,490
Diesel	6,924	10,139	14,575	17,513	18,403	18,345	
Fuel oil	977	1,182	2,316	3,986	4,174	4,043	
Naphtha	366	440	792	664	851	663	
Electricity	1,226	2,330	4,279	6,808	7,269	7,487	7,778
Total	56,221	68,008	86,111	109,438	111,122	114,171	115,922
Rate of petroleum	73%	76%	72%	66%	67%	64%	64%

Caution: Total consumption includes other consumption not described.
Rate of petroleum products is defined by ”(Petroleum total) / (Total- Renewable)”.
Source：IEA non-OECD countries 2005

(6) Domestic supply of primary energies

Figure 2.1.2 shows domestic primary energy supply. The average growth rates are advanced by 8.5% in the 1980s and 4.2% in the 1990s. Most of the domestic primary energy supply was oil in 1980, and the contribution of oil drastically declined from 78% in 1980 to 46% in 2003. Meanwhile, the coal contribution was 0.7% in 1980 and 17% in 2003, and the natural gas contribution was 21% in 1980 and 31% in 2003. It means the contributions of coal and natural gas increased during the terms. The growth rates of natural gas and coal supply were higher than those of other primary energies in the 1990s.

Unit: kTOE



Source: IEA," Energy Balances of Non-OECD Countries", 2005

Figure 2.1.2 Primary Energy Supply in Domestic Use

The contribution declined drastically during the terms. Meanwhile, the coal contribution was 0.7% in 1980 and 17% in 2003, while the natural gas contribution was 21% in 1980 and 31% in 2003. The growth rates of natural gas and coal supply were higher than those of other primary energies in the 1990s.

Table 2.1.31 Primary Energy Supply (Unit: kTOE)

Energies	Items	1980	1985	1990	1995	2000	2001	2002	2003
Coal	Production	187	1,230	6,449	25,304	47,111	56,912	63,574	70,896
	Imports	25	29	492	391	0	0	0	0
	Exports	-69	-665	-2,989	-19,261	-35,294	-40,148	-45,619	-52,079
	PES	167	594	3,952	6,358	11,817	16,764	17,954	18,817
Crude oil	Production	80,045	67,266	74,589	78,909	71,253	69,600	63,973	60,498
	Imports	0	594	6,321	9,459	11,073	15,628	17,188	17,883
	Exports	-60,922	-42,915	-38,095	-39,638	-29,657	-32,305	-28,653	-26,012
	PES	18,663	23,891	42,815	48,731	52,670	52,923	52,508	52,369
NG	Production	14,963	26,519	42,649	58,649	62,984	60,811	65,879	68,889
	Imports	0	0	0	0	0	0	0	0
	Exports	-10,014	-17,665	-24,146	-29,180	-31,744	-28,878	-32,885	-33,468
	PES	4,949	8,854	18,502	29,469	31,240	31,933	32,995	35,421
Renewable	Production	29,659	32,785	37,348	40,277	41,121	41,672	42,921	43,463
Energy	Imports	0	0	0	0	0	0	0	0
	Exports	-29	-24	-50	-104	-106	-106	-106	-106
	PES	29,629	32,761	37,298	40,173	41,015	41,566	42,815	43,357
Geothermal	Production	0	191	942	1,900	4,187	5,185	5,363	5,429
	Imports	0	0	0	0	0	0	0	0
	Exports	0	0	0	0	0	0	0	0
	PES	0	191	942	1,900	4,187	5,185	5,363	5,429
Hydro	Production	194	332	579	707	861	1,002	855	781
	Imports	0	0	0	0	0	0	0	0
	Exports	0	0	0	0	0	0	0	0
	PES	194	332	579	707	861	1,002	855	781
Total	Production	125,048	128,323	162,556	205,746	227,517	235,182	242,565	249,956
	Imports	25	623	6,813	9,850	11,073	15,628	17,188	17,883
	Exports	-71,034	-61,269	-65,280	-88,183	-96,801	-101,437	-107,263	-111,665
	PES	53,602	66,623	104,088	127,338	141,790	149,373	152,490	156,174

Renewable energy in above table means wood and charcoal.

Sources: “Energy Balances of Non-OECD Countries” 2005

Table 2.1.32 Contribution of Primary Energy Supply（Exclusive Wood and charcoal）%

	1980	1985	1990	1995	2000	2001	2002	2003
Coal	0.7	1.8	5.9	7.3	11.7	15.6	16.4	16.7
Crude oil	77.9	70.6	64.1	55.9	52.3	49.1	47.9	46.4
NG	20.6	26.1	27.7	33.8	31.0	29.6	30.1	31.4
Geothermal	0.0	0.6	1.4	2.2	4.2	4.8	4.9	4.8
Hydro	0.8	1.0	0.9	0.8	0.9	0.9	0.8	0.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Calculation from Table 2.1.31

2.1.3 Primary Energy Outlook in Indonesia

(1) Primary Energy Outlook in the World

According to IEA's World Energy Outlook 2004 up to 2030, the world primary energy and Indonesian energy outlook is as follows:

■Oil

- The world energy supply will increase by 1.6% per year from 77 million bbl/day, and it will reach 121 million bbl/day in 2030. Most of the additional energy demand is for the transportation sector.
- Oil suppliers in future will be non-OPEC countries. When considered from the long range viewpoint, OPEC countries will become suppliers. The oil supply contribution of OPEC countries in 2002 was 37%, and this will increase to 53% in 2030.
- Additional investment for the oil sector will be required in response to the world oil demand. The total amount of the investment is estimated to be US$3 trillion from 2002 to 2030.
- Oil reserves of the world oil companies were revised downwards in 2003 and 2004. As a result of the announcement of the oil companies, a feeling of disbelief in the companies arose in the oil business companies of the world. There is a need to strengthen the reliability of oil reserves for the purpose of enhancing capital investment
- IEA's outlook for oil demand in Indonesia is 1.2 million bbl/day in 2002, 1.6 million bbl/day in 2010, 2.1 million bbl/day in 2020 and 2.6 million bbl/day in 2030. The growth rate from 2002 to 2030 is 2.9%. Meanwhile, the figure in the same period for China is 3.4%, for India it is 2.9% and the average for OECD countries is 2.7%. Indonesia shows near equivalence to the average for non-OECD countries.

■Natural gas

- The world natural gas demand in 2030 will be double the 2002 demand owing to increases in consumption in the power sector. The growth rate per year is 2.3%. Regarding regional demands, Africa, Central and South America and the Asian developing countries will have a high growth rate.
- GTL products will be marketed in the energy sector. Remote natural gas fields from consumption area and small-size natural gas fields are not profitable due to high transportation costs. GTL technology can reduce the cost of natural gas transportation. It is predicted that GTL products will be produced at the level of 0.4 million bbl/day in 2010 and 2.4 million bbl/day in 2030.
- It is believed that the R/P of natural gas is 66 years based on 2002 production. The reserves and production will increase in the future. Contributions of the production will be weighted to Russia and The Middle East countries.
- Most foreign trade of natural gas in 2030 will be transported by LNG, not pipelines. The trade of LNG in 2030 will be three times of LNG trade in 2002. The current LNG trade of all natural gas occupies 30%, and this will increase to 50% of the world's natural gas trade.
- The capital investment for gas supply in the world is estimated at US$2 trillion from 2002 to 2030.

This is US$ 100 billion per year. Half of the capital investment is expended on search and exploration of gas fields.

- Natural gas demand in Indonesia was 1.3Tscf(36BCM) in 2002 and will be 1.5Tscf (53BCM) in 2010, 2.1Tscf (75BCM) in 2020 and 2.7Tscf (93BCM) in 2030. The growth rate will be 3.5% up to 2030. The growth rate of China is 5.4%, of India is 5.0% and the average of developing countries is 3.9%. Indonesia is lower than 3.9% that of developing counties and higher than 2.3% of the average of the world's countries.

■ **Coal**

- Coal demand in 2030 will have a 22% share of the total energy consumption. This share is the same as that in 2002. The power sector consumes 95% of the incremental demand for coal.
- In China and India, the coal demand has increased rapidly. These countries consume 65% of the incremental coal demand. Recently, the price of coal has remained in a high position, but it is expected to go down in the long term due to oversupply of coal.
- The world's coal reserves are 900 billion tons and the R/P is 200 years based on production in 2002. 40% of coal reserves are located in the OECD countries.
- The foreign trade of coal is expected to increase in future and coal will be supplied to Asian and OECD countries . The biggest coal supplier is Australia.
- Capital investment for coal from 2003 and 2030 is estimated at US$400 billion. When the capital investment for coal-fired power plants is added to this, the figure is US$1700 billion.
- Indonesian coal demand will increase at a 4.6% growth rate. The demand is estimated to increase from 29 million tons in 2002 to 102 million tons in 2030.
- Indonesian coal exports are increasing due to the fact that the domestic coal price is being kept low by the Government and coal suppliers want to export their coal at a high price. In the mid- 1980s, coal exports were 1 million tons and this expanded to 74 million tons in 2002. The coal exports are forecast to be 146 million tons in 2030. Most of the coal is exported to Asian and Pacific markets.

(2) Primary energy forecasting in Indonesia

Table 2.1.33 gives the primary energy outlook as estimated by IEEJ. The final energy demand, power generation and primary energy consumption up to 2020 are shown.

Table 2.1.33 Primary Energy Demand (Million TOE)

Primary energy	2000	2010	2020	2020/2000
Coal	14.0	25.0	39.0	5.3
Oil	53.0	76.0	109.0	3.7
Natural gas	28.0	40.0	57.0	3.5
Nuclear	0	0	0	0
Hydro	0.8	0.9	1.2	2.0
Geothermal	2.3	2.1	2.8	1.0
Renewable	0	0.1	0.2	0
Total	98.0	144.0	209.0	3.9

Source: The Institute of Energy Economics, Japan, Published in March 2004

Table 2.1.34 shows the Indonesian final energy demand outlook in 2005 and 2010, as estimated by MEMR. The future demand is forecast for the baseline case, energy conservation case and energy diversification case. According to the forecast, Indonesia will need to import more oil and petroleum products in future.

Table 2.1.34 Final Energy Demand Outlook (Million TOE)

Cases	Energies	2000	2005	2010
Baseline scenario	Oil	43.5	55.2	71.8
	Coal	3.0	3.8	4.8
	Electricity	6.6	10.2	15.6
	Natural gas	5.0	6.3	8.0
	LPG	1.2	1.4	1.7
	Non-Energy use	3.6	3.8	4.4
	Ethanol	-	-	-
	Biomass	29.8	31.9	34.2
	Total	92.7	112.6	140.7
Energy save scenario	Oil	43.5	52.5	65.0
	Coal	3.0	3.6	4.4
	Electricity	6.6	9.8	14.1
	Natural gas	5.0	6.2	7.5
	LPG	1.2	1.4	1.6
	Non-Energy use	3.6	3.8	4.4
	Ethanol	-	-	-
	Biomass	29.8	30.3	31.0
	Total	92.7	107.6	127.9
Diversification scenario	Oil	43.5	50.0	57.9
	Coal	3.0	5.2	8.4
	Electricity	6.6	10.7	16.7
	Natural gas	5.0	7.7	11.8
	LPG	1.2	2.1	3.3
	Non-Energy use	3.6	3.8	4.4
	Ethanol	-	0.9	2.6
	Biomass	29.8	32.3	35.5
	Total	92.7	112.7	140.6

Sources：Indonesia's Energy Outlook 2010 by MEMR Oil density:0.85

(3) The changes of energy prices in Indonesia

By looking at Indonesia coal export price and LNG export price, it is possible to analyze current energy price movement in Indonesia. The coal prices in domestic market are lower than export prices due to difference of the coal quality between two markets. Regarding Indonesian crude oil export price, the difference between Indonesia crude oil and WTI was $5/bbl in 2004. In 2005, it is said that Asian crude oil price is $10/bbl lower than WTI. However Minas crude oil price in 2005 is $4/bbl lower than WTI. It means Minas crude oil price is located in higher position shown table 2.1.35 when comparing it to other Asian crude oil prices. Natural gas price in domestic market is $5/mmBtu (According to Jakarta US embassy news). It is also lower than LNG price exported.

Table 2. 1. 35 Indonesia Energy Prices

	Coal price	LNG price		Crude oil price	WTI
	Thermal coal price for export (FOB)	At Japan port from Indonesia (CIF)		Minas oil spot price (FOB)	WTI spot price (FOB)
	$/ton	$/ton	$/mmBtu	$/bbl	$/bbl
1998		134.1	2.8	12.3	14.4
1999		198.4	3.8	17.8	19.3
2000		271.4	5.2	28.8	30.3
2001		224.9	4.3	24.1	25.9
2002	24.4	245.2	4.7	25.6	26.1
2003	22.6	258.4	5.0	29.5	31.1
2004	26.41	317.5	6.1	36.9	41.4
2005	32.57 (first half)	320 (est)	6.2 (est)	53.7 (est)	57.2 (est)

Sources Coal：International Coal Report Crude oil, LNG,WTI：Energy Intelligence

2.1.4 Development Plan of Oil, Natural Gas and Coal

(1) Policies of oil, natural gas and coal

According to the "Indonesian National Energy Plan" published in March 2004, the primary energy policies can be summarized as follows:

（The national energy plan includes rural development, measures to combat poverty, new energies and conservation; these items are omitted in the chapter.）

① Introducing market-oriented system of energy business
② Promoting oil-substituting energies
③ Improving energy utilization efficiencies
④ Promoting foreign investment
⑤ Development of capacity of native experts

Table 2.1.36 Primary Energy Policies in National Energy Policy

	Items
Targets	・Increased business roles that lead towards a market mechanism to raise added values so as to deliver larger contributions to the national economy and to creating an efficient national industry. ・Development of energy infrastructures that capable of maximizing public access to energy and exploitation of energy for export. ・Increased strategic partnerships between domestic and international energy industries in discovering domestic and foreign sources of energy. ・Increased utilization of local contents and increased roles of national human resources in the energy industry are resulting a reduction of dependence on foreign sources of energy.
Strategies	・Improvement of difference between domestic energy price and export price ・Support to make Energy master plan ・Introduce market mechanism from producers to consumers ・The role share between government and private companies on large scale projects. ・Support the small scale energy developers ・Development and research of technologies and human resources ・enhancing cooperation minds among energy related staffs ・Capacity development for staffs in energy sector
Action plan Oil Upstream	・Measures are pursued to increase reserves and production by stepping up exploration and exploitation in mature areas through application of appropriate technologies in overlooked hunting zones and frontier areas. ・Measures are pursued to increase oil production through enhanced oil recovery (EOR) processes and other advanced technologies. ・Measures are pursued to develop marginal fields by offering incentives such as revisions to the patterns of production sharing and other incentives. ・Measures are pursed to step up conservation of oil reserves to maintain oil reserves as long as possible.

	Items
Action plan Gas	・Measures are pursued to increase access to domestic and foreign natural gas to maintain an availability of supplies. ・Measures are pursued to increase reserves and production through intensive exploration and exploitation. ・Measures are taken to develop natural gas infrastructures to increase supplies through, among others, construction of transmission pipelines networks, LNG terminals and its re-gasification facilities, CNG transportation facilities and distribution pipelines networks. ・Measures are taken to increase research and development of alternative technologies on gas transportation, such as small-scale LNG technologies and gas liquefying technologies to overcome the limited infrastructures for gas distribution. ・Measures are pursued to apply gas prices in conformance to their economics values to ensure continuity in the supply of natural gas and construction of infrastructures. ・Measures are pursued to enforce domestic market obligations to ensure domestic supplies of gas by requiring business entities or permanent business entities to give some their production to fulfill domestic needs. ・Measures are taken to optimize consumption of natural gas to meet domestic needs with priority, in the following order, on gas as the raw material for fertilizer production, fuel for electric generations, state gas company and fuel for other industries. Consideration is given to needs, availability of natural gas infrastructures as well as technical and economic aspects. ・Measures are taken to maximize flare gases through small LNG/LPG plants to fulfill domestic needs and for export.
Action plan Coal	・Measures are pursued to step up exploration and evaluation of coal reserves to change existing resources potential status to proven reserves; thereby the national economic value of coal is known either in deep mines or open pits. ・Measures are taken to step up coal exploitation programs to meet domestic needs and for export by placing priority on deep mines in anticipation of global demands for environmentally friendly mining. ・Measures are pursued to increase access to domestic and imported coal, including promotion of low-rank domestic cola to meet needs for energy through construction of mine-mouth steam-fired power plants. ・Measures are taken to step up diversification of coal consumption through direct burning by small and medium enterprises, production of coal briquettes, liquefying of coal, gasification, coal upgrading and development of coal bed methane in consideration of environmental factors. ・Measures are taken to enforce coal domestic market obligation on players in mining within the framework of securing domestic supplies. ・Measures are taken to step up efforts at attracting investors through restructuring of regulations, integrated construction of infrastructures, particularly in isolated areas, by offering an incentive system. ・Measures are taken to promote or create new industrial centers in isolated areas that possess substantial coal resources. ・Measures are taken to promote industries based on coal fuel.

	Items
Action plan Petroleum	・Measures are taken to increase the capacities of oil refineries to fulfill domestic needs for petroleum; investors are offered opportunities to build new refineries. ・Petroleum prices are established in conformance to mechanism on sound and reasonable business competition. However, in its implementation, the government social responsibility to certain group of people should not reduce. ・Measures are taken to accelerate transformation of downstream oil and natural gas business climate toward a reasonable, sound and transparent business competition mechanism. ・Opportunities are offered to players in the production and distribution of petroleum through price determination in conformance to market mechanism.
Action plan Pipeline	・Measures are pursued to accelerate construction of infrastructures to establish an integrated natural gas distribution system in Indonesia. ・Measures are taken to accelerate the construction of small scale LNG, hydrate gas and gas liquefaction refineries to distribute gas to areas where pipelines networks are not available. ・CNG transportation facilities are developed to deliver gas to areas where pipelines networks are not available or are difficult to connect. ・Rates on transportation of natural gas through pipelines, that are attractive to investors, are established and applied in conformance to technology and economic principles. ・Measures are taken to develop LNG terminals and re-gasification facilities in the island of Java in anticipation of increased demands for gas due to industrial growths and increased demands for gas by communities in Java. The foregoing is pursued since natural gas reserves outside Java are substantial but distances between producers in the outer islands and consumers in Java are extensive. ・Development of ASEAN gas pipe lines
Action plan Gas・LPG utilization	・Measures are taken to increase consumption of liquefied petroleum gas in areas that are not reached by natural gas pipelines networks. ・The government establishes and supervises the quality of liquefied petroleum gas in circulation. ・Measures are pursued to increase consumption of domestic liquefied petroleum gas, hydrate gas and liquefied gas products (DME, GTL). ・Measures are pursued to increase consumption of gas fuel and liquefied petroleum gas as part of efforts at environmental preservation and to gradually reduce consumption of petroleum, particularly by the transportation sector. ・Measures are pursued to create a more competitive business climate for gas fuel and liquefied petroleum gas through, among others, a restructuring of the products' commercial framework.

	Items
Action plan Electricity Electrification	・Measures are pursued to increase generation of electric power with natural gas that is delivered either through pipelines networks or liquefied petroleum re-gasification terminals because steam-fired electric generation are more efficient than other electric generation. ・Measures are pursued to increase the utilization of sources of renewable energy such as geothermal, hydropower and other sources of renewable energy, including marginal gas. The utilization of the said sources of energy will diversify energy supplies and reduce dependence on oil. ・Local sources of energy are exploited in rural and isolated areas. Access to these areas is difficult and network construction requires substantial funds. The utilization of local sources of energy will reduce the price of electricity. ・Measures are taken to build mine-mouth power plant to increase consumption of low-rank coal. The substantial potentials could be utilized optimally to generate electricity only. Their remote locations from consumers require extensive transmission grids. However, the electric generations can compete economically with other generations and the electricity produced may be exported to neighboring countries. ・Measures are pursued to develop small-scale gas-steam power plants. ・Measures are taken to step up utilization of efficient technologies such as co-generation and fuel cells. Since these technologies may reduce the costs of electric generation, they could offer a better option in comparison to other types of technologies. ・Measures are focused on environmental preservation, particularly the social impacts of every phase of activity in the operations of electric power generations. These operations have potentials for creating negative impacts on the environment if they are not managed properly. Fulfillment of environmental standards is a prerequisite for electric power operations. It could preserve the environment.
Action plan Domestic use Commercial use	・Measures are taken to increase consumption of natural gas and coal (briquettes) through construction of infrastructures such as roads to transport and store coal and coal briquettes in consideration of environmental factors. The prices of natural gas and coal briquettes are lower than oil. However, the lack of natural gas and coal briquettes infrastructures prevent households and commercial sector from using the two products. ・Natural gas prices are established for households and small subscribers in consideration of the people's purchasing power. ・Measures are taken to increase use of energy-saving equipment, such as energy-saving lamps, and so forth. An increased utilization of the energy-saving equipment will reduce energy consumption by households and commercial sectors. The foregoing will save energy nationally. Furthermore, the cost of electricity that the people pay will go down. ・Standards and labels on energy-saving equipment are applied. Application of the standards is designed to reach a good level of efficiency in household equipment that uses electricity. Labels are posted to provide clear information to the people on consumption of electricity and household electronic equipment. Thereby, the people can choose equipment that saves the most energy. ・Measures are taken to develop transportation technologies and small-scale, economical and safe storage of gas to increase consumption of natural gas as a source of energy in households and commercial sector.

	Items
Action plan Industry use	・Measures are pursued to increase supplies of electricity from electric utilization to replace captive power. ・Measures are pursued to increase consumption of natural gas as fuel and as a raw material for industries through construction of energy infrastructures. ・Measures are taken to promote researches on and development of conversion technologies in the gas sector to substitute oil. ・Measures are pursued to promote co-generation of electric power not only to fulfill energy needs but also to increase efficiency. ・Measures are pursued to increase consumption of local energy to meet needs for electricity and heating in areas where electricity is not available. ・Utilization of local energies in un-electrification area ・Measures are pursued to increase consumption of coal briquettes, particularly by small and home industries that consume energy for extended periods, such as to dry area, rubber or to heat poultry farms and so forth.
Action plan Transportation	・Measures are taken to increase consumption of fuel gas (CNG and LPG) in land transportation. Increased consumption of fuel gas in transportation will reduce oil consumption and environmental pollution caused by oil consumption. An increase in fuel gas consumption is appropriately accompanied by an increase in the construction of infrastructures. ・Measures are pursued to increase consumption of gas in transportation through consumption of alternative sources of energy, such as LNG, hydrate gas and DME. ・Measures are pursued to promote bio-diesel as an alternative fuel. ・Measures are pursued to use electricity in the development of modes of mass public transportation in urban areas and in inter-city transportation. ・Energy efficiency standards are applied on motor vehicles. Application of energy efficiency standards reflects an accurate volume or level of consumption and supports efforts at using efficient motor vehicles.
Action plan Capacity Development	・Efforts are pursued to create energy education and training institutions that are accredited nationally and internationally. ・Measures are pursued to enhance national human resources competencies in the energy sector through technical education and training conducted by appropriate and accredited institutions. Thereby, these human resources possess capacities to compete in the era of globalization. ・Community development funds for the energy sector are provided to train national human resources in areas where energy projects are present. ・Measures are pursued to create link-and-match programs that establish a synergy between utility companies and energy education and training institutions.

Under the above energy policies, primary energy projects in recent years are as follows:（The following projects are expressed in 2005）

(2) Oil projects

In the past years, PERTAMINA has had a monopoly of production sharing contracts on oil and gas, domestic sales and export/import. From 2002, BP-MIGAS became in charge of contracts and management. In the upstream sector, many foreign companies（Caltex、Exxon Mobil、Unocal and so

on）participated in crude oil production, and produce more than half of the crude oil produced in Indonesia. The total capacity of oil refineries in 2002 was 1 million bbl/day. Plants are operating at full capacity while and new plants and new projects are planned. The projects related to crude oil and oil products are follows:

① Investment plan for synthetic diesel, ethanol and bio-fuels in substitution of oil
② Investment for developing energy resources
③ Plan for non-oil energy generation
④ Plan for constructing oil refineries
⑤ Plan for development of oil resources

It appears likely that the Indonesian national energy polices mentioned in the above table will be realized when comparing the following projects to the national energy polices.

Table 2.1.37 Oil and Related Projects

Projects	Contents	Timing
Synthetic diesel from coal	PERTAMINA and Canadian petrochemical company(Acceron) will invest US$6 billion for Synthetic diesel. The capacity is 28 million bbl/year	Operation start in 2008
Oil development plan	The government starts development of 6 crude oil field rehabilitation including Cupe in East Java. The capacity is increased from 1 million bbl/day to 1.3 million bbl/day.	Published in 2005
Gasoline sale deregulation	Domestic gasoline sales were deregulated from November 2005. 100 foreign and domestic companies (Shell, Exxon Mobil, BP and Elnusa) will participate in the market.	Published in 2005
Change power generation from auto to public power	Mitsubishi Material will stop their power generation system that use gas fired plants in 2006, and use PLN power. By the replacement, the company can save 30% power cost.	Start in 2006
Oil shipment from Central Sulawesi	Medco Energi International will start oil shipment from Central Sulawesi in Jan 2006. It is sent to PERTAMINA refinery factory in South Sumatra. The capacity of the vessel is 75,000bbl.	Published Jan, 2006
Geothermal generation plan	Chevron has a plan to build 110MW geothermal plants in Garutin（Darajat 3 project）. The power is sold to PLN. The generation will start from the Middle of 2006.	Start the Middle of 2006
Construction of oil refinery plants	PERTAMINA and SINOPEC will construct refinery plants in Tauban, East Java. The capacity is 200,000 bbl/day. Its cost is 1 billion US$.	Complete 2007
Construct oil stock bases	Oiltanking has a plan to construct oil stock tanks in Banten, Cilegon. The capacity is 300,000bbl. Other companies have also the same plans.	Operation start in 2007
Ethanol production	Medco Energi International has a plan to construct ethanol plants in Lampung province, South Sumatra. Its cost is US$34.1milion, the capacity is 60,000kl、The raw materials are casaba.	Operation start in 2007
Eleven companies get license for bio fuels	The companies will produce bio diesel and ethanol of 5000kl～15000kl in Lampung. One of the companies will produce coconut oil for gasoline.	
Japanese companies will invest to source development.	ITO trading co. will invest coal, oil refinery and geothermal business. The cost is $2.7bil from 2005 to 2010. Mitsubishi, Mitsui and Sumitomo trading companies have the same plans.	

Sources: Jakarta Post and NIKKEI Sangyo

(3) Natural gas projects

Foreign investments for the exploration and production of natural gas were controlled by PERTAMINA until the first half of 2002. These tasks have been transferred to BP-MIGAS since the second half of 2002, as well as oil. AT present, ten companies including Exxon Mobil, Total Elf and

BP are operating in the upstream of natural gas. Transmission and distribution of natural gas in the Indonesian domestic market are controlled by BPH-MIGAS and the operation is being implemented by Perum Gas Negara（PGN）(Natural gas supplied by PERTAMINA). New projects related to natural gas including pipeline construction and building LNG plants recently have also been planned.

① Exploration and exploitation of gas fields by foreign and domestic companies
② Preparing gas pipeline plans for international and domestic markets
③ Constructing LNG terminals for export.
④ Utilization of natural gas as CNG

In Indonesia, many types of natural gas projects have been planned and scheduled in recent years, and the following table shows some of the projects that have been announced.

Table 2.1.38 Natural Gas Projects and Relevant

Projects	Contents	Timing
Natural gas development by native companies	Medco Energi International merged Nobas Petroleum Co established by Australian company.	In 2004
	Medco Energy International merged Exxon Mobil gas fields in Aceh, Sumatra. Exxon Mobil withdraws the gas fields due to the earthquake.	In 2005
	Medco Energi International participates natural gas development in Natuna.（Exxon Mobil gave up the development） The reserves is 46Tscf.	Published in 2005
Gas development by Chinese company	MOU for oil and gas development is contracted between Indonesia and China	Published in 2005
Gas field development by Japanese companies	International Oil Development Co will start to operate new gas fields over north west Java sea from August in 2006, 100 million scf（18,000bbl/d） is produced	Start August 2005
	Mitsui Oil development Co bought 20% right of Merangin gas concessions in South Sumatra from Medco Energi International.	Published in 2005

Sources: Jakarta Post and NIKKEI Sangyo

Table 2.1.39 Gas Pipeline Projects and Relevant

Projects	Contents	Timing
Gas pipeline for export	Natuna (3 gas filed) ～Jurong islands (Singapore) 2.5 Tscf(current) 7～8 Tscf(coming 1 and 2 years	Jan 2001
	After PERTAMINA develops natural gas in East Natuna, NG will supply to Malaysia, Singapore, Thailand and domestic use in Indonesia	Published in 2002
	Gas pipeline : South Sumatra(Grikusigas fields)～Jurong islands （Singapore） 0.5Tscf（starting）,1.3Tscf（in 2009）	Published in 2003
Gas pipeline for domestic transmission	Gas pipeline plan: East Kalimantan～West Java by PGN(Joint venture project by China and Indonesia)	Complete in 2010～2011
Agreement of Asian countries for Gas grid systems	Energy ministers in Asian countries agree to construct gas pipeline connected in the regions. Participant countries are India, China, Japan, Korea and Central Asian countries.	Starting in 2020

Sources: Jakarta Post and NIKKEI Sangyo

Table 2.1.40 LNG/CNG Projects and Relevant

Projects	Contents	Timing
Capital grants from USA for gas development	Indonesia government is planned gas distribution system by US funds. PGN has a plan to use natural gas as CNG for reducing oil utilization.	Published in October 2005
Construction of LNG factory	PERTAMINA and Medco Energi International have a plan to construct LNG plants with the capacity of 0.7 million tons in 2007. The cost is US$240 millions.	Complete in 2007

Sources: Jakarta Post and NIKKEI Sangyo

(4) Coal project

The coal producers are separated to four group including State coal company(PTBA)、Contractors、KP holders and Village Cooperative (KUD).

① PTBA is the only state coal producer. It has coal mines in Ombilin（West Sumatra）and Tanjin Enim (South Sumatra)) Its production share is 10% of that of the whole country. The coal production was 9.5 million ton in 2002.

② Eight companies are operating in the contractor group and their coal production was 8.7 million tons in 2002.

③ The KP-holder group has 104 member companies. Eight companies are operating in the group and their coal production was 6.8 million tons in 2002.

④ Seven KUD have coal mine concessions. The coal production of KUD was between 5,000 tons and 50,000 tons in 2001.

Projects related to the following items have been planned recently.

① Incremental production plan for coal

② Development plan by domestic companies

③ Coal-fired power generation plan

Coal is becoming a main energy as an oil-substituting energy in Indonesia, and Indonesian coal exports are expected to increase.

Table 2.1.41 Coal Projects and Relevant

Project	Contents	Timing
Incremental production plan for coal	Main four coal producers (Adaro, Bumi.Resource, Kideco, Jayaagun) produces 20% incremental coal in Kalimantan	2005
Coal companies merged by Indonesian companies	A Indonesian investor took over Adaro from Australian companies	2005
Japanese companies invest coal fired power generation	TEPCO invests Paiton Energy and takes management right. The site generates 1.230 GW.	2005

Sources: Jakarta Post and NIKKEI Sangyo

2.1.5 Significant Issues Related to Primary Energy Supply and Demand Balance

(1) Issues on oil

■ Primary energy production

In Indonesia, the energy production of the main oil and gas companies with the exception of Exspan, Exxon Mobil and Kodeco is in decline owing to the fact that no new oil or gas reserves have been discovered and the existing plants become older. The exploration of new oil and gas reserves are now concentrated in a small area of offshore reserves in Sumatra, Java and Kalimantan. And it is required to vital investment from foreign companies.

When considering Indonesian energy importation, most imports consist of petroleum products such as gasoline, kerosene and diesel. Hereafter, there are concerns to increase import petroleum products in company with domestic demand increase. For decreasing the importation, it is important to introduce oil substitution energies and energy conservation in final energy consumption. And as petroleum products are derivatives, it is expected that the production of the petroleum products and the demand meet in a country. For realizing it, the government is required to make a suitable energy policy.

■ Oil subsidy

Indonesian oil consumption share in the total energy consumption is so high (63% in 2003). Most of the people use oil products in their lives. And the oil subsidy of the government has been suppressed oil prices lower than international market prices for protecting the lives of low income persons and rural area dwellers. Indonesia's oil price subsidy amounted to US$8.9 billion in 2005, while the financial deficit of the government was US$3 billion in 2005. The financial deficit includes the oil price subsidy. If the subsidy is excluded, the government finance has a surplus of $5.9 billion. The government has implemented reduction of oil subsidy for improving government budget and aiming reduction of oil consumption by oil price increasing. As shown Table 2.1.42, the government carries out to increase oil prices by the oil subsidy cut. By the policy, the lives of low income persons are affected. It becomes important policy how to introduce oil substitution energies in final consumption.

Table 2.1.42 Petroleum Product Prices （1998 ～2005） (unit: Rp/liter)

Year Month		Gasoline	Kerosene	ADO	IDO	FO
1998-05	S-Price	1,200	350	600	500	350
2001-05	S-Price	1,150	350	600	550	400
	M-Price50%	1,150	1,165	1,150	1,115	825
	M-Price100%	1,970	2,330	2,300	2,230	1,650
2002-05	M-Price75%	1,750	1,410	1,400	1,390	1,120
	M-Price100%	1,750	1,890	1,900	1,860	1,500
2003-05	Retail price	1,810	1,800	1,650	1,650	1,580
	Check-price	1,980	1,930	2,080	2,030	1,580
2005-09before	Retail price	2,400	2,200	2,100	2,200	2,300
2005-10after	Retail price	4,500	HH 2,000	4,300	5,500	3,500
			CO 6,200			

S-price: Subsidy price M-price : Market price

Source: Petroleum Report Indonesia 2003 written by American Embassy in Jakarta

HH: kerosene used in household、CO：kerosene used in industrial use

(2) Issues on natural gas

■ **Natural gas pipeline and domestic supply**

Regarding the effective utilization of natural gas, a gas shortage has occurred around Jakarta due to a shortage of domestic-use gas pipelines. According to PGN, the company supplies natural gas to 600 factories around Jakarta, and more than 600 factories are waiting for receiving natural gas through PGN pipelines as of February 2006(Source: Marketing Performance in PGN brochure). For the purpose of supplying natural gas to the factories and other consumers, PGN is implementing five transmission pipeline plans (SSWJ1,SSWJ2, Dumai—Medan, East Kalimantan -Central Java, East Java – West Java) and seven distribution pipeline plans (Bontam, Batam, Pekanbaru, Jambi, Lampung, Banten/West Java, Semarang Central Java). There is an urgent requirement that the transmission and distribution pipeline plans should be completed quickly.

As 39% of PGN stakeholders are public and other belongs to the government, PGN has a strong profit orientation as compared with other government business entities. To achieve high public relations orientation, PGN should consider introducing new contract schemes for large-scale natural gas consumers such as PLN.

PLN has to make a purchasing contract with PGN when PLN wishes to use natural gas through PGN gas pipelines. However, PLN and PGN have not agreed on the contract owing to the fact that the sales price is not acceptable to the two sides, even though negotiations have been in progress for one year. The government does not currently have any intention of intervening in the negotiations.

As electric power supply has high public visibility, PGN needs to have not only a market-oriented mechanism but also a public orientation concept. BP-MIGAS and BPH-MIGAS must recognize the importance of public relations orientation by business entities.

The balance between LNG exportation to retain the foreign incomes and domestic consumption of LNG is other important issue for the government, and then energy balance model for solving the issues is required by the government.

■ **Issues on natural gas development**

. Natural gas exports increased in the 1990s, but since 2000 such exports have not increased and have remained at the level of 30,000kTOE. Hereafter as considering that domestic demand and export increase rapidly, plant rehabilitation, exploration and exploitation of natural gas fields are expected. The possibility of Tungguh LNG project is expected highly. For achieving the project, huge capital funds from foreign companies are required.

For the purpose of attracting foreign capital funds, the government is entering into a Production Share Contract with foreign companies based on the joint venture system for developing oil and gas upstream. According to the PSC, 85% production of crude oil had previously belonged to the Government and the remainder to the counterpart companies. 70% production of natural gas had also belonged to the Government and the remainder to the counterpart companies.

Since 2002, BP-MIGAS has had exclusive competency in the exploration and exploitation of oil and gas in Indonesia. At present, 20 foreign companies are operating oil and gas fields in Indonesia under the PSC system. According to the new PSC system in new oil and gas regulations in force since 2002, the government share has decreased to 65% for oil and gas production. This means that the share of the counterpart companies has increased. However, the PSC share is actually decided on a case-by-case basis in line with access conditions, regional risk conditions and differences between onshore and offshore.

In Indonesia, the PSC ratio has been improved in order to promote foreign investment, but it appears that other kinds of difficulties such as gas shortage in factories, 25% domestic market

obligation, the need for foreign enterprises to build up infrastructure by themselves to construct their factories, and high priority given to domestic companies in special districts are preventing foreign investment in primary energy development. Recently, domestic market obligation for natural gas has been discussed by the government. If this regulation is implemented, it is afraid that foreign investment will be discouraged. Regarding foreign investment in primary energy, it is essential for the government to introduce more incentives and gas price mechanism decided by cost + suitable return. And it can be considered to introduce Public Private Partnership on capital investment of foreign companies.

(3) Issues on coal

Indonesia has rich coal resources. The high quality coal such as anthracite coal and bituminous coal have been important international trade energies to retain foreign income. Coal exports will have increased by more than average growth rate of 13% from 2000 to 2003. In particular, high-quality coal from Kalimantan can be exported to India and China. Meanwhile, the investment environment for coal development is delayed due to transportation issue and instability of political issues, especially in Central Kalimantan.

On the other hand, for low quality coal such as sub-bituminous coal and lignite, technical transfer including Clean Coal Technology (CCT) that can use it safety and useful is expected. Table 2.1.43 shows Indonesian requests to Japanese government. When seeing the table, the technologies such as coal liquefication and bio coal briquette for making coal more useful are required. And regarding bio briquette, under the conditions of improving sea transportation regulation and enacting new regulations in Japan, if RPS is applied to bio coal, the spread of bio coal utilization in commercial base is expected in Japan.

Table 2.1.43 Fifteen Coal Projects Requested from Indonesian Government

No	Contents	Possibility	C/P
1	The study on the competitiveness of Indonesia and Australian Coal	○	DMCE
2	The study on Indonesia Coal export potential	○	
3	Coal prospect Evaluation For Underground mine in East and South Kalimantan	○	DIMR
4	Coking Coal Prospect in Papua	○	
5	Exploration Coal Deposit in Meulaboh Area, nangroe Aceh Darussaiam		
6	Proposal for Joint Study on Treatment of Fine Coal in Indonesia Mining	○	DMCT
7	Reducing environmental impacts of coal mining	○	
8	Study of High Wall and underground Potential Reserves in Air Laya Mine and Surrounding	○	PTBA
9	Development of Upgraded brown coal (UBC) demonstration plant in Indonesia	×	TekMIRA
10	Study on sustainable coal-mine activities for environmental protection along mahakam River	On study	
11	Development of coal liquefaction pilot plant in Indonesia		
12	Production of activated carbon from Indonesia low rank coal (Pilot Plant 1ton/day)		
13	Joint research and technology development on foundry coke making from Indonesian coal		
14	The underground coal technology enhancement project at Balai Diklat Tambang Bawah Tanah (BDTBT) Phase I		P3TMB
15	Training Project on Coal Mining Technology PhaseII	On study	

The study team evaluated whether the 15 projects would be able to have official support from Japan or not. In the table, the ○ sign means high possibility, the ×sign means no possibility, and the no sign means not evaluated.

■ **Comprehensive energy plan**

MEMR-MIGAS makes oil and gas policies, BP-MIGAS regulates the up stream of the oil and gas business and BPH-MIGAS regulates the down stream of the oil and gas business including gas pipelines and the gasoline service business. MEMR-MIGAS leads and advises BP-MIGAS and BPH-MIGAS on important issues. As imbalance of oil and gas export and domestic demand is happened in recent Indonesia, MEMR-MIGAS requires comprehensive econometric energy balance model for making good energy balance between energy export and domestic demand. Especially MEMR-MIGAS wants to make primary energy balance models. Table 2.1.44 shows trail future primary energy balance, and MEMR-MIGAS should be made energy policy using by such kinds of the simulation model.

Table 2.2.44 Trail Future Primary Energy Balance in Indonesia

		Growth	2003	2010	2015	2020	2025	2030
Production	Coal	10	64	124	200	321	518	834
	Natural Gas	3	66	81	94	109	126	146
	Crde oil	−5	56	39	30	24	18	14
	Other	3	64	79	91	106	123	142
			250	323	415	560	785	1,137
Import		3	33	41	48	55	64	74
Export	Coal	9	52	95	146	225	347	534
	Natural Gas	2	33	38	42	47	52	57
	Crde oil	−5	23	16	12	9	7	6
	Other	0	0	0	0	0	0	0
			108	149	201	282	406	596
PES			175	215	262	333	443	614
	Power	7	22	36	50	70	99	138
	FEC	3	153	188	218	253	293	340
EC			175	224	268	323	392	478

PES: Primary Energy Supply FEC： Final Energy Consumption, EC ：Energy Consumption

Source：Calculated by JICA Study Team

< Pre-conditions>

① Primary energy demand is separated in power sector and in other sector
Energy demand of power sector by 2030 7.0% up (5% up from 2000 to 2003)
Energy demand of other sector by 2030 3.0% up (2% up from 2000 to 2003)

② The growth rate of energy production
Coal production by 2030 10% up (15% up from 2000 to 2003)
Natural gas production by 2030 3% up (3% up from 2000 to 2003)
Crude oil production by 2030 5% down (5% down from 2000 to 2003)

③ The growth rate of energy import
3% up to 2030 in company with decreasing crude oil production

④ The growth rate of energy export
Coal export by 2030 9% up (14% up from 2000 to 2003)
Natural gas export by 2030 2% up (2% up from 2000 to 2003)
Crude oil export by 2030 5% down (4% down from 2000 to 2003)

2.2 Current Situation and Issues of Renewable Energy

2.2.1 Current Situation of Renewable Energy

(1) Policy on renewable energy

The current situation of renewable energy is an important consideration, given the need for an alternative to oil due to the rapid escalation of the oil price and the progress of deregulation and decentralization. Since 2003, the need for renewable energy development as an alternative source to oil has come into greater focus. . In 2004, "The National Energy Policy" was issued with an emphasis on the promotion of oil alternatives. Table 2.2.1 shows the contents of renewable energy in the Policy.

Table 2.2.1 Renewable Energy Policy in The National Energy Policy

Current Situation ・Hydro and geothermal, which have similar potential reserve to LNG and coal, have not attained their optimal utilization. ・New and renewable energy sources are not progressing due to their prices being less competitive than fossil fuels. A financial incentive is required for their promotion. ・The huge potential of geothermal power is not being utilized.
Target ・Renewable energy, excluding large hydro, is estimated to supply 5% of national energy needs by 2020. It is important for achievement of the target to promote the development of geothermal, biomass and mini/micro hydro.
Action Plan 【Geothermal】 ・Conduct Potential Survey ・Modify the Law for the promotion of large-scale development ・Develop small-scale geothermal plants where alternatives are poor ・Promote geothermal utilization in industrial sector. 【Hydro】 ・Promote development as alternative energy ・Optimize development plan in Java where there are many hydro potential sites ・Assist a sustainable development of region due to hydro development ・Promote mini/micro hydro which contributes to the progress of local economic development through government incentives 【Others】 ・Financial assistant ・Assemble renewable facilities in Indonesia ・Oblige power utility to power purchase form renewable energy ・Select districts to utilize mini/micro hydro and photovoltaic development

Source：The National Energi Policy 2003-2020、2004

The Green Energy Policy (2003) is a guideline for green energy development, which mainly focuses on renewable energy development and energy conservation. The policy states that the term 'renewable energy' in the Green Energy Policy means energy that can be renewed and if managed properly, such resources will not be exhausted. Table 2.2.2 shows the guideline of the policy.

Table 2.2.2 Guideline in the Green Energy Policy (2003)

Opportunity and Barriers

- Classified into three types, namely;
  a) already developed commercially (biomass, geothermal and hydro energy);
  b) already developed but still limited (solar, wind);
  c) still at the research stage (ocean energy);
- Biomass is converted into energy in the form of liquid, gas, thermal and electric fuel.
- Biomass energy has been utilized for a long time and it is estimated that 35% of the total national energy consumption comes from biomass.
- The potential of wind energy is relatively small. It is estimated that 0.5 MW has been installed, especially for rural electricity.
- Having a relatively good potential of solar energy, two technologies have been applied, namely thermal solar and photovoltaic.
- Thermal solar energy is used for cooking, drying of agricultural products and water heating. The use of thermal solar energy for cooking and drying of agriculture products is still very limited, while use for water heating has reached the commercial phase. Photovoltaic solar energy is used to meet rural electricity requirements, water pump, television, telecommunication and refrigerator in Community Health Center. The utilization of solar energy especially in the form of SHS (Solar Home Systems) has reached the semi-commercial phase.
- The potential of hydropower throughout Indonesia is theoretically estimated to be around 75,000 kW spread over 1,315 locations.
- The potential of mini-hydro (200 up to 10 MW) and micro-hydro (up to 200 kW) is around 460MW; the 64 MW of which has been utilized, is generally used for rural electrification.
- Regarding geothermal, there are 70 areas which have the prospect to be developed as the source of energy with a total potential of 19,658 MW, specifically, 5,331 MW on Java Island, 9,562 MW on Sumatra Island and the remaining 4,765 MW spread over Sulawesi and other islands. The development of geothermal sources which are far from consumer centers and most of the sources are located in the preservation forest area.
- Geothermal energy can be utilized directly as well as indirectly. Direct utilization among other uses, includes drying of agricultural products, sterilization of the media for planting mushrooms and tourist pool-water heating. While indirect utilization involves geothermal energy being converted into electricity.

As shown above, the policy regarding renewable energy development is mainly focused on geothermal, hydro and biomass.

On January 26, the Presidential Decree of No.5 2006 referring to the target for renewable energy implementation was launched. The Decree indicated new target values for renewable development, which were approved by BAKOREN in April 2004.

Regarding renewable energy, the following numerical provisions are outlined:

- Geothermal energy to account for 5% share of the primary energy supply by 2025.
- Bio-fuel energy is also to account for 5% share of the primary energy supply by 2025.
- Target for new and other renewable energy sources, including nuclear power generation, is a 5 % share of the primary energy supply by 2025.

The transitions for the numerical targets are shown in Table 2.2.3.

Table 2.2.3 Target of Renewable Energy

Issued year	Authority	Target year	Target
2004	Minister	2020	Overall renewable 5%
2005	Minister	2025	Geothermal 3.8%、Others 4.4%
2006	President	2025	Geothermal 5%、Biofuel 5%、Others 5%

(2) Law and regulation

The most recent law on renewable energy is the Geothermal Law enacted in 2003. Now, an Energy Law for the promotion of renewable energy utilization is being prepared for submission to the parliament.

Compared to previous Decrees, this Law aims to be more practical for stakeholders regarding their responsibilities and obligations.

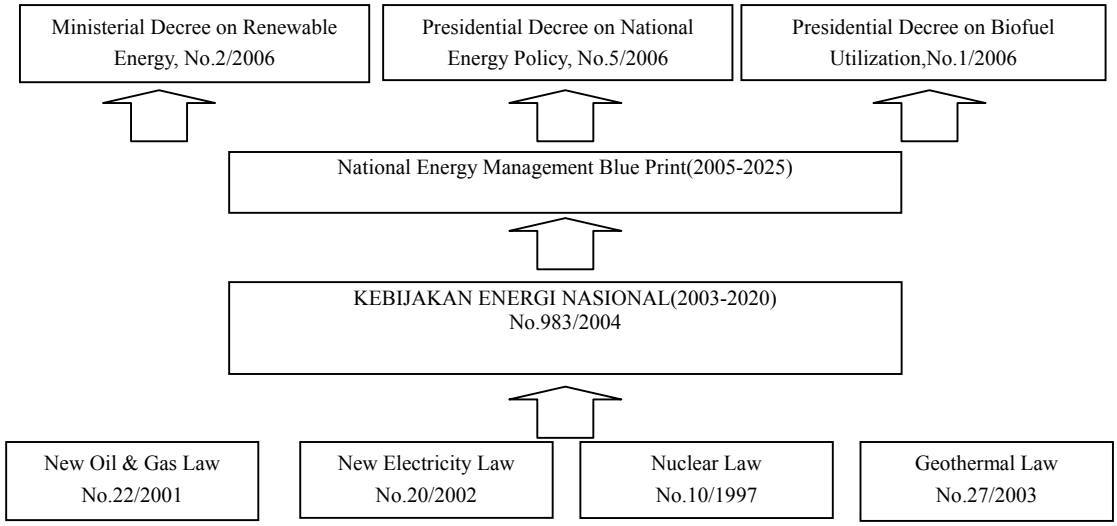


Figure 2.2.1 Laws and Regulations Encompassing Renewable Energy

(3) Power Purchase from Renewable Energy Sources

The Ministerial Decree on renewable power purchase No.2/2006 was issued in January 2006. This Decree expands the capacity and the duration of renewable energy purchases procured by the state utility company. Compared to the existing regulation, the capacity is expanded from 1 MW to 10 MW and the duration is extended from one year to ten years. The Decree appeals to power utilities to increase power purchases from renewable energy sources, but offers no compensation for the supplemental cost of purchases from renewable energy. Table 2.2.4 shows the comparison of the regulations.

Table 2.2.4 Regulation of Renewable Power Purchase

Decree No./year	No.1122/2002	No.2/2006
Capacity	up to 1MW	from 1 MW up to10MW
Duration of Contract	one year	ten years
Price	Low Voltage Connection: 60% of Production Cost Medium Voltage Connection: 80% of Production Cost	

This Decree promotes the replacement of the existing diesel power plants in the areas of local grid. MEMR is planning further energy regulation for rural electrification. According to the interview, the rural electrification program will prioritize renewable energy utilization. For 2006, there will be no more diesel power plants constructed for rural electrification as they will be replaced by renewable energy-based power. It is concluded that MEMR is looking for participation by the private sector in the areas of rural electrification. However, the discrepancy between existing and new regulations was pointed out for the micro-hydro development in rural areas.

2.2.2 Current Situation of Renewable Energy

(1) Target for Renewable Energy Development

The Presidential Decree on National Energy Policy does not issue the target for each renewable source but rather in terms of three categories such as geothermal, bio-fuel and other renewables. However, specific target of renewable energy were shown in the Blue Print, these values are considered to be same in the Decree. The action plan for the Decree is the same as that for the Blue Print. These target values, according to MEMR, are shown in Table 2.2.5.

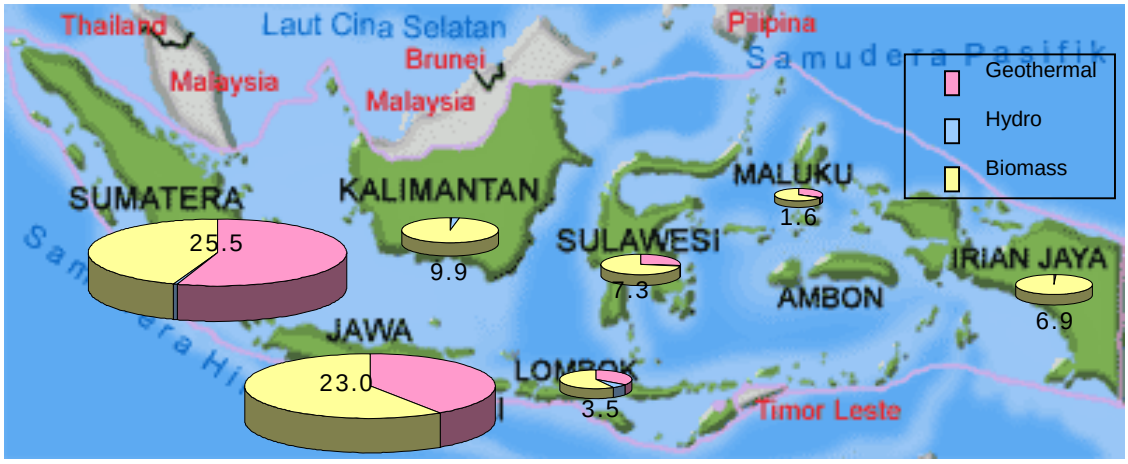
Table 2.2.5 Targets for Renewable Energy Implementation

Type	Unit	2010	2015	2020	2025
Bio diesel	Kilo liter	720,000	1,500,000	-	4,700,000
Bio ethanol	Kilo liter	550,000	850,000	1,500,000	-
Bio oil	Kilo liter	400,000	700,000	-	900,000
Geothermal	MW	3,442	4,600	6,000	9,500
Wind	MW	-	25.6	-	255
Solar	MW	24.8	50.4	67.5	78.6
Micro hydro	MW	169	298	488	-

Source: DGEEU

(2) Renewable energy potential

Some specific efforts are being made in order to utilize renewable energy potential. In the areas of bio-diesel, a quality standard was established by MEMR in December 2005 and public seminars are frequently held to promote public involvement. Figure 2.2.2 shows the distribution of leading renewable potential. The renewable potential is located in scattered areas and the share of biomass potential is larger than others.



Source: Master Plan of New& Renewable Development in Indonesia (1997) and JICA Study Team

Figure 2.2.2 Distribution of Renewable Energy Potential (Unit:GW)

Table 2.2.6 Renewable Energy Potential

	Gethermal (MWe)	Mini/MicroHydro (MW)	Biomass (MW)	Total Renewable	Solar (kWh/m2)	Wind (m/s)
Sumatra	14,071	116.9	11,345	25,533	4.1-5.2	2.5-5.8
Java-Bali	9,329	6.5	13,624	22,959	2.5-5.3	2.4-5.4
NTB-NTT	1,233	264.5	2,042	3,539	5.1-5.7	2.5-5.1
Sulawesi	1,932	63.9	5,266	7,261	4.9-5.5	2.8-3.1
Maluku	534	2.3	1,093	1,630	-	2.6-4.7
Papua	50	9.7	6,814	6,874	5.7	2.9-4.2
Kalimantan	50	243.8	9,624	9,917	4.2-4.8	2.5-3.5
Total	**27,189**	**708**	**49,807**	**77,714**	-	-

Source: Master Plan of New& Renewable Development in Indonesia (1997), JICA Study Team

■ **Geothermal**

The latest geothermal potential in Indonesia is estimated to be located in 251 sites and amount to 27 GWe, previously 70 sites at 20 GWe, out of which the current utilization is 7 sites at 807 MWe. The installed capacity of PLN's facility is 380 MW and PERTAMINA owns the rest. Most of geothermal power plants are located in the Java Grid.

Table 2.2.7 Geothermal Power Plants in Indonesia (2005)

Plant／Island	PLN	JOC*	Total
Kamojang／Java	140 (3unit)	-	140 (3unit)
Sibayak／Sumatra		2	2 (1 unit)
Darajat／Java	55 (1unit)	90 (1 unit)	145 (2unit)
Gunung Salak／Java	165 (3unit)	165 (3 unit)	330 (6unit)
Wayang Windu／Java	-	110 (1 unit)	110 (1unit)
Dieng／Java	-	60 (1 unit)	60 (1 unit)
Lahendong／Sulawesi	20 (1 unit)	-	20 (1 unit)
TOTAL	380	427	807

Note: JOC, Joint Operations Contract

■ **Biomass**

Biomass potential in Indonesia is the largest installed electricity capacity among renewable energy and estimated at 50 GWe. Generally, biomass potential is divided into bio-fuel and biomass electricity, but a target of biomass electricity has not been designated yet. Biomass energy is one of the traditional energy sources in Indonesia, and it constitutes 35% of energy consumption in rural areas as the cooking fuel in private sector. The current utilization of biomass is 445 MW. This is the second largest capacity of renewable energy.

■ **Hydropower**

The hydropower potential study conducted in 1999 estimated the potential at 75 GW, nominated amongst more than 5 MW capacity. Figure 2.2.2 shows the distribution of mini/micro hydro potential. As PLN is conducting a survey of hydro potential of less than 5 MW, hydro potential regarded as renewable energy should be estimated as much larger. The current utilization of mini/micro hydro is 84 MW. The increase in capacity is only 400 MW, but the number of power plants is quite large in order to reach the target for mini/micro hydro development.

Table 2.2.8 Hydropower Potential in Indonesia

	Number	Capacity (MW)	Energy (GWh/year)
Sumatra	447	15,587	84,110
Java-Bali	120	4,200	18,042
Kalimantan	160	21,581	107,202
Sulawesi	105	10,183	52,952
Papua	205	22,371	133,759
NTB-NTT	120	624	3,287
Maluku	53	430	2,292
Total	**1,210**	**74,976**	**401,644**

Source:Potensi Hidro Indonesia,PLN,2003

■ **Wind, solar and other energies**

In terms of the respective potentials for wind and solar power, the numerical capacity values are not shown. . The present target for development is estimated to be lower than the other renewables, to account for the fact that existing solar and wind power plants have issues regarding operation and maintenance.

The total installed capacity of wind power is 0.5 MW, with approximately 200 units. BPPT or Winrock International constructed these plants, but they are not utilized for rural electrification. The total installed capacity of solar power is 5 MW, with approximately 100,000 units, most of which were constructed by BPPT. The generated energy is utilized for lighting, water pumps, televisions, telephones, refrigerators and so on.

Nuclear power is classified not as a type of renewable energy but as a type of new energy in Indonesia. According to RUKN, a nuclear power plant is scheduled for commission in 2017.

2.2.3 Issues Related to Renewable Development

The essential renewable energy issue in Indonesia is the lack of commitment from the public. In the view of consumer's items, people are quite unaware of renewable energy compared to oil. However, the government has issued the Ministerial Decree for distributed power generation. This Decree, as mentioned earlier, is aimed at increasing renewable energy utilization for power generation and to encourage business entities to become involved in renewable energy development for electricity generation.

In terms of reviewing the numerical target of renewable energy development, it is difficult to explain problems based on the numerical data. Each individual renewable energy problem is described in the following. The problems of each renewable energy development are measured by comparing a benchmark that is regarded as a target of geothermal development in the Blue Print.

■ **Geothermal**

Geothermal potential in Indonesia is estimated at 27 GWe, out of which the current utilization of geothermal is 807 MWe, due to large investment costs and low accessibility to the grid.

The Government of Indonesia enacted the Geothermal Law No. 27 in 2003. The objective of the Law on Geothermal is to promote the utilization of geothermal energy for supporting sustainable development and to contribute additional energy value.

Moreover, it aims not only to increase government revenue and improve the economic development of

Source：World Bank Web Site

Photo 2.2.1 Geothermal Power Plant

Indonesia but also to give opportunities for IPP's participation. A development study on geothermal development is to be prepared through a JICA technical cooperation program. It is hoped that the JICA development study will successfully promote public involvement in geothermal development.

In the road map of geothermal development, the numerical target of geothermal development by 2025 is 9,500 MWe, that is equivalent to a 3.8% share of total energy consumption. The geothermal potential is located in the areas where it is relatively easy to connect to the national grid, such as Java and Sumatra. In fact, it has been announced in newspapers that IPP geothermal projects which were suspended due to the 1997 economic crisis are to proceed to tender after March 2006. In the other islands, geothermal power plants will be used as a power source to replace diesel generators. The main barrier for geothermal development is the considerably high production cost requiring a higher level of investment.

■ **Biomass**

Current utilization of biomass is 445 MW, but biomass potential in Indonesia has a larger installed electricity capacity than geothermal and is estimated at 49.81 GWe. On January 25, the Presidential Decree No.1 2006 outlining biofuel utilization targets for fossil substitution was launched. This Decree instructs related public sectors to take necessary initiatives and actions for biofuel development from supply side to the demand side.

MEMR considers the alternative energy from renewable energy resources for fuel substitution such as bio-diesel, bio-ethanol, bio oil and so on. Since these alternatives relate directly to the livelihood of urban people, public involvement is the key to promotion. However the Decree does not instruct the private sector on the utilization of biofuel. In order to boost the interest in renewable energy, the promotion of the biofuel policy is considered a necessity for the private sector area.

Source：Takuma Corp. Web Site

Photo 2.2.2 Biomass Power Plant

In the road map of biomass development, the numerical targets for bio-diesel, bio-ethanol and bio oil up to 2025 are shown in Table 2.2.5, but a numerical target for biomass electricity has not been indicated. Biomass electricity is planned to be developed to the extent of a 0.8% share of total energy in the Blue Print. Assuming the same plant factor as geothermal, total installed capacity is estimated to be 2,000 MW. It is considered that the main utilization of biomass is direct combustion, but some alternatives should be prepared according to the condition of biomass resources. Biomass development has just commenced only for the practical bio-diesel approach, the promotion of other biomass utilization should be undertaken immediately.

■ **Hydro**

Hydropower potential in Indonesia is estimated at 75 GW, of which 500 MW is small scale. Current utilization of mini/micro hydro is 84 MW. The target of mini/micro hydro is similar to the potential. The expansion of the mini/micro hydro potential is the urgent issue to for the achievement of the development target. Generally, hydropower is considered to be sustainable and technically mature, but social environmental issues such as resettlement and deforestation is the barrier to the development. Acting on the Ministerial Decree on Distributed Power Generation enacted in December 2005, environmentally friendly hydropower, up to 10 MW, should be designated as Renewable Hydro in order to expand the capabilities of hydropower development.

Source：ADB Web Site

Photo 2.2.3 Mini Hydro Development

Mini/micro hydro development is planned to be developed to the extent of a 0.2% share of total energy in the Blue Print. Of all hydropower, the share would be increase of 2.4 % to 2.6 %. The hydro share would decrease from 3.4 % to 2.6 %, but the total installed capacity would steadily increase to meet the demand and promote utilization as an oil alternative. Hydropower should be developed successively.

The classification of hydropower in Indonesia is not clearly defined, therefore comprehensive efforts for the promotion of hydropower development less than 10 MW should be made in order to achieve the development goal.

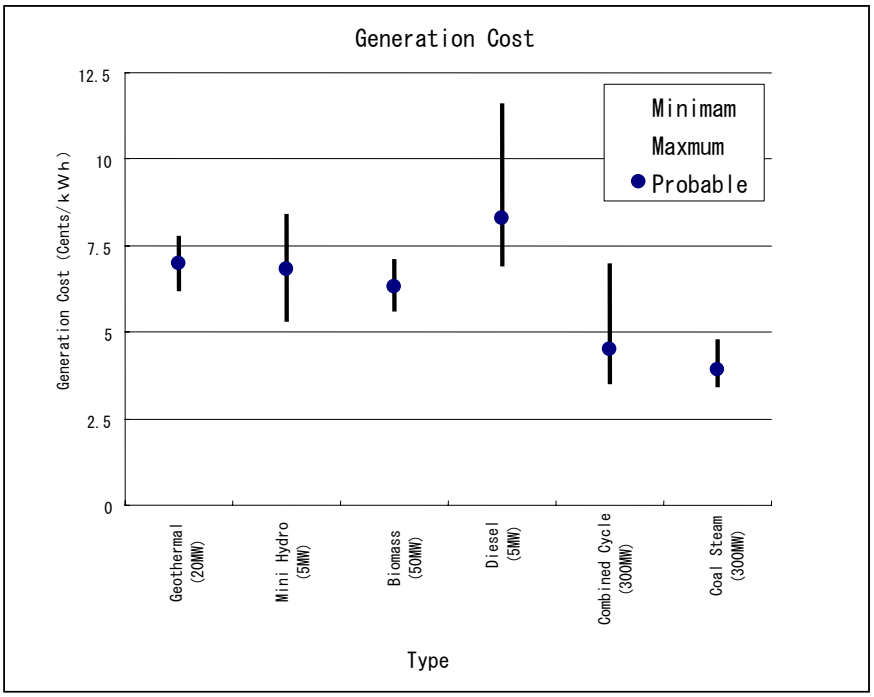
■ **Wind, solar and other energies**

As mentioned earlier, geothermal and hydropower have become the two commercially developed renewable energy sources with the highest potential in Indonesia. According to the National Energy Management Blue Print (2005-2025), nuclear, biomass, mini/micro hydro, wind and solar are regarded as other renewable energy sources. After the Presidential Decree on the national energy policy, 'other' renewable energy is considered to be nuclear, biomass for electricity and mini/micro hydro.

In the field of grid-connected electricity, the main renewable sources are biomass and hydro. However, their respective generation costs are more expensive than conventional thermal power plants. A comparison of the generation costs is shown in Figure 2.2.3. The higher cost of renewable electricity is a barrier to the introduction of renewable power facilities. As for wind and solar, which are utilized for rural electrification, technical assistance including institutional and educational programs should be provided.

Nuclear power will be one of possible alternatives to supplement Indonesia's future electricity demand. As Indonesia is located in a significant outstanding seismic area, Japanese technical transfer is of great importance for the preparation of nuclear power development not only in terms of safety management but also risk management.

As the problem for operation and maintenance by time dependent defectives clearly exists for solar and wind power plants utilized in rural electrification, institutional reform and human resource development are important fields for technical assistance.



Source: Off Grid, Mini-Grid and Grid Electrification Technologies ,World Bank

Figure 2.2.3 Generation Cost of Electrification Technologies

2.3 Current Situation and Issues in the Electricity Sector

2.3.1 Positioning of Power Sector in the Energy Sector

The electricity share is generally used as the index for expressing the positioning of the power sector in the energy sector quantitatively. The electricity share is the ratio of final consumption of electricity to the total final consumption of energy and is calculated as below.

＊Electricity share (%) = Final consumption of electricity / Total final Energy consumption

Table 2.3.1 shows the transition of the electricity share in Indonesia. The electricity share in 2002 was 10.3%. It is considerably lower compared to the value (14.7%) in Japan in 1971. Figure 2.3.1 shows the transition of electricity shares in Asian countries, etc. The electricity share in Indonesia is expected to increase more drastically than that of the growth of GDP, considering the electricity share of 19.3% (Asian countries) and 23.6% (Japan).

Electric power is vital for the use of lighting, air-conditioning and communication and at the same time is produced by a variety of resources, such as coal, renewable energy, nuclear energy and so on. Electric power also plays an important role in avoiding the use of petroleum and natural gas. Consequently, increase of electricity share is very important for the diversification of energy in Indonesia.

Table 2.3.1 Electricity Share in Indonesia (Mtoe)

	1971	1980	1985	1990	1995	2000	2002
Final consumption of electricity	0.153	0.536	1.05	2.33	4.28	6.81	7.49
Total final consumption	6.78	20.6	24.7	33.5	49.0	70.0	72.9
Electricity share	2.26%	2.61%	4.26%	6.95%	8.73%	9.73%	10.3%
(Ref.) Japanese electricity share	14.7%	18.9%	20.7%	22.5%	23.1%	23.7%	23.6%
〃 Asian electricity share	9.69%	11.6%	12.2%	13.9%	15.6%	18.3%	19.3%

Source : Hand book of energy & economic statistics in Japan (2005)

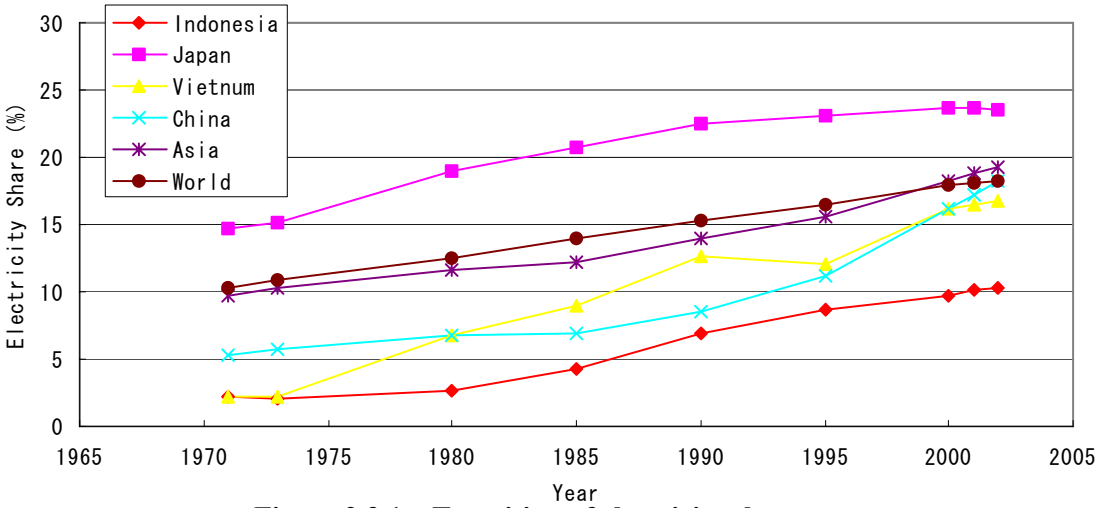


Figure 2.3.1 Transition of Electricity Share

2.3.2 Electricity Sector Reform: Progress and Issues

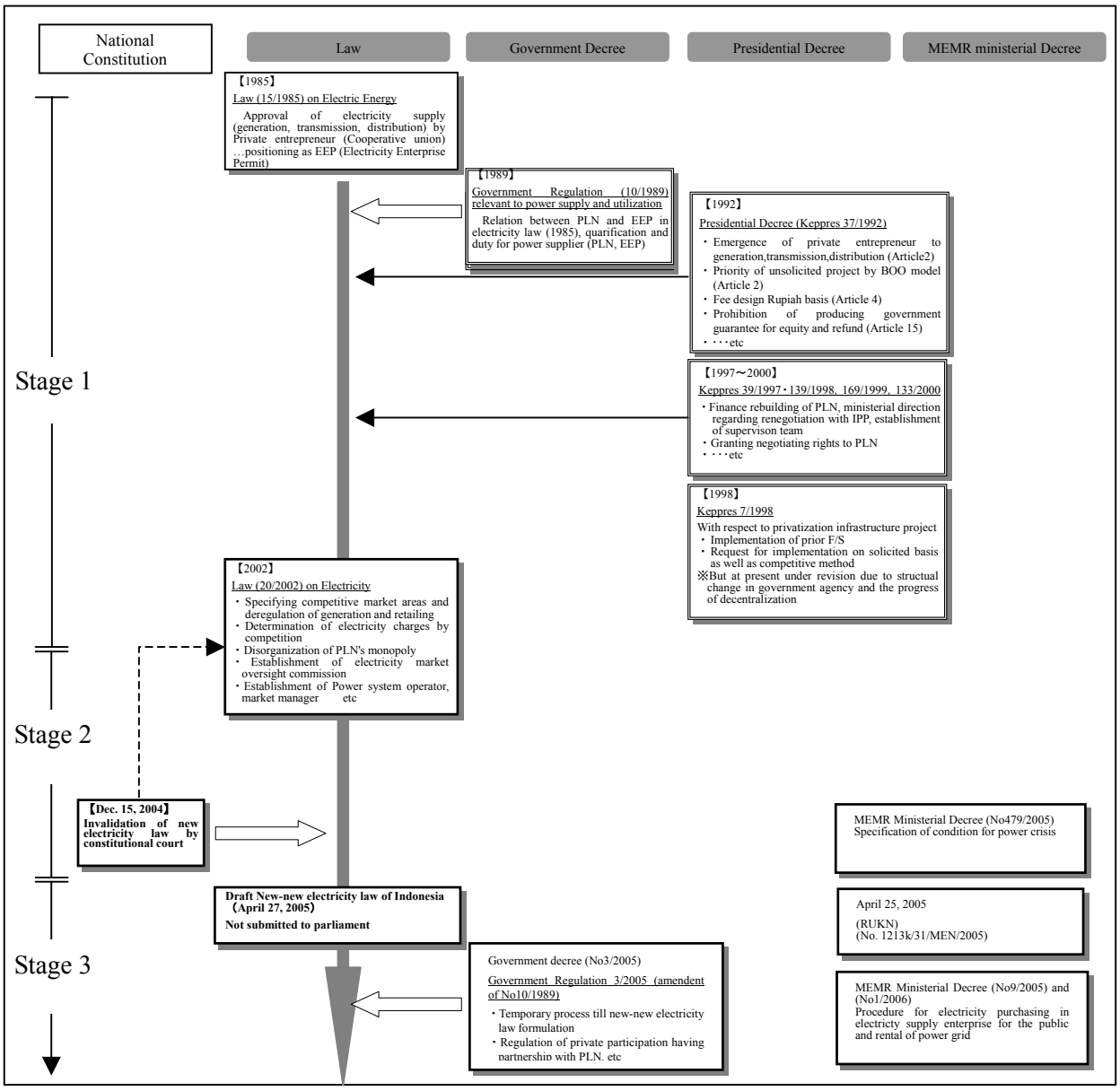
(1) Progression of electricity-related laws in Indonesia

The deregulation of electric utilities, in terms of governing laws, is organized into the following three time frames:

（Stage Ⅰ） The term from the establishment of the Electricity Law (1985) to the enforcement of the new Electricity Law (2002): During this time 27 IPP contracts were concluded. However, after this, the Asian economic crisis hit the Indonesian economy.

（Stage Ⅱ） The term from the enforcement of the new Electricity Law (2002) to the time of its invalidation on the grounds of being unconstitutional as adjudged by constitutional court

（Stage Ⅲ）The term from the invalidation of the new Electricity Law to the present (reinstatement of Electricity Law (1985) and government decree (No3/2005))



Source: Compiled by JICA study team in reference to Indonesian government data

Figure 2.3.2 Outline of Laws Relevant to the Power Sector from the Historical View Point

(2) Unconstitutional adjudgement on new Electricity Law and the temporary decree

New Electricity Law (No.20/2002) implemented on Sep. 2002 was declared unconstitutional to be abolished by the constitutional court. On Jan. 16 2005, to avoid confusion in law enforcement, the government of Indonesia established government regulation (No3/2005), which was an amendment of government decree (No10/1989) relevant to electricity supply and utilization. This is a temporary decree until a new electricity law replaces the law (No20/2002). Preparation for this new electricity law has been conducted[1]. Table 2.3.3 outlines the points of amendment in the government decree (No.3/2005).

Table 2. 3. 2 Points of Amendment in the Government Regulation (No.3/2005)

Related articles
「Electric enterprise is conducted nationally. And actual tasks are conducted by national enterprise. Government decree stipulates the national enterprise as holding a stake conducts electric enterprise for public service.」 <Article 3 (1)>
「Enterprise holding an authority of electric utility can purchase electricity from cooperative unions, local public utilities, private companies, citizens' organizations and individuals」 <Article 11 (3)>
「Power purchase is conducted by public tender」<Article 11 (5)>
「Power purchase can be conducted by nominating the following directly. a. Renewable energy, marginal gas, coal at colliery, generation from indigenous energy b. Surplus power c. In case of local power system in danger」<Article 11 (6)>

In the MEMR ministerial decree (Article16/No9/2005), in addition to the renewable energy and mine mouth generations, PKUK and PLUKU can purchase electricity directory from power suppliers without bidding process in case the local power system is in a power crisis. For this purpose, MEMR ministerial decree (No.479-12/43/0600.2/2005) (table 2.3.3) indicates the areas where electricity supply is insufficient in the Java-Bali and Madura outer islands. These measures are almost exclusively for areas outside Java-island. This nomination is revised annually.

Table 2. 3. 3 Decree of Ministry of Energy and Mineral Resources on Specification of a National Power Supply Crisis

Second: Order to make following efforts to overcome insufficient electricity supply in the areas indicated in the "first" to PT PLN (Persero) as an enterprise holding an authority of electric utility

1. Suppression of demand at peak time
2. Prompt conduct of repair of power plants
3. Capacity improvement of existing power plants
4. Prompt conduct of interconnected transmission lines
5. Power purchase from power suppliers without bidding process in accordance with government decree (No3/2005) and MEMR ministerial decree (Sep. 2005)

(3) Transition of electricity tariffs

Figure 2.3.3 shows the transition of electricity tariffs in PLN. Electricity tariffs dropped to about 2 cents/kWh due to the decline of the Rupiah in the economic crisis although they were maintained at about 7 cents/kWh before the economic crisis of 1997. On US$ basis, they have already recovered to the price level before the economic crisis of 2003 due to fare hike and changes in exchange rate. On Rupiah basis, electricity tariffs were raised year after year and reached three times the level of the price before the economic crisis. But the real price is not raised due to inflation.

[1] The preparation of new-new electricity law has been conducted after unconstitutional judgment on Dec. 2004. As of Feb. 2006 it is under interministerial consideration. Some newspaper says that this law will be submitted to parliament on Jun., 2006

This increase in electricity tariffs results from: 1. Underlying spread between buying cost for IPP in US dollar basis and selling price in Rupiah basis due to economic crisis (Rupiah drop-off), 2. Steep rise of international primary energy prices

With respect to the past contract of power purchase from IPP, renegotiation (for the lower level) in buying price was conducted between PLN and IPPs. For private investors, this leads to untruthfulness of PLN in the contracts and becomes a disincentive for investment to the power sector.

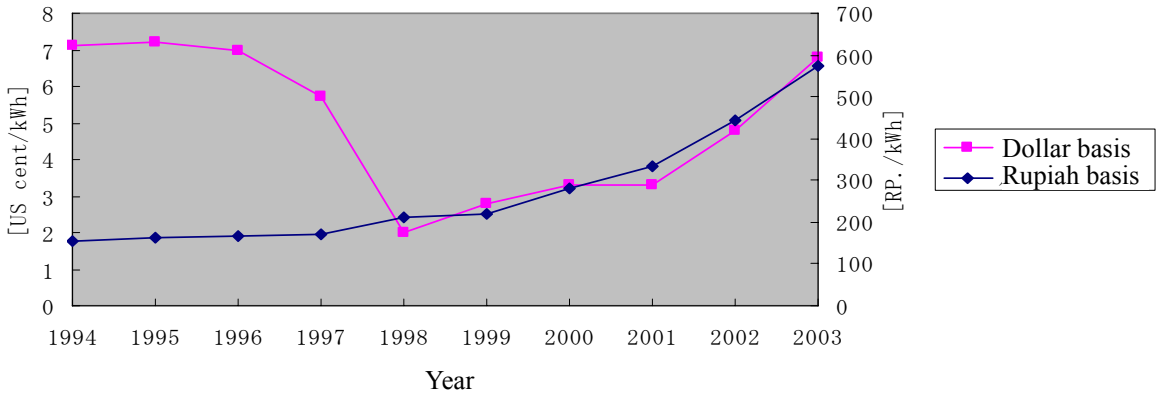


Figure 2.3.3 Transition of Electricity Tariff in PLN

2.3.3 Power Development Plan and Issues

■ Electricity supply and demand situation

Table 2.3.4 shows the supply and demand balance in the RUKN. The supply and demand balance in Indonesia in 2006 by RUKN is that the generation capacity is 22,639MW while the forecasted peak demand is 21,354MW. Although the necessary generation reserve margin is estimated at 25%[2], not every area satisfies this criterion. As a result, scheduled outage is usually implemented. Therefore, the demand supply balance is on the verge of a real crisis.

Table 2.3.4 Supply and Demand Balance in Indonesia (2006)

Location	Generation Capacity (MW) a	Forecasted Peak Demand (MW) b	Generation Reserve Margin (%) (a-b)/b
Java-Bali	18,658	15,886	17
Sumatra	3,494	2,911	20
Kalimantan	820	1,102	▲26
Sulawesi	641	823	▲22
Others	476	365	30
Total	22,639	21,354	6%

Source: RUKN (2005)

The situation in each region is as follows.

The Java-Bali region: The generation reserve margin is 17%, because there is a lowering of generation output due to deterioration and shutdown of generating plants due to

[2] Necessary Generation Reserve Margin calculated in the previous JICA study "The study on the optimal electric power development and operation in Indonesia"

faults and fuel problems. The power system is balanced by daily load shedding, especially at peak times from 18:00 -to 20:00.

Sumatra region: The situation is the same as the Java-Bali power system. Scheduled outages exist in some areas.

Kalimantan region: Electricity supply capability is completely insufficient. Scheduled outages are conducted daily.

Sulawesi region: Same as Kalimantan region

<Reference> Difference between RUKN and RUPTL

The PLN prepares the power supply plan (RUPTL) independently in reference to RUKN by MEMR. RUKN is a future power system plan based on the national energy policy, while RUPTL is an actual power supply plan reflecting actual projects.

Name	Division	Purpose
RUKN	MEMR DGEEU Electricity Power Program	Provide orientation and information necessary for participants of electricity enterprise and promote participation of private sector in the electricity market
RUPTL	PLN System Planning	Describe actual plans relevant to power supply plan in accordance with RUKN

■ **Power development plan**

The annual average rate of power demand increase from 2005 to 2025 is forecasted at about 7%. The estimated maximum demand for 2010 is 41,309MW and that of 2025 is 79,920MW. This is about four times higher than that of 2005. Table 2.3.5 shows the power development plan. The additional capacity is specified only by 9,319MW in the decade ahead. Then the additional capacity in the new power supply plan does not meet the increase of demand. In addition, there is an opinion that demand estimation in RUKN is relatively high. Public information disclosure relating to the basis of estimating demand is necessary for encouraging private investment to the power sector.

Though IPPs are expected to play an important role in future power development, it is planned that investment into power generation sector will be conducted not only by IPPs but also through PLN funds. For securing supply capability not yet determined in the RUKN, several projects are listed for public tender in “Indonesia Infrastructure Summit 2005”. Table 2.3.6 shows the projects.

Table 2.3.5 Power Development Plan

(MW)

System	Power station	Type	2005	2006	2007	2008	2009	2010	2011 ～ 2015	Total
Java-Bali	Pemaron	C/C			50					50
	Cilegon	C/C		730						730
	M.Karang	C/C				270				270
	T.Priok	C/C					720			720
	M.Tawar	C/C				225				225
	Not determined	C/C				400				400
	Jawa	GT			400				2,000	2,400
	T.Jati B	Coal		1,200						1,200
	Cilacap	Coal		600						600
	Kamojang#5	Geo						60		60
	Kamojang	Geo		60						60
	Patuha	Geo		60		120				180
	Wayang Windu	Geo			110					110
	Derajat#3	Geo			110					110
	Dieng	Geo			60	60				120
	Bedugul	Geo			10					10
	Subtotal		0	2,650	740	1,075	720	60	2,000	7,245
Sumatra	Keramasan	C/C							86	86
	Keramasan	GT						100		100
	Teluk Lembu	GT		20						20
	Arun	GT					60			60
	Sengkang	GT			65					65
	Cerenti	Coal							600	600
	Sibolga A Sicanang	Coal			70	35		200		305
	Labuhan Angin	Coal					200			200
	Tarahan	Coal			100	100				200
	Ulubelu	Geo							110	110
	Subtotal		0	20	235	135	260	300	796	1,746
Kalimantan	Tanjunk Batu Mel	GT			20					20
	Not determined	Coal		50						50
	Subtotal		0	50	20	0	0	0	0	70
Sulawesi	Amurang	Coal						105	110	215
	Lahendong	Geo					20	20		40
	Subtotal		0	0	0	0	20	125	110	255
Other	Ulumbu	Geo			3					3
	Subtotal		0	0	3	0	0	0	0	3
Total			0	2,720	998	1,210	1,000	485	2,906	9,319

Source: RUKN (2005)

Table 2.3.6 Projects Presented at the Indonesia Infrastructure Summit 2005

No	Project	Location	Capacity (MW)	Sum of money (Million US$)	Remarks
1	Tanjung-Jati A coal-fired plant	Java	1,320	1,311	
2	Serang coal-fired plant	Java	450	500	
3	Tanjung-Jati C coal-fired plant	Java	1,320	1,311	
4	Pasuruan thermal plant	Java	500	555	
5	Ciregon coal-fired plant	Java	400	400	BOO, 2011/12
6	Paiton 3&4 coal-fired plant	Java	800	889	
7	Sibolga coal-fired plant	Sumatra	100×2	200	BOO, 2008/09
8	Amurang coal-fired plant	Sulawesi	25×2	50	BOO, 2008/09
9	Parit baru coal-fired plant	Kalimantan	55×2	105	
10	Mulut tanbang kalsel coal-fired plant	Kalimantan	110	110	

Source: KKPPI, "Project Profiles"

2.3.4 Transmission Grid Development Plan and Issues

The transmission grid in Indonesia is separated by Java-Bali, Sumatra, Sulawesi and Kalimantan. In addition, the grids of Sumatra, Sulawesi and Kalimantan are segmented into smaller parts: northern - southern systems or eastern - western systems.

■ The Java-Bali power system

Figure 2.3.4 shows the Java-Bali power system. The Java-Bali power system is narrow and stretches east to west for 1,000km. In principle, the power flow is westward from large-scaled power plants in East Java (Paiton coal-fired plan, etc) to the load center in west Java. The restriction[3] of power generation is conducted due to stability issues. To alleviate this situation, 500kV south route transmission line is under construction. However, it is yet to be completed due to the compensation problem involving transmission lines between Pedan substation and DepokⅢsubstation. PLN has set the target date for completion as Apr. 2006 based on the ministerial decree (No.975/1999) relevant to compensation under transmission lines and presidential decree（No.36/2005） relevant to compulsory acquisition of land. However, this is not guaranteed. On sep. 2006, Tanjung-Jati B power plant will be in commercial operation in central Java. Early completion is required due to the possibility of power generation restriction in the absence of the 500kV south route transmission line.

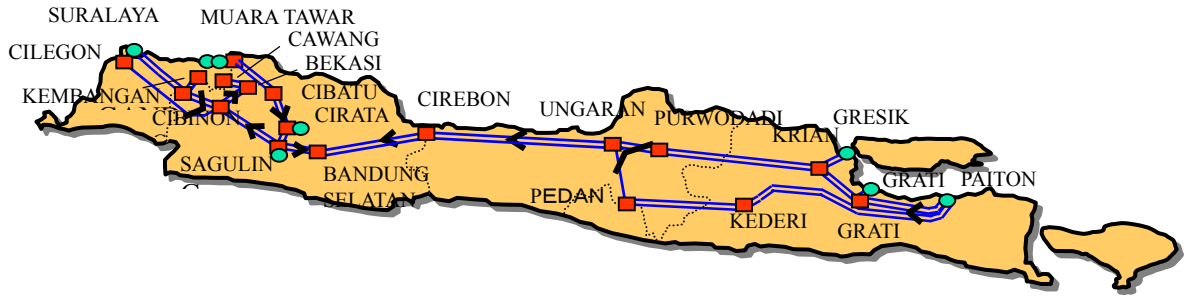


Figure 2.3.4 500kV Java-Bali Power System

[3] For stable supply the load flow should be within 1,300MW by the JICA study "the study on the optimal electric power development and oparation in Indonesia (2002.8)". But the practical accomplishment of load flow is around 1,800MW.

Table 2.3.7 shows the operation status of 500/150kV transformer in 2004. 27 units out of 32 units are operated to 80% or more of their load factor, 7 units operated more than 100% (short time overload), which means there are several areas with insufficient transformer capacity. Therefore, reinforcement of transformer with transmission lines is necessary.

Table 2.3.7 Utilization Rate of 500/150kV Transformers

Name of substation / power plant	Capacity	Number	Utilization rate
Ciregon	500MVA×2	7	Over 100%
Kembangon	500MVA×2		
Cibatu	500MVA×2		
Mandirancan	500MVA×1		
Bekasi	500MVA×2	20	Over 80%, under 100%
Cawang	500MVA×2		
Cibinong	500MVA×2		
Gandul	500MVA×2		
Banden Slaten	500MVA×2		
Ungaran	500MVA×2		
Pedan	500MVA×2		
Kalian	500MVA×2		
Paiton	500MVA×2		
Grati	500MVA×1		
Kediri	500MVA×1		
Cirata	500MVA×2	3	Over 60%, under 80%
Grasik	500MVA×1		
Suralaya	250MVA×2	2	Over 40%, under 60%
Total	15,500MVA	32	－

Source:「Evaluasi Operasi Sistem Tenaga Listrik Jawa-Bali Tahun 2004」

For the distribution system, the existence of three different technical standards is not effective. Therefore, technical transfer regarding distribution planning is necessary for the consolidation of the three technical standards.

■ **Sumatra power system**

Although the present system consists of two main systems, the Sumatra system was divided into three main systems: north Sumatra (Aceh, etc), west Sumatra (Riau, Jambi, etc), south Sumatra (Lampung, Bengkulu, etc). Then the 150kV transmission line connecting west Sumatra and south Sumatra was completed on July 2004.This alleviates scheduled outages in the west and south Sumatra and enables economical operation of generating plants.

■ **Sulawesi and Kalimantan power system**

The voltage of trunk line in Sulawesi is 150kV. There is no large demand in the central area of Sulawesi. And only two power systems exist: northern system and southern system which separated far from northern system. The main generation method is off-grid generation such as diesel generator in Kalimantan system. It is not a large power system.

2.3.5 Fuel Supply

(1) Emergent fuel supply and demand

A steep rise in the international price of fossil fuel has a great impact on the securing of fuels by PLN. The issue of fuel procurement in Suralaya coal-fired power plant has been resolved. But the deficiency in natural gas near Jakarta is serious and securing of fuel has been become progressively more difficult in gas power plants. As a result, power plants listed in Table 2.3.8 use HSD as an alternate fuel.

Table 2.3.8 Power Plants where HSD is used

Power plant	Capacity (MW)	Remarks
MuaraTawar	920	Java-Bali
Grati	462	
Gresik	1579	
Berawan	817	Northern Sumatra

Source: PLN

The rise of the HSD price due to the curtailment of subsidy consequently worsens income and expenditure. At the same time, it has the effect of lowering power generation efficiency and increasing inspection cost. Also, LPG will be planed to be used in the power plants, listed in Table 2.3.9 those don't have combustion equipment for HSD.

Table 2.3.9 Power Plants where LPG is planed to be used

Power plant	Capacity (MW)	Remarks
Sunyaragi	361	Java-Bali
Tambak Lorok		
Siantan		
Sei Kledang		
8 power plants	931	Next year

Source: PLN

It is thought that the condition regarding gas supply will be improved by the completion of south Sumatra-west Java gas pipeline (SSWJ: Phase2). The negotiation of fuel supply between gas suppliers such as PGN and PLN does not go well so far because of the differences between selling and buying prices requested by both sides. In addition, fuel procurement is the fundamental requirement for implementing the combined cycle projects in west Java financed by Yen loan such as Muara Karan repowering, Muara Tawar expansion and Tanjung Priok repowering (total output is approximately 2,000MW). In case the constructions of these power plants does not be constructed due to the above reason, power crisis in Java-Bali system is expected to be occured.

(2) Medium and long term plan

Figure 2.3.5 shows a plan of generated energy by RUKN. The generated energy is estimated to become about five times greater over the coming twenty years in response to the increasing power demand. Securing fuel for this situation is necessary. Medium term issues are that coal fuel is planned to be increased over 40% of the base load and oil fuel is to be replaced with gas. Nuclear energy is planed to be introduced on a long-term period.

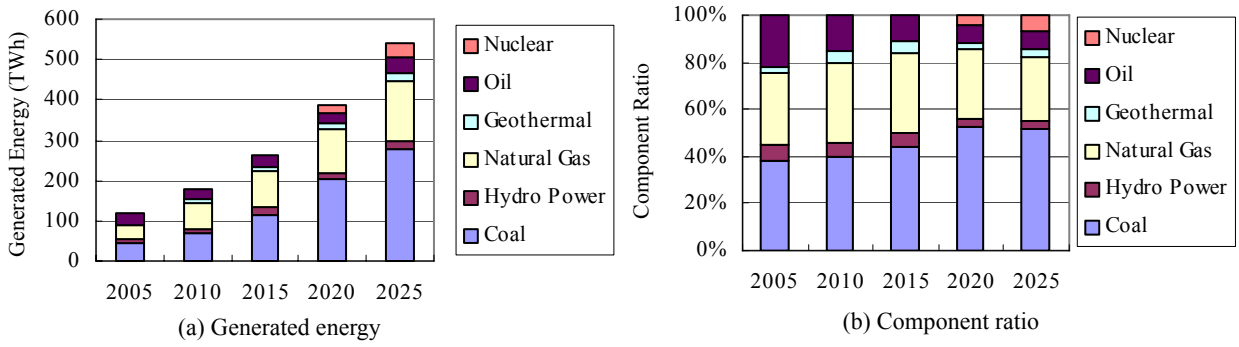


Figure 2.3.5 Primary Energy for Generation in Indonesia (Source: RUKN2005)

2.3.6 Power Sector Issues

■ **Fuel procurement**

The final JICA report of the previous study "the study on the optimal electric power development and operation in Indonesia" stated that the most important issue for avoiding the predicted power crisis was secure fuel procurement. However, PLN still cannot secure enough fuel for power stations in west Java. Therefore, HSD and LPG are used as supplemental fuels in some of these power plants. From a critical viewpoint, case studies on power plant operation and development plan should be prepared based on the scenario that new gas supply for PLN should be obtained only from SSWJ and LNG terminals which PLN plans to construct with independent financing.

One of the reasons why new gas supply contracts between PLN and gas suppliers cannot be concluded smoothly is considered to be that the suggested gas price offered by suppliers, who importantly have no regulations restricting their activity, is not affordable to the PLN who is restricted by a budget regulation in terms of electricity tariff. Figure 2.3.6 shows a brief outline of the current situation.

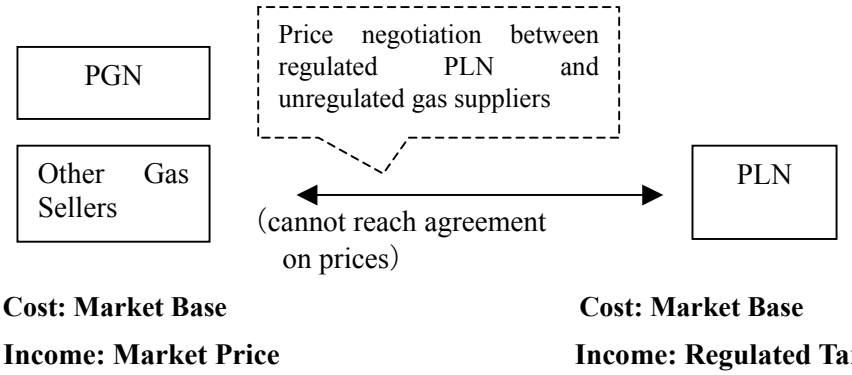


Figure 2.3.6 Fuel Procurement Contract Issue

There are two options for resolving the issues caused by the fundamental differences in between the PLN and gas suppliers to facilitate PLN in securing the necessary fuel.

1) Governmental mediation in the price negotiation
   Since the fuel price negotiation is considered a private issue between gas suppliers and the PLN, there has been no government mediation so far.
2) Increase of electricity tariff to base market price
   Since the increase of electricity tariff is a very sensitive issue, public acceptance should be achieved by introducing a transparent tariff system which recognizes the fuel cost adjustment.

■ **Insufficient supply capability**

Several studies have previously been conducted as a response to the prospect of a power crisis in the Java-Bali power system in 2004 or after. In 2000, the task force assigned for prevention of the power crisis was formed by Ms. Megawati, vice-President at that time. The Jakarta Japan Club, consisting of Japanese-affiliated firms, established the investigative committee against the power crisis and advocated the need for developing emergency power plant construction. JICA also studied the need for emergency power supply and short-term countermeasures against it in "the study on the optimal electric power development and operation in Indonesia ".

With respect to existing power equipment, maintenance is not conducted properly and there are some considerable issues such as lowering of output and energy efficiency, etc. For the purpose of taking full advantage of existing equipment capacity, it is important to conduct technical transfer regarding the operation method of power equipment.

Government of Japan has supported development of some power plants though yen loan projects for the emergency power supply in the Java-Bali power system. And fuel procurement contracts are requested as basic conditions to implement these Yen loan natural gas fired power plant projects (total output is approximately 2,000MW) such as Muara Karang repowering, Muara Tawar expansion, Tanjung Priok repowering and so on. In the latest understanding, foregoing contracts are necessary for the tender announcement. However, the fuel procurement contracts were not concluded so far. Therefore, the progress of yen loan projects has been confronted with progress difficulties. The PLN staff members are concerned about this issue and termination of the yen loan projects due to the delay in fuel contract agreements.

■ **Condition of IPP tender**

Now Cirebon thermal power plant, a coal fired unit with the capacity of 600MW, is under tender with the conditions of ① No government guarantee, ② Land acquisition by bidder, ③ Burden of transmission expenses. These conditions are very severe for IPP investors. To encourage IPP investors, promotion of PPP (Public-Private-Partnership) is important. In addition, the terms of reference should be prepared considering the economic merit of a large-scale plant compared to a small-scale plant. For example, providing an option of priority for future expansion enables the successful bidder to design the unit in a more economical manner in consideration of common use of coal yards and related facilities with a future unit. As a result, investment for this plant will be minimized.

WASP-IV is used in the power development plan by PLN and there is no issue in operating this software. However, further capacity development is necessary to acquire the knowledge and experience for handling the scale merit of power plants, long-term fuel prices and demand forecasting.

■ **Government guarantee**

Table 2.3.10 shows the IPP projects under tender which were announced on Sep.7 2005 by MEMR. The first project is Cirebon IPP, mentioned above.

Table 2. 3. 10 IPP Projects under Tender as Announced by MEMR

No.	Project	Location	Capacity (MW)	Year of Commencement of commercial operation
1	PLTU Cirebon	West Java	1 x 600	2010
2	PLTGU Pasuruan	East Java	1 x 500	2011
3	PLTU Java Tengah	Central Java	2 x 600	2011
4	PLTU Paiton 3, 4	East Java	2 x 400	2012
5	PLTU Bali	Bali	2 x 100	2008/2009
6	PLTU Sumatra Utara	North Sumatra	2 x 100	2010
7	PLTU Sulawesi Utara	North Sulawesi	2 x 25	2010
8	PLTU Kalimantan Timur	East Kalimantan	2 x 60	2010

Source：Prepared by JICA Study Team based on the MEMR's information

In order to promote these IPPs, government guarantee seems to be essential. However, Indonesian government takes a policy that a government guarantee is provided for projects that satisfy the relevant criteria in several risk assessments, contingent liabilities of public sector etc. in terms of financial sustainability considering the macro economy. With respect to government guarantee, the presidential decree, "Peraturan Presiden Republik Indonesia Nomor 67 Tahun 2005 tentang Kerjasama Pemerintah Dengan Badan UsahaDalam Penyediaan Infrastruktur" refers to the cooperation between investors and government. In the provisions of Article 13, 14, 15 and 16, compensation for projects is stipulated. Also, the authority of Infrastructure Construction Promotion Policy Committee (KKPPI) was established in accordance with Presidential Degree (No.42, 2005) and the risk management committee was established by the minister's decree No.518/KMK01.2005 for managing risk in the

public sector.

■ **Transmission and Distribution System**

Stretching from east to west with heavy demand in the west, the Java-Bali system has issues with stability due to full-time heavy load flow to the west. To solve this issue, construction of new 500kV southern transmission lines in addition to the existing 500kV lines is being implemented. In addition, power system conditions vary significantly because of the completion of large-scaled power stations such as Tanjung-Jati B. Besides the Java-Bali system, in the other 'back-burner' systems in Indonesia, it is necessary to construct new power stations, new transmission lines and new substations due to the unstable conditions of power supply.

In order to achieve a robust power system in terms of stable power supply from the aspect of transmission lines, power system planning with power system analysis such as load flow analysis and stability analysis should be carried out respectively. At present, the stability analysis is not conducted accurately due to the insufficient level of staff in the power system planning division of PLN. Therefore, power system analysis specialists should be brought up in PLN.

For the distribution system, the existence of three different sets of technical standards is ineffective. Therefore, technical transfer relevant to distribution planning is necessary for the consolidation of three technical standards.

■ **Long-term Fuel Requirement**

Views are held that the only new gas fuel sources available for PLN are the SSWJ (Phase 2) project and the LNG terminal project implemented by PLN's own financing. This is a critical but fairly realistic assessment considering the present situation of gas procurement negotiation between PGN and PLN. Therefore, a lot of coal thermal power plants will be constructed as alternatives, however, power development concentrating on coal-fired thermal plants should be avoided in terms of CO2 emission and energy security. Renewable energy including geothermal energy is expected to developed more, however, considering the generation cost and renewable energy potential as alternatives, large scale hydropower and nuclear power offer realistic options to meet energy requirements in Indonesia.

As large scale reservoir type hydropower projects sometimes have residential and environmental issues, etc., Yen loan applications for such projects seem to become temporarily suspended. To solve residential issues such as relocation of residents, the dialogue with the residents on support for removal and secure of livelihood is important. To solve the environmental issues, the implementation of appropriate EIA and cooperation with NGOs and experts is necessary. Provided efforts are made to solve the issues proactively, Yen loan studies should resume.

As for nuclear power plants, the national and international consensus on development of nuclear power plant is needed. The step-by-step studies are necessary with related law enactment, capacity development in construction technology, waste treatment technology reactor operation and maintenance technology.

Although the picture of the power sector in future should be outlined in RUKN prepared by MEMR, previous RUKN was prepared by modifying RUPTL and prepared by PLN. Therefore, capacity development in power development plan for MEMR is necessary in order to provide capability for establishing power sector policy independently based on the national energy policy.

■ **Unclear laws relevant to power sector**

One of the purposes of the new electricity law was to introduce the market mechanism to the power sector in order to encourage private investment in the electricity market. As a huge investment is required for developing power sources, promotion of private investment in the long and medium term is necessary. Enacting the new electricity law is the first step for establishing a trustful investment

environment for foreign investors, and also for wiping out distrust by investors regarding renegotiation of electricity selling price of past IPP projects. Therefore, early establishment of the new electricity law[4] is desirable for encouraging investment in the electric sector.

2.4 Current Situation and Issues of Energy Conservation

2.4.1 Current Situation of in Energy Demand

(1) Basic information

In analyzing changes of energy consumption in Indonesia, population statistics, GDP, and other basic information are extremely important. Table 2.4.1 shows changes in final energy consumption in Asian countries. In 2003, final energy consumption in Asia totaled approximately 1.7 billion tons (energy converted to tons of oil equivalent, hereafter referred as "TOE"). Indonesia accounted for 74 million tons TOE (about 4.4%) of the energy consumed, which was one-fifth of Japan's final energy consumption of 354 million TOE.

Table 2.4.1 Changes in Final Energy Consumption in Asian Countries (million TOE)

Country	1971	1980	1985	1990	1995	2000	2002	2003	%
Asia	513	756	896	1,143	1,419	1,509	1,602	1,694	100.0%
Japan	199	233	245	292	327	353	356	354	20.9%
China	186	313	386	482	590	551	592	668	39.4%
Thailand	5.4	9.2	11.8	21.6	37.2	41.9	47.2	50.0	2.9%
Philippine	6.1	7.9	6.8	9.52	15.0	17.6	18.2	18.4	1.1%
Indonesia	6.8	20.6	24.7	36.1	50.2	71.7	74.7	74.2	4.4%

Source: Energy Economics Handbook 2006 (The Energy Data and Modelling Center)

Table 2.4.2 shows changes in population of Asian countries. The population in Asia totaled some 3.4 billion in 2003. Indonesia accounted for 215 million (6.2%), which was 1.7 times the population of Japan.

Table 2.4.2 Changes in Population of Asian Countries (million)

Country	1971	1980	1985	1990	1995	2000	2002	2003	%
Asia	2,025	2,429	2,649	2,897	3,127	3,346	3,428	3,467	100.0%
Japan	106	117	121	124	125	127	127	128	3.7%
China	841	981	1,051	1,135	1,205	1,263	1,280	1,288	37.2%
Thailand	36.8	46.7	51.1	55.6	58.6	60.7	61.6	62.0	1.8%
Philippine	37.6	48.0	54.2	61.0	68.3	76.6	79.9	81.5	2.4%
Indonesia	120	148	163	178	193	206	212	215	6.2%

Source: Energy Economics Handbook 2006 (The Energy Data and Modelling Center)

[4] A newspaper has reported that submission of this new law to the parliament will is scheduled for June.

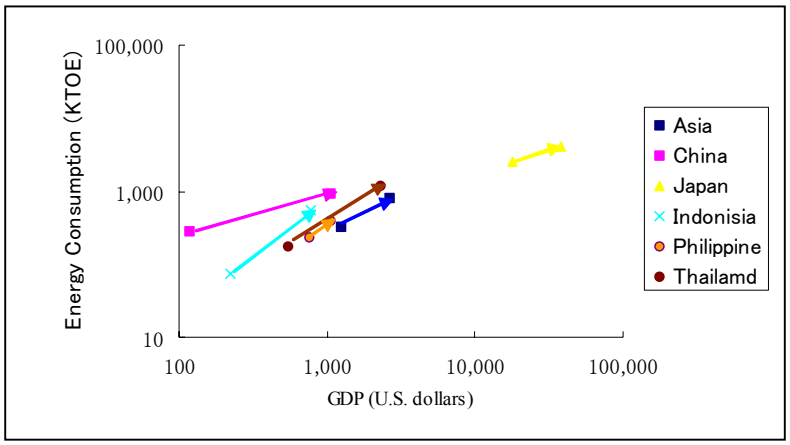
Table 2.4.3 shows changes in the GDP of Asian countries. The GDP in Asia totaled 9.2 trillion U.S. dollars in 2003. Indonesia accounted for 168 billion dollars (about 1.8%), just 3.4% of Japan's GDP.

Table 2.4.3 Changes in the GDP of Asian Countries (billion U.S. dollars)

Country	1971	1980	1985	1990	1995	2000	2002	2003	%
Asia	2,506	3,802	4,655	6,007	7,183	8,394	8,821	9,246	100.0%
Japan	1,888	2,791	3,250	4,108	4,429	4,746	4,750	4,876	52.7%
China	99.4	170	283	413	727	1,081	1,258	1,375	14.9%
Thailand	20.1	37.3	48.6	79.4	120	123	132	141	1.5%
Philippine	28.2	47.6	44.6	56.2	62.6	75.9	81.6	85.3	0.9%
Indonesia	26.9	53.5	70.4	99.3	145	150	161	168	1.8%

Source: Energy Economics Handbook 2006 (The Energy Data and Modelling Center)

Figure 2.4.1 shows changes in GDP per capita and energy consumption per capita in Asian countries from 1971 to 2003. Although Indonesia experienced sharp increases in its GDP and energy consumption from 1971 through 2002, the absolute values still remained small. These trends suggest that Indonesia will continue to increase energy consumption due to continuing economic development in the future, and also requires further promotion of energy conservation technologies.

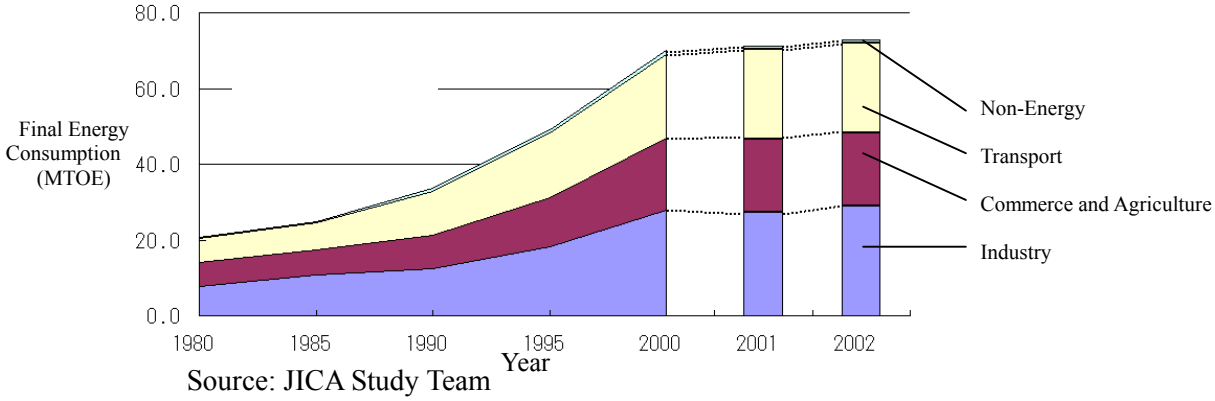


Source: Energy Economics Handbook 2006 (The Energy Data and Modeling Center)

Figure 2.4.1 Changes in GDP and Energy Consumption per Capita by the Countries

(2) Demand for energy within the industrial, consumer, and transport sectors

Figure 2.4.2 shows changes in final energy consumption in Indonesia. Final energy consumption has steadily increased since 1980 irrespective of consumption in the transport, consumer, and industrial sectors. Demand for energy is expected to continue its steady increase in the future.



Source: JICA Study Team

Figure 2.4.2 Changes in Final Energy Consumption in Indonesia

Table 2.4.4 shows changes of final energy consumption in different sectors. From 1986 through 2002, energy consumption in the industrial sector increased threefold, while energy consumption in the consumer sector increased tenfold. Considering that total energy consumption doubled, the greater increases within the industrial and commercial sectors were remarkable.

Table 2.4.4 Changes of Final Energy Consumption (millionTOE)

Sector	1986	1990	1995	2000	2001	2002	2002/1986
Industrial	10.8	13.9	19.9	29.8	29.1	31.2	2.9
Agriculture	0.7	1.0	1.6	1.9	2.0	1.9	2.7
Commercial	0.4	0.6	2.2	3.5	4.0	4.2	10.5
Household	36.3	40.3	44.7	51.1	51.6	52.5	1.4
Non-Energy	0.2	0.8	0.7	0.8	0.8	0.8	4.0
Sub-Total	48.4	56.6	69.1	87.1	87.5	90.6	1.9
Conversion	7.7	11.4	17.0	22.3	23.6	23.7	3.1
Ground-Total	56.1	68	86.1	109.4	111.1	114.3	2.0

Source: IEA, “Energy Balances of Non-OECD Countries”

Electricity demand in Indonesia experiences peak usage from 5 p.m. until 10 p.m. This night peak is caused mainly by consumption of electricity for domestic lights, which is not easy to shift. Thus, restraining total demand is necessary to conserve energy in the industrial and commercial sectors while promoting effective peak control measures because these sectors are large consumers of electricity.

(3) Outlook and issues of energy demand in the industrial, residential and transport sectors

In March 2004 after considering the latest energy and economic changes in Indonesia, the Institute of Energy Economics Japan formulated forecasts of final energy demand, production of electricity, and primary energy consumption until 2020 as shown in Table 2.4.5. According to this table, final energy consumption until 2020 is expected to increase at a relatively high and steady average growth rate of 3.9%, which urges Indonesia to formulate a reliable primary energy purchase plan and implement step-by-step energy conservation technologies.

Table 2.4.5 Final Energy Consumption until 2020 (millionTOE)

Sector	2000	2010	2020	2020/2000
Industrial	23.0	36.0	52.0	4.2
Transport	21.0	30.0	43.0	3.6
Consumer	21.0	33.0	47.0	4.0
Non-Energy	0.7	1.0	1.4	3.3
Total	67.0	99.0	144.0	3.9

Source: The Institute of Energy Economics Japan (March 2004)

(4) Conserving electric power for commercial use

Indonesia is characterized as having much demand for electric power for commercial use as shown in Table2.4.6. The use of energy in the commercial sector, especially PLN's demand for electric power should be restrained, for example, by adopting ESCO (Energy Service Company) and other high-efficiency energy usage methods on the assumption of using natural gas, LPG, and other resources.

Table 2.4.6 Ratios of Electric Power Consumption by Sectors (%)

	Electric power consumption (kTOE)	Total energy consumption (kTOE)	Ratio of electricity (%)
Industry	3,075	30,821	10%
Commerce	1,564	4,907	32%
Residential	3,139	53,397	6%
Total	7,778	115,922	7%

Source: IEA, “Energy Balances of Non-OECD Countries”

2.4.2 Energy Conservation Efforts

(1) Efforts in the industrial, consumer, and transport sectors

Southeast Asian countries, including Indonesia, are rich in energy resources and have relatively inexpensive energy costs. Hence, the average person’s awareness of energy consumption is low and no aggressive conservation efforts have been made so far.

Since 1995, reductions in CO_2 emissions have been in the spotlight within the international community in relation to global warming. In addition, an increasing number of Japanese and foreign companies operating in Indonesia have been obtaining ISO 14000 certification and implementing those standards, indicating a growing awareness of energy conservation. However, lack of energy conservation technology and the costs of high-efficiency systems have led to delays in promoting energy conservation measures in Indonesia.

Beginning in early 2005, domestic oil distribution decreased. Foreign corporations operating in Indonesia have begun to emphasize energy conservation and conduct related promotional activities. For example, PLN has established an educational program that targets third- to sixth-grade primary school pupils in promoting energy conservation. On October 1, 2005, the price of oil was raised by 126%, which led to a notable decrease in oil consumption by consumers, especially among low- and medium-income earners. According to PERTAMINA, the decrease in consumption for premium gasoline was especially notable. This was apparently attributable to decreasing use of passenger vehicles due to the increase in the price of oil. Although the decrease was not achieved by efforts of energy conservation, awareness and efforts to conserve energy will be boosted if the price of oil continues to rise in the future.

■ **Industrial sector**

Plants and factories that have a high demand for heat are bearing increasing costs for energy due to oil price hikes. Some sites have begun discussing the possibility of shifting their source of fuel from oil to coal. Shifting fuel from oil to natural gas will open the door to the possible introduction of high efficiency gas heating systems and gas co-generation systems. However, Indonesia has few natural gas pipeline facilities for industrial sector; therefore shifting to natural gas seems quite difficult. It has been reported in newspapers that PLN is planning to raise the price of electricity. This move will urge Indonesians to implement cost-saving measures to reduce energy consumption.

■ **Commercial sector**

Although it is difficult to say that Indonesia is aggressively working for energy conservation, many buildings are using energy-conserving electric lights and switching them off when they are not needed. Meanwhile, however, most people have little awareness of how to effectively control air conditioners in buildings. Many air conditioners are still set to relatively low temperature. Thus, people need to change in the way of thinking of controlling room temperature.

■ **Transport sector**

The guidelines for energy conservation, to be described later, recommend a shift from the present premium fuel to Pertamax fuel that has high specifications and to which no subsidy is applied. However, it seems that few individual owners of vehicles have shifted to this more expensive fuel.

■ **Households**

Energy-conserving electric lights (fluorescent lamps), which have been recommended by the DSM program, were approximately ten times more expensive than the price of existing incandescent light bulbs. However, inexpensive energy-conserving electric lights (about two times more expensive than incandescent light bulbs), manufactured in Indonesia, are winning increasing support from ordinary households, especially in central Jakarta.

(2) Energy conservation policy

Indonesia's energy policy is defined in the National Energy Policy 2003-2020, which was formulated in March 2004 (refer to “Energy Systems and Policy,” described later). Prior to formulating a national energy policy related to energy conservation, the Ministry of Energy and Mineral Resources formulated its “Policy on Renewable Energy Development and Energy Conservation (Green Energy)” in December 2003.

The Green Energy policy forecasts a 30% energy reduction if appropriate measures are implemented in both the supply and demand sides. Table 2.4.7 shows short-term programs for the next five years and long-term programs to be implemented by 2020, as follows

Table 2.4.7 Energy Conservation Program in Green Energy

Program	The main contents in connection with energy conservation
Short Term Program (5 years)	
Investment	➢ Promote of program to the funding institutions, bank, and guarantors in-country ➢ Cooperation with international donor institutions ➢ Providing access assistance to the funding sources
Incentive	➢ Imposing regulations on incentive-giving, in the form of fiscal incentives ➢ Providing free interest loan for engineering part of development
Energy Price	➢ Continue energy price subsidy elimination
Standardization and Certification	➢ Promoting the formulation of national standard ➢ Implementation of goods and services certification ➢ Promoting the formulation and enforcement on a competence standard for technical executors
Human Resources	➢ Conducting local and overseas training and education, seminars, technical guidance ➢ Improving quality of human resource in the regions
Information	➢ Developing data base and its data management canter ➢ Developing a clearing house ➢ Disseminating information on the utilization of energy conservation technology ➢ Holding seminars, workshops, etc ➢ Effort on put information on a website
Research and Development	➢ Developing priorities ➢ Expanding fund sources for development ➢ Establishing a partnership program between research institutes and industries
Institution	➢ Creating networking at national and international level ➢ Promoting coordination among central and regional institutions for the implementation of an integrated program
Regulation	➢ Draft joint decree of MEMR and MOF on incentives ➢ Draft law on energy utilization ➢ Energy conservation specifications
Long Term Program (2020)	
➢ Application of mandatory to save energy ➢ Application to utilize efficient and environmentally friendly technology ➢ Establishment funding institution in order to energy conservation program	

The "National Energy Management (Blueprint) 2005-2025" formulated in 2005 also covers programs related to energy conservation based on the above policy, but no specific approach, means, and goals are defined in their individual programs.

Specific energy conservation programs have been implemented thus far by presidential decrees. A recent example is the "Presidential decree concerning an urgent energy conservation measure (No. 10/2005)," announced on July 10, 2005. The contents of the presidential decree are as follows:

- ○ Implementation of energy conservation programs that target electric lights and air conditioners used in buildings of governmental bodies and corporate offices
- ○ Implementation of energy conservation programs that target energy-consuming equipment used in buildings of governmental bodies and corporate offices
- ○ Energy conservation measures that target official vehicles owned by governmental bodies and private corporations

○ Energy conservation promotion efforts that target private enterprise and the general populace
○ Implementation of energy conservation monitoring in six-month intervals

In accordance with the presidential decree mentioned above, the Ministry of Energy and Mineral Resources announced "Energy Conservation Guidelines (No. 31/2005)" on July 22, 2005. This ministerial ordinance outlines energy conservation measures to be implemented in commercial buildings and facilities of governmental bodies, and in the household, industrial, and transport sectors (see Table 2.4.8).

Table 2.4.8 Description of Energy Conservation Guidelines (No. 31/2005)

Sector	Description
Commercial buildings	・ Setting the lowest temperature of air conditioners to 25°C ・ Reducing the use of room lighting to a maximum of 15 W/m^2 ・ Limiting the time for operating air conditioners and escalators from work starting times until one hour before work ending times ・ Restricting elevators to stop only at every other floor
Offices of governmental bodies	・ Setting the lowest temperature of air conditioners to 25°C ・ Reducing indirect lighting ・ Limiting the time of operating air conditioners and escalators from work starting times until one hour before work ending times ・ Restricting elevators to stop only at every other floors
Ordinary households	・ Allowing use of energy-conserving electric bulbs only ・ Reducing at least 50W of electricity consumption during the load peak time from 5:00 p.m. to 10:00 p.m. ・ Setting the lowest temperature of air conditioners to 25°C
Transportation	・ Requiring private cars with 2000 cc or larger engine displacement to use Pertamax, especially in Sumatra, Java, and Bali ・ Promoting the use of natural gas fuel in official vehicles
Industry	・ Implementing energy audits of industries that consume large amounts of energy ・ Promoting the use of energy-conserving equipment and technologies
Other	・ Promoting the use of high-efficiency lighting systems for public roads, advertisements, and other facilities ・ Ceasing the use of diesel oil in mixtures of oil fuels

■ **Examples of other items related to energy conservation**

・ Ministry of Information and Communication (No. 11/P/M. Kominfo/2005): Limiting the broadcasting time for television and radio
・ Jakarta City (Government Order No. 77/2005): Call for energy conservation among citizens
・ Public Electrical Lighting Agency in Jakarta: Switching off a portion of the street lights on main roads after 10 p.m. (while still ensuring public safety)

(3) Promotion of energy conservation activities

To promote energy conservation, PT. Konservasi Energi Abadi (KONEBA), a government-owned corporation, was established in 1987 with a subsidy from the World Bank. KONEBA has approximately 25 engineers (among 50 employees or so) who have conducted energy conservation audits of more than 100 facilities including 70 plants, 20 buildings, and 10 other facilities. The corporation also holds energy conservation seminars for facility managers. The main service items of KONEBA are as follows:

○ Consultancy
○ Design and Engineering
○ Construction Management and Project Management

○ Testing and Inspection
○ Maintenance

In addition, the DSM Action Plan was formulated in 1992 with assistance from USAID. The plan aims to reduce the cost of electricity and to improve the quality of the power grid. An example was the implementation of a pilot project that uses high-efficiency lighting fixtures, which was forced to be suspended at the time of the Asian Economics Crisis in 1997. Energy-conserving promotional activities that have been implemented are as follows:

○ Promotional campaign program
Introduces the advantages of implementing energy conservation measures to people through posters, TV, radio, and newspapers, and enhances general awareness of energy conservation
○ Energy audit program
A free of charge program that analyzes energy usage and flow in all sectors, such as the industrial and transport sectors, and for commercial buildings; assesses energy consumption efficiency; offers methods for efficient energy usage and calculates the investment cost of improvements in energy efficiency
○ DSM program
- Urges low-income earners to upgrade electric bulbs (40W) to energy-conserving lamps (8W)
- Upgrades street lights in major cities with high-efficiency lamps in order to reduce demand for electricity during the peak usage time at night
- Attaching labels that indicate the energy consumption efficiency of electrical appliances for consumers (although this program has been devised, it has not yet been implemented because the assessments needed for labeling of all electric appliances have not been completed)

Note that the abovementioned free of charge energy audit program is implemented by KONEBA in cooperation with a university and PLN funding of 1 billion Rp/year.

(4) Green Aid Plan (GAP)
Since fiscal 1992, Japan's Ministry of Economy, Trade and Industry has started the Green Aid Plan (GAP) that aims to transfer and promote energy and environmental technologies, accumulated through pollution control measures and experiences in Japan, to overseas countries including Indonesia through international cooperation. Indonesia has adopted the following GAP programs, most of which are environmental measures and energy-conservation efforts are hardly seen.

- Environmental Pollution Control Operator
- Support to environmental control measures for the rubber industry (constructing a wastewater treatment system)
- Environmental standard (industrial wastewater) compliance and improvement cooperation program

Japan has also promoted international cooperation with India and Philippine in the energy-conservation field. The "Basic Policy of Economy and Industry Technical Cooperation for Fiscal 2005" also emphasizes the cooperation to promote energy conservation in the future.

2.4.3 Issues Related to Promoting Energy Conservation

(1) Circumstances surrounding the promotion of energy conservation
Indonesia, a producer of oil and other primary energy resources, has little awareness of energy conservation because the nation is rich in energy resources and the domestic price of energy is inexpensive. Specifically, in accordance with the First Long-Term National Development Plan (fiscal

1969 to 1993), the Government of Indonesia had the following policies of primary energy:

1) Available energy resources are abundant in Indonesia.
2) Fossil fuel resources can meet the needs of domestic demand and their export will earn foreign currencies.
3) The price of energy is to be maintained lower than its true economic value.

Subsequently, since the Second Long-Term National Development Plan (fiscal 1994 to 2018), energy conservation has been introduced into the concept of effective use of energy. However, it is difficult to say that the idea of promoting energy conservation has been well recognized because the government has not worked aggressively in this regard. Moreover, energy consumers have little awareness of energy conservation and such technology is sparsely available. In other words, Indonesians generally are apparently not conscious of controlling their use of energy. Hence, the Indonesian government, private corporations, and industries need to establish circumstances that urge governmental bodies, private enterprises, and industries to cooperate in promoting the efficient use of energy.

Policies:	Energy conservation laws, guidelines (technical standards), preferential measures for conservation of energy
Promotion:	Compiling a technical database, controlling energy data, and training personnel
Awareness:	Obligation of reporting management results, creating regulations, and offering incentives
External factor:	Corporate CSR, consideration of the environment, ESCO markets

Table 2.4.9 shows the barriers against the introduction of energy conservation measures to consumers.

Table 2.4.9 Barriers against Introduction of Energy Conservation Measures

Barrier	Description
Inexpensive energy price	Government subsidies of energy have maintained an inexpensive energy pricing system (electricity rate) leading to ineffective energy conservation investments.
Insufficient energy demand data	Lack of energy control has led to a lack of data necessary for discussing and promoting energy conservation.
Lack of energy conservation technology	Little knowledge of energy conservation and technology leads to ineffective discussions of energy conservation measures.
Investment in facilities and equipment	Energy conservation equipment and high-efficiency equipment are quite expensive, and also require corresponding knowledge and technology to determine their effects.
Regulations and laws	Indonesia lacks an awareness of energy conservation since laws are inadequate to deter the use of energy and there are no regulations concerning energy consumption.
Incentives	Preferential measures and aid systems are not established to promote energy conservation.

(2) Urbanization plan that pays attention to the environment

Promoting energy conservation measures will lead to ensuring a stable supply of energy and preventing global warming as well by reducing environmental burdens. These cannot be achieved by merely implementing energy conservation measures for facilities in major cities. The policy and vision which leads to a structure of resource conservation are required for consideration of the energy

demand structure in the residential and transport sector, and restructuring the current large energy wasting structure. However, the present system promoting energy conservation has failed to consolidate different sectors and industries for energy conservation.

The energy conservation policy which considers a lifestyle to prevent wasting energy, such as promotion of utilization of a public transport means, increase in efficiency of a physical distribution, and an improvement in automobile traffic style, from a long-term viewpoint, and aimed an urbanization policy that pays attention to energy conservation and the environment impact is required.

2.5 Energy Policy and Institution

2.5.1 Energy Policy

(1) Background

As one of the most energy-resourceful nations in Asia, Indonesia proposed its first long term national development plan (FY 1969-1993) based on the following understandings:

- There are abundant energy resources in Indonesia.
- The amount of fossil fuels is sufficient enough to satisfy national consumption, and to also be a reliable export material for the acquisition of foreign currency.
- Energy prices should be determined by their market value

However, the basic understanding has been altered in the second long term national development plan (FY 1994-2018) as below:

- Energy resources are not necessarily abundant.
- Fossil fuels should be recognized as fuels and basic ingredients for export materials.
- Energy prices should be determined by their market value.

Based on the most recent understanding, the comprehensive development and application of energy policy should follow the concepts below.

- Energy demand for both export and national consumption is growing.
- Capacity development for long-term energy supply is expected.

In this summation, the purpose of the energy diversity policy has been shifted from the reduction of national oil-dependence to avoiding fossil fuel exhaustion.

The finish line of the energy development is described as the construction of high value-added nation with energy security and flexible governance.

Figure 2.5.1 shows the rebuilding of the energy policy in Indonesia.

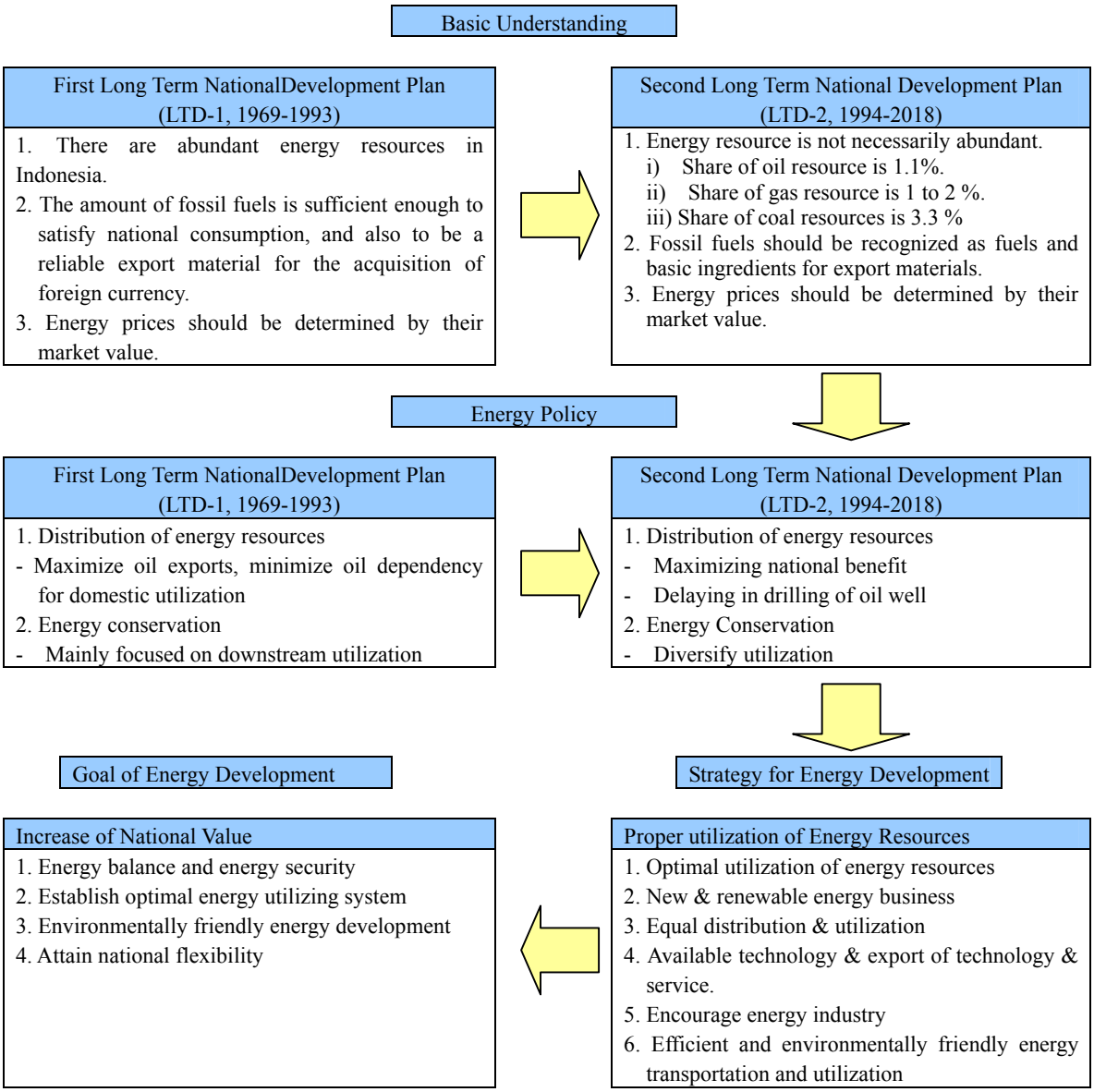


Figure 2.5.1 Rebuilding of Energy Policy in Indonesia

(2) National energy policy

Current Indonesian energy policy is outlined in National Energy Policy 2003-2020, March 2004, based on the second long term national development plan. Main policy is listed as follows:

- The promotion of stable energy supply, to accommodate national development and population increase.
- The diversification of energy sources, aiming at the most appropriate and economic resource composition.
- The promotion of energy conservation

To achieve these policies, the following strategies are presented.

- The development of infrastructure
- The introduction of market economy in energy sector
- The formulation of safeguard for low-income group in urban and peripheral areas

- Environmental protection
- The collaboration among public and private sectors in the energy sector
- Human resource development in the energy sector, particularly in rural areas and isolated islands
- Research and development in the energy sector
- The establishment of an effective management system in the energy sector

In addition, the following numerical targets are proposed.
- To increase electrification ratio to 90 % by 2020
- To increase the percentage of renewable energy, excluding large-scale hydropower, to 5% by 2020
- To decrease energy intensity 1% a year

(3) The National Energy Management Blue Print

The amount of primary energy supply and technological advancement in each energy source was forecasted based on the National Energy Policy. 'Peraturan Presiden Republik Indonesia Nomor 5 Tahun 2006 tentang Kebijakan Energi Nasional' presented the preferable primary energy composition to be achieved by 2025. Specifically, the expected proportion of each energy source in national energy consumption is described as below:

- Oil .... less than20%
- Gas ... more than30%
- Coal...more than 33%
- Biofuel more than 5%
- Geothermal more than 5%
- Other... New & renewable energy (biomass, nuclear, hydro, solar, wind） ... more than 5%
- Liquefied coal... more than2%

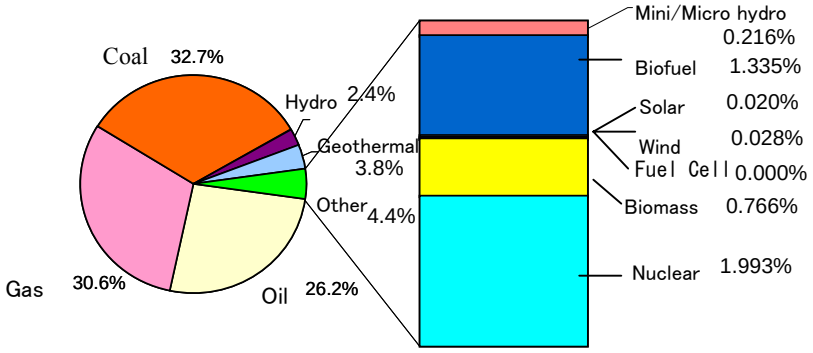


Figure 2. 5.2 Target of Primary Energy Mix

2.5.2 Energy-Related Laws and Policy Organizations

Energy-related laws and policy organizations are summarized in this chapter.

(1) The Status of energy-related laws

The energy policy in Indonesia was set by the National Energy Policy 2003-2020 (enacted in March 2004), and a number of laws have been enacted according to this policy. Additionally, the National Energy Management Blueprint 2005-2025 was established in 2005, and it forecasts the primary energy supply and development of individual energy technology up to 2025. However, confusion occurs in energy policymaking and system design, as specific articles of the Oil and Gas Law and the new Electricity Law were declared unconstitutional by the Supreme Court, which has thus prevented private investments. The Energy Law itself is still in draft form as of February 2006. The current status of energy sector related laws in Indonesia is shown in Table 2.5.1.

Table 2.5.1 Energy-Related Laws

Sector	Name	Outline
Energy policy	National Energy Policy	The basis of Indonesia's energy policy. It is assumed that continued energy supply will be secured to support the development of the nation. Enactment in March 2004.
	Presidential Decree (No.5/2006)	The Presidential Regulation on the National Energy Policy. It regulates the content of the National Energy Management Blue Print. <Goal for primary energy mix in 2025> 1) Oil: less than 20% 2) Gas: 30% or more 3) Coal: 33% or more 4) Biomass fuel: 5% or more 5) Geothermal: 5% or more 6) Others, new energy/renewable energy (especially biomass, hydro, solar, wind): 5% or more 7) Liquefied coal: 2% or more
Electricity	Presidential Decree on power supply by private sector (No.37/1992)	Presidential Decree No.37: Keppres 37/1992 Government Regulation 10/1989 - Private companies enter into generation, transmission and distribution sectors (Article 2) - Priority of unsolicited projects by BOO model (Article 2) - Rate design in Rupiah (Article 4) - Prohibition of issuing government guarantees for equity and repayment (Article 15)
	Government Regulation (No.25/1999)	Government Regulation on Electric Power Support Businesses
	Government Regulation (No.53/2003)	Government Regulation on the Creation of the Electric Power Market Supervisory Board
	Government Regulation (No.0003/2005)	Government Regulation on the supply and utilization of electric power (revision order of No.10/1989). Enactment in February 2005. When the private sector enters an electric power project (excluding renewable energy), it is necessary to execute it jointly with PLN through the tender.
	Ministerial Decree (No.9/2005)	Ministerial Decree on Energy and Mineral Resources on the procedures for electric power purchases and/or -transmission network rentals in power supply business for public interest. Enactment in April 2005.
	Decree of Ministry of Energy and Mineral Resources No.479-12/43/600.2/2005	Specification of a national power supply crisis
	Decree of Ministry of Energy and Mineral Resources No.726-12/600.4/2005	Power failure investigation in the Java Madura Bali system
	No.001/2006 Decree of Ministry of Energy and Mineral Resources on the procedure for purchasing electric power and/or rental transmission networks for the public interest.	No.001/2006 Decree of Ministry of Energy Mineral Resources on the procedure for purchasing electric power and/or rental transmission networks for the public interest.
Oil and gas	New Oil and Gas Law (No.22/2001)	It eliminates the monopoly of PERTAMINA by separating the function and liberalization of the oil and gas sector, and introduces a principle of competition into the sector (November 2004). Enactment in November 2001. The government is now preparing to amend this law following the decision of the Constitutional Court that revoked Article 28 of the Law. The amendment will follow the court's decision that fuel pricing should not be based on the market mechanism.
	Government Regulation (No.42/2002)	It regulates the supervision of upstream activities in the oil and natural gas sectors.

Sector	Name	Outline
	Government Regulation (No.67/2002)	It regulates the supervision of downstream activities in the oil and natural gas sectors.
	Government Regulation (No.31/2003)	It concerns the conversion of the State Oil and Natural Gas Company into a public company.
	Government Regulation on Upstream Oil and Gas Business Activity (No.35/2004)	- It regulates petroleum and gas upstream activity. - 10% of the participation right is given to the regional public company (Article 34). - It regulates the supply obligation for domestic demand as 25% of the output (Article 146).
	Government Regulation on Downstream Oil and Gas Business Activity (No.36/2004)	- It regulates downstream activity. - The government decides the price for domestic use and small-scale users. Additionally, it is regulated by the market competition mechanism.
	Decree of Ministry of Energy and Mineral Resources No.1321K/20/MEM/2005	Master Plan for the National Gas transmission and distribution network
Coal	Electric power and energy use Bureau Regulations No.751-12	It regulates domestic products and service use and the construction of a coal fired power plant which has up to 8MW of connecting capacity per plant.
	National Coal Policy	Enactment in January 2004. It aims at an additional value increase for coal use, supply stability of domestic coal and an increase in coal exports.
	Regulation of Minister of Finance on setting of export collection money of coal (No.95/PMK.02/200)	Charges of 5% on every 30 dollars (1.5 dollars) are established.
Energy Conservation	Presidential Rugulation on Energy Conservation (No.10/2005)	Government Regulation concerning energy conservation. Enactment in July 2005.
	Ministerial Decree on implementation procedures for Energy Conservation (No.0031/2005)	It regulates the targets for implementation of Energy Conservation. It executes monitoring of the implementation of Energy Conservation. It regulates concrete energy-conservation standards for household, transportation, government office, and industry use.
Renewable Energy	Decree of Ministry of Energy and Mineral Resources (No.1122/2002)	Government Regulation on decentralized power supply
	Decree of Ministry of Energy and Mineral Resources (No.0002/2004)	Government Regulation on renewable energy. Government regulation on the development and conservation of new energy (e.g. green energy such as biomass, geothermal, solar power, hydro power, wind, and oceans).
	Geothermal Law (No.27/2003)	It regulates the management and development of geothermal energy resources.
	Decree of Ministry of Energy and Mineral Resources (No.002/2006)	Medium-scale renewable energy power-generation activities
Nuclear Energy	Nuclear Energy Law (No.10/1997)	It regulates the utilization of nuclear energy, including regulations on construction of nuclear-powered generating stations and creation of a Nuclear Energy Agency and Nuclear Energy Control Board.
	Government Regulation (No.134/2000)	Government Regulation on Non-Tax State Revenue Rates applied by the Nuclear Power Supervisory Board.
	Government Regulation (No.27/2000)	Government Regulation on Management of Radioactive Wastes.
	Government Regulation (No.26/2002)	Government Regulation on Safety in the Transport of Radioactive Substances.

Sector	Name	Outline
Government guarantee to support Infrastructure development	Decree of Minister of Finance on establishing risk management committee (No.518/2005)	Establishment of a committee that assesses risks of infrastructure projects.
	Presidential Decree on cooperation of the Business unit and Government in infrastructure supply (No.67/2005)	Presidential Regulation on the cooperation of the business unit and government in infrastructure supply. Reference to "compensation" to the business unit which takes the initiative in the cooperation project.
	Presidential Decree on land procurement for public development (No.36/2005)	It regulates the rights of land expropriation and compensation.

Source: National Energy Policy, http://www.djlpe.go.id/eng/Link%20Kiri/KenEng.pdf
MEMR HP News Archive, http://www.esdm.go.id/newsarchives.php
Prepared by JICA investigation team through field study conducted in February 2006.

The hierarchy of laws in Indonesia is regulated by Law No.10/2004 on Government Regulations regarding the establishment of legislation.

Table 2.5.2 Law No.10/2004 on Government Regulations

Article 1
(3) A Law is a regulation that the Diet establishes with mutual agreement by the President.
(5) A government regulation is a regulation that the President establishes to execute laws.
Article 7
(1) The hierarchy of Legislation is as follows:
a. 1945 Constitution
b. Act/Government Regulation/Peraturan in Lieu of Act
c. Government Regulation/Peraturan
d. Presidential Regulation/Peraturan
e. Regional Regulation/Peraturan

Note1: The hierarchy of Ministerial Decrees and Regional Regulations is divided into two cases.
a) A Ministerial Decree ranks higher than a Regional Regulation when the Ministerial Decree is delegated by other Regulations (Law or Presidential Decree).
b) In case of no delegation:
The regions need not apply for a Ministerial Decree. When the regulations of central and regional government conflict with each other, the decision is entrusted to the Supreme Court.

Note 2: Based on Article 7 of Act No. 10/2004, the existence of a Ministerial Regulation is recognized and binding, as long as it is decided by a higher level of legislation.

Note 3: Related to the hierarchy of legislation, the authority of the Supreme Court includes judicial review of legislation under the level of an Act and other authority which is provided by an Act. Related to the hierarchy of legislation, the authority of the Constitutional Court is judicial review of Acts related to the 1945 Constitution and deciding disputes among state institution authorities, which is provided by the 1945 Constitution.

Note 4: The Administrative Court is the executor of the judicial power to examine, decide, and settle disputes in administrative matters, such as decisions of government agencies or decisions of government officials.

Note 5: A Presidential Regulation is a rule or order having the force of a Presidential Regulation issued by an executive authority of the government which has the power to regulate. A Presidential Decree is a decision having the force of a Presidential Decree issued by an executive authority of the government which has the power to decide.

Table 2.5.3 Laws Regulated by the Constitution

	Corresponding part in the Constitution	Responsible	Grounds in Constitution
Law	Article 5, Clause 1 and Article 20, Clause 1	President and the Diet	(Replaced by the first revision). "The President has the right to propose bills to the Parliament"; "The Parliament has the authority to enact laws."
Government Regulation	Article 5, Clause 2	President	"The President enacts a government regulation necessary to put a law into force."
Presidential Decree	Article 4, Clause 1	President	"The President of Indonesia is assumed to follow the Constitution and to hold political power."

(2) Energy policy framework

Under the Energy Policy framework of Indonesia, an Energy Law should have been enacted first. However, it is still in the draft stage at this moment in 2006, and the New Oil and Gas Law (2002), Electricity Law (2002) (judged unconstitutional in 2004) and Geothermal Law (2003) were enacted before establishing an Energy Law. The draft Energy Law includes, 1) DMO (Domestic Market Obligation): obligation of energy supply priority to domestic market, 2) tax credit to clean energy production, 3) obligation of utilizing renewable energy to energy producers, 4) tax reduction and interest waiver to renewable energy/new energy, 5) obligation for state governments to prepare the Regional Energy Plan, etc..

These energy law and policy systems in Indonesian energy sector are summarized in the Figure below.

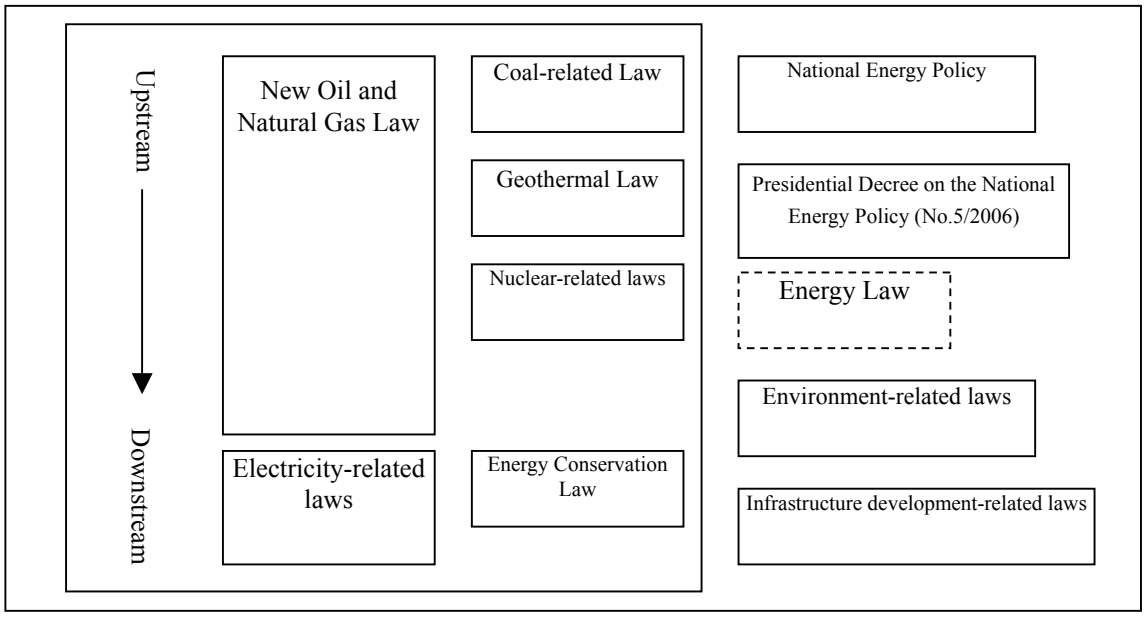


Figure 2. 5. 3 Energy-Related Law System

2.5.3 Organizations Related Energies

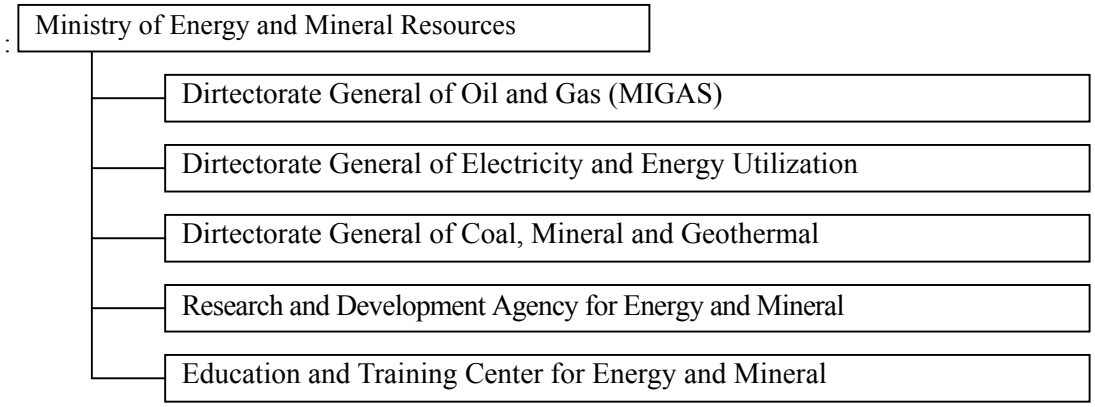
(1) Energy Coordination Council (BAKOREN)

Indonesian energy policies are authorized by the Energy Coordination Council (BAKOREN) that was established in 1980. The chairperson of BAKOREN is a minister of MEMR and the members are ministers of the energy-related ministries. The energy and resource technical committee (PTE) that provides support in technical matters is attached to BAKOREN. The main tasks of BAKOREN are as follows:

(i) Coordination among ministries on energy administration
(ii) Authorization of energy development plans and energy supply and demand balance

(2) Ministry of Energy and Mineral Resources (MEMR)

MEMR has responsibility for establishing and implementing energy policies and it supervises the oil and gas industry. MEMR consists of six bureaus and five departments as shown in the following figure.



(3) Directorate-General of Oil and Gas (MEMR-MIGAS)

MEMR-MIGAS has responsibility for supervising the oil and gas business and establishing energy plans and policies. MEMR-MIGAS has discretionary power in important oil and gas development. MEMR-MIGAS is also required to advise BP-MIGAS and BPH-MIGAS.

(4) BP-MIGAS

By establishing new oil and gas regulations, MEMR-MIGAS regulates Production Share Contracts for oil and gas exploration and exploitation. Since implementation of PSC, BP-MIGAS has regulated contractors instead of PERTAMINA as in previous years. BP-MIGAS also carries out the sale promotion of government oil and gas, and selects trading companies for it.

(5) BPH-MIGAS

BPH-MIGAS is established for regulating down stream business. BPH-MIGAS regulates petroleum product supply and prices, and carries out monitoring survey every week. BPH-MIGAS also regulates natural gas pipelines operated by PGN and other pipeline companies.

(6) PERTAMINA

PERTAMINA was established as oil and gas state monopoly company in 1957. The contents of the company are oil and gas development, production, oil refinery, oil transportation, oil and gas sale and export. The monopoly of PERTAMINA had been discontinued as a result of the New Oil and Gas Law No: 22/2001. PERTAMINA released all rights of implementation on oil and gas regulation, and became one of the players in the oil and gas business together with other domestic and foreign companies. PERTAMINA's upstream business are follows;

Table 2. 5. 4　Up Stream Business of PETAMINA in 2004

	Business Field	Quantity
Production	Oil	133,000 bbl/day　（48.7 million bbl /year）
	Natural gas	1,078 mmscf/d　(391 Bcsf /year)
	Geothermal	137,000 ton/d (50 million ton /year)
Oil and gas development	Oil well development	9（6 :productive、3: dry）
	New Oil reserves	24 million bbl
	New NG reserves	2,571　billion scf

Source：brochure of PERTAMINA

By developing the above table, new oil reserves are increased with 467.7 million bbl in 2004 comparing to 274.9 million bbl in 2003.

Regarding down stream of PETAMINA, in 2004, PERTAMINA had sale business of gasoline (103 million bbl), diesel (169 million bbl), kerosene (7.5 million bbl), fuel oil (37 million bbl) and others.

(7) PGN (Perusahaan Negara GAS)

PGN was established as a state-owned company in 1965. In 1985, Perusahaan GAS Nagara, as a state-owned company, was transformed into a public service company. In 2003, the corporation stock was placed on the stock market, and this meant privatization of PGN. The Ministry of State-Owned Enterprises (MSOE) holds 61% of PGN stock and the remainder (39%) is held by the public. According to the PGN brochure, MEMR-MIGAS supervises PGN and BPH-MIGAS regulates PGN.

Table 2.5.5　Construction Plan of PGN Gas Pipeline

Years	Pipeline construction
1998	Grissik-Duri(536km)　Existing　　Capacity :325mmsfcd
2003	Grissik-Batam – Singapore Existing　Capacity :650mmscfd
2004	S.Sumatra-West Java （SSWJ PhaseI, SSWJ PhaseII） under construction Phase1: capacity 250mmscfd Phase2: capacity 400mmscf

Source：brochure of PGN

PGN sales recorded US$0.4 Billion in 2004. The contribution of transmission sales is 19% in the total and distribution sales is 81% in the total. The number of customers of PGN is follows:

Table 2.5.6　Number of Customers of PGN

Sector	2001	2002	2003	2004
Residential	48,401	51,941	64,889	75,244
Commercial	1,160	1,330	1,305	1,158
Industry	626	646	675	677

Source:　PGN publications

(8) Director General of Coal, Mineral and Geothermal (DGCMG)

In Directorate General of Coal, Mineral and Geothermal, Mineral & Coal Development Enterprise division is in charge of regulating coal companies, Mineral, Coal & Geothermal Program Supervision division is in charge of making strategic policies for coal and geothermal business. And the rules of the government works related coal are separated to central government and local government.

The rules of the central government are regulation of coal mines spread to more than two states, offshore coal mines located over 12 nautical mile far from the nearest shore, coordination of resources, reserve and new coal mine survey, coordination of issues among ministries, and production, safety and

environment issues.

(9) National Nuclear Energy Agency (BATAN)

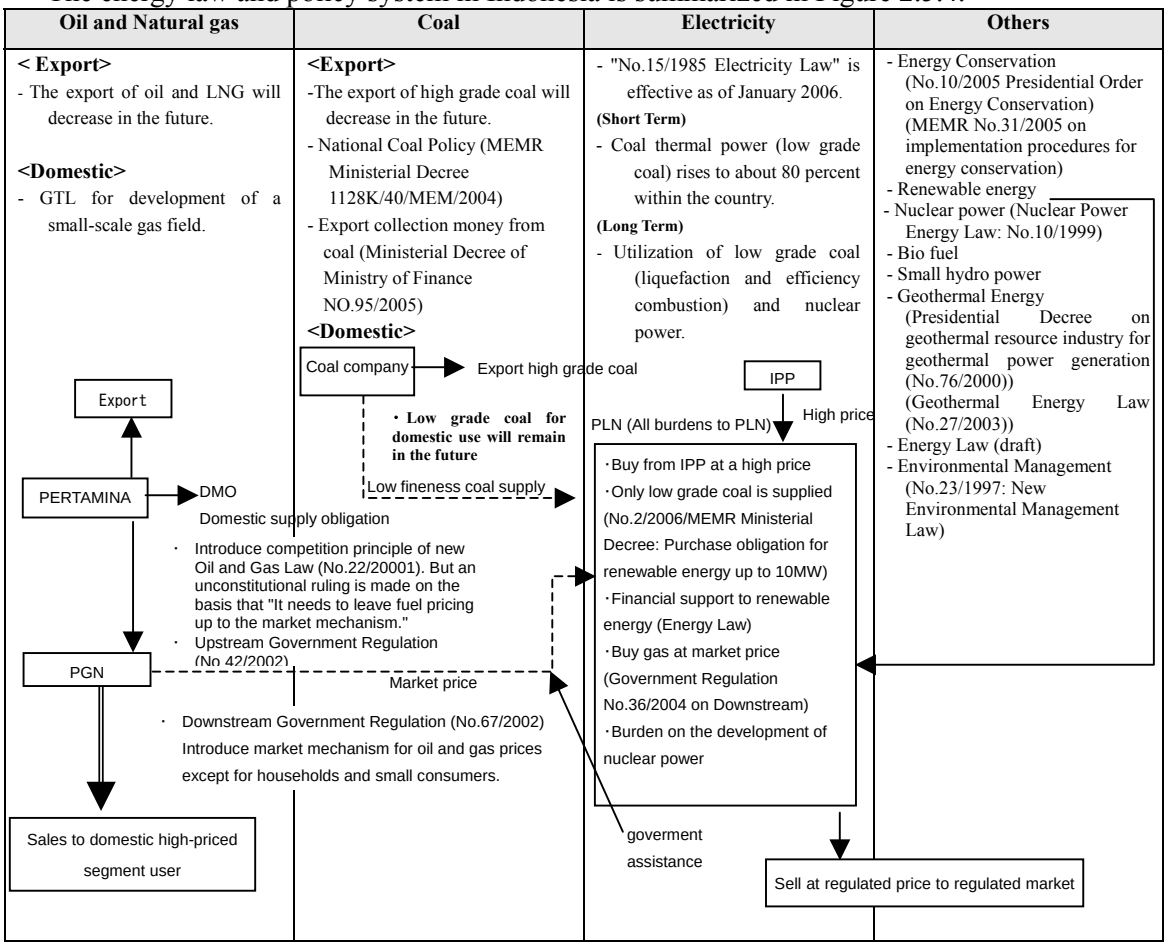
National Nuclear Energy Agency directed by the President is in charge of policy making, research and development for nuclear issues in Indonesia. The Government announced in Jan 2003 that Indonesia would start nuclear power generation in 2016, and the nuclear plants will be constructed in Muria peninsula in Central Java. The Government already surveyed comprehensive nuclear power generation plan in collaboration with IAEA in 2001 and 2002.

2.5.4 Issues in the Energy Policy

(1) Inconsistencies across the range of energy policies

There is an important issue to be addressed regarding the lack of consistency among energy policies and laws in Indonesia, even though it is partially balanced and consistent in terms of support of renewable energy and the poor, marketing tariffs, and domestic supply obligation. In particular, although PLN has obligations on the input side, such as buying gas at market price, IPP, and buying renewable energy, there are restrictions on the output side, such as revenue from tariffs. Therefore, these inconsistencies, caused by the liberalization of the energy sector are consolidated in the financial structure of PLN. This situation is illustrated in the figure below.

The energy law and policy system in Indonesia is summarized in Figure 2.5.4.



Source: Prepared by JICA investigation team from various materials

Figure 2.5.4 Energy Law and Policy Systems in Indonesia

(2) Stagnation in the development of the related-laws

In the current situation, in which rulings of unconstitutionality were made on the New Electricity Law and on a part of the New Oil and Natural Gas Law, the legal system regulating the energy sector

has not been adequately developed yet. An immediate solution for attracting private investment needs to be formulated. In particular, although Government Regulation No. 3/2005 (the revision order of No. 10/1989 on the supply and utilization of electric power) describes the utilization of private investments as the basic policy, the contracts and procedures for the investments as well as the specific system, sharing responsibilities and the decision making need to be clearly defined.

(3) Relationship with the regional administrations

As for regional administration, the authority on investments, industries and energy has been transferred to regional governments under Chapter 7 (2) of No. 22 Regional Administrative Law and Government Regulation No. 25 (dated 6 May 2000). Moreover, the shares of petroleum oil of central and regional governments is regulated under the No. 25/1999 Balanced-budget Law and No. 33/2004, as shown in the table below; and it is thought that effective utilization of these shares will contribute to the energy supply in the regions. Further investigations on the current status need to be made.

Table 2.5.7 Shares of Petroleum Gas of Central and Regional Governments

	Law	Central	Regional
Oil	Law No. 25/1999	85.0%	15.0%
	Law No. 33/2004	84.5%	15.5%
Gas	Law No. 25/1999	70.0%	30.0%
	Law No. 33/2004	69.5%	30.5%

2.6 Analysis of Current Situation and Issues of Regional Development and Rural Electrification

This section analyzes (1) the current situation of regional development and rural electrification in Indonesia and (2) the possibility and issues of how the energy sector in general and rural electrification projects in particular can contribute to regional and rural development in terms of poverty alleviation and human security by referring to the relevant literature and the field survey of Nusa Tenggara Province.

2.6.1 Regional Development

(1) Current situation of regional development

■ **Regional development in the national development planning**

The Mid-term development plan (2000-2004) of Indonesia refers to the followings as the development issues.

- Establishment of a democratic political system and maintenance of national unity
- Establishment of the rule of law and good governance
- Restructuring of the economy and strengthening of the basis for sustainable and fair development (e.g., poverty alleviation, SME development, stabilization of economy and finance, expansion of investment and export, strengthening of international competitiveness, infrastructure development, and environmental conservation and management)
- Improvement in the national welfare and religious life and creation of vigorous culture (e.g., education, science and technology, health and sanitation, protection of workers and the disadvantaged, and improvement in women's status)
- Facilitation of regional development (capacity development of the local governments, reduction of disparity between the regions, capacity development and participation of people)

Thus, the Plan regards the promotion of regional development as one of the priority development issues. Under decentralization policy, the role of the central government is limited to national issues, while the provincial government is responsible for addressing interregional issues and those that are delegated by the central government. The relationship between the ministries of the central government and local (regency and city) governments has shifted from "control" to "consultation". Regional development plans formulated by the local government include the long-, mid-, and short-term plans, based on the law of national development plan system, which will be discussed later.

■ Regional development plan

The outline of regional development plans is briefly described in the Law No. 32 (2004). According to this law, the provincial, regency, and city governments are required to formulate regional development plans to manage regional administrative tasks in line with the national development plan.

The law on national development plan system, which was formulated as the Law No. 25 in October 2004, describes the detail of both national and regional development plans.[5] The law aims to achieve (1) the coordination between development stakeholders, (2) the synergy effect and regional and functional integration of the central and regional governments, (3) linkage and harmonization of planning, budgeting, implementation, and monitoring, (4) public participation, (5) efficient and effective fairness and sustainable utilization of the resources. The long-, middle-, and short-term development plans of the country are formulated in line with these objectives

Table 2.6.1 Types of National Development Plans

Type	Form	Term
1) National long-term development plan (PRJP)	Law to be approved by the Parliament	20 years
2) National mid-term development plan (PRJM)	Presidential decree	5 years
3) Ministerial strategic plans (Renstra-KL)	Presidential decree	5 years
4) Government work plan (RKP)	Presidential decree	1 year
5) Ministerial annual work plan (Renja-KL)		1 year

Source: Satoshi Iijima

Note: RPJP: Rencana Pembangunan Jangka Panjang; RPJP: Rencana Pembanguan Jangka Menengah; Renstra-KL: Rencana Strategis Kemenrian/Lembaga; RKP: Rencana Kerja Pemerintah; Renja-KL: Rencana Kerja Kementrian/Lembaga

The local government is responsible for formulating the long-, middle-, and short-term development plans in a systematic manner like the central government. The development planning department (BAPPEDA) of each local government coordinates the formulation of plans.[6] The responsibility for implementing plans lies in the departments of the local government.

The draft development plans are prepared by BAPPEDA and discussed among stakeholders at the development planning meeting. Based on the outcome of discussion, BAPPEDA finalizes the plan.

Table 2.6.2 Types of Regional Development Plans

Type	Form	Term
Long-term regional development plan (RPJPD)	Regional regulations to be approved by the local parliament	20 years
Mid-term regional development plan (RPJMD)	Regulation set by the head of local government	5 year
Regional strategic plan of local government departments (Renstra-SKPD)	Regulation set by the head of local government departments	5 years
Local government work plan (RKPD)	Regulation set by the head of local government	1 year
Annual work plan of local government departments (Renja-SKPD)		1 year

Source: Satoshi Iijima

Note: RPJPD: Rencana Pembangunan Jangka Panjang Daerah; RPJMD: Rencana Pembangunan Jangka Menengah Daerah; Renstra-SKPD: Rencana Strategis Satuan Kerja Perangkat Daerah; RKPD: Rencana Kerja Pemereintah Daerah; Renja-SKPD: Renja Satuan Kerja Perangkat Daerah

The long-term plan of the local government reflects the content of the long-term national

[5] Satoshi Iijima, "Formulation and Significance of the National Development Planning System of Indonesia", July 2005

[6] The Decentralization Law (1999) gives a very limited role to the provinces and places them at the same level of regency and city governments. However, the revised decentralization law (No. 32/2004) reviews the role of the province as the intermediate government and removes and gives the role of supervision and coordination for regency and city governments.

development plan. The middle-term plan refers to the long-term plan, while the short-term plan refers to the middle-term plan and the annual work plan of the central government. Each local government department formulates the strategic plan and annual work plan, including mission, objectives, strategies, policies, plans, and action plans, based on the long- and middle-term regional development plans. The departments of the local government not only formulate the plans but also regularly monitor and evaluate the implementation, while BAPPEDA is responsible for overall monitoring.

BAPPENAS is currently formulating the activity plan including (1) the production of information system and database system, (2) the formulation of regional development models (target setting and formulation of priority development issues and programs), (3) the establishment of development planning forums, and (4) the promotion of inter-regional cooperation in order to construct and manage the development planning system.

■ **Case of West Nusa Tenggara province**

West Nusa Tenggara province has formulated the middle-term plan (2003-2008), although it was prepared before the enforcement of the Law No. 25 (2004). This plan specifies the vision and mission of the provincial government and describes the objectives, targets, policies, programs and activities based on the SWOT analysis.

Although the matrix that summarizes the above items, it lacks tangible targets and prioritization as the number of listed targets, policies, and programs reaches up to 40-80. The plans do not clearly indicate the process to address the priority issues as budgets and schedule are not specified.

The annual work plan (RKPD) of 2006 of the province identifies the following development issues: (1) poverty alleviation, (2) creation of employment opportunities through investment and export promotion, (3) revitalization of rural areas and agriculture, (4) improvement of access to and quality of religious education, (5) reform on law enforcement and elimination of corruption and bureaucracy, and (6) stable security and conflict resolution. The plan also clarifies the target and policy direction of each development issue.

This annual work plan of the province contains the matrix that includes the detail of the middle-term plan and the annual work plan and the budget to maintain consistency between these two plans. But the budget does not contain the concrete figures. In addition, despite the name of “work plan”, this work plan lacks clarity of the target, implementation process, and schedule of each program and has much room for improvement as a management tool.

(2) Issues of regional development

As described above, the legal framework of regional development plans is already in place. Local governments have started producing the plans. However, several issues need to be resolved.

■ **Production of regional development system**

The regulations should be formulated and enacted as concrete documents in order to enforce the laws and should be harmonized between them without contradiction. The information system and regional development model should be established in order to run the system.

BAPPENAS provides a training program for development planning to the local government staff with a limited budget only. The Regional Development Department (BANGDA) of the Ministry of Home Affairs, which is in charge of regional development as well, issues the guidelines for development planning process, but does not have the training budget.

In fact, the development plans are descriptive and are not clear about the priority issues and implementation process due to a lack of budget and schedule. In addition, the local governments seem to lack the evaluation ability. For example, a development plan document of a province declares that

almost all the expected inputs, outputs, outcomes, and impacts are achieved without indicating any evidence. Thus the local governments are unlikely to be able to effectively monitor a series of processes, including planning, implementation, monitoring, evaluation, and feedback. The local governments have much room for improvement in this regard.

■ **Development budget of the local government**

Even if the development plans are formulated, the budget is not sufficient for implementation. For example, the Central Lombok regency government submitted the budget proposal of Rp. 1.6 trillion but secured Rp. 479 billion only. Of the entire budget, the development budget is only Rp. 184 billion, while the rest is allocated to the administrative cost such as salary.

■ **Increase in the number of the local governments**

As of February 2006, 99 local governments including 21 provinces submitted a request for separating from other local governments and are waiting for the screening of the Ministry of Home Affairs.[7] The majority of the requests are from governments that are endowed with the abundant natural resources. Since the enforcement of the decentralization law, five provinces, 81 regencies, and 18 cities have been created.

However, many of the newly established local governments suffer from (1) insufficient subsidy due to the serious financial difficulty of the central government, (2) a lack of human resources, and (3) delay in infrastructure development. All of the above hinder efficient realization of regional development.

2.6.2 Rural electrification

Rural electrification had been promoted mainly by grid extension of PLN as a national priority policy to narrow the gap among the regions. The rural electrification ratio for households increased to over 50% in 1997 from 30% in 1993. However, there had not been much progress since the economic crisis in 1997 and the electrification ratio stayed at 54.8% in 2003. Although the MEMR, the organization in charge of rural electrification, aims to increase this ratio to 75.2% by 2013 and 90% by 2020, its achievement is regarded as extremely difficult under the current environment.

(1) Current situation of rural electrification

■ **Rural electrification policy**

Rural electrification policy is significantly influenced by the decision of the court on the unconstitutionality of the law (No. 20/2002). At present, the revision of the law is still under discussion and the policy direction is not yet clear. The law (No. 20/2002) assumed that the central and local governments should provide the fund for rural electrification, while the central government and PLN in fact took a substantial responsibility before the enforcement of this law. However, even with this law, the division of responsibility between the central government and the local governments and the source of the fund were not clear. Furthermore, PLN dissolved the department in charge of rural electrification and withdrew from this work with the move toward PLN's breakup and privatization. The court judged that the power sector should not be exposed to competition in the market because of the nature of this industry as a key industry and the central government should maintain the responsibility for the sector.

■ **Organization in charge of promoting rural electrification**

The division of roles and responsibilities among the organizations is not clear although many are involved in rural electrification. MEMR is the one responsible for supervising rural electrification policy and has the budget for this purpose.

The measures for rural electrification are mainly divided into (1) on grid (grid extension by PLN)

[7] Jakarta Newspaper, February 8, 2006

and (2) off grid in the area where grid is difficult to extend. The majority of the electrification is on grid, which is the responsibility of PLN. If grid is extended to the area with an off grid system, the generators (mainly diesel generators) are transferred to the unelectrified areas. MEMR supports both type of electrification by providing the grant to PLN for the construction of distribution facilities.

On the other hand, off grid electrification projects refer to projects to construct the decentralized generation system and electrify the area where PLN's grid is unlikely to be extended. Though many ministries are involved in off grid electrification projects, the institutional structure of the government for rural electrification is not clear. There is one type of the project in which PLN constructs and operates the system, while there is another type in which MEMR, MOC, or the local governments construct the system. In the latter, the responsibility for operation and maintenance tends to fall on community organizations or cooperatives. Furthermore, in addition to MOC and the local governments, BPPT promotes the electrification projects by using the decentralized solar power generating systems.

Table 2.6.3 Role of the Organization in charge of Electrification

	On grid		Off grid	
	Construction	O&M	Construction	O&M
MEMR	Construction of distribution systems (grant to PLN)	PLN	Construction of diesel and micro hydro power projects (grant)	PLN (Diesel), Cooperatives & community organization(micro hydro)
MOC	―	Cooperative (meter reading, fee collection), delegated by PLN	Construction of micro hydro power projects	Cooperatives
Local gov't	―	―	Construction of micro hydro and decentralized solar power projects	Cooperatives, community organizations
BPPT	―	―	Decentralized solar power projects	Cooperatives, community organizations

■ **Fund for rural electrification**

Rural electrification as social infrastructure requires public funding. Although MEMR is an organization responsible for rural electrification policy and has the budget for this purpose, the budget is not still sufficient for achieving the target of electrification ratio. Indeed, the share of the budget for rural electrification is less than 1% of the total development expenditure of the local governments.

Table 2.6.4 Rural Electrification Budget of MEMR

(Unit: billion rupiah)

Year	2003	2004	2005	2006
Budget	390	423	476	648

Source: MEMR

Table 2.6.5 Rural Electrification Projects of MEMR (2006)

Grid extension		SHS	Micro hydro		Wind power	
Length (km)	Budget (billion rupiah)	No.	Site	Generating capacity (kW)	Site	Generating capacity (kW)
3,155	241.6	22,160	59	6,573	7	560

Source: MEMR

Table 2.6.6 Micro Hydropower Projects of MOC (unit: billion rupiah)

	2004	2005
Budget	6	1
No. of projects	7	1

Source: MOC

Rapid grid extension is difficult because of PLN's financial difficulty. According to the ex post evaluation of JBIC's rural electrification project, the income statement of rural electrification of 2002 reports that the revenue is approximately Rp. 6.50 trillion and the expenditure is Rp. 6.58 trillion, which resulted in the loss of Rp. 83.2 billion (loss ration of -12.8%). The evaluation report analyzes the cause of this loss deriving from the low profitability of the business in outer islands. If looking at the benefit structure of the outer islands alone, the revenue is Rp. 2.29 trillion and the expenditure is Rp. 3.27 trillion, which results in Rp. 971.6 billion (-42.4%).

On the other hand, MOC gives technical and managerial guidance to those cooperatives that engage in operating and maintaining the electrification system. In addition, the Ministry has the budget for the construction of micro hydro power generating facilities, though it is extremely small compared with that of MEMR. However, the budget of the Ministry significantly decreased from Rp. 6 billion (7 projects) in 2004 to Rp. 1 billion (1 project).

Thus, rural electrification, regardless of on grid or off grid, has the limited budget, which makes it difficult to implement the projects. It is worth considering the option of establishing the social electrification fund by adding the surcharge to the tariff and promoting the electrification by using this fund in order to resolve this constraint. As mentioned earlier, the distribution to the rural electrification of the revenue from oil and gas should be also considered.

However, it should be checked how the fund scheme will be dealt with in the revised electrification law that is scheduled to be submitted to the Parliament in June 2006.[8] In addition, the revenue from oil and gas may be spent for other priority development projects such as road and irrigation, if the current limited ratio of the rural electrification component in the development budget is taken into consideration.

- **Rural electrification plans**

It was assumed under the electricity law that the local governments would be required to prepare the rural electrification plan (RUKD: Rencana Umum Ketenagalistrikan Daerah). Some governments already prepared the plan; others did not due to the court's decision on the unconstitutionality of the law.

In the case of West Nusa Tenggara province, the RUKD of 2002 was legalized after the approval of the provincial parliament. However, the RUKD of 2004 is not approved by the parliament due to the court's decision. Central Lombok regency has not prepared the RUKD yet, though it recognized the need to prepare the plan before the decision.

- **Case of West Nusa Tenggara province**

As stated earlier, the RUKD of 2004 is still at the draft stage, though that of 2002 was legislated. The team was formulated to prepare the RUKD by BAPPEDA, Department of Environment, Department of Energy, other relevant departments and Mataram University.

The RUKD of 2004 describes the issues of (1) current situation of power supply system, (2) policy on electrification, financing, renewable energy, environmental impact assessment, (3) demand forecast,

[8] The social electricity department of MEMR was unable to give a clear answer to the question on the possibility of establishing the fund due to the fluid situation of the revision of the law.

(4) generation and transmission development plan, (6) rural electrification plan, and (7) potential of primary energy.

○ **Supply and demand of electricity**

Electricity of the province is supplied mainly by PLN, partially by KLP Sinar Rinjani (electricity cooperative), which covers a part of West Lombok regency and by the privately-owned power generators. Examples of the private generators include a 185MW generator by the US company running gold mines and the 5MW of hotels, industry, and commerce.

Table 2.6.7 Power Supply of West Nusa Tenggara Province

Item	PLN				KLP	Total
	Lombok	Mataram	Sumbawa	Bima		
Installed capacity (MW)	116.65	—	29.47	26.16	10.214	182.494
Generating capacity (MW)	82.15	—	18.05	16.23	3.79	120.22
Peak load (MW)	70.82	70.82	15.26	15.93	—	102.01
Generators	34	—	39	24	—	97

Source: West Nusa Tenggara province RUKD (2004 draft)
Note: Peal load of KLP is approximately 4.3 MW according to the KLP staff.

The peak load of the province is 102MW, 89.6% of the generating capacity. If the estimated percentage of annual increase of demand is 6.8%, the peak load is likely to reach up to 93.6% of the generating capacity at the end of 2004, which makes the increase of generating capacity an urgent need. At present, one consortium of Indonesian and Malaysian companies are planning to construct two 25MW generators in West Lombok regency. One Indonesian company plans to construct two 5MW generators in Sunbawa and Bima.

On the other hand, the power demand in the PLN-covered area is mainly for households (93.31%) and is small for business (3.23%). The demand for industry is only 0.04%. As the majority of the demand is for households with low tariff structure, PLN is making a loss in this region.

Table 2.6.8 Electricity Demand of West Nusa Tenggara Province

Type	Percentage
Social	2.70%
Household	93.31%
Business	3.23%
Industry	0.04%
Government	0.72%
Multi purpose	—
Total	100.00%

Source: West Nusa Tenggara province RUKD (2004 draft)

○ **Electrification ratio**

The ratio of village electrification has already reached 95.2% in the province, while that of household electrification is still 45.0%. At the end of 2003, the PLN regional office has received 16,435 applications for grid connection. The province aims to achieve a 100% of village electrification ratio by 2014.

Table 2.6.9 Village Electrification Ratio of West Nusa Tenggara Province

Regency/city	Electrified	Non electrified	Total
West Lombok regency	98	2	100
Central Lombok regency	117	2	119
East Lombok regency	109	-	109
West Sumbawa regency	34	4	38

Regency/city	Electrified	Non electrified	Total
Sumbawa regency	134	18	152
Donpu regency	54	3	57
Bima regency	147	7	154
Bima city	12	1	13
Mataram city	23	-	23
Total	728 (95.2%)	37 (4.8%)	765 (100.0%)

Source: West Nusa Tenggara province RUKD (2004 draft)

Table 2.6.10 Household Electrification Ratio of West Nusa Tenggara Province

Regency/city	Households	Electrified	Percentage
West Lombok regency	177,172	72,461	41.0
Central Lombok regency	194,237	79,637	41.0
East Lombok regency	235,213	103,817	41.0
West Sumbawa regency	24,215	12,508	51.7
Sumbawa regency	98,899	56,900	57.5
Donpu regency	47,699	24,803	52.0
Bima regency	129,490	67,288	52.0
Bima city	8,047	6,091	75.7
Mataram city	84,789	34,763	41.0
Total	1,017,761	458,448	45.0

Source: West Nusa Tenggara province RUKD (2004 draft)

○ **Rural electrification plan**

The rural electrification plan of the RUKD states that the plan aims to promote economic activities and improve welfare of communities and identifies the issues such as reduction of fuel consumption, environmental conservation, and contribution of community organizations such as cooperatives.

The plan emphasizes the utilization of locally available energy sources such as micro hydro power, wind power, solar power, and biomass. Furthermore, the plan makes an effort to provide the budget for the electrification programs that utilize the local energy sources. However, the province implements SHS and micro hydropower projects with the funding of MEMR.

The plan targets the areas that meet the following conditions: (1) the area is near PLN's distribution network, (2) there is the potential of economic development, (3) electrification ratio is low, and (4) the energy source exists such as micro hydro and geothermal power.

(2) Issues in rural electrification

This section summarizes the issues to be taken into consideration in the analysis of technical assistance project, based on the current condition of rural electrification and regional development.

■ **Oversight capacity of the central government**

The facilities of the rural electrification projects funded by MEMR are normally transferred to community organizations or cooperatives. Therefore, MEMR does not monitor or evaluate the projects. Those cooperatives that engage in operation and maintenance do not submit the report of micro hydropower project to MOC due to decentralization policy. Combined with the low managerial capacity of the local government and community organizations, this factor is a serious constraint for achieving sustainable operation of the electrification projects.

However, counter measures started tackling such issues. For example, MOC imposed the condition that the cooperatives must save 40% of the revenue from the project to the bank account and can not withdraw money without a prior approval of MOC. In addition, MOC gives the guidance on the appropriate level of tariff (e.g., Rp. 50,000 per month), which is much higher than the average tariff of the visited sites (Rp. 10,000).

■ **Organization, human resource and financial capacity of the local government**

The level of organizational capacity and human resources of the local government regarding the electric utility is low. There is a case that PLN staff go on loan to the local government as the local government does not have know-how in this area. In the case of Central Lombok regency, there is no staff in charge of electric utility on a full-time basis at the department of energy and mining, which makes it difficult for the local government to take an initiative for rural electrification.

Even if the authority and responsibility are decentralized to the local government, it lacks the capacity to finance the projects and faces difficulties in securing the budget for electrification. As mentioned earlier, the local government has a relatively small development budget compared with the administrative budget.

For example, Central Lombok regency has the electrification budget of Rp. 120 million only, which is just enough to install 20-25 sets of solar home systems. Though the project of 100kW micro hydro power project is being planned, the regency government only provides land, while the provincial government designs the facility and the central government gives the budget and equipment. Therefore, the immediate transfer to the local government (regency and city) of the responsibility for the electrification projects seems difficult to achieve the smooth monitoring and management.

■ **Managerial capacity of community organizations**

Decentralized rural electrification schemes, especially solar power and micro hydropower generation, are often operated and managed by cooperatives or community organizations. Communities would ideally be equipped with the necessary capacity for operation and maintenance and the system should generate sufficient profit to achieve sustainable operation. However, the communities face a variety of difficulties in reality. This section analyzes the issues of management by the community organizations in terms of (1) a sense of responsibility for operation and maintenance, (2) operation and maintenance system, and (3) finance.

○ Sense of responsibility for operation and maintenance

The communities tend not to take seriously their responsibilities for operation and maintenance of the community-managed rural electrification projects. It would be ideal if they paid careful attention to the management of the project as a public asset.

For example, in the SHS project of Mareje village, solar home systems are granted to a village cooperative (KUD) and are further leased to those households who are selected based on predetermined criteria. Both the cooperative and beneficiary households signed the lease agreement clarifying the responsibility for operation and maintenance of the cooperative, the responsibility for monthly lease payment of the beneficiaries, and the future transfer of the ownership after the payment of a certain period. However, the beneficiaries ceased to pay the leasing fee after six months. This may be because (1) solar home systems were given to the neighboring village as a gift by a politician and (2) the beneficiaries assumed their leased system as a gift as well.

Box 2.6.1 Mareje village SHS project

Kedaro cooperative were provided solar home system sets with a grass root grant of the Embassy of Japan. Kedaro cooperative signed the agreement with users on the following conditions.

1) The cooperative guarantees the quality of the equipment (module for 10 years, controller for 5 years, and battery for 8 years)
2) Users pay Rp. 25,000 as the installation cost and Rp. 7,500 as monthly leasing fee for 190 months after the installation. The ownership of the system will be transferred to users after the full payment.
3) The cooperative monitors the functioning of the systems monthly.
4) The cooperatives removes the system once a user fails to pay the fee for three months.

As a result, the cooperative is unable to save the money necessary for maintenance such as replacement of batteries. Users are continuing to use old batteries or purchase the batteries with their own money. There are many cases that users have sold the systems to others or the systems are not functioning properly.

○ **Operation and maintenance system**

The operation and maintenance system of the community organizations is not enough in terms of technical capability, (2) type of technology utilized, and (3) the distance from the organization in charge to the project site.

Though community organizations normally attend the training for the basic operation, they need to depend on technicians or the governmental organizations in case of breakdown. However, due to the low financial capacity, community organizations are often unable to receive the repair service by technicians. The governmental organizations do not have sufficient budget for repair.

Spare parts are sometimes unavailable in the local market as they are too sophisticated. For example, in the case of solar power/micro hydropower hybrid system, the community was unable to find the spare parts for the system and, as a result, requested the government office for the supply. In this hybrid system, the revenue is too low to earn the necessary money for replacing many batteries, which is too high compared with the monthly revenue. This is an example that the expensive equipment makes it difficult to continue the operation.

○ **Finance**

The issue of operation and maintenance is deeply rooted in the low earning capacity of the organization in charge of operation. Batteries, the controller and the generator need to be replaced periodically for solar home systems and micro hydropower generation respectively. The money for such replacement should be generated by accumulating a part of the revenue.

However, the organizations in charge of operation tend to fail to recognize the need for saving and keep the connection fee and electrification tariff at low level. For example, the Sedau micro hydropower project started its operation in 1999. In the beginning, the organization did not charge any fee for the connection. It started to charge Rp. 500,000 in 2005 and Rp. 1 million in 2006 for this purpose, but the fee level is not sufficient to cover the connection cost. The electricity tariff was Rp. 7,500 in 2005 and Rp. 10,500 in 2006, both of which are lower than the expenditure for kerosene, dry batteries, and battery charging before the electrification.[9] As a result, the organization saved Rp. 2.4 million only as accumulated profit. Although the generator is not functioning properly, the organization can only submit a request for repair to the department of energy and mining of the local government.

The supervision on the organization in charge of operation by the local government is lacking as well. The organization in charge of the Sedau project is required to submit quarterly financial reports to the local government. Though the government office should check the financial condition and give proper guidance such as the increase of tariff, such supervision is not practiced yet.

■ **Cost effectiveness of rural electrification**

If the local government is to play the role of implementing rural electrification projects, it may have a negative impact on their development and efficiency. As decentralization is assumed to devolve power to local governments, it also decentralizes resources to them, which may harm the economy of

[9] According to Chapter 9 of the JICA-funded study on the utilization of renewable energy, the average monthly expenditure on alternative lighting such as kerosene lamps of the households in the unelectrified village is Rp. 20,670 (minimum Rp. 5,925, maximum Rp. 64,400).

scale. A system to alleviate this negative impact becomes necessary.

The following issues can be pointed out as the constraints on rural electrification.[10]

1. Local areas and rural villages in particular have low population density, which makes the centralized supply system difficult and costly.
2. Decentralized electrification system can provide only the limited power and the component such as solar panel becomes costly.
3. Low population density increases the cost for tariff collection, which results in higher electricity tariff.
4. The region, which depends on agriculture, forestry, and fisheries, has a large population of the poor and a stagnant economy, both of which lower the demand for electricity.

Thus, due to the low population density and low demand for electricity, the cost of electrification becomes extremely high in rural areas, which necessitates the provision of a grant to grid extension or the off grid electrification for the promotion of electrification.

In fact, JBIC's ex-post evaluation concludes that electrification in rural areas of outer islands is not profitable due to the low demand density and the fact that the majority of electricity is generated by diesel generators with the higher generating costs. Many users have the low voltage contract for household, which has a low electricity tariff structure. These issues should be carefully taken into consideration at the time of establishing the institutional and organizational structure for the development of rural electrification initiatives. In particular, regency and city governments lack the capacity to promote rural electrification.

2.6.3 Role of Energy Supply for Regional Development

While energy supply is essential as the base for industrial development, it plays another important role in facilitating livelihood improvement and poverty alleviation. As the urban/rural gap is serious in the electricity utility infrastructure and living standards, the linkage between energy supply and regional development is important as well.

For example, the World Bank states in its report that the supply of efficient and clean energy is a key for economic growth and can alleviate poverty through various linkages.[11] Use of modern energy and economic development/human development (health, education, life expectancy) is correlated and this linkage takes many forms.

No country has succeeded in alleviating poverty without increasing energy utilization. Unless a majority of the people benefit from the minimum energy service, the country cannot go beyond a subsistence economy. However, the introduction of cheap and easy-to-use energy alone does not necessarily lead to socio economic development. Energy is consumed in the process of producing assets and services and is a derived demand of other assets and services.[12]

The impact on regional and rural development of energy supply (electrification in particular) may be well recognized. This section briefly summarizes details of the impact and process.[13]

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[10] Lalith Gunaratne, "Rural Energy Services Best Practices", May 2002

[11] Energy and Mining Sector Board, World Bank, "The World Bank's Energy Program: Poverty Reduction, Sustainability and Selectivity", December 2001, p.1-2

[12] Energy Working Notes, p.5

[13] This description of this section depends mainly on Michel Matly Marge (2003), "Rural Electrification in Indonesia and Sri Lanka: From Social Analysis to Reform of the Power Sector", JBIC (2003)、"Ex post evaluation of rural electrification project (2)", Abul Barkat et al. (2002), "Economic and social Impact Evaluation Study of the Rural Electrification Program in Bangladesh".

(1) Improvement in welfare and economy of households
Households benefit from electrification in a variety of areas such as economy, education, and health.

■ **Impact of lighting and electric appliances**

Lighting is a priority use of electricity in the household. According to the result of JBIC's ex-post evaluation, 99.5% of the questionnaire respondents started to use lighting equipment after electrification. Improved lighting is beneficial to studies of children and leads to the increase of income by extending working hours of the cottage industry. Bulbs are relatively inexpensive and easier to enjoy their benefit compared with other expensive electric appliances.

Beneficiaries tend to purchase expensive electric appliances compared with their income level. The impact study of the electrification in Indonesia and Sri Lanka, which was done by the World Bank, concludes that electrification quickly leads to the investment in electric appliances and a substantial amount of money continues to flow into such investment.

Indeed, JBIC's study reveals that 48.5% of the questionnaire respondents purchased electric fans, 17.5% purchased refrigerators, and 17.0% purchased electric water pumps. Except the radios that use dry batteries or rechargeable batteries, 65% of the respondents increased the number of electric appliances. It should be however noted that few households use large-size electric appliances such as refrigerators in the case of micro hydropower and solar power generation that are characterized by the limited generating capacity and operating hours.

Thus, electrification could have positive impacts on the reduced burden of house work and increased time of economic activities by utilizing electric appliances.

■ **Improved environment for education**

Educational level such as literacy rate or enrollment rate in the electrified area and household shows better results compared with unelectrified areas and households. Improvement in education by electrification can be realized through the increased study hours under electric lights, better access to information via television and radio, and education by parents after sunset. Increased expenditure on education by increased income and better recognition on the value attached to education of parents by the influence of television can be also realized in an indirect manner.

According to JBIC's ex post evaluation study, 78.5% and 77.0% of the questionnaire respondents purchased radios and television sets respectively. Approximately the three-quarters of the beneficiaries could have better access to information via these media.

This change could lead to the increased expenditure on education, better academic record, reduced drop out rate, and increased school attendance.

■ **Improved health and sanitary conditions**

Electrification can contribute to the improvement in health knowledge through information dissemination by television. Though this is the result of the impact study of electrification in Bangladesh, it was found that the electrified landless and poor people have better knowledge on public health than the unelectrified wealthy farmers with a large plot of farming land.

Such improved knowledge could induce proper consultation behavior to see those who have medical knowledge and skills in case of sickness. The percentage of childbearing attended by trained personnel becomes higher, which also leads to the increase in the ratio of prenatal care and post delivery examination. In this manner, better knowledge by electrification could be an inducement to proper health behavior. This desirable linkage between health and electrification can be achieved in vaccination of infants and family planning as well. Needless to say, such improved knowledge and proper behavior can reduce morbidity and mortality in the future.

The same process can occur in public hygiene. Campaigning for hand washing with soaps and the use of proper toilets via radio and television can disseminate information in an efficient manner and facilitate a behavioral change of people.

■ Stimulation of economic activities

Economic impact of electrification at the household level can be realized in the various forms and processes. Energy consumption is strongly correlated with the national income.[14] Economic growth that creates employment and increased income depends on more and efficient utilization of energy.

The poor in developing countries depend on human and animal power and are forced to spend more money on low quality energy, which shares a relatively large percentage in the income than the rich or those in the developed countries are paying to high quality energy. The poor people need energy for cooking, lighting, heating, refrigeration, communication, and information service. They also need the energy to operate the equipment to increase productivity and income.

A positive impact on industry can be achieved by shortened production lead time, improved product quality, and reduced costs. For example, a furniture manufacturer can shorten production period and reduce production cost by using the electric saw. This can increase profit and expand business. However, unstable power supply and frequent blackouts may have a negative impact on business.

On the other hand, it should be noted that electrification does not necessarily stimulate economic activities automatically. Mere supply of cheap electricity does not guarantee the economic development, which is also influenced by other factors. For example, though the local agro industry requires electricity for power, refrigeration, lighting, processing, the benefit may become smaller than expected if it fails in market pricing and marketing strategy.[15] According to the evaluation report of a renewable energy project, one of the conclusions is that the potential of generating income should be evaluated in advance in terms of agriculture, livestock, handicraft, labor force, and scale of market.[16]

The impact evaluation study of grid electrification in Bangladesh confirms the positive impact on economic activities. There is an opinion that it would be time consuming and difficult to develop production activities in line with electrification. [17] In the case of micro hydropower and photovoltaic generation projects in Indonesia, the development of the cottage industry in the sites was not realized due to the limited generating capacity and operating hours, except for kiosks extending their business hours. In fact, there was one site that prohibits beneficiaries from using electricity for a production purpose.

However, the business of telecommunication service combining the mobile phone and the solar home system was observed in one site in Lombok. This service seems sustainable and profitable because it can make an enough profit to replace batteries and equipment and maintain the system by meeting the need of the residents in the area where no fixed-line phones or cellular phones are in service.

■ Improvement in livelihood through various steps

Increased income, capital accumulation, and asset formation can be achieved by electrification

[14] World Bank, p.9
[15] Energy and Mining Sector Board, World Bank, “ENERGY Working Notes”, No.4, May 2005
[16] The E7 Network of Expertise for the Global Environment, “Project E7-1: INDONESIA Renewable Energy Supply Systems Final Report –Lessons Learned-“, March 2001
[17] Michel Matly Marge, Rural Electrification in Indonesia and Sri Lanka: From Social Analysis to Reform of the Power Sector", World Bank, 2003

through various processes as follows.

Table 2.6.11 Process of Improvement in Livelihood

Item	Content
Employment / income	■ Electrification creates employment directly and indirectly. Irrigation agriculture and development of cottage industry creates employment directly. Extended working hours at night can increase production volume. Agro industry may be developed in rural areas. ■ Agro industries such as rice milling in the electrified village can absorb the demand of the unelectrified neighboring villages. ■ Cooperatives in charge of operation and maintenance on the generating facility can hire the management and maintenance staff.
Expenditure	■ Electrification increases cost-saving effect. It reduces the expenditure on kerosene, dry batteries and car batteries. The impact evaluation study of Indonesia reveals that 70% of the cost was curtailed after electrification.[18] ■ Dietary habit of the electrified households in rural areas tends to resemble urban areas in terms of diet and protein intake, compared with the unelectrified in rural areas. The former spend more money on education and health.
Saving & loan	■ Saving of the electrified households increases more quickly by increased disposable income after the creation of jobs and the increase of income. ■ As saving and asset increase, borrowing capacity increases as well. Borrowing capacity increases if saving or fixed asset is used as collateral. This increase leads to the reduction in high interest loan from moneylenders, which in turn increases the surplus money of borrowers and improve livelihood due to low interest payment.
Asset	■ The above process through increased disposable income can increase the asset. ■ If the asset is accumulated for productive purpose, it further increases the income. Assets such as house or electric appliance could improve the quality of life and increase leisure time. Indeed the evaluation study concludes that the electrified households accumulate the asset more progressively compared with the unelectrified houholds. －Farming land, livestock －Construction and expansion of houses: Investment in own houses including kitchen garden and room innovation can realize the quality of life. －Electric appliances: The number of electric appliances significantly increases once electrified as they are relatively inexpensive. The gap in the electric appliances between the electrified and unelectrified households is remarkable.

Source: Abul Barkat et al. (2002), "Economic and social Impact Evaluation Study of the Rural Electrification Program in Bangladesh"

(2) Improvement in public services

The poor households may have restricted use of electricity if the connection fee and the electricity tariff are high. However, the public services improved by the electricity can benefit the wide sector of the population including the poor. Health, education, and religious facilities are major public facilities that can be improved by electrification.

■ **Health services**

Health facilities can utilize lighting, wireless telecommunication, refrigerators for medicine and vaccines, water pump by electrification. The local governments assist the health facilities at village level in the construction of buildings, personnel cost, and supply of medicine only. The facilities may have difficulties in procuring the electric appliances as they tend to depend on the assistance of the village and medical fee for the operation and maintenance cost. To improve the service, it has to secure the fund for the procurement of equipment.

■ **Educational services**

Schools can use lighting, television, computers, and language learning equipment by electrification. High schools and vocational schools may use electricity for student dormitories and machine tools, depending on the generating capacity. However, majority of the government budget is allocated to the salary of teachers. As the subsidy for school infrastructure is limited, schools often collect donation

[18] Michel Matly Marge, p. 25

from parents to support the management and extracurricular activities, though such donation is not sufficient yet for infrastructure development. In the case of West Nusa Tenggara province, televisions were procured to each school with the budget of the central and provincial government to promote the utilization of the educational television programs. If the housing conditions of teachers are improved by electrification, it would become an incentive to work in the rural areas.

■ **Religious facilities**

Religious facilities are regarded as public facilities that utilize electricity. One advantage of electrifying religious facilities is its easiness to collect the fund. Indeed, there are cases that fund raising is regularly done or the wealthy people donate money.

Almost all of the visited electrification sites have electrified the religious facilities, which are using a lighting and speaker system. In the case of Sedau micro hydro power project in Lombok, Rp. 500 is added on the monthly tariff as a donation to mosques.

2.7 Review of Indonesian Energy Sector Cooperation Project Experience

A considerable amount of study and research on Indonesia has been conducted by various donor institutions. A brief description of projects conducted by each institution is outlined below.

(1) Japan International Cooperation Agency (JICA)

JICA has conducted several projects concerning infrastructure development in the energy sector since 1970's Master Plan Study to assist in the formulation of the electricity development plan, hydro, thermal, geothermal power plant development, distribution and transmission system development and related feasibility studies have been implemented by JICA. Recently, achieving the effective operation of existing facilities to cope with the expected electricity crisis is a key objective, for example, Study on Reliability of Power Facilities in Java-Bali Region（October,2005-December,2006） From now on, assistance for human resource development in rural areas is identified as important, along with ongoing infrastructure development.

(2) Japan Bank for International Cooperation (JBIC)

JBIC's financial assistance to the Indonesian electricity and gas sector reached a total 790 billion yen in March 2004. More than 100 projects have been proposed for energy sector, including tied and un-tied projects. Eleven projects were conducted concerning distribution and transmission system in the 1970s and 1980s. Transmission projects regarding the Java Bali system were carried out in 1990s. The assistance towards construction of emergency power plants to deal with a forecasted electricity crisis has become a priority since 2000.

(3) New Energy and Industrial Technology Development Organization (NEDO)

NEDO proposed a wide range of projects on energy sector, for example, analysis in renewable energy. In particular, a significant amount of assistance has been carried out on the cooperative search for coal and the development of coal utilization technology. Fundamental research on CDM are also conducted.

(4) The World Bank

The World Bank has conducted 143 projects in Indonesia, primarily on education, rural development and poverty reduction. There are several notable projects in the energy sector, such as fund-rising for the Southbound 500kv transmission line (East part) and Java-Bali Power Sector Restructuring and Strengthening Project（approved in 2003). The projects on the power generation, transmission and gas sectors were carried out in response to undersupply issues in Java Bali from 1990-1995.

(5) Global Environment Facility (GEF)

GEF has carried out projects on renewable energy utilization in the climate change operation

program in the Small Grants Programme. These were mostly small-scale and short-term projects which were conducted as direct and flexible approaches towards rural institutions.

(6) Asian Development Bank (ADB)

ADB has consistently assisted the deregulation of the electricity market in Southeast Asian nations, such as the Philippines and Indonesia. To deal with transmission line congestion and to establish deregulated electricity markets, ADB funding reached US$140million in 2002. Previously, ADB committed funds of US$337million in collaboration with OECF to projects on the enforcement of transmission line.

ADB also conducted feasibility studies concerning renewable energy on PREGA（Promotion of Renewable Energy, Energy Efficiency and Greenhouse Gas Abatement), funded by Holland. At the same time, small-scale hydropower projects are proposed in Mongango (2 x 600 kW), Lobong (2 x 800 kW) and Merasap (2 x 750 kW), for the Renewable Energy Sector Development.

Chapter 3　Assessment and Strategy for Solution of Issues

3.1 Strategy for Addressing Current Issues

In Chapter 3, we discuss and devise a technical cooperation strategy to address the current issues in the energy sector. This will be performed through analysis of current issues, including findings of the field survey, and consideration of possible future issues, including development of a solution for cooperation that accounts for issues specific to the energy requirements of the different socioeconomic areas in Indonesia. These areas are categorized into firstly, the economic infrastructure area and secondly, the rural and community area. Strategies and solutions for addressing the issues in the cooperation program are examined through the following approaches.

■ **Program approach for the economic infrastructure area (primary energy (fossil fuel, renewable energy) electric power, energy demand, etc.)**
As relationships and partnerships already exist between members of the economic infrastructure sector, it is essential that this is given due consideration in terms of the schedule, collaboration and scale of the support project (support program resources).

■ **Collaborative approach for social infrastructure (Regional development / community development including rural electrification)**
Since it is estimated that issues in the project area are not limited to the energy sector but include other sectors, a comprehensive approach covering all sectors on condition of governmental support etc. is taken (support for regionalization).

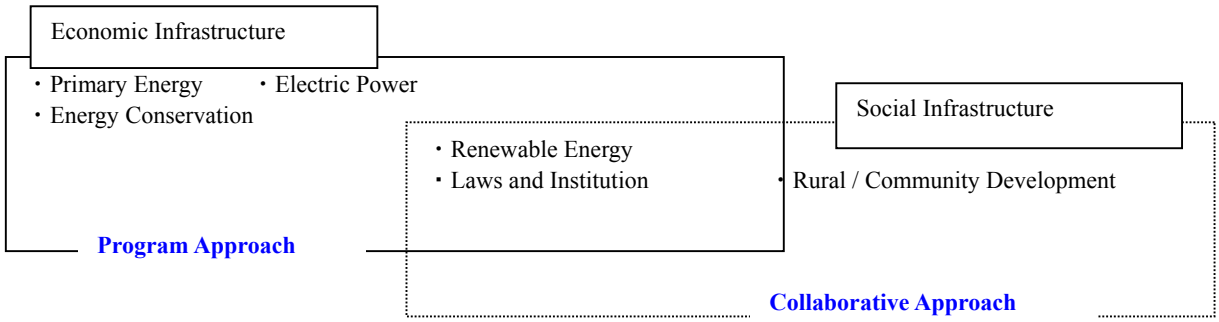


Figure 3.1.1　Technical Cooperation Approach for Energy Sector

3.2 Assessment and Strategy for solution of issues in economic infrastructure sector

3.2.1 Ideal Economic Infrastructure Sector

(1) Review of current situation and issues

As explained in the previous chapter, the current situation and issues are mutually related. Figure 3.2.1 shows the relationship between current energy issues and government policy on the natural gas sector, a sector with important correlations with other sectors.

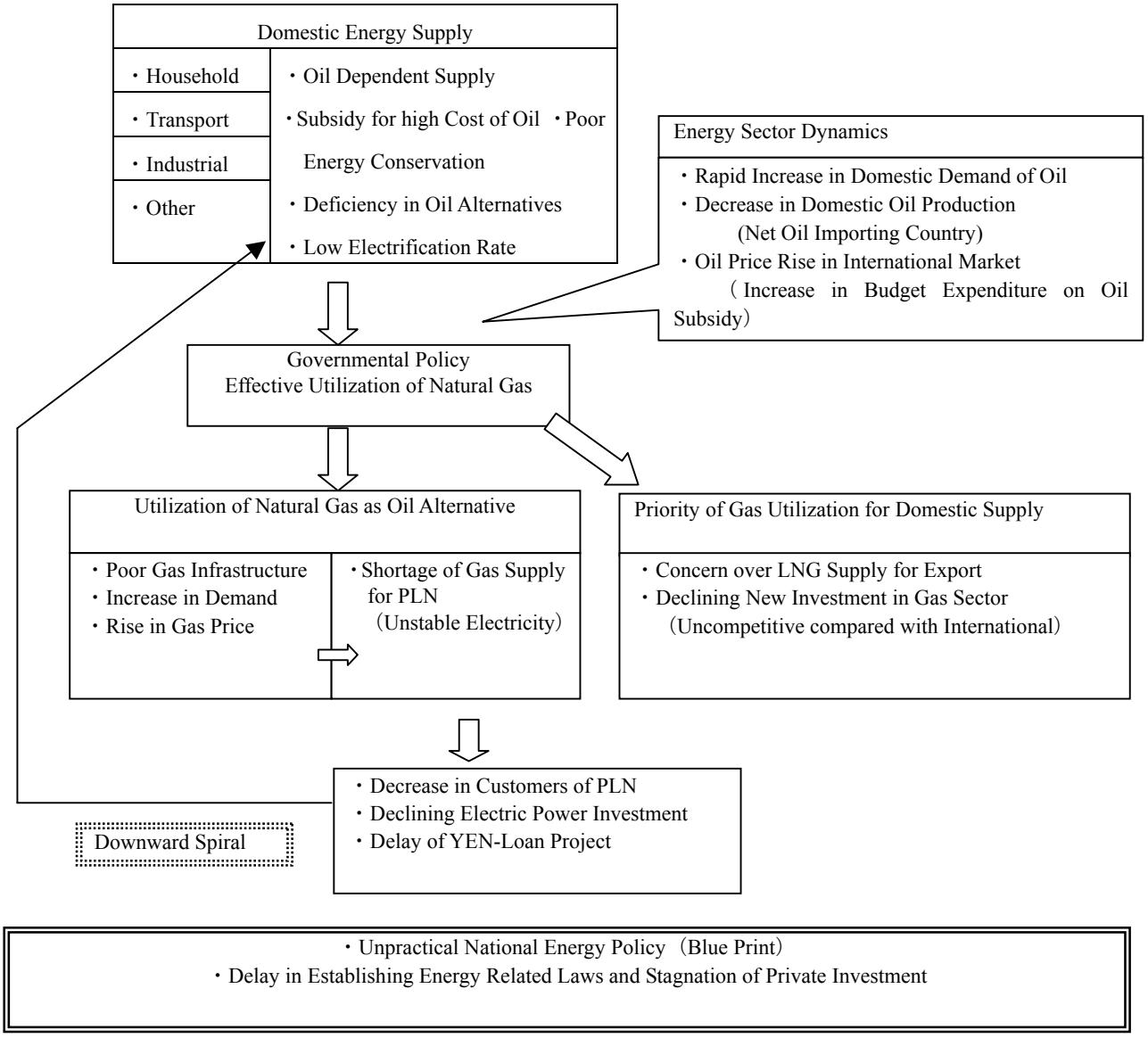


Figure 3.2.1 Review of Current Energy Sector Conditions and Issues (Natural Gas Supply Viewpoint)

(2) Ideal Energy Sector Structure

The essential issue of the energy sector in Indonesia is how to reverse the downward spiral outlined in Figure 3.2.1 above and transform it into an upward spiral, as shown in Figure 3.2.2. In order to achieve this, short-term target and medium-long-term targets are outlined as follows:

- Short-Term Target: Rapid establishment of stabile energy supply based on effective utilization of natural gas as oil alternative
- Medium and Long-Term Target:
  - ①Minimize domestic utilization and maximize export of natural gas due to increase earnings of foreign currency
  - ②Utilization of coal and renewable energy as natural gas alternatives and improve of rate of electrification.

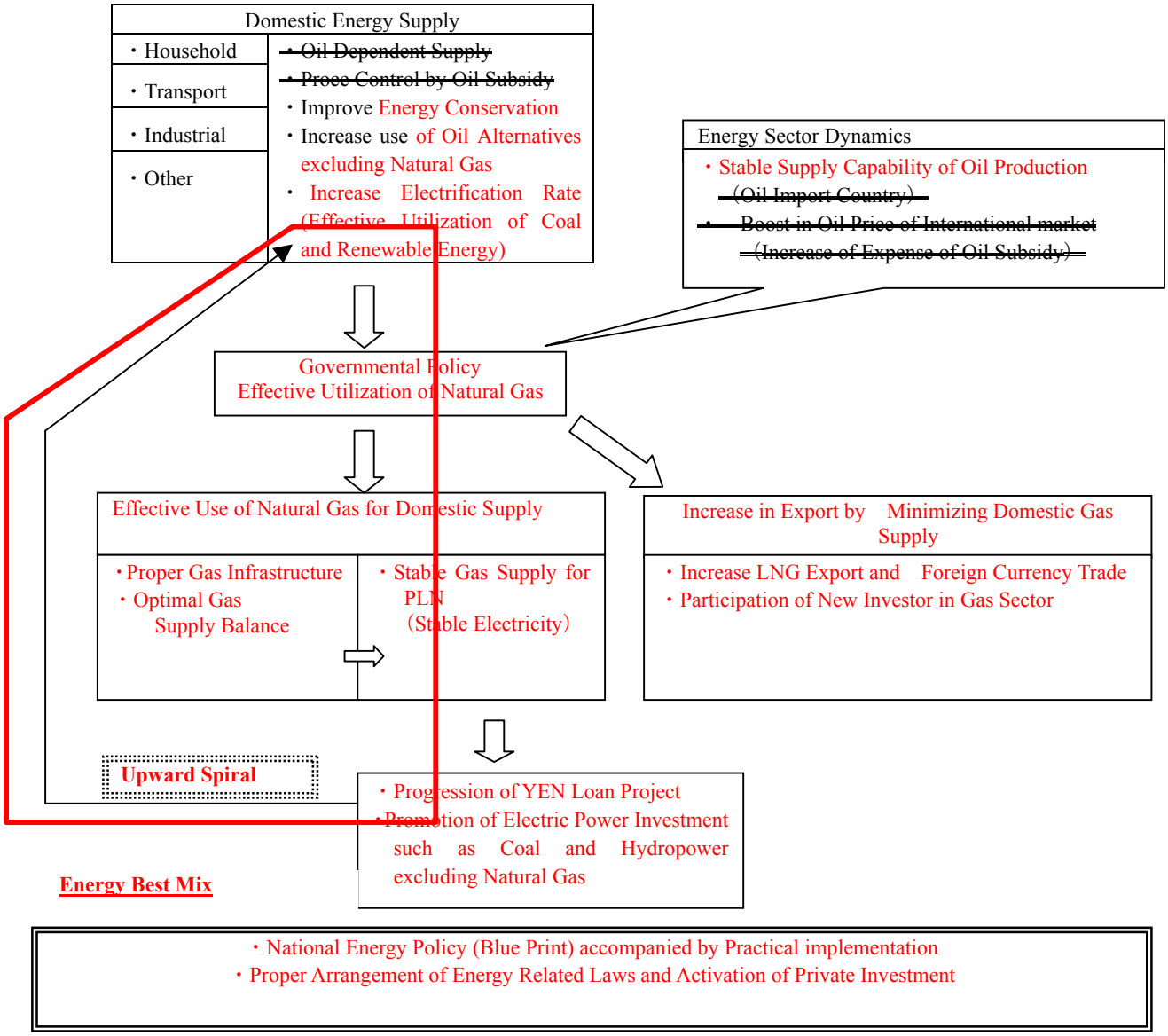


Figure 3.2.2 Ideal Energy Sector Structure

3.2.2. Methodologies on Issues and Solution of Economic Infrastructure

(1) Methodologies on issues and solution of primary energy balance
(Please refer to 2.1.5 Significant Issues Related to Primary Energy Supply and Demand Balance)

■ **Issues on oil and petroleum products**

Regarding new oil fields, the development is expected in Eastern oil fields and Offshore. In particular, exploration and exploitation by foreign companies are anticipated, because huge amounts of capital funds are required for the development of Eastern oil fields and Offshore.

New oil and gas regulations that unconstitutional judgment are sentenced to the parts of them need to be urgently enacted for the purpose of promoting investment activities, and it is important that an oil and gas development system including a preferential tax system, improvement of the investment environment and application of PSC should be implemented as soon as possible.

When considering Indonesian energy importation, most of the importations consist of petroleum products, so it can be said that oil refinery plant capacity is insufficient in present-day Indonesia. For this reason, there is a requirement for new oil refinery plants in consideration of the energy balance, including oil exporting countries from which Indonesia imports petroleum products.

By increasing international petroleum product prices, as the government budget has deficit by the expenditure of oil subsidy, the government makes an efforts to decrease the oil subsidy. By the policy, recent domestic oil prices increase in Indonesia markets. The policy results in an economically difficult environment for low-income persons. Therefore, it is reasonable that the government makes the supporting schemes for such low income persons. And it is considered that the government should be clear the time schedules for avoiding the oil subsidy system. .

■ **Issues on natural gas**

Effectiveness of natural gas utilization is expected as oil substitution energy. However, as pipelines are not prepared so much as the demand, the construction of the gas pipelines are required urgently. South Sumatra pipeline (SSWJ: Phase 1 = Japan loan/ Phase 2 =PGN funds) are under construction, however the estimated natural gas reaches in high prices effected by international market price.

Gas transmission and distribution including SSWJ are managed like monopoly by PGN. As the 40 %stocks of PGN are privatized on stock market, PGN is managed in view point of high return mind. As the results, PGN has strong market control power. In future some regulations such as profitability constraints to gas pipeline business of PGN will be required. The system design for gas business might be required by the year of 2008 when gas market will be opened.

Meanwhile, LNG export is important method for retaining foreign income. The policy that natural gas should be supplied to domestic market preferentially is issued in order to occur natural gas shortage for domestic consumers. Concretely the government has an intention to negotiate new LNG contracts with considering the domestic market demand against the existing contractors that are expired from 2010 to 2015. It is important that LNG supply and demand optimize under the conditions that government minimizes domestic supply of natural gas and maximizes export of it. For example, the natural gas in Java and around islands should be developed for domestic market, and natural gas fields in remote islands should be developed for export. And also it is valuable that Japan supports infrastructure that Indonesia develops small size gas fields, because Japan is the biggest LNG importer from Indonesia.

In upsteam of natural gas industry, rehabilitation of production equipment as well as crude oil are expected.

■ **Issues on coal**

High quality coal has been used as export, electric power generation fuel and industry use. Hereafter, it should be main theme that low quality coal is used effectively in future. In the upstream of coal industry, as environmental issue that powdered coal accumulates in the bottom of the Mahakam river is happened, it is valuable to transfer the technologies such as suitable coal mining technologies and establishing the regulations and to make efforts to protect the environment.

In down stream of coal industry, it is necessary to transfer Clean Coal Technologies (CCT) such as CFBC and desulfurization technologies for protecting the environment, and the technical transfer should be implemented with the limitation that the technical transfer should be applied to only power generation sector such as PLN and IPP rather than auto generation sector. And also some incentives and vital policies for constructing mine mouth power generation should be considered.

CWM(Coal Water Mixture) and coal liquefaction technologies are discussed for enhancing coal utilization. Regarding bio coal contained limestone, it is expected to improve combustion characteristics and direct desulfurization effects. However, as the cost of bio coal is higher than direct coal combustion, there is concerns about not to come into wide use. In future, by improving sea transportation regulation and enacting new regulations in Japan, if RPS is applied to bio coal, the spread of bio coal utilization is expected in Japan.

■ **Comprehensive energy plan**

National Energy policy (Blue print) is designed in New and Renewable Energy & Conservation in MEMR. As the policy is not discussed enough among other governmental organizations, it does not have the reality to be implemented. Otherwise, The oil and gas policy in Indonesia is been in change of Directorate General of Oil & Gas (MIGAS) in MEMR. As imbalance of oil and gas export and domestic demand is happened in recent Indonesia, MEMR-MIGAS requires comprehensive econometric energy balance model for making good energy balance between energy export and domestic demand including activities of industry, residential, transportation and power sectors. And it is required that MEMR makes total energy policy in Indonesia. For supporting it, it is required to transfer suitable technologies and capacity development for the staffs.

(2) Methodologies on issues and solution of renewable energy utilization

(Please also refer to 2.2.3 Issues Related to Renewable Energy)

Indonesia possesses considerably large geothermal energy resources and the government aims to supply five percent of the national energy demand through geothermal energy. Japan has a high level of experience and technology in the field of geothermal energy utilization and technological assistance to enable formulation of the Master Plan.

Concerning other renewable energy sources, the mandatory purchase requirements for renewable energy in relation to CDM was increased in January so that PLN now has a responsibility to purchase medium-scale renewable energy, that is less than 10 MW. Therefore, the structural plan for the energy sector, including application of CDM scheme, is also required. The plan should include the promotion of the IPP business sector involving small-scale hydropower energy or biomass. In addition, nuclear power should be carefully discussed with the aim of forming a long-term strategy. All renewable energy is expected to be supplied in the form of electric power.

At the same time, the Indonesian government seems interested in developing the utilization of jetropa as a bio-fuel. Efforts should be made to support the promotion of the bio-fuel, for example, to make it compulsory for official vehicles to use the bio-fuel.

(3) Stable Power Supply and Energy Best Mix

(Please also refer to 2.3.6 Issues in Electric Sector)

It all comes down to the fact that the urgent issue in the power sector is securing natural gas for fuel.

Government intervention regarding fuel negotiation between unregulated gas suppliers and regulated PLN in electricity tariff may be necessary, even though it involves a private contract. In addition, as defined in the literature related to the Yen loan agreement, the fuel procurement contract is the fundamental requirement for implementing the gas combined cycle genaration projects in west Java, such as Muara Karang repowering, Muara Tawar expansion, Tanjung Priok repowering and so on. Unless the fuel procurement problem is resolved, construction of these projects will not be proceed. Meanwhile, SSWJ (Phase 1) financed by JBIC as a Yen loan project is considered only to supply gas for the public/industrial/residential sectors. However, it seems worthful for Indonesian gorverment to examine the open use of SSWJ (Phase 1), as it would allow PLN to procure natural gas a little bit cheaper, considering the issues mentioned above.

As for existing power plants, there are several problems regarding output and heat efficiency due to inadequate maintenance and operation. Therefore, technology transfer is required in this area. The conclusion and recommendations of the ongoing “The study of improved operation and maintenance plan for power plants in Java Bali system” will be a good reference for solving these problems.

Regarding the new power plants, IPPs may tender for a coal power unit with the condition of ① no government guarantee, ② land acquisition by bidder, ③ burden of transmission line expenses. However, these conditions are very severe for IPP investors. Reconsideration of government guarantee application is one way to overcome the obstacle, and establishment of guidelines for PPP (Public-Private-Partnership) project should be studied as another option in order to develop related infrastructure. The situation regarding Yen loan projects were mentioned earlier.

As for the transmission system, reinforcement of facilities is urgently required. In addition, capacity development of transmission planning for PLN staff members is necessary to improve their capability in power flow and stability analysis. For the distribution system, technology transfer relevant to the distribution planning is necessary for the consolidation of three technical standards, considering the demand increase.

From a long-term viewpoint, there is an important step to be realized with regard to electricity and switching energy supply from oil and natural gas sources to coal and renewable resources. By supplying electricity in a stably manner and at a reasonable price, the increase of electricity share out of the total amount of energy consumed can be achieved. Through the above, a synergistic effect is expected for the effective use of renewable energy.

As for development of large scale reservoir type hydropower projects, solving residential and environmental problems through the dialogue with the relevant individuals is essential. As for use of nuclear power, firstly, national and international consensus on development of nuclear power plants is needed, followed by the step-by-step studies on related laws and technology transfer. These projects should be studied in terms of replacing the energy sources of oil and gas as a part of national energy policy.

The future picture of power sector should be outlined in RUKN prepared by MEMR, however, the previous RUKN was prepared by modifying RUPTL prepared by the PLN. Therefore capacity development in power development plan for MEMR is necessary in order to provide capability for establishing power sector policy independently based on the national energy policy. In addition, new frame work covering all energy related sectors would should be studied considering the be national energy flow in order to encourage investors. For example, providing an option of natural gas equivalent in alternative energy may be attractive to IPP investors in large-scale coal fired power plants, because these plants would contribute the reduction of natural gas for domestic use.

Finally, early enactment of new electricity law is desirable for encouraging investment in the electric power sector.

(4) Encouraging energy conservation

(Please also refer to 2.4.3 Issues Related to Promoting Energy Conservation)

The Indonesian government has maintained low prices of domestic energy with subsidies for a long time. As a result, there is lacking in energy conservation technology, expertise, and personnel. However, large demand for energy conservation measures are foreseen for plants and office buildings because of continuing oil price hikes in the future. For this reason, the Indonesian government needs a large degree of technical assistance from Japan, including the institutional arrangement of energy conservation agencies and promotion circumstances. To this end, it is necessary to establish a core center that will urge cross-sectional and cross-industrial cooperation in order to promote energy conservation. Moreover, the government will need to implement an ESCO project and a CDM project to promote energy conservation.

Furthermore, the government is urged to adopt a policy for restructuring energy supply and demand structure in the consumer and transport sectors from a long-term viewpoint. Although clearly distinct from promoting the energy conservation technologies mentioned above, the optimization of transporting means (for example, introduction of monorails and subways) and energy conservation that requires the construction of infrastructure (for example, construction of gas-supply infrastructure and the introduction of natural gas co-generation systems in commercial buildings and plants in cities) are essential issues. These infrastructures will also require technical assistance for urbanization plans that presume the implementation of energy conservation measures.

(5) Issues in Energy Policy and others

Measures to promote investments and to review liberalization frameworks for the whole energy sector

In the current situation, where rulings of unconstitutionality were made on the New Electricity Law and to a part of the New Oil and Natural Gas Law, the legal system regulating the energy sector needs to be developed. Although a tentative energy sector law was enacted, there is a lot of uncertainty regarding the parts related to investor involvement. As a first step, an immediate solution for attracting private investment needs to be formulated. Although PLN has obligations on the INPUT side, such as buying gas at the market price, IPP, and buying renewable energy, there are restrictions on the OUTPUT side, such as revenue from tariffs. Therefore, the contradictions caused by the liberalization of the energy sector are consolidated in the financial structure of PLN.

Therefore, it is first necessary to review the liberalization framework of the whole energy sector. If the contradictions in the liberalization framework and design of the energy sector are not removed, the financial structure of PLN will not improve. From this point of view, it is worth considering the establishment of a financial simulation model which takes liberalization into account, so that the whole energy sector may run smoothly. It may allow for political consideration of the optimization of oil, gas, coal, renewable energy, and electricity prices. In addition, setting the benchmark for the management of PGN and measures to promote new entry in the gas transmission and distribution sector should be considered so as to prevent PGN from exercising dominant market power.

Investment promotion-related legal systems will become important, as well as the New Investment Law which is being discussed in the Diet at this moment. In particular, when private investment is utilized for exploration and development in oil and natural gas upstream activities, a broad range of discussions will be required, which include preferential treatment on contracts for the production sharing system, the pricing mechanism (cost recovery + return) in case domestic supply is imposed, and the role of government guarantee and preferential tax treatment.

3.3 Issues on Social Infrastructure and Measures for Solution

3.3.1 Direction of Analysis for the Issues on Social Infrastructure

(1) Summary of the current situation and issues

The current situation and issues on regional development and rural electrification systems were analyzed in 2.6.1 and 2.6.2. Each system is vulnerable and not functioning as expected. Furthermore, neither system is well coordinated though it is possible to coordinate them and produce synergy impacts. The limited generating capacity of the electrification projects tends to contribute to regional development on a limited scale. The current situation and issues are summarized in Figure 3.3.1.

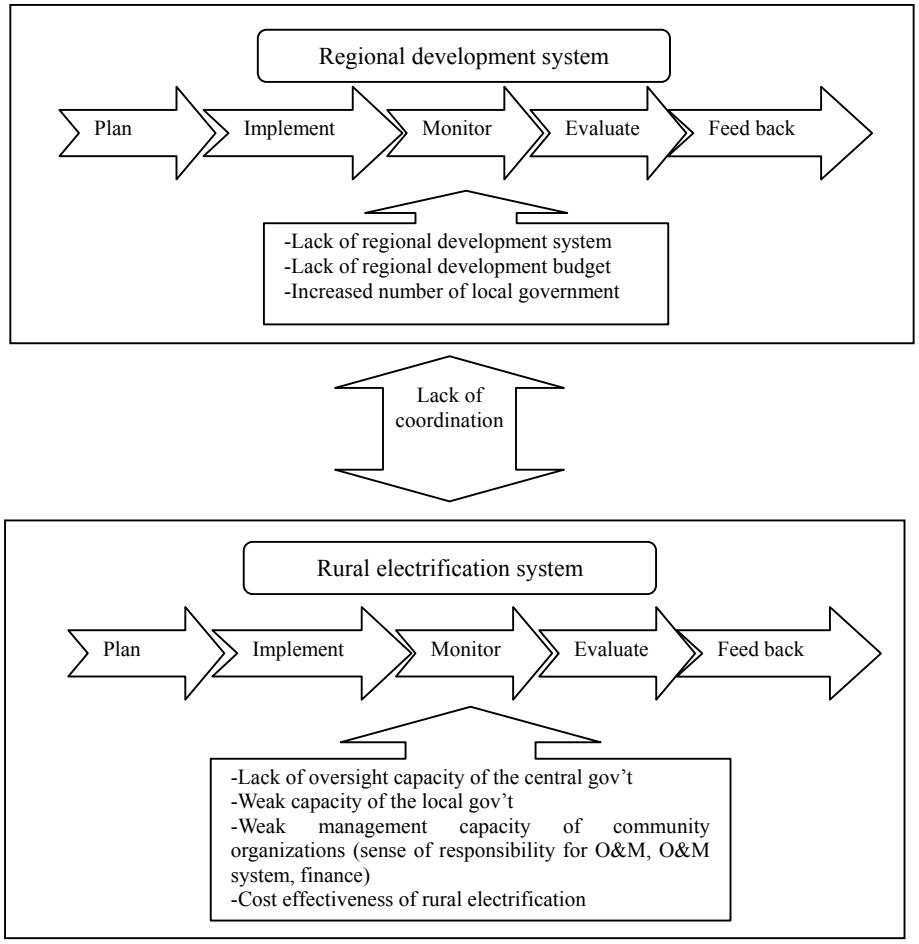


Figure 3.3.1 Current Situation and Issues on Regional Development and Rural Electrification in Indonesia

(2) Direction of analysis

In order to promote rural electrification and effectively contribute to regional development, both systems should be structured, function, and coordinate with each other.

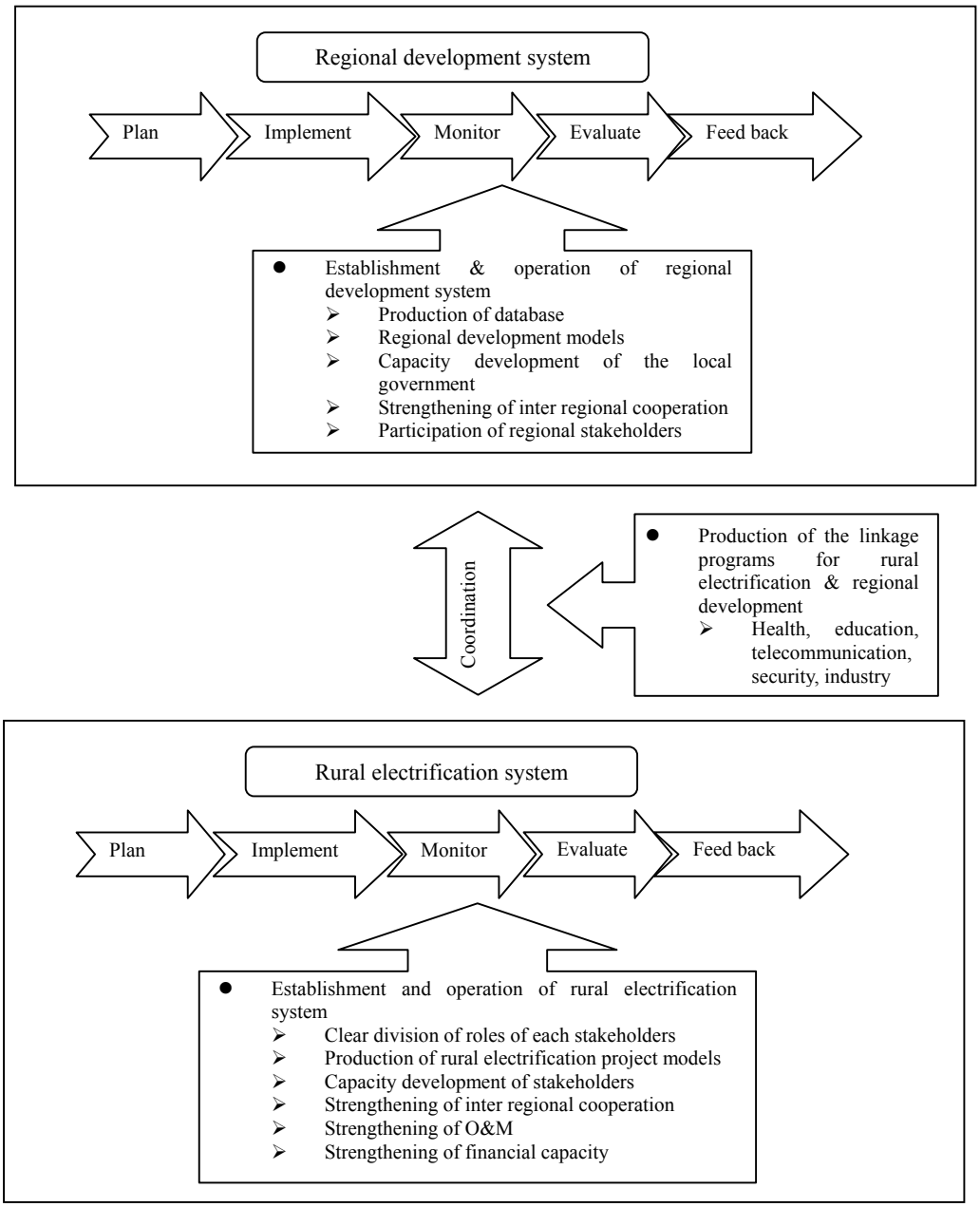


Figure 3.3.2 Direction of Solution for the Issues on Rural Electrification and Regional Development in Indonesia

3.3.2 Measures to Solve the Issues on Social Infrastructure

(1) Establishment and operation of the regional development system

The need for structuring the system, the difficulty in securing the budget and the vulnerability due to the increased number of the local governments are referred to as the issues related to regional development to be resolved in 2.6.1 (2). The initiative to establish the regional development system has just started. BAPPENAS, which is playing a major role for this purpose, is planning the measures and activities such as the establishment of the information system and database, the production of regional development models, the establishment of regional development forums, though the staff in charge admits the need for donors' assistance. As the first step, the comprehensive regional development system should be established to cover a series of processes of planning, implementation, monitoring, evaluation, and feedback. It should also be disseminated to each of the local governments

with the assistance of capacity building.

In fact, JICA has been supporting the projects regarding regional development, such as the projects on Sulawesi rural community development, human resource development for local governance, and regional development policies for local governments in the past.. However, as the assistance of JICA has so far not covered the whole process from planning to feedback, a possibility of the assistance to this area is worth considering.[19]

(2) Establishment and operation of the rural electrification system

Oversight capacity and authority of the central government ministries, the human resource and financial capacity of the local governments, project management capacity of community organizations, and the cost effectiveness of the rural electrification projects were analyzed as the crucial issues in 2.6.2 (2). Though it depends on the revised content of the electricity law, it is essential to address the issues such as the clearer division of roles among the central and local governments and community organizations, the establishment of the whole process including planning, implementation, monitoring, and evaluation, capacity development of each stakeholder, and the securing of the budget.

The ministries of the central government should establish the efficient and consistent system to implement the rural electrification projects, structure and disseminate the sustainable operation and maintenance system, training for the local governments and community organizations, and the budgeting. The local governments should implement the projects in cooperation with PLN, the private sector, NGOs, and community organizations, supervise the implementation and operation of each project, and the budgeting. If economy of scale is taken into account, the cooperation between the local governments and more active role of the provincial governments may need to be strengthened.

Community organizations are assumed to be organizations that directly manage the rural electrification projects. However, there were several cases observed such as inappropriate tariff setting, lack of operation and maintenance, and the closedown of the system. The measures to address these issues are necessary, including the increased sense of ownership and responsibility for operation and maintenance, the capacity development of operation and maintenance, the preparation of the guideline to improve the financial condition, and awareness raising before the project implementation.

As the electrification cooperatives went bankrupt in the case of Indonesia and careful consideration should be given to the electrification through this system, the applicability of the good practice, which is observed in the electrification of Bangladesh and Chile, is worth analyzing. The case of Bangladesh has several practices that can be replicated such as the enhanced training system, good communication with customers, the performance-based incentive mechanism, the securing of transparency, and the establishment of technical levels. The case of Chile proves the effectiveness of the incentive mechanism to the local governments.

[19] For example, the final evaluation report of the Project on Regional Development Policies for Local Governments concludes in :"Efficiency" that the Project had difficulties in covering a long cycle of survey (baseline survey, understanding of the status quo, issue analysis), planning, implementation, monitoring, and evaluation, even in individual program and project.

Box 3.3.1 Bangladesh rural electrification project[1]

Rural electrification in Bangladesh is implemented by the Rural Electrification Board (REB), which was established in 1977. REB does not directly implement the project in rural areas, but assign this task to rural electrification cooperatives (PBS: Palli Bidyut Samity), which are formed as autonomous organizations by REB. REB supervises all PBS in the country by giving technical, financial, administrative, and human resource assistance. As PBS takes off, the involvement of REB decreases accordingly. At the time of October 1998, 67 PBS were approved for establishment by the government and 54 PBS started the distribution. The distance of distribution line reaches 96,000 km and a total of 1.7 million meters are already installed. It is estimated that 23 million people in rural areas have access to electricity.

The performance of the REB's rural electrification projects is extremely excellent. The percentage of the system loss in 1997 is reported 16.3% and the average collection rate of the electricity tariff is 95.2%. The key success factors were identified as follows.

- REB has its own training facility and provides the various training programs to the staff and management of REB.
- PBS has the division that engages in awareness raising on such matters as the right and obligation of customers. There is a system of village advisor who promotes the communication with customers.
- Performance target agreement is introduced to facilitate the competition between PBS. Each PBS agrees on the targets of the performance with REB at the beginning of the year and receives bonus or penalty, depending on the level of the achievement. They also make an effort to make the business efficient by subcontracting the meter reading to the private sector.
- The performance of the management of PBS is checked by the board and REB in order to avoid authority centralization and corruption.
- Standard technology is checked in detail. Infrastructure and operation and maintenance comply with this standard.

Box 3.3.2 Chile rural electrification[1]

Rural electrification of Chile succeeded in increasing its ratio from 53% in 1992 to 86% in 2002. One of the success factors is the incentive system that gives the budget depending on the selection of better electrification sites. City governments submit the candidate sites to the provincial government, which in turn takes the responsibility for the site selection and the distribution of the grant from the central government. On the other hand, the central government distributes the rural electrification fund based on (1) the progress of electrification in the previous year, (2) the number of houses without access to electricity. This incentive mechanism is evaluated as effective in increasing the electrification ratio and narrow the gap between the regions at relatively low cost.

(3) Production and application of the packages linking rural electrification and regional development

If the regional development system and the rural electrification systems work properly, the regional development through electrification is likely to occur. The development of the packages for the effective linkage is beneficial to those regions that have constraints in infrastructure and funding. In West Nusa Tenggara province, a wireless telephone system combined with a solar home system is a case in point. The system requires a small battery, which lowers the maintenance cost and profitable as a business model. By assisting the initial investment, those areas where no fixed line exist and mobile phones are not available can continue to provide telecommunication services without additional assistance. The introduction of the low cost and sustainable package is unlikely to face difficulties in operation and maintenance, which often occurs in the regional electrification project. It is also easy to earn revenue, realize positive impacts, and guarantee the operation and maintenance.

Furthermore, this type of package can be integrated into the government- or donor-funded program targeting the regional infrastructure development as one of the components. In this sense, the Kecamatan Development Program of the World Bank can be referred to as the good practice in terms of the competition in the process of project selection, the counterpart funding of the local government, and the funding for various types of infrastructure.

Box 3.3.1 World Bank Kecamatan Development Project

The Kecamatan Development Project of the World Bank is a community development and poverty alleviation project, focusing on participatory village planning process and the project selection at sub district (kecamatan) level. Major components of the Project are the provision of the grant to the infrastructure development projects for road, irrigation, water supply, bridge, and electricity, which are selected at sub district level. The grant is between $55,000 and $110,000.

Table: Achievement of the Project

	KDP (Phase I) (1998-2002)	KDP (Phase II) (2003－2004/8)
Road	16,700 (19,000km)	6,038 (7,623km)
Bridge	3,500	779
Water supply	2,800 units	1,310 units
Irrigation	5,200	942
Market	400 (new) 16 (renovated)	141 (new) 26 (renovated)
Electricity	260 activities	47 activities
Job creation	2.5 mil labor-days	1.2 mil labor-days
Health	140 health posts	663 health posts
Education	285 (new) 190 (renovated)	290 (new) 403 (renovated)

Competition in the project selection contributes to the higher return of the selected projects. According to the project evaluation, the internal rate of return ranges from 39% to 68%. The cost of the Project is lower than that of the Ministry of Public Works and local governments by 56% in average.[1] The local governments are required to contribute 20-70% of the total cost to the Project as the counterpart funding, depending on the level of the poverty ratio.

3.4 Strategy for Ideal Structure

To devise a strategy for achieving the ideal energy sector structure we must examine the means of resolving the issues reviewed in sections 3.2 and 3.3, taking into consideration the role of both related agencies in Indonesia and in Japan. Accordingly, expanded operation of existing supporting tools or a new framework for more effective utilization of supporting tools is introduced.

■ Proposal for Cooperation Program

In the execution of issue analysis and preparation for the cooperation program, available tools based on the expanded operation of existing assistance from JICA or new developing schemes are proposed as follows:

- **Tool 1 : Effective Utilization of Small-Scale Follow-Up Study**

  After completing large-scale development study like master plan study, continual follow-up studies should be conducted to maintain the established recommendations from the large-scale study.

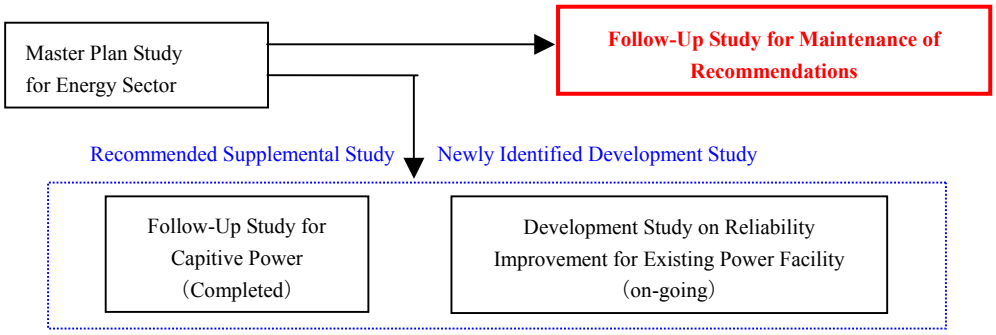


Figure 3. 4. 1 Effective Utilization of Small-Scale Follow-Up Study

- **Tool 2 : Project Preliminary Study ahead of Master Plan Study**

  If a Master Plan is sure to have close relationship with other sectors, a small-scale study like a Preliminary Study should be conducted in advance to confirm relating sector issues and upgrading of efficiency.

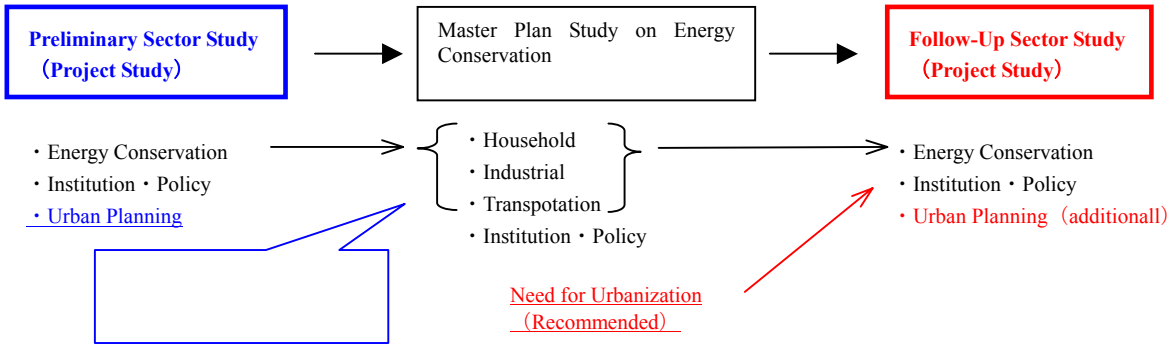


Figure 3. 4. 2 Project Preliminary Study for Master Plan Study

- **Tool 3：Collaboration Program with JBIC**

  Since the Government of Indonesia is inclined to request a large scale project for JBIC loan due to request-based assistance in Japan's ODA policy, excessive small and medium-scale grant project requests are excluded. The Government of Indonesia reasons that small and medium-scale projects are financed domestically. However, such projects usually seem to be postponed or neglected. Therefore, the outline of q framework for Japanese projects through JICA's initiative should be arranged in the JBIC Loan negotiation in order to implement the recommendations of Development Study of JICA.

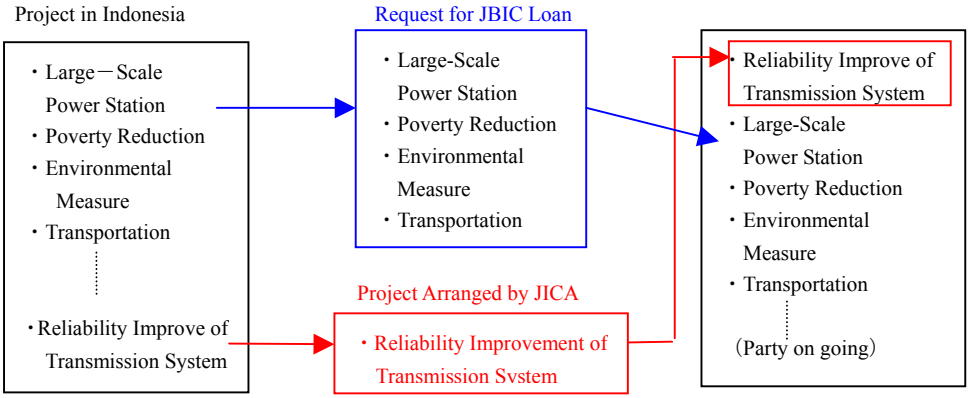


Figure 3. 4. 3　Collaboration Program with JBIC

- **Tool 4：Project Review by Follow Up Study (Master Plan for Renewable Energy Utilization)**

  The development studies which feature changes in evaluation due to the alteration of the policy and international relations in the field of renewable energy, CDM and so on, should be combined as a group of studies which consist of large-scale studies such as master plans and periodical small-scale studies such as follow-up in order to adapt the changes of environment and importance of the project.

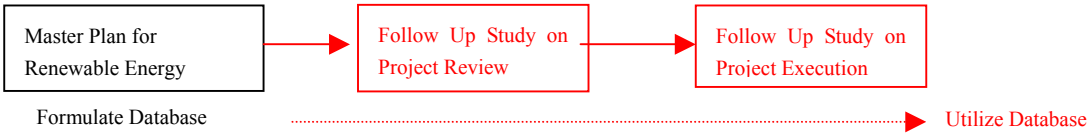


Figure 3. 4. 4　Project Review by Follow Up Study

Chapter 4　Cooperation Program

4.1 Cooperation Program Proposal for Economic Infrastructure

4.1.1 Road Map for Economic Infrastructure

As described in 3.2.1, a short-term approach for energy issues involves the utilization of gas as an alternative for oil and medium-long term approaches are to minimize gas supply for domestic use and maximize export of gas as a measure to increase earnings of foreign currency. Utilization of coal and renewable energy as natural gas alternatives and improving the rate of electrification are also important measures. Figure 4.1.1 shows the road map of the energy sector in the field of economic infrastructure.

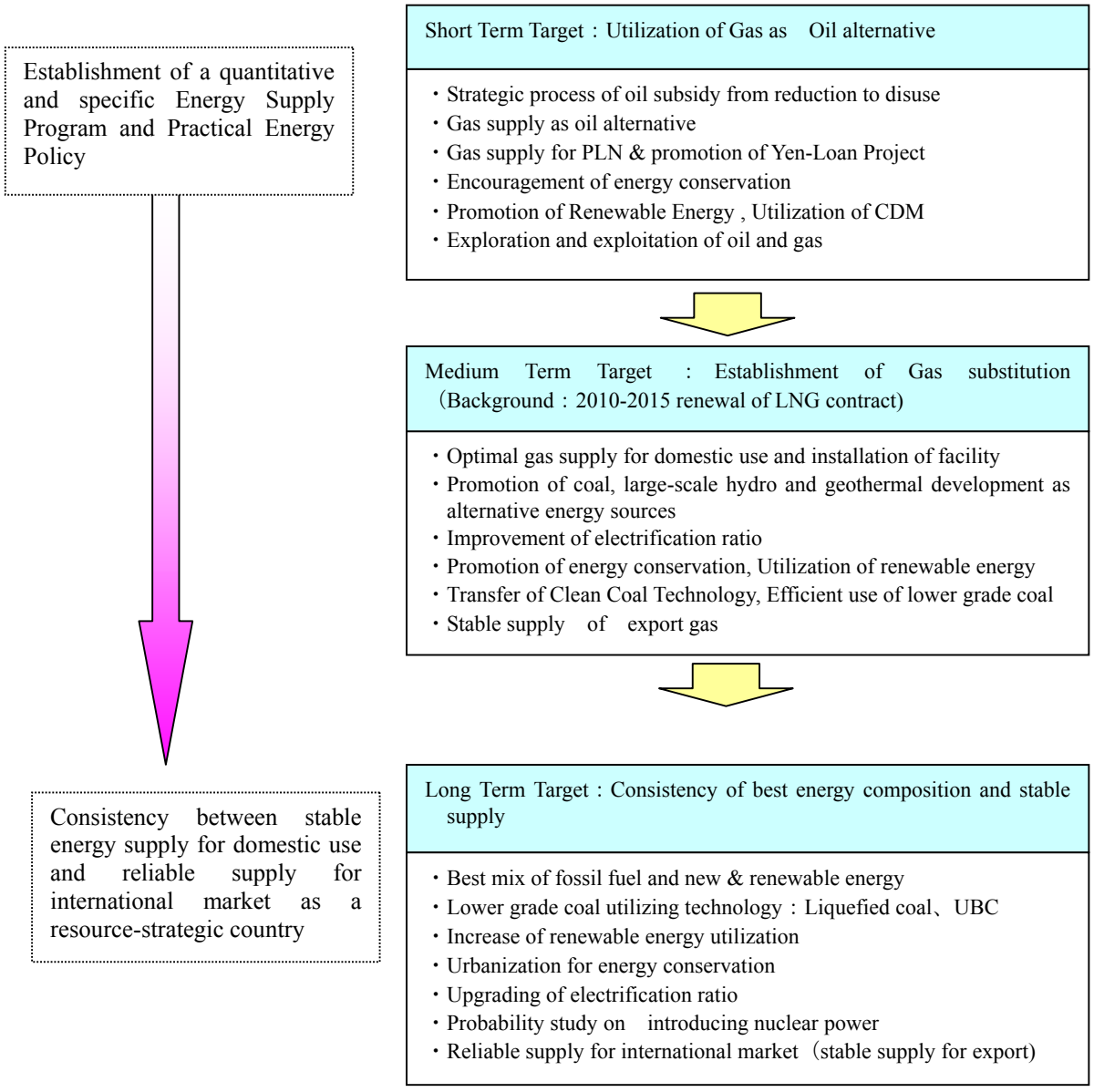
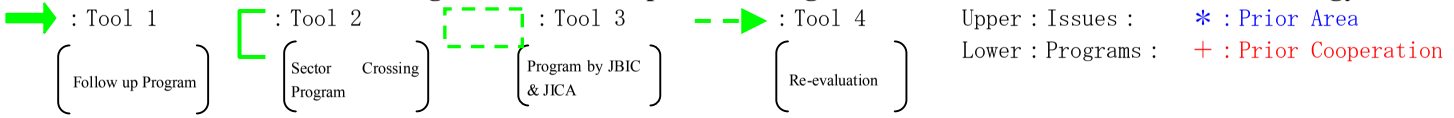


Figure 4. 1. 1　Road Map for Stable Energy Supply

Term	Short Term （2006-2010）	Middle Term （2010-2015）	Long Term （2015-）
Target	Urgent Stabilization of Energy Supply and Demand Utilization of Gas/Diminution of Oil Consumption	Diminution of Gas Consumption Acquisition of Foreign Currency by LNG Export	Best Mix of Energy Composition Stable Energy Supply Inside and Outside
Primary Energy	**Stabilization of Domestic Energy Supply** ・Development Manufacturing Capacity for Petroleum ・Revision of Subsidy System ・Utilization of Gas, Infrastructure Development ・Assistance for the Formulation of Basic Plan Master Plan on the Primary Energy＋ （Incl. Database, Expert Dispatch）	**Supply by Alternative Energy** ・Optimization of Gas Utilization＊ ・Low-grad Coal and Clean Energy＊ ・Assistance for Hydropower Development ・Master Plan for LNG Supply＋ ・Master Plan for Coal Utilization＋ （Incl. Expert Dispatch for Coal Technology）	**Long-Term Best Mix of Energy Composition** ・Formulation of Policy as Supplier ・Formulation of Plan for Best Mix＊ ・Evaluation for introduction of Nuclear＊ ・Assitance for Comprehensive Plan ＋ ・Technical Transfer on Clean Coal＋
Renewable Energy	**Introduction of Renewable Energy** ・Analysis of Long Term Development Potential＊ ・Formulation of the Promotion Plan＊ ・Assistance for Geothermal Development＋ ・Assistance for Analysis of Biomass promotion＋	**Promotion of Renewable Energy** ・Assistance for Development＊ ・Enhancement of Promotion Plan＊ ・Strategy for Development ・Rural Development by Renewable Energy	**Promotion of Renewable Energy** ・Best Mix of Renewable Energy＊ ・Optimization of Renewable Energy ・Comprehensive Strategy for Utilization
Electricity Supply	**Action towards Short Term Energy Crisis** ・Fuel Reservation （Natural Gas Securement） ・Commencement of Power Plants by Yen Loan ・Reinforcement of Transmission System ・Assitance for the Formulation of MP＋ ・Capacity Development for Generation ＋	**Middle Term Development** ・Assistance for Coal PP Development＊ ・Assistance for Geothermal Development＊ ・Assistance for Hydropower Development ・Follow up for Master plan on Transmisson＋ ・Effective Utilization of PPP	**Long Term Best Mix** ・Promotion of Renewable Energy ・Introduction of Nuclear Power ・Improvement of Ratio of Electric Power ・Master Plan on Optimization ・Master Plan on Improvement of Ratio＋
Energy Demand	**Reinforcement of Promotion of Energy Conservation** ・Formulation of Strategy for Energy Conservation＋ ・Technical Transfer on Energy Conservation ・Formulation of Master Plan＋ ・Capacity Development for CDM＋ ・Technical Transfer on Energy conservation＋	**Promotion of Energy Conservation** ・Technical Transfer ・Follow up for Master plan＋ ・Development of Promotion Structure＋ （Incl. Technical Transfer）	**Development of Energy-Saving City** ・Technical Transfer for Urban Planning （Improvement of Transport an Pipeline） ・Master Plan on Urban Planning （Based on Yen Loan）
Policy and Institution	**Development of Energy Related Laws** ・Energy Related Laws ・Laws on Promotion of Private Investment ・Improvement of Policy Making Capability＊ ・Promotion of Private Investment （PPP etc） ＋ ・Development of Bio-fuel＋	**Development of Promotion Structure for Private Investment** ・Monitoring of Primary Energy Policy ・Development of Promotion Structure＊ ・Assistance on Hydro and Coal PP Construction （PPP/Export Credit）	**Presence of Indonesian Government** ・Confirmation of Responsibility as Suppler ・Evaluation for Introduction of Renewable Energy ・Development of Laws for Renewable （ex. Technical Standard on Nuclear）

Figure 4. 1. 2　Cooperation Program on Economic Infrastructure in Energy Sector



4.1.2 Concrete Cooperation Program

In the section, cooperation programs are shown and made each relation among them, finally the concrete cooperation programs are described.

(1) Primary energy

The cooperation program is shown in Figure 4.1.1. For making cooperation programs in primary energy, at first, necessary capacity development will be implemented for making energy polices by MEMR, after that, it is supported to make natural supply master plan and coal utilization master plan in line with the said energy policy. And if necessary, some follow up study should be implemented.

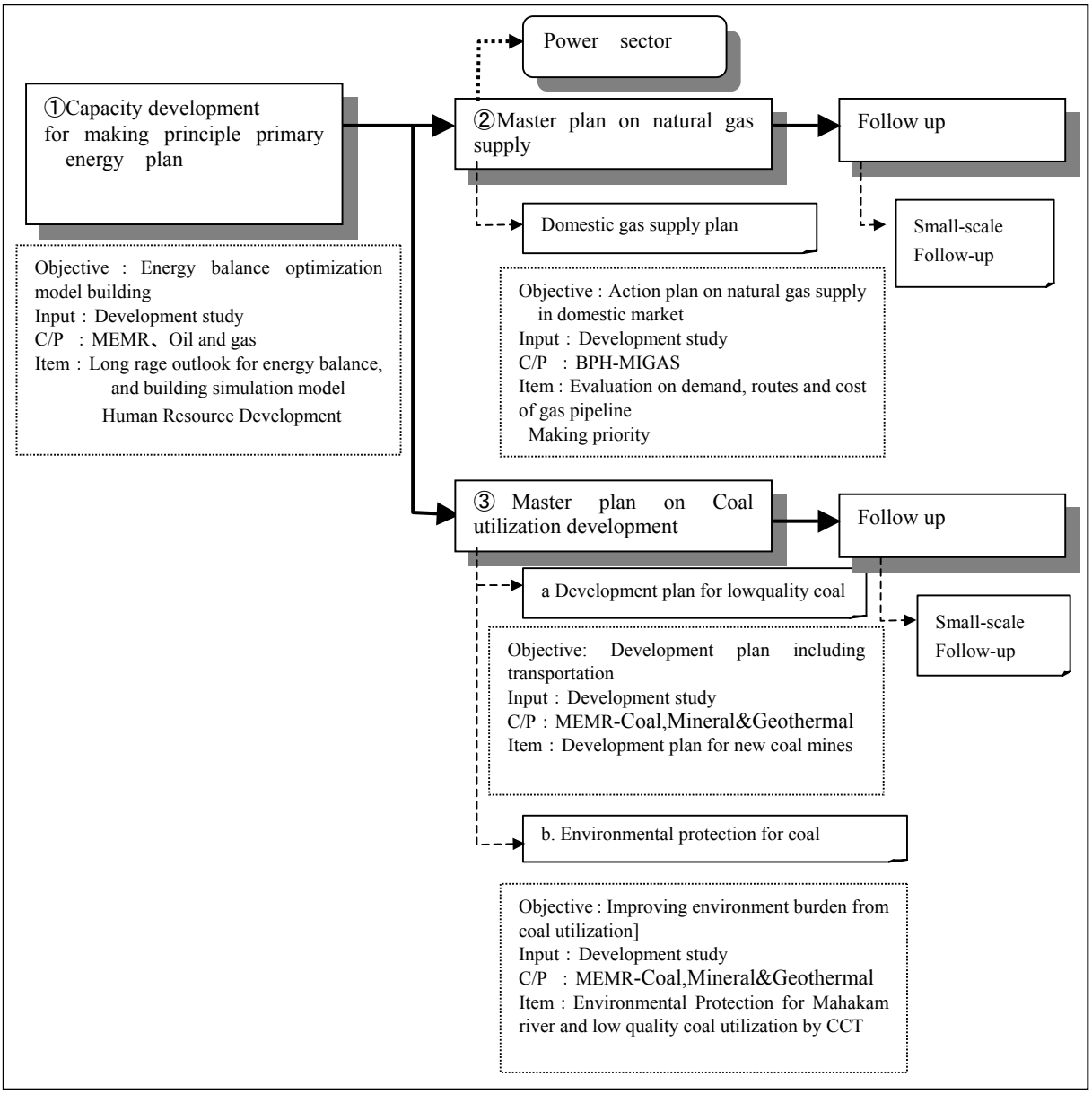


Figure 4.1.3 Cooperation Program in Primary Energy

① Capacity development for making principle primary energy plan

In Indonesia, there are concerns about increasing of importation of crude oil and petroleum products. For deceasing the importation, it is important to promote the development of oil substituting-energies

and energy conservation in the final consumption sectors. Meanwhile, as the petroleum products are derivatives, it is profitable when the production of petroleum products meet the domestic demand, then the government is required to make such kind of energy plan. And the government should consider export after making energy balance in domestic market. The principle energy plan that realize supply of oil substitution energies is required. For the purposes, the support for making simulation model and training the staffs of MEMR-MIGAS as counterparts are required.

② Master plan on natural gas supply

Regarding the effective utilization of natural gas, a gas shortage has occurred around Jakarta due to a shortage of domestic-use gas pipelines. Therefore PGN is implementing five transmission pipeline plans projects and seven distribution pipeline plans projects. There is an urgent requirement that the transmission and distribution pipeline plans should be completed urgently. And it is required to optimize natural gas supply. For the purposes, master plan study on gas pipelines should be implemented with BPH-MIGAS. At the same time, the substitution plan for gas supply should be discussed before completing gas pipelines.

③ Master plan on coal development and utilization

The master plan projects concerning coal are as follows;

a. Development plan for low quality coal

Hereafter, low coal quality coal should be used positively as well as high quality coal in Indonesia. Indonesia government started already to discuss it with Ministry of Economic Trade and Industry in Japan. In future, the master plan that makes clearly the issues and the solving procedure is required. Especially it is required to concrete development plan including transportation system in Sumatra due that foreign investors have plans to develop the coal mines. For examples, new coal mine development in Bunian and Kunkilan, coal high utilization plan such as UBC(Upgraded Brown Coal), hyper coal and bio briquette can be pointed out.

b. Environmental measures for coal and low quality coal utilization

Environmental issue that powdered coal accumulates in the bottom of Mahakam river is happened. JICA already started the study for protecting and improving the environment. For improving the environment, it is necessary to improve the factories around the rive. Today, it is said that clean coal technologies such as CFBC are useful for the improvement. When considering the wide range of CCT, it is useful in environment and cost aspects. For surveying usefulness of CCT, the following items should be examined.

(2) Renewable energy

The cooperation program is shown in Figure 4.1.4.

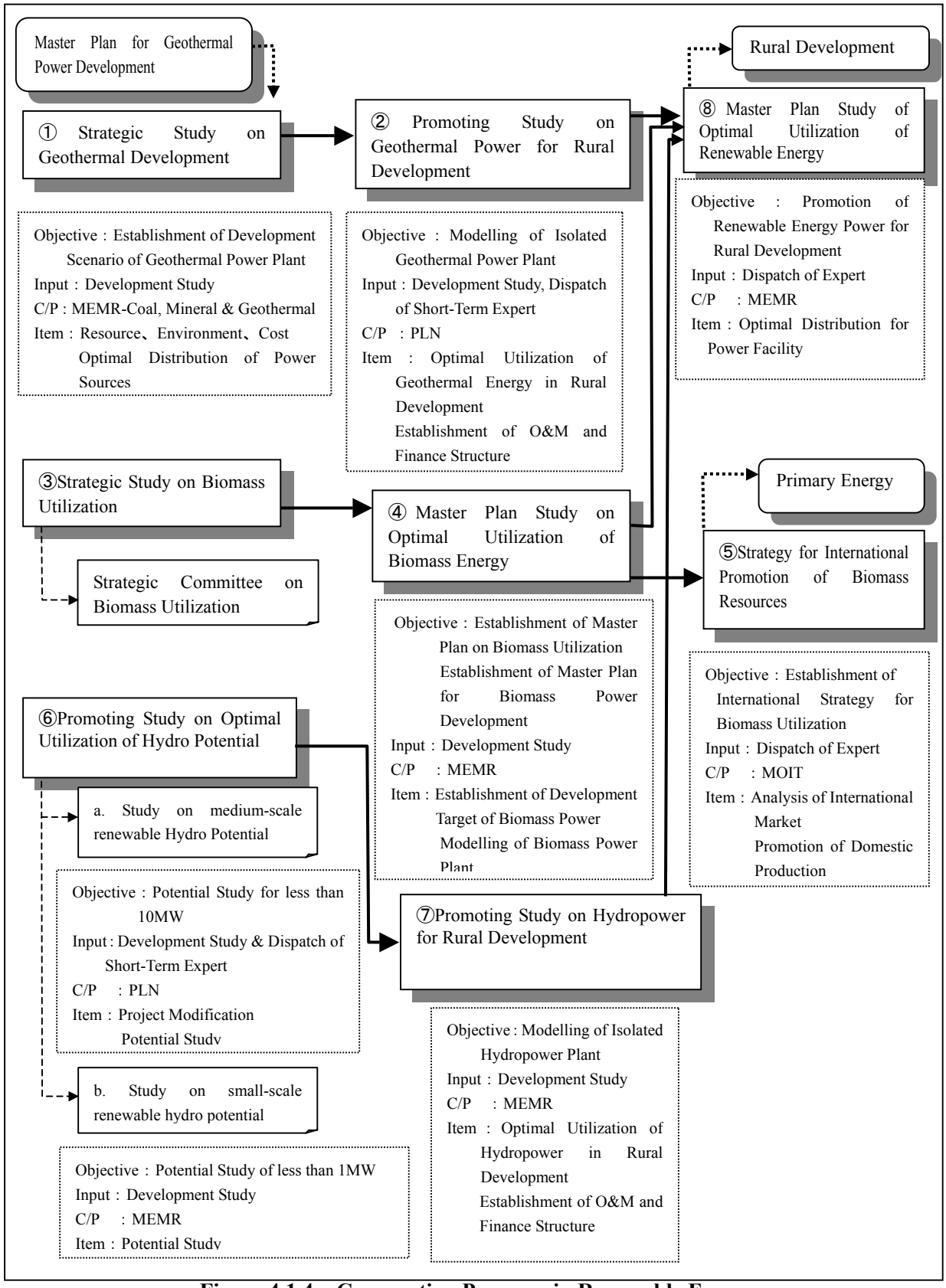


Figure 4.1.4 Cooperation Program in Renewable Energy

After executing the Master Plan Study for Geothermal Power Development, in the field of renewable energy, a Strategic Study on Geothermal Development should be undertaken. Renewable energy development should focus mainly on collaboration with local development to make a clear distinction between economic infrastructure and social infrastructure. Regarding biomass, an international strategic plan is needed and should give due consideration to the current global energy demand.

① Strategic Study on Geothermal Development（Development Study）

The Master Plan study on Geothermal Power Development being planned by JICA should encompass the estimation of resources contained in geothermal project candidates and database installation. Based on this Study, a strategic development plan of geothermal utilization could commence successively. Considering the latest policy for renewable energy development, for example, incentives for medium-scale (less than 10 MW) renewable power purchase, an evaluation of geothermal development, taking into consideration potential, environment, cost efficiency and energy security should be prepared. Moreover, optimal distribution between grid connection and the isolated system should be estimated by examining the share between private investment and the PLN, and establishment of temporary or permanent regulations and incentives.

② Promoting Study on Geothermal Power for Rural Development

The Study establishes a development model for isolated geothermal power plants including technical transfer of maintenance and financial system for rural development. The Study counterparts are considered to be local governments and the PLN.

③ Strategic Study on Biomass Utilization

In the utilizing biomass resources, a cooperative relationship is important with regard to the procurement of crops and utilization of generated energy. A Strategy Study on Biomass Utilization is introduced based on this approach.

A practical plan is devised through comprehensive discussion including security of food, industrial development and trade, and participation of the agricultural, forestry, industrial and energy sector. The structure of the strategic committee on biomass utilization is shown in Figure 4.1.5.

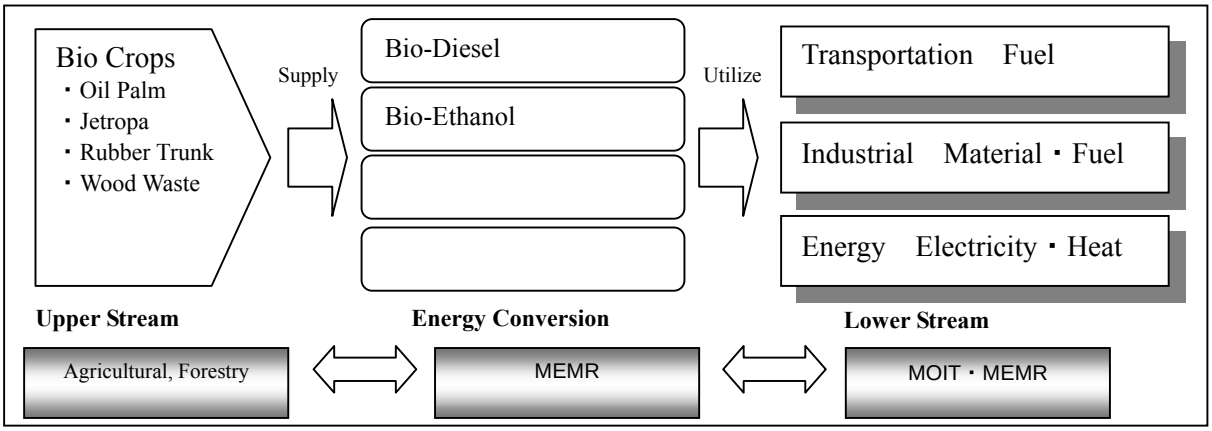


Figure 4.1.5 The Structure of the Strategic Committee on Biomass Utilization

The participation of the private sector is important for the introduction of biomass energy for business use and a comprehensive approach, involving various business resources, is required. The related business sectors include agricultural traders who provide material crops, energy producers who convert the material crops into fuels or electricity, and industrial energy consumers.

A comprehensive approach, including every related sector, should be adopted in forming the

strategy for the introduction of biomass energy for business use. Consensus should be reached among the different sectors in proposing the strategy. The energy converting sectors are expected to play a leading role.

④ Master Plan Study on Optimal Utilization of Biomass Energy

Advancing the development target of bio-fuel, the Master Plan Study on Optimal Utilization of Biomass Energy is focused on the development target of the entire energy converting sector including biomass generation. In order to achieve the target, identification of the project location and development schedule is essential. Therefore, local government participates in the steering committee. The committee is composed of a general meeting group and a sub-task force which deals with individual regional matters and crops in order to clarify roles and responsibilities. One counterpart is MEMR, which is the administrative member of the general meeting group.

⑤ Strategy for International Promotion of Biomass Resources

A strategy for the international promotion of biomass energy could be required following its promotion within Indonesia. The international market for bio-fuel has been developing, therefore, after establishing domestic utilization, the export of bio-fuel could be the next issue to be addressed.

⑥ Promoting Study on Optimal Utilization of Hydro Potential

Being the most mature technology in renewable energy, hydropower is an attractive solution for promoting renewable energy. The Study aims to avoid delaying the utilization of Indonesia large potential in this area.

a. Study on medium-scale (1-10MW) renewable hydropower potential

Following the increase of investment in medium-scale renewable energy, suspended hydropower development projects should be revised and new sites should be appointed. Basic data about the hydropower projects should be disclosed.

b. Study on small-scale (less than 1MW) renewable hydropower potential (concerning rural electrification)

Small scale renewable energy has been removed from the focus of investment in CDM methods, therefore, incentives to develop it are in decline. However, small-scale renewable energy could be effectively developed in some areas according to regional characteristics. The promotion of small-scale renewable energy should be considered as one of the possible alternatives.

⑦ Promoting Study on Hydropower for Rural Development

The Study establishes a development model for isolated hydropower plants including technical transfer of maintenance and financial system for rural development. The Study counterparts are considered to be local governments and the PLN

⑧ Master Plan Study of Optimal utilization of Renewable Energy (Local Energy Best Mix)

Regarding the effective utilization of renewable energy, the role assignment for private-sector participants and the government for each task must lead to the design of effective methods. At the same time, the periodical renewal of the energy development plan and the public information disclosure are essential for involving all participants in a comprehensive development of the energy sector. There is an urgent requirement that the replace of diesel generator and rural electrification by renewable energy should be improved. For the purposes, master plan study on optimal utilization of renewable energy should be implemented in rural area. Proposed projects are showing as follows:

a. Promotion of investment in renewable energy

Coordination with renewable energy based power producers and the PLN, the single buyer for the energy, is crucial with regard to the Ministerial Decree on duty of power purchase. The introduction of standard PPA, which is carried out in Sri Lanka, could be effective to promote the investment in

renewable energy.

b. Study on Optimal Distribution for Rural Development

Through a collaborative approach, optimal study for rural energy supply in relation to rural development plan is supported in order to encourage renewable energy development.

c. Analysis of assistance for application of CDM scheme to renewable energy

CDM scheme has been widely introduced to the renewable energy sector, however, ODA funds cannot be diverted to renewable energy projects and JICA's approach tends to be a limited one. Under these circumstances, indirect assistance towards the Indonesian government is more preferable than direct commitment to the projects. Assistance towards capacity development for CDM project countries is also required as follows.

① Grid connecting projects (PPP project to extend grid line)
② Rural electrification projects (demand evocation)
③ CDM capacity development (data base improvement, human resource development)

(3) Power sector

Figure 4.1.6 shows cooperation program relevant to the power sector.

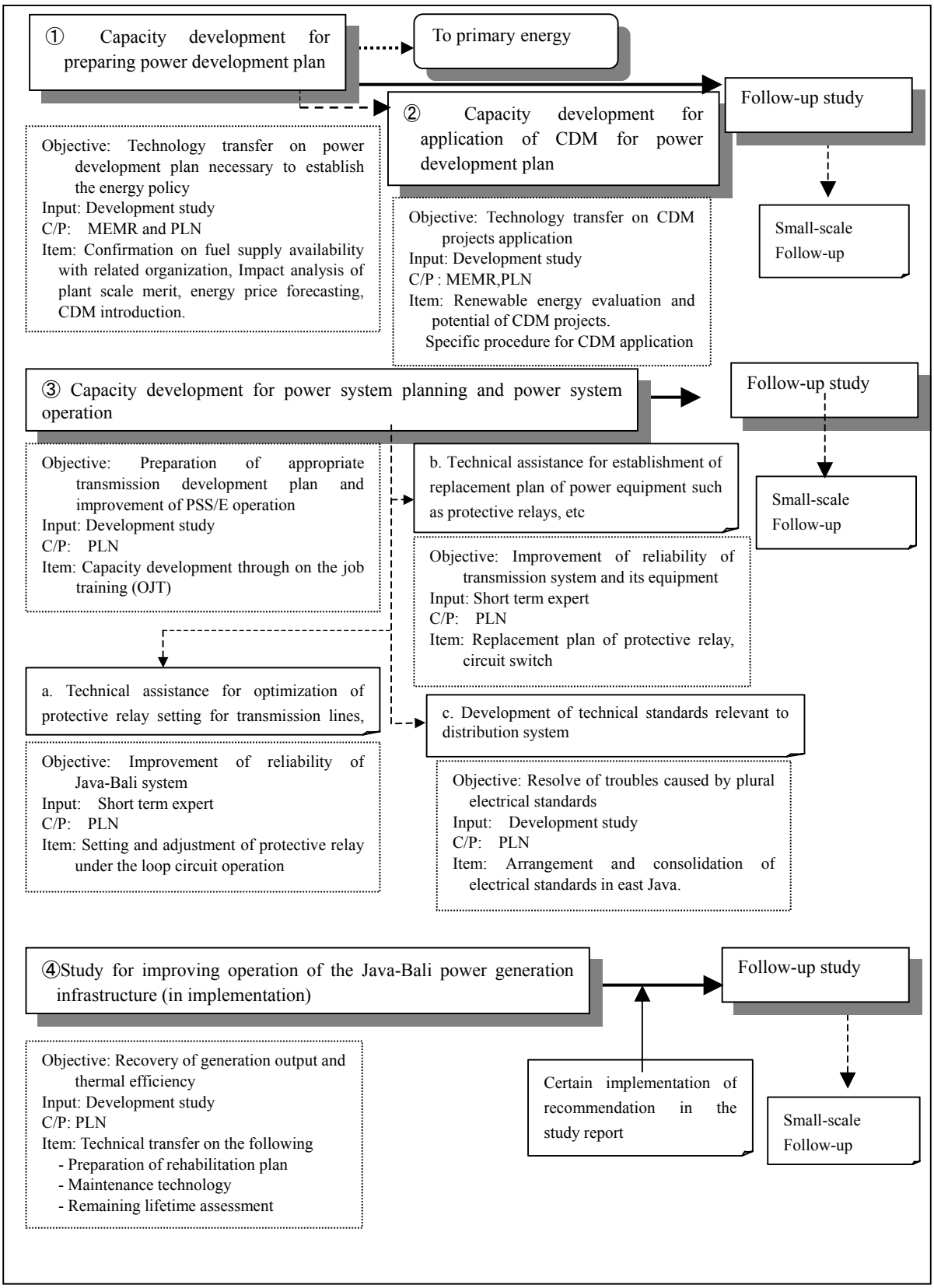


Figure 4.1.6 Cooperation Program in Power Sector

Regarding technical assistance in the field of electric power, first of all, capacity development for preparing the power development plan will be implemented as a priority so that the power source planning may be formulated as a part of the policy making for primary energy. Technical assistance in this area, although it has been conducted repeatedly in Indonesia, will be continuously followed up until it is proven to be effective. In terms of the capacity development above, technical transfer of CDM's basic philosophy will be conducted, with the transfer of procedures and the implementation methods as its sub-programs. The on-going project, 'The Study on the Improvement Measures for Electric Power Generation Facilities in Java-Bali Region in the Republic of Indonesia' will be followed up steadily, the details of which are to be determined based on the results of the study.

① Capacity development for preparing power development plan (development study)

The technology transfer for preparing power development plan can be implemented as a part of JICA 's development study related to this technology. For example, adequate level of capacity developments for MEMR and the PLN consistent with their roles can be carried out as a part of power development plan in Sulawesi area, it is planed to be implemented as a new development study. Items of technology transfer to the central government, and also to the rural government, should be clarified considering their roles. The following shows the outlines:

- For MEMR, technical transfer regarding the power development plan planning method reflecting the national energy policy should be conducted. The aim of this assistance is for MEMR, as the policy maker, to acquire the technical skills for preparing the power development plan as a tool for establishing the energy policy. For example, asking for PLN amendment of the power development plan by simulating the amount of energy necessary for the power sector and adjusting issues regarding fuel procurement with related divisions.
- For PLN, as it is capable of conducting basic simulations, technical transfer for an examination method regarding economies of scale as previously stated and forecasting energy-price in the future and so on should be conducted. By conducting technical transfer with MEMR simultaneously, they will confirm the conflict of interests between the policy maker for the power sector and power utilities and this will contribute to formulating a specific and effective energy policy.

In the small follow-up survey (refer to 3.4 tool 1), technical assistance for updating (including development policy) a previous study[20] regarding power development plan and information disclosure for private enterprises should be conducted. An indication of technical transfer achievement and grasp of remaining issues should be conducted for future assistance in this area.

② CDM capacity development for organizations involved in the power development plan (Development study)

Capacity development for the power development plan includes how renewable energies are examined and reflected in the power development plan. In order to utilize CDM as a tool for this, as a sub-program of the capacity development for the power development plan, CDM capacity development will also be conducted, dealing mainly with its procedure.

③ Capacity development for power system planning and power system operation (Development study, short-term expert)

PLN decided to use PSS/E from 2004 though PLN had used various power system programs in the past. However, inadequate utilization of PSS/E was observed in PLN. As power utility, technical transfer relevant to both power system planning and power system operation should be conducted. And in the small follow-up survey (refer to 3.4 tool 1), an indication of the technical transfer achievement and grasp of remaining problems should be conducted for future assistance in this area.

[20] In Indonesia, 「The study on the optimal electric power development and operation in Indonesia」(2002),「The study on the optimal electric power development in Sumatra」(2005)

With respect to the following matters confirmed in this field survey, further investigation regarding the current situation should be verified in this capacity development and development study or short-term expert will be introduced as needed.

a. Technical assistance for optimization of protective relay setting for transmission lines, etc (short-term expert)

For the prevention of a large-scale blackout, appropriate setting of protective relays for transmission lines, those can remove power system faults promptly and accurately is important. With a view to improving power supply reliability in the Java-Bali system, technical transfer to PLN engineers with respect to the optimization of protective relay setting for transmission lines, etc should be conducted.

A more advanced relay setting technique is needed for the loop operation after the completion of 500kV south route, therefore, relevant technical assistance for competence in this areas should be conducted.

b. Technical assistance to establish a replacement plan for power equipment such as protective relays, etc (short-term expert)

In Indonesia, protective relays for transmission lines, etc that triggered blackouts in past years have not been replaced. Therefore, technical assistance to PLN engineers to establish a replacement plan for power equipment such as protective relays, etc should be conducted. In the replacement plan, identifying deterioration of power equipment and the importance of supply area should be considered.

c. Establishment of technical standards relevant to distribution facilities (short-term expert)

There are three technical standards in the distribution system of Java, namely Japanese standards, American standards and European standards, due to the inconsistency of historical technical assistance. Since it is ineffective to have various standards being applied in one island, standardization of technical standards of the power distribution system and should be conducted in parallel with training of personnel.

④ Study for improving operation of the Java-Bali power generation infrastructure (Development study, in implementation)

The on-going project, ‘The Study on the Improvement Measures for Electric Power Generation Facilities in Java-Bali Region in the Republic of Indonesia' will be followed up steadily, with details to be determined based on the results of the study.

(4) Energy conservation

The cooperation program for energy conservation is shown in Figure 4.1.7.

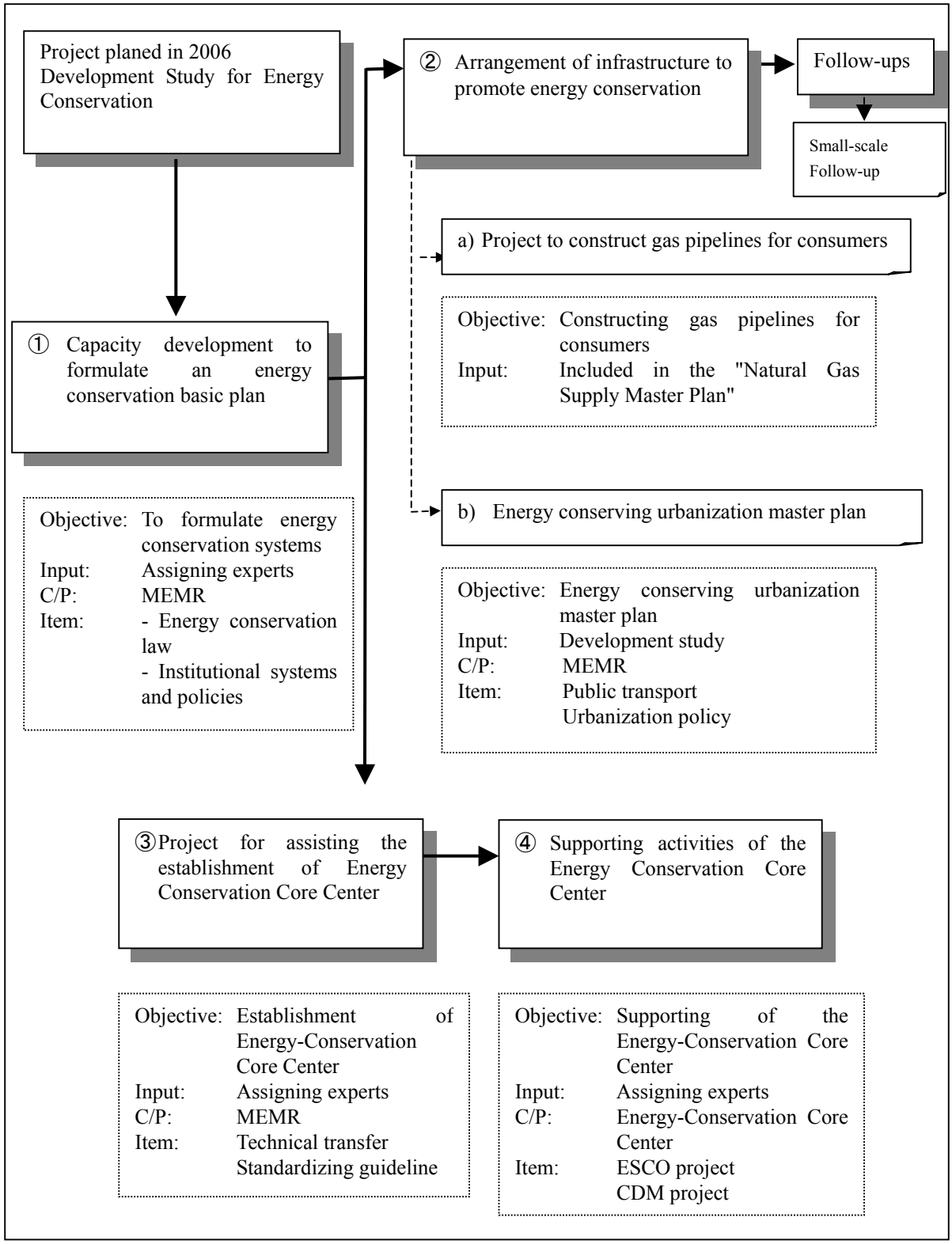


Figure 4.1.7 Cooperation Program for Energy Conservation

In the energy conservation field, it is urged to build the capacity needed for MEMR to formulate energy conservation policy in the future. Based on the energy conservation basic plan to be formulated by MEMR, an energy conservation core center must be founded to execute specific energy conservation measures. Furthermore, establishment of an ESCO market is needed, such as establishment of the ESCO association. The cooperation project needs to be covered these follow-ups. From medium- and long-term viewpoints, the cooperation project also needs to be covered investment promotion for energy conservation and cooperation to formulate a vision for energy-conserving urbanization.

① Capacity development to formulate an energy conservation basic plan

Based on the existing energy conservation policy (Green energy), MEMR (Directorate of New Renewable Energy and Energy Conservation) will need help in formulating energy conservation basic policy. JICA plans a project on develop study for energy conservation, in which technical cooperation on the formulation of an energy conservation basic plan can be conducted. After the project is completed, technical cooperation will be proposed to enact an energy conservation law.

Energy conservation should be separated from the present energy law (proposed) and be enacted as an independent energy conservation law, which covers large consumers' obligation to manage energy and the compulsory introduction of an energy manager system.

As the same time, investment environments must be improved to subsidy the cost for energy conservation facility introduction, to exempt import duties, and to adopt a preferential measure for interest relating to investment.

② Arrangement of infrastructure to promote energy conservation (medium- and long-term)

Energy conservation accompanied by the construction of infrastructure (example: construction of gas infrastructure and the introduction of a natural gas-cogeneration system into commercial buildings in cities) will require a drastic measure. Thus, technical cooperation is proposed on the assumption of an energy-conserving urbanization plan. Technical cooperation will be provided for formulating energy policy from medium- and long-tern viewpoints, such as formulating a master plan for energy-conserving urbanization, and assisting the formulation of energy visions. Specific input projects are as follows:

a. Project to construct gas pipelines for private sectors (plants)

Shifting fuel to gas from oil is essential to promote energy conservation at plants. The construction of gas pipelines in cities will be an effective means to transform into a post-oil era. As proposed in the "Natural Gas Supply Master Plan" program for cooperation in the primary energy field, the construction of gas pipelines for the private sectors needs discussions.

b. Energy conserving urbanization master plan

A master plan should be formulated to promote energy conservation in cities. To shift energy supply and demand structure in the consumer and transport sectors and to promote energy-conserving urbanization, Jakarta is set to a model city in which MEMR will formulate energy conserving urbanization policy with technical assistance.

③ Project for assisting the establishment of Energy-Conservation Core Center

To promote energy conservation, a cross-sectional cooperation and promotion system is essential. To this end, it is needed to establish energy conservation core centers under the umbrella of MEMR, MOIT, PLN, and other agencies, and organize a research and development section, a data control section, and an education section to support their efforts.

○ **Research and Development Section**

This section will be a comprehensive research and development to promote activities for the foundation of human resource development for energy conservation. More specifically, the section will promote exchanges of information among domestic and foreign institutions, perform research and analysis, and formulate and promote strategies and plans that train personnel for industrial development. Research results will become feedback for the energy conservation data control section and the energy conservation education section operating in alliance.

○ **Data Control Section**

This section will accurately grasp the current situation of energy supply and demand, and the related structure; establish a database of energy conservation information; analyze trends in energy consumption in different industries and areas based on the database; examine effective energy conservation measures; prepare guidelines in cooperation with the research and development section and other organizations concerned; and publicize new information to promote energy conservation and PR activities.

○ **Education Section**

This section will implement appropriate energy conservation educational programs by sectors and areas, foster energy managers, and conduct technical and on-the-job training for experts in professional fields.

④ Supporting activities of the Energy-Conservation Core Center

Long-term experts will be assigned to the center to transfer technology on energy conservation subjects that are analyzed and studied at the center, and foster experts on energy conservation. In addition, cooperation will be provided to assist the formation of institutional systems to promote energy conservation programs (ESCO project, CDM project.)

(5) Development of legal systems and sectors to promote investments

■ Capacity development of BP-MIGAS and BPH-MIGAS

The following reviews will be made to realize the composition of an efficient gas market, as it is necessary to attempt the optimization of gas supply in Indonesia prior to the liberalization of the gas market in 2008.

- ○ To compare Indonesia's gas regulatory body with the gas regulatory bodies in other countries, then to optimize its function, number of staff and budget.
- ○ To set the benchmark in the gas sector for efficiency.
- ○ To establish a policy for promotion of private investment.

■ Support for energy optimization at minimum cost to the economy and environment

Since the crude oil price has increased, the government encouraged replacement of diesel combustion with stalker boiler combustion, mainly for small and medium-sized companies; however, Sox emission and processing of ash becomes a big environmental issue.

Therefore, policy inducement is necessary to achieve energy optimization at a minimum cost to the economy and environment in Indonesia, considering CDM, etc., therefore policy support needs to be put in place.

■ Support for review of the whole framework of the Indonesian Energy Sector

For years the World Bank, ADB, and JBIC have been requesting the financial recovery of PLN as a condition for financing. The demand by donors for reviewing the nationwide uniform charge and unbundling the rate will continue in the sector reform. However, it is necessary to review the whole framework of the energy sector to improve the financial structure of PLN, since the contradictions in the liberalization of the sector are manifested in PLN. Moreover, supplying and distribution of gas are almost monopolized by PGN, and there is the possibility that the market dominance would be created when there is no new entry in the domestic gas market. Therefore, there is support for a review of the whole Indonesian energy sector framework.

4.2 Cooperation Programs for the Assistance to Social Infrastructure

The systems of both rural electrification targeting social infrastructure and regional development have much room for improvement and lack coordination. This section describes the cooperation programs in both areas based on the issues analyzed in Chapter 2 and the approach identified in Chapter 3. All of the programs are intended to realize the situation that both systems can be closely coordinated.

Period	Short term (2006-2010)	Mid term (2010-2015)
Goal	**Establishment and operation of regional development and rural electrification systems**	**Expansion of regional development and rural electrification systems**
Regional development / rural electrification	・ Establishment and operation of regional development system＊ ・ Establishment and operation of rural electrification system＊ ・ Coordination of regional development and rural electrification＊	・ Expansion of regional development system ・ Expansion of rural electrification system
	・ Project on the establishment of regional development project+ ・ Project on the establishment of rural electrification project+ ・ Project on strengthening of O&M for SHS/micro hydropower systems+	・ Regional development program (to be funded by loans and/or government fund) ・ Rural electrification program (to be funded by loans and/or rural electrification fund)

Figure 4.2.1 Cooperation Program for Social Infrastructure

4.2.1 Cooperation Program for Regional Development

Cooperation program for regional development is presented in this section. The rural electrification/regional development linkage project can be a part of the project on the establishment of the rural electrification system, which will be described later.

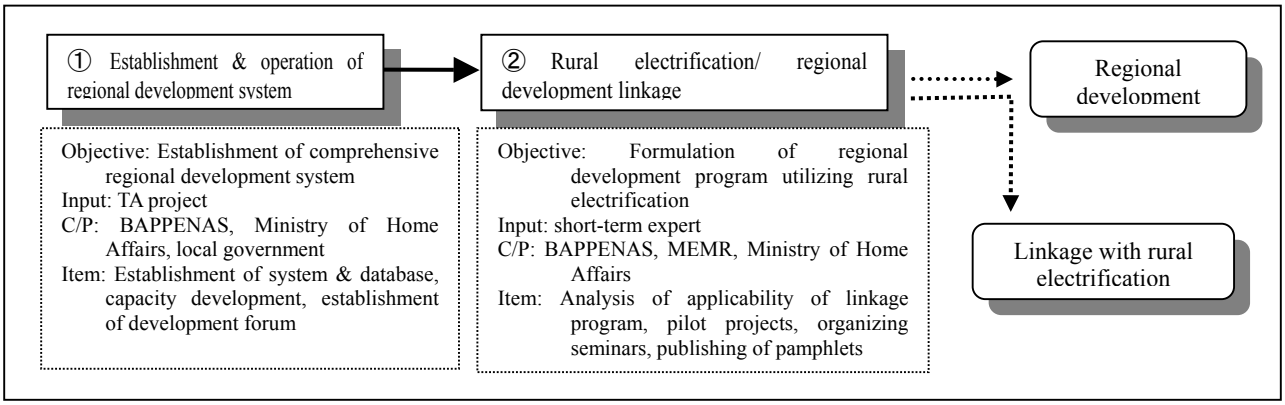


Figure 4.2.2 Cooperation Program for Regional Development

① Establishment and operation of the regional development system

Though there is a legal framework for regional development planning under the law on the national development plan system (2004), the issues such as the establishment of the necessary system and the capacity development of the local governments need to be tackled. In fact, BAPPENAS recognizes the need of donors' assistance despite the existence of a rough plan for establishing the system. The assistance should be given to the following items.

- Establishment of the system including planning, implementation, monitoring, evaluation, feedback (issues analysis, analysis of improvement plans, preparation of guidelines,

implementation of pilot projects)

- Production and administration of the database system
- Capacity development of the central and local government
- Establishment of regional development forums with the participation of stakeholders including community people

② Production and application of the packages linking rural electrification and regional development

The assistance to rural electrification does not regard electrification as a final goal, but it is a means to poverty alleviation and regional development. Even if an effort is made to promote the regional development program utilizing the electrification project, there may be an obstacle such as a lack of coordination between the organizations concerned due to bureaucratic sectionalism in public administration. Therefore, the following assistance should be provided for the local government to become able to incorporate the linkage programs into the regional development plan.

- Analysis of the current situation on the utilization of electricity for other sectors programs such as health and education
- Analysis of applicability of the linkage packages
- Implementation of the linkage packages in the pilot project sites
- Organizing of seminars to disseminate the linkage packages
- Publishing of pamphlets to disseminate the linkage packages

4.2.2 Cooperation Program for Rural Electrification

This section describes the cooperation program for strengthening the rural electrification system. The project on the establishment and operation of rural electrification will be major assistance. However, there are potential factors that may influence the institutional aspects of rural electrification such as the revision of the electricity law. The dispatch of a short-term expert is also necessary to grasp the status quo and prepare the terms of reference for the above project. As there are several good practices in Bangladesh and Chile, careful consideration should be given to the applicability of such practices to Indonesia.

On the other hand, though MEMR and MOC have made efforts to implement the photovoltaic and micro hydropower projects by their own budget, there are serious operation and maintenance issues observed in the field survey in West Nusa Tenggara province. Assistance to the strengthening operation and maintenance of solar home systems and micro hydropower project is urgently needed.

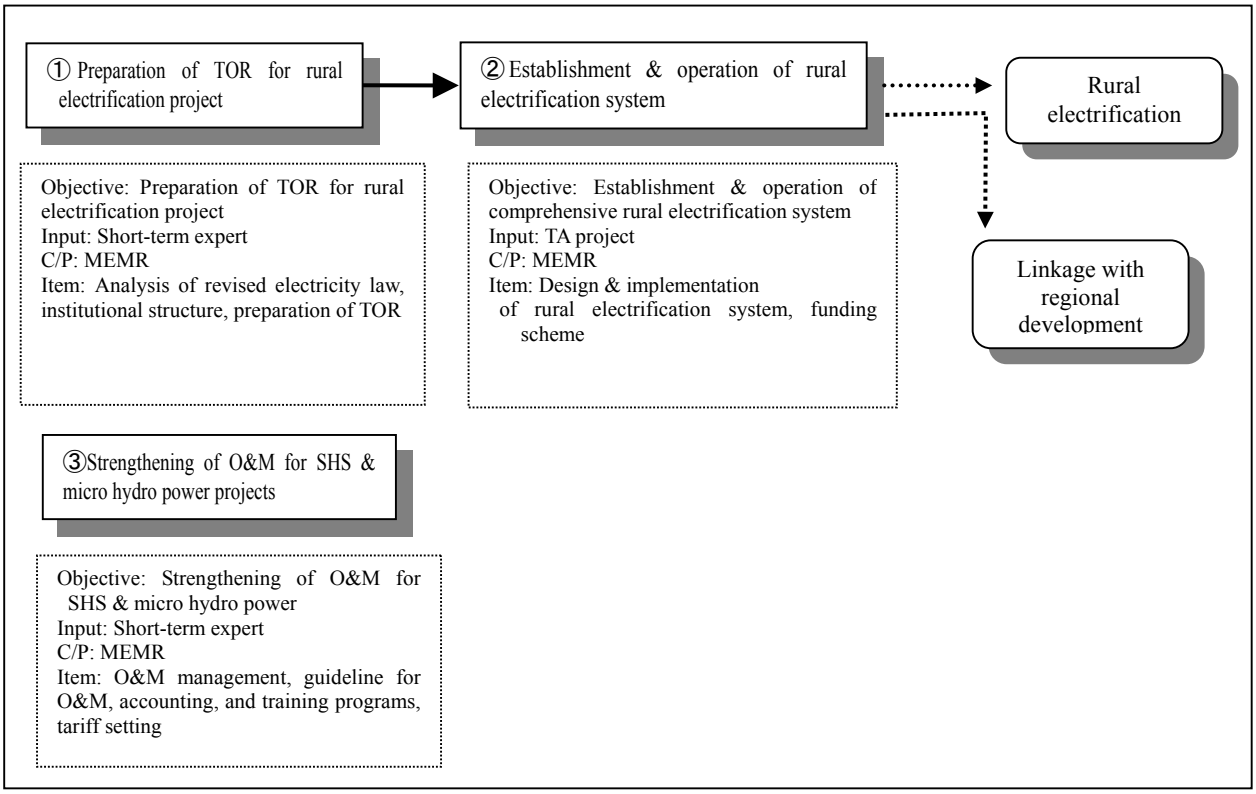


Figure 4.2.3 Cooperation Program for Rural Electrification

①Preparation of the terms of reference for the project on the establishment and operation of the rural electrification system

JICA has dispatched the long-term experts on electricity business management and rural electrification planning for 11 years since 1993 and provided technical assistance, mainly on technology of micro hydropower generation. Although the counterpart staff members have been equipped with the knowledge and skill and the number of micro hydropower projects increased, the development of institutional and funding mechanisms should be developed to expand the projects to other areas, requiring further assistance of donors.

However, the institutions and organizations related to electricity are in a fluid condition due to the future submission of the revised electricity law. It may be necessary for donors to actively engage in creating the favorable environment for the promotion of rural electrification as Indonesian side may lose interest in this area without further support of donors. This assistance aims to grasp the situation

of changes in the legal framework and the institutional and organizational structure through the following means.

- Understanding of the situation of the revised electricity law
- Grasping of the status quo of the institutional structure of rural electrification
- Preparation of the terms of reference for the project on the establishment and operation of the rural electrification system

②Establishment and operation of the rural electrification system

This assistance shifts its focus from the project-based technical assistance in the past to the strategic assistance to rural electrification policy and institutional building. Major areas for assistance can include the institutional development including the coordination mechanism between the ministries concerned, the demarcation of roles of the central and local governments, the funding scheme, and human resource development. Regardless of the result of the revision of the electricity law, each of the central government, PLN, the local governments, and community organizations have serious issues on the promotion and implementation of the rural electrification. It requires the comprehensive restructuring of the system.[21]

- Analysis of the current institutional setting and stakeholders for rural electrification
- Analysis of the content of the revised electricity law
- Design and implementation of the rural electrification system
- Analysis of the funding schemes
- Analysis of the introduction of the incentive mechanism to the local governments

③Strengthening of the operation and maintenance system for solar home systems and micro hydropower projects

As observed in the cases of West Nusa Tenggara province, it seems difficult to continue the operation of the project with high customer satisfaction due to lack of technical and financial capability, lack of sense of ownership of the beneficiaries, and application of inappropriate technology.

It is urgent to establish a sustainable operation and maintenance system, though it should be dealt with as part of the above project in principle. Therefore, the following assistance should be provided in order to establish financially and technically sustainable operation and maintenance system and to strengthen the organizations in charge of the existing projects by utilizing the guidelines produced in the past.

- Production of the guidelines for operation and maintenance
- Production of the guidelines for accounting
- Analysis of appropriate tariff setting
- Production of the guidelines for training programs
- Implementation of the in country trainings and seminars

[21] The possibility of the assistance to the structuring of the rural electrification system is analyzed in detail by Preparatory Study on Rural Electrification in Indonesia in January 2005.

Chapter 5 Recommendation

5.1 Recommendations for Reinforcement of Infrastructure for Economic Activities

A stable energy supply in Indonesia is very important, not only for Indonesia but also for Japan. In particular, an increase in domestic use of natural gas is considered a realistic option for reducing domestic oil consumption, while liquefied natural gas (LNG) has been an important export product to acquire earnings from foreign countries. Rapid adoption of natural gas as an oil alternative is an effective measure for supplying a stable primary energy in Indonesia within the short term. However, optimizing and minimizing the domestic use of natural gas by effectively utilizing coal and renewable energy should contribute to securing a sufficient amount of LNG for export as mentioned in chapter 3. Through this, trade profit may continue and status as a net energy export country can be attained.

To achieve this, establishment of a realistic national energy plan is of great importance. Also, problems with energy supply for domestic use or to the international market should be studied diligently, taking into consideration the pricing mechanism, as this has an important impact on the behavior of investors. It is essential to start the process by securing the energy supply for domestic use, then to progress through deregulation in a step-by-step manner, involving establishment of related laws to provide equal opportunity for all energy sector participants.

To implement the energy policy, applications for finance, including Yen loan and Public-Private-Partnership (PPP), should be considered, and technology transfer on effective energy utilization methods, such as clean coal technology and renewable energy technology, should be carried out. As a tool for establishing the national energy policy, preparation of a quantitative and realistic energy supply plan is vital, and technical support for this plan should be transferred through Japanese assistance.

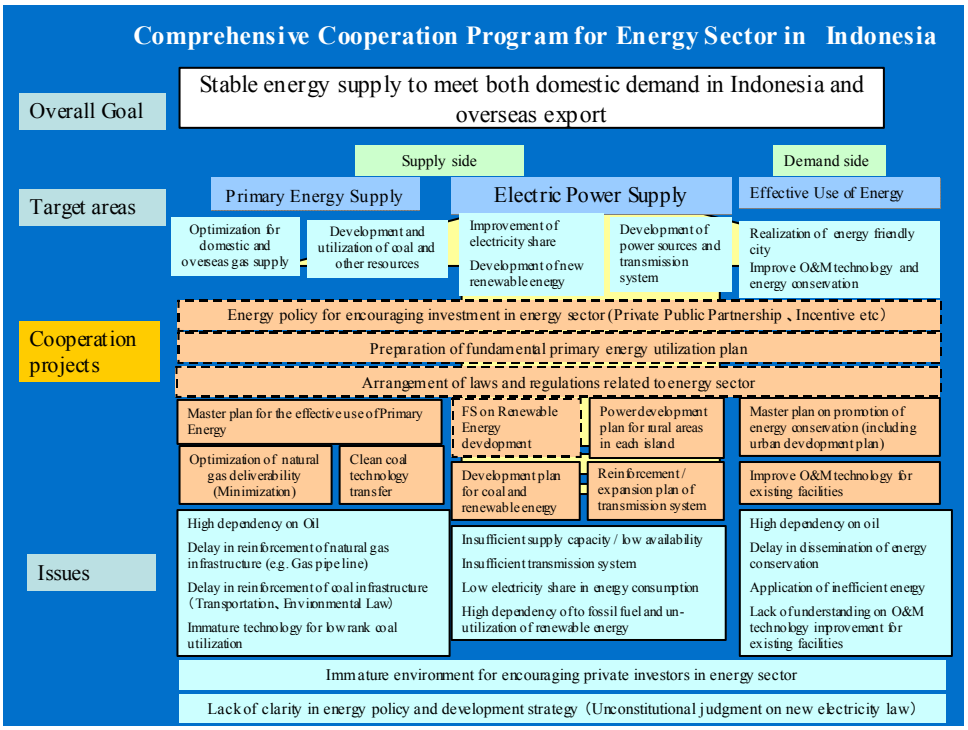


Figure 5.1.1 Comprehensive Cooperation Program for Energy Sector

5.2 Recommendations on the Assistance to Electrification as Social Infrastructure

Rural electrification has various issues to be resolved at each level of the central government, local governments and communities. On the other hand, regional development faces institutional and financial difficulties such as the establishment of regional development system, the development budget of the local government, and the increased number of local governments.

Ideally, rural electrification and regional development should be well coordinated to achieve the planned objectives. However, in reality these two systems are neither functioning properly nor coordinated effectively. In the short term, it is necessary to dispatch short-term experts regularly to grasp the possible significant changes of the environment due to the revision of the electricity law and to formulate the appropriate assistance plans. Both systems require long-term efforts and assistance. In the future, rural electrification should become an integral part of regional development programs after two systems are strengthened and well coordinated. Furthermore, it should take into consideration how to financially sustain the programs by utilizing the loan or the government budget. In addition, the incentive mechanism should be built to improve the performance of the programs.

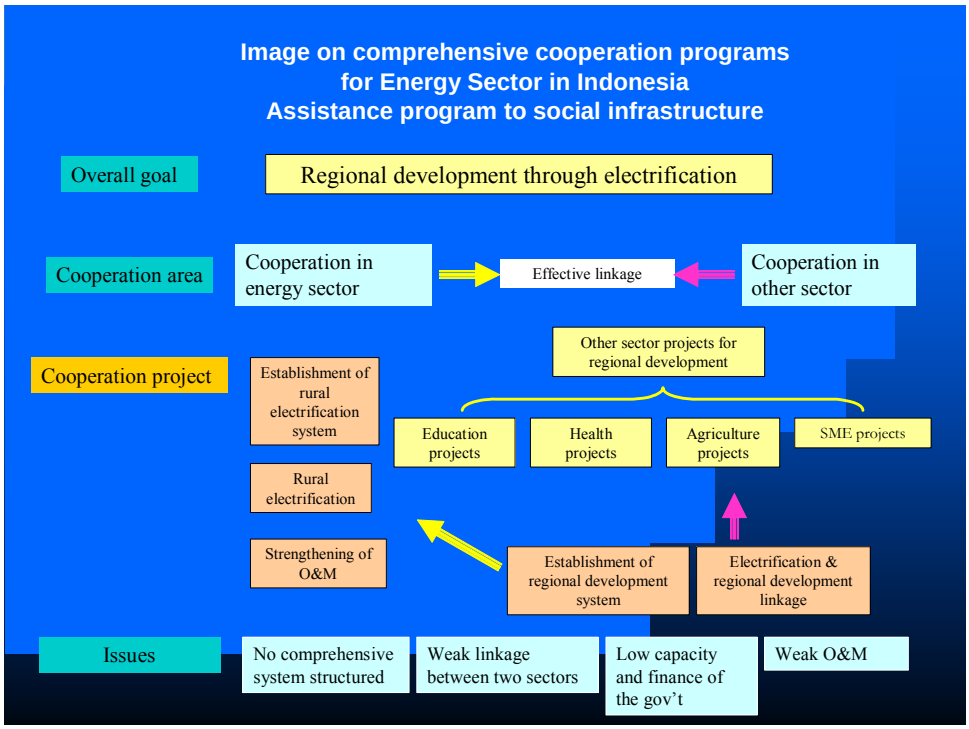


Figure 5.2.1 Assistance Program to Rural Electrification & Regional Development