INDONESIA

1. Overview of National Energy Policy

The basis for renewable energy development in Indonesia is the Presidential Regulation (Peraturan Presiden) no. 5/2006 on National Energy Policy (Kebijakan Energi Nasional, KEN). It sets a national target for the optimal energy mix in 2025 to be: (i) less than 20% from oil; (ii) more than 30% from gas; (iii) more than 33% from coal; (iv) more than 5% from biofuel; (v) more than 5% from geothermal; (vi) more than 5% from other renewable especially biomass, nuclear, microhydro, solar and wind; and (vi) more than 2% from liquefied coal.

In the same year, a Presidential Instruction (Inpres) no. 1/2006 was issued for biofuel development. The roadmap for biofuel has been prepared which aims to develop pro-growth, pro-poor, and pro-job biofuel projects in Indonesia. The government seeks to use investment in biofuel projects to provide a sustainable source of energy supply while at the same time helping to alleviate poverty and supporting national development.

The Energy Blueprint issued by the MEMR to guide the development of energy in Indonesia is based on Perpres 5/2006. The Blueprint includes a number of programs including a subsidy phase-out in the energy sector, introduction of new incentives, and introduction of a carbon tax. The Blueprint also includes roadmaps for energy development including solar, geothermal, and nuclear.

In 2004, MEMR launched the National Energy Policy (Kebijakan Energi Nasional) to provide strategic direction to energy development till 2020. That policy specifically included community empowerment to self-sufficiently develop energy supply especially in rural areas.

- Utilize local energy resources in order to reduce the costs.
- Develop the capacity of rural communities to manage rural energy services
- Implement new approaches which promote the growth of rural electrification
- Provide subsidies and other incentives for strategic action
- Establish a new system for subsidy – “Social Electricity Development Fund”

Energy Subsidy Removal Program

To reduce the burden of energy subsidies in the state budget, the government plans to increase the price of energy, particularly for oil and electricity. This is an important item in the economic restructuring program, which aims to mitigate the economic crisis, as detailed in PROPENAS (Program Pembangunan Nasional, National Development Program) 2001 Law.

Elimination of the oil subsidy will open the opportunity for developing other types of energy. Unsubsidized oil prices and electricity tariffs will help encourage industry and residential and commercial consumers to practice energy conservation. Renewable energy options, which have so far had difficulty penetrating the market because it cannot compete with subsidized oil prices, will become least-cost options in many locations.

Oil and Gas Law

The government has moved steadily to promote greater capacity and efficiency in the downstream oil and gas sectors. Oil and Gas Law No. 22/2001 stipulates that downstream oil and gas operations, including processing, transportation, storage, and marketing of oil fuel products shall proceed in a transparent manner, and that transparent pricing mechanisms based on market prices shall be established. It also ensures investors and other actors equal regulatory and legal treatment.

For the upstream sectors, oil and gas exploration and exploitation will be managed by an Executive Agency with Parliament approval. These activities will also be conducted in a transparent manner and private companies and state-owned enterprises (such as Pertamina) will have the same role in upstream activities.

Regional Autonomy Law

In order to strengthen democracy and pay more attention to community aspirations, regional autonomy laws have been enacted. Under Laws No. 22/1999 and No. 25/1999, regional governments will have a greater role in natural resource management in their respective regions, particularly in the mining and energy sectors. Each region will be able to adjust energy sector management to conform to its own socio-economic condition and the availability of energy resource in the particular region.
The energy sector in Indonesia is dominated by four key policies and objectives:

- *Diversification:* A key objective of the GOI is to reduce dependence on oil by expanding the use of coal, gas and renewable energy sources.
- *Rational Energy Pricing:* The GOI recognizes that it can no longer sustain uniform pricing for electricity and petroleum products across the country, and has begun to eliminate subsidies.
- *Energy Sector Reform:* The combination of decentralization of government decision making to give greater involvement to regional authorities and the need to attract capital for investment in the energy sector makes energy sector reform that introduces greater transparency to planning and decision-making a critical priority for the government.
- *Rural electrification:* The GOI wants to bring electricity to 90 percent of the population by 2020.

The "Indonesia Energy Outlook 2010 Study" conducted in 2002 recognized the many problems the country faces resulted from the policy of subsidizing oil fuels adopted and maintained by the government over the past few decades. Prices were set lower than market prices to enable all strata of the community to easily procure. The policy has led to an approximately 75% reliance on oil fuels in the current national energy mix.

The oil price subsidy policy put other energy options at a financial disadvantage, hampering programs for energy conservation and energy diversification. Rural electrification programs developed based on diesel generators rather than lower cost renewable energy options. As domestic oil production declined and international oil prices increased, the economic and financial cost of rural electricity service jumped dramatically. The subsidy program also encouraged economic inefficiencies. Smuggling of oil fuels to other countries proliferated during the financial crisis in 1997 when the exchange rate of rupiah to US dollars was weak and the subsidized price of domestic oil fuels was below the international market price.

To reduce the burden of energy subsidies in the state budget, the government has committed to increase the price of energy, particularly for oil and electricity. Elimination of the subsidies will open the opportunity for developing other types of energy. Unsubsidized oil prices and electricity tariffs help encourage industry and residential and commercial consumers to practice energy conservation. Renewable energy options, which have so far had difficulty penetrating the market because they cannot compete with subsidized oil prices, will become least-cost options in many locations.

Electricity Law

The financial viability of national utility Perusahaan Listrik Negara (PLN) was severely damaged by the economic crisis in the late 1990s and efforts to restructure the electricity sector were initiated in 1998. The restructuring aimed to separate the commercial, social and regulatory functions of PLN. Electricity Law No. 20 was passed in 2002 to facilitate the liberalization and privatization of the electricity sector by introducing a multi-sellers-multi-buyers system in which private investors could sell power to PLN which would control the transmission and distribution system. However, on December 15, 2004, the Constitutional Court decided that:

- The Electricity Law No. 20 of 2002 was not in line with Article 33 of the Indonesian Constitution of 1945 and it was annulled.
- All contracts issued based on Law No. 20/2002 are still valid until the end of the contracting period.
- The Electricity Law No. 15/1985 has been reenacted to replace the Electricity Law No. 20/2002.
- The GOI has to draft a new electricity law in line with Article 33 of the Indonesian Constitution of 1945.

The largest implication of this decision is to return the electricity sector to a monopoly with centralized control. With the liberalization of the energy sector, the GOI gave the Ministry of Energy and Mineral Resources (MEMR) more responsibilities to oversee market activities especially in the oil and electricity markets. In addition, there is greater emphasis on transparency and decentralization in response to delegation of greater authority to regional governments in managing energy resources in their respective regions.

Table 1. Relevant Decrees, Regulations, Policies and Laws Affecting the Indonesian Energy Sector

Law	Purpose
Presidential Regulation No.5 on National Energy Policy (2006)	▪ Set energy diversification targets for 2025 that include 5% biofuels, 5% geothermal and from other renewables. ▪ For energy conservation sets target to reduce energy intensity by 1% per year.
Blue Print of National Energy Implementation Program 2005-2025 (2005)	• Delineate measures for Indonesia to enhance energy supply security. • Provides development "roadmaps" for various sectors • Describes programs to phase our subsidies and improve of energy efficiency.
Government Rule No. 3 year 2005 on supply of Electricity (2003)	• Supports law No. 15/1985 on electricity, which was reenacted late 2005 following Constitutional Court ruling that annulled Law No. 20/2202 on electricity. • Private sector must partner with PLN to develop electricity projects. • However, companies generating power for their own use or those using renewable energy can set-up plants independently without having to partner with PLN.
Oil and Gas Law No. 22 (2001)	• Stipulates that downstream oil and gas operations, including processing, transportation, storage, and marketing or oil fuel products shall proceed in a transparent manner. • Pricing mechanisms are to be based on market prices • Provides investors equal regulatory and legal treatment.
MEMR Regulation 8 (April 2005)	• Seeks to attract private investments in exploration. • Allows an additional 20 percent cost recovery for developers of marginal oil and gas fields. • Offers more favorable split to contractors for oil and gas development in the 2005 round of bidding.
PROPENAS 2001 Law (2001)	• Reduce burden of energy subsidies in the state budget, • Increase the prices of energy, particularly for oil and electricity.
Law No. 27 on Geothermal Power (2003)	▪ Provide certainty of law to the geothermal industry. ▪ Defines new rules under which exploration and development can occur using a competitive bidding process to grant three-year licenses for exploration with possible two year extensions to complete feasibility studies.
Presidential Decree No.1 on Supply and Use of Biofuels (January 2006)	▪ Set targets for biofuels utilization.
Ministerial Decree No.	• Requires PLN to purchase electricity generated from

1122/K/30/MEM on Small-Scale Power Purchase Agreement (June 2002)	renewable energy sources by non-PLN producers for projects of up to 1 MW capacity. • Institutions eligible to participate are cooperatives, private and government companies. • Purchase tariffs will be calculated at 80% for medium voltage and 60% for low voltage of PLN's announced "Electricity Base Price" which is supposed to be its marginal production cost at the location where the plant is to be built.
Ministerial Regulation No. 2 on Medium Scale Power Generation from Renewable Energy Sources (January 2006)	• Extends the same price guidelines as MD No. 1122/K/30/MEM for projects from 1 MW to 10 MW • Sets a minimum contract period of ten years.
Ministerial Decree No. 141/Men-LH (2003)	• Make motor vehicles compliant with Euro 2 by January 2005 for new types of motor vehicles and by January 2007 for current motor types.
Ministry of Environment Mandatory Disclosure of Automotive Emissions Program (MDOAE) (2003)	• Complements Ministerial Decree No. 141/Men-LH • Help implement Clean Air Act of Indonesia • To support development and sale of environmentally friendly vehicles and prevent import of "dirty" vehicles. • Vehicle manufacturers must have their vehicles tested to measure emissions of CO, HC+NOx, and particulates using procedures developed by the program.
Regional Autonomy Law Laws No. 22 and No. 25 (1999)	• Give regional governments greater role in natural resource management in their respective regions • Each region can adjust energy sector management to conform to its own socio-economic condition and the availability of energy resource in the particular region.

2. National Programs/Policies and Targets for Renewable Energy

Renewable energy projects have received significant attention from policy makers in Indonesia. The electricity regulations for small- and medium- scale power generation from renewable energy resources described in the table above specifically seek to increase the use of renewable energy. Other electricity regulations for selling power to the grid include:

- Ministry Regulation No. 001/2006 (Revision of Regulation No. 09/2005) on Procedures for Electric Power Purchase and/or Transmission Line Leasing for Public Electricity Supply
- Ministry Regulation No. 010/2005 on Procedures for Electric Power Business Licenses for Inter-Provinces, Regions, or for National Grid Connections
- Ministry Regulation No. 1122K/30/MEM/2002 on Scattered-Small Power Generation Using Renewable Energy

- Ministry Regulation No.1213K/31/MEM/2005 on National Electricity General Plan (RUKN)
- Ministry Regulation No. 2059K/31/MEM/2005 on Establishment of PLN's Power Supply Plan for 2006-2015.

Despite efforts to clarify procedures and terms of sale, negotiation of power purchase agreements with PLN that achieve acceptable rates of return on investment for renewable energy projects remains challenging even in locations where the renewable option is significantly cheaper than the conventional diesel generators used by PLN.

Renewable Energy Policies

Green Energy Policy

To encourage development and utilization of renewable energy and to improve efficiency on energy utilization, a "Policy on Renewable Energy and Energy Conservation" – also called the "Green Energy Policy" was promulgated by the Ministry of Energy and Natural Resources on 23 December 2003. This policy provides the reference for renewable energy development and energy conservation in Indonesia to support sustainable development.

Under the Green Energy Policy, renewable energy in Indonesia has been classified into three types: (a) already developed commercially (biomass, geothermal and hydro energy); (b) already developed but still limited (solar, wind); and (c) still at the research stage (ocean energy).

The Green Energy Policy defines the following renewable energy strategies:

- Determining energy price in accordance with the economic aspect;
- Encouraging the development of renewable energy and energy conservation infrastructure which is supported by the society;
- Prioritizing the use of renewable energy;
- Implementing energy saving principles in energy management;
- Applying energy saving life style;
- Increasing the role of stakeholders in the utilization of renewable energy and energy conservation;
- Improving cooperation at the national, regional, and international levels especially in the context of information access, financing, and transfer of technology;
- Encouraging the use of domestic services and goods in the field of renewable energy and energy conservation;
- Improving the quality of human resources in the field of renewable energy and energy conservation;
- Improving the renewable energy and energy conservation supporting ventures in the country;
- Improving the society's access to energy;
- Formulating the priority scale of renewable energy development based on available potential and technology, financial, and social feasibility.

The Green Energy Policy defines actions steps consisting of formulation of more specific policies and programs. These include policies for: (a) investment and funding; (b) incentives; (c) energy pricing; (d) human resources; (e) information dissemination; (f) standardization and certification; (g) research and development; and (i) institutional development.

Distributed Small Scale Power Generation (PSK Tersebar)

In June 2002, MEMR issued a new regulation for small renewable energy projects interested in selling power to PLN known as PSK Tersebar (Ministerial Decree on Small-Scale Power Purchase Agreement (MD No.1122/K/30/MEM/2002). The regulation requires PLN to purchase electricity generated from renewable energy sources by non-PLN producers for projects of up to 1 MW capacity. Institutions eligible to participate are cooperatives, private and government companies. Purchase tariffs will be calculated at 80% for medium voltage and 60% for low voltage of PLN's announced "Electricity Base Price' which is supposed to be its marginal production cost at the location where the plant is to be built.

The first project was completed in December 2003 with PLMTH Kalimaron, a community based organization in Seloliman, East Java, which owns a 25 kW micro-hydro power plant. PLN agreed to buy its excess generation of 12 kW. This provided extra earning of IDR 3,000,000 (US$300) per month. The following shows the other plants operating under PSK Tersebar as of September 2005.

Table 2. Plants operating under PSK Tersebar in 2005

	Installation	Price	Comments
1	Micro Hydro Curung Agung, 12 kW, Subang, West Java	Rp 432/kWh	60% marginal production cost for low voltage Yearly extendable contract
2	Micro Hydro Cinte Mekar, 100 kW, Subang, West Java	Rp 432/kWh	60% marginal production cost for low voltage Yearly extendable contract
3	Micro Hydro Waikelosawah, 14 kW, West Sumba, NTT	Rp 218/kWh	Not in line with PSK Tersebar In process of adjusting price
4	Micro Hydro, 25 kW, Mojokerto, East Java	Rp 341/kWh	80% marginal production cost for medium voltage Marginal production cost reduced from first year

Despite the regulation, it remains challenging to negotiate agreements. The following table shows additional projects under negotiation (DGEEU, 2005). Although the number

of projects participating in the program has increased, the extendable one year contracts make it difficult to obtain financing from financial institutions. Program growth is also constrained by the lack of clarity in how to calculate the tariff and the need to negotiate each deal with the local PLN office where the project will be located.

Table 3: Plants in Negotiation for PSK Tersebar Contracts in 2005

	Installation	Price	Comments
1	Micro Hydro Dompyong, 25 kW, Trenggalek, East Java	Rp 302/kWh	60% Marginal production cost for low voltage Yearly extendable contract
2	Micro Hydro Santong, West Lombok, NTB		Low voltage Rehabilitation of existing plant
3	Micro Hydro Anggrek Mekar Sari, 900 kW, Pasaman, West Sumatra		Medium voltage Under construction
4	Micro Hydro Kalumpang, 1 MW, Luwuk, Central Sulawesi	Rp 470/kWh	Medium voltage Commissioning test Price not in line with PSK Tersebar
5	Micro Hydro Hanga Hanga, 2x1 MW, Luwuk, Central Sulawesi	Rp 470/kWh	Medium voltage Price not in line with PSK Terseber 20 year contract
6	Micro Hydro Wangan Ali, 120 kW, Wonosobo, Central Java		Medium voltage Under construction
7	Micro Hydro Ulu Danau, 224 kW. South Sumatera		Medium voltage Under construction
8	Micro Hydro Cipayung, 250 kW, Bogor, West Java		Medium voltage Rehabilitation
9	Micro Hydro Cileunca, 900 kW, Pangalengan, West Java		Medium voltage Land Acquisition
10	Micro Hydro Curug Gede, 120 kW, Luwuk, Central Sulawesi	Rp 470/kWh	Medium voltage Commissioning test Price not in line with PSK Tersebar 20 year contract
11	Wind TurbineNusa Penida, 80 kW, Bali		Medium voltage Under construction
12	Wind Farm, 960 MW, Soe, NTT		Medium voltage Documentation in process

In January 2006, MEMR issued Ministerial Regulation No. 002/2006 on Medium Scale Power Generation from Renewable Energy Sources that applies the same price guidelines for projects from 1 MW to 10 MW and sets a minimum contract period of ten years.

Biofuels

In 2006, the government of Indonesia launched a plan to rapidly develop a biofuels industry and pledged to invest a total of Rp 13 trillion (US$1.4 billion) to encourage the development of the country's fledgling biofuel industry. They plan to allocate nearly 500,000 hectares of land for new biofuels development in 2007. Under the plan, Indonesia will use palm and jatropha as the primary feedstocks for biodiesel, and sugarcane and cassava as the primary feedstocks for ethanol. A national standard for biodiesel was established in 2006. Following successful tests in 2006 by PLN, Indonesia also plans to use an 80% blend of pure palm oil with diesel to replace diesel for power generation in power stations off the main grid that now use diesel. Because of the minimal processing, pure palm oil is less expensive to produce than biodiesel. Indonesia also and plans to develop a Bio Oil product to displace household uses of fossil fuels. The following table gives production targets through 2025.

Table 4: Biofuel Production Targets through 2025

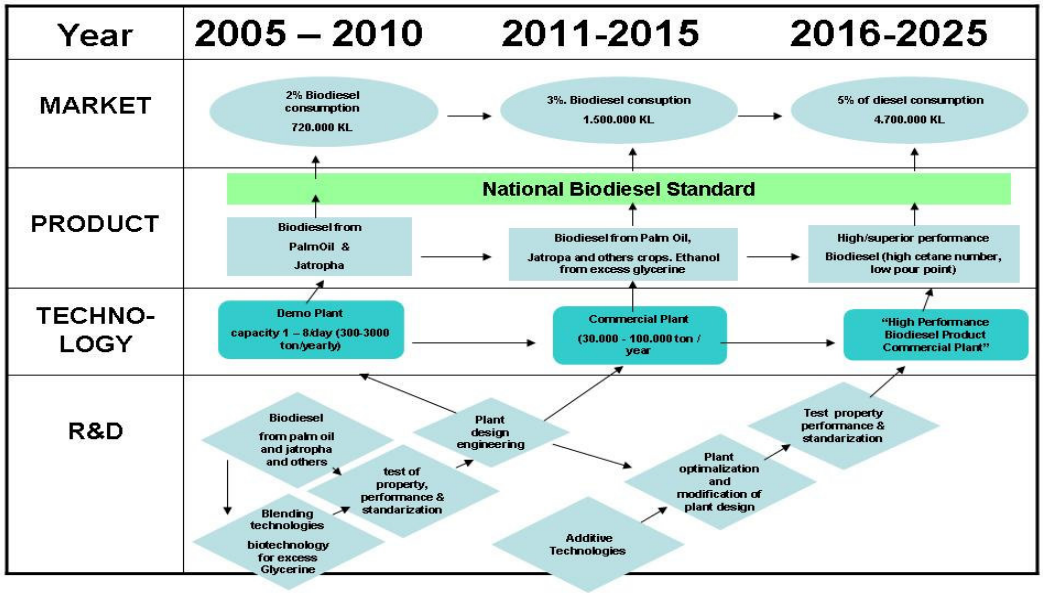
Type of Energy	Unit	2010	2015	2020	2025
Biodiesel	kl	720.000	1,500.000		4,700.000
Gasohol	kl	550.000	850.000	1,500.000	
Bio oil	kl	400.000	700.000		900.000

Biodiesel: Biodiesel is made by combining vegetable oil with an alcohol through a process called transesterification, and can be made from a range of feedstocks. Pertamina began distributing a 5 % blend of biodiesel in May 2006 through 197 retail outlets in Jakarta, adding 12 retail outlets in Surabaya in August. Indonesia is the world's second-largest palm oil producer. Currently, two companies supply the biodiesel being used by Pertamina. The Indonesian company PT Bakrie Sumatera Plantations Tbk announced plans to build the country's first modern biodiesel plant in a joint venture with the construction firm PT Rekayasa Industri. The plant, projected to cost $25 million, would add capacity to produce 60,000-100,000 tons of biodiesel per year. Indonesia, which consumes 27 million kilolitres of diesel oil per year, plans to expand production to 4.7 million kilolitres by 2025. The figure below shows the Road Map for Biodiesel development. The plan does not consider other promising pathways for the production of biodiesel.

Feedstock represents 70-80% of the total cost for biodiesel. When the Indonesian biodiesel program was launched, the price of palm oil was low enough that biodiesel

could be produced for less than the price of diesel. Oil prices have declined slightly and disruptions in international vegetable oil markets have pushed up prices for palm oil so that the cost to produce biodiesel at the end of 2006 is greater than the cost of diesel.

Figure 1. Road Map on Biodiesel



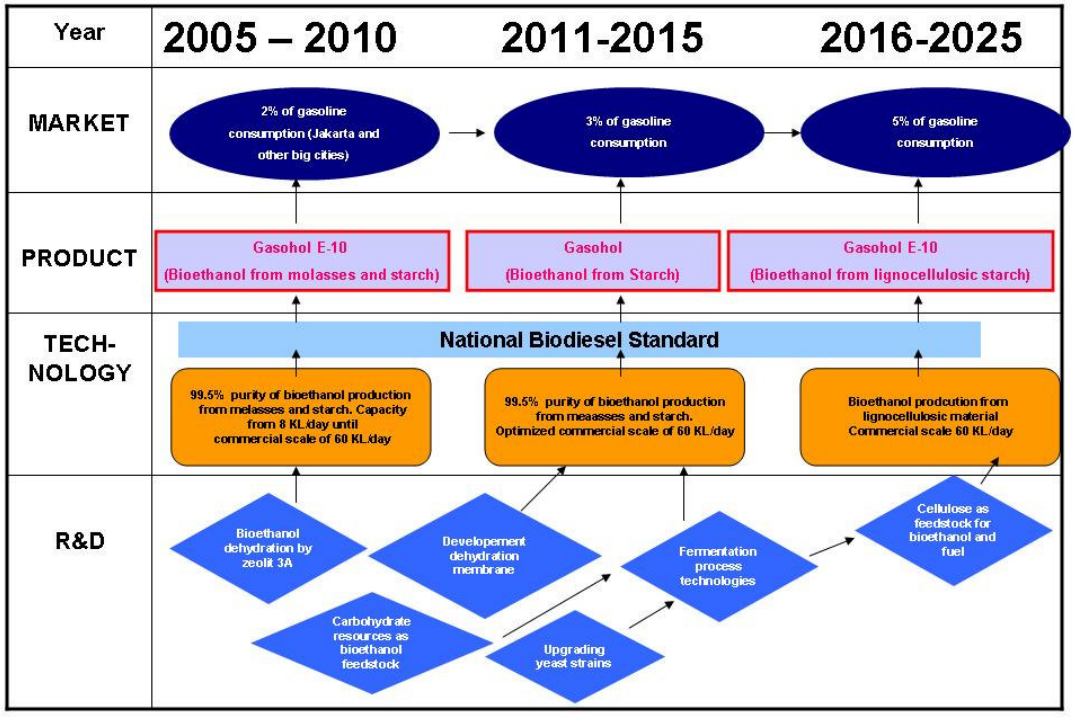
Ethanol Fuel: Ethanol can be made from a variety of sugars and starches with a fermentation and distillation process. In most countries, ethanol has been introduced to markets as a straight blend with gasoline. Most automobile manufacturers warranty their cars for blends with up to 10 % ethanol. Ethanol has some solvent characteristics that in higher concentrations can cause corrosion of certain metals and deterioration of some plastics and rubbers used in gaskets and hoses. Ford and General Motors both manufacture flexible-fuel versions of some of their vehicles that can accommodate up to 85% ethanol. However, the solvent characteristics of ethanol can cause greater problems in the ethanol distribution and storage infrastructure.

Progress with the introduction of ethanol blends in Indonesia has been slower. Pertamina has begun sales of an ethanol blend at one station in Malang. The figure below provides the Road Map for Bioethanol in Indonesia. Notably, it does not address distribution and storage issues for ethanol fuels. Although, the fermentation process has been known for thousands of years, significant improvements have been made in recent decades that reduce the costs and energy requirements of the process. New enzymatic hydrolysis processes hold the promise of producing ethanol from lignocellulosic materials. The Road Map for Indonesia does include research on lignocellulosic paths to the production of ethanol in later years.

For ethanol, feedstocks represent 50-70 % of the total cost depending on the feedstock selected. Brazil is the lowest cost ethanol producer in the world and believes it can produce ethanol to compete with crude oil at as little as $35 per barrel. The estimate of

the price at which ethanol from corn becomes competitive without subsidies in the United States is $55 per barrel of crude.

Figure 2: Road map on Bioethanol



Pure Palm Oil: Pure vegetable oil can be burned directly in most diesel engines saving the cost of transesterification. Because the viscosity of pure vegetable oils increases as temperatures decrease, it is not commonly used as a direct fuel in temperate climates. Different oils have different characteristics and some (e.g. coconut oil) blend more easily with diesel fuel than others. In Indonesia's climate, it should be possible to use pure palm or jatropha oil in diesel engines with minor engine modification. PLN has been actively experimenting with the use of pure palm oil for its remote diesel generators and announced in December 2006 that it would expand the program to other sites. (Jakarta Post, 2006) It has asked regional mangers to survey their regions for potential local suppliers who may be willing to provide pure palm oil under contract to PLN.

National Policy for Biofuels

Introduction of biofuels can have a broader impact on national economic development than reducing fuel costs and emissions. In Indonesia, plans call for both biodiesel and bioethanol to be produced from agricultural crops. Achieving the production targets set out in the Road Maps will require investment to increase yields of existing crops and to expand planted area. It can also produce higher revenue per hectare and create jobs in rural areas where the majority of Indonesians live.

Presidential Instruction on Biofuels issued in 2006 underscores the need for a multi-sectoral approach to biofuels development and commercialization and illustrates the

complexity of implementing a successful program. The Presidential Instruction specifies roles for eleven different ministries in biofuels development as outlined in Table x. A special budget of $11.2 million for 2006 was allocated to four ministries: Agriculture, Industry, Research and Technology and Energy and Mineral Resources.

Table 5. Roles Assigned Collaborating Ministries for Biofuels Develoment

Ministry	Roles
Coordinating Minister for Economy	Coordinate the preparation of the Implementation Plan for the utilization of biofuel as a replacement for other fossil fuels (petrol and diesel in particular)
Ministry for Energy and Mineral Resources	Coordinate the compilation of policy incentives for biofuel utilization developers (except in those where the raw material to be used to make biofuel is already commercial) Compile and provide standard for biofuel quality Design a system and simple procedure to test biofuel Prepare simple licensing & business regulations for biofuel to fit in to the existing fossil fuel regulations. Coordinate the utilization of biofuel through the Coordinating Agency for National Energy (BAKOREN)
Ministry of Agriculture	Provide information to developers/growers of biofuel crops especially on *critical* land Facilitate supply of seeds and seedlings Push for the integration of growing and after harvest processing of biofuel
Ministry of Forestry	Provide licenses for forestry areas that are not productive and can be used for growing biofuel crops
Ministry of Industry	Increase the development of local facilities for biofuel production Push and encourage the development of biofuel processing industry
Ministry of Transport	Facilitate the increased utilization of biofuel in this sector
State Ministry of Research and Technology	Coordinate research and development of growing, processing and utilization of Biofuel
State Ministry of Cooperatives and Small Enterprise	Help and push cooperatives and small and medium enterprises to participate in growing and processing biofuel crops
State Minister of State-Owned Companies	Push state companies in agriculture and plantations to participate in growing and processing

	biofuel crops Push state companies in the industry sector to develop biofuel processing plants Push state companies in the field of engineering to develop biofuel processing technologies
Ministry of Interior	Coordinate with the Governors and Regents to facilitate the availability of land in their respective areasfor the growing of biofuel crops.
Ministry of Finance	Provide fiscal incentives for the biofuel sector, growers and biofuel processing industry

Sustainability Issues - Land Clearance and Biodiversity

Increasing demand for biofuels as countries seek alternatives to diesel and gasoline will require identification and development of new feedstocks. Indonesia announced a plan in 2006 to set aside an additional 500,000 hectares of land for development of palm oil plantations. Several NGOs have expressed concern that development of biofuels could have negative impacts on the environment and on the people living in areas targeted for biofuels development. Environmental impacts include increased pressure on forests and other areas of critical biodiversity, expanded use of fertilizers and pesticides, and effluents from the biofuel processing facilities. Social impacts include pushing local people, especially the poor, off of the land they depend upon for survival and exploitative labor practices.

Recent studies by WWF, Friends of the Earth, and Greenpeace have highlighted the environmentally and socially destructive nature of the palm oil industry in South East Asia, one of the leading suppliers of feedstock oils for the biodiesel industry. While most palm oil is used in the food processing, cosmetic industries, and other non-fuel industries, anything that increases the demand could exacerbate the problem.

From a base of 120,000 hectares in 1968 there are now around 5 million hectares of land in Indonesia given over to palm, most of it owned by a few large producers. At least 19 million hectares more have been earmarked for plantations by provincial governments, while the central government has said there are 27 million hectares of 'unproductive forest land' available for development. Land clearance not only has implications for the health and sustainability of ecosystems, but also for climate change. Bringing forest, peatland or grassland under cultivation releases CO_2 into the atmosphere.

Renewable energy development initiatives

The Blue Print for the National Energy Plan 2005 – 2025 sets out targets for renewable energy development. Table 11 shows the targets through 2025. Indonesia has successfully developed a wide range of renewable energy applications.

Table 6: Targets for Renewable Energy Development through 2025

Type of Energy	Unit	2010	2015	2020	2025
Geothermal	MW	3,442	4,600	6,000	9,500
Wind	MW		25.6		255
PV	MW	25	50	70	80
Micro Hydo	MW	169	298	488	700

Solar Photovoltaics Application Projects

Demonstrations and Pilot Projects: The first rural electrification in Indonesia using photovoltaic cells packaged as solar home systems was in Sukatani village, Java, where 85 SHS (solar home systems), public lighting systems and 15 streetlights were installed in 1989. The program was funded by the Dutch aid agency DGIS, and involved the BPPT, the Ministry of Co-operatives, the local government and the international and local branch of the PV manufacturer "R&S" (now Shell Solar). The success of the Sukatani project led to a similar rural electrification scheme in the village of Lebak, in which a further 500 45Wp SHS were installed. By the end of 1996, government sponsored solar PV projects and private initiatives had resulted in the installation of over 1 MWp of PV capacity in rural areas.

These pilot programs were followed by the Presidential Aid Programme (BANPRES), which provided interest-free credit for 3,000 SHS. Programs to disseminate solar home systems in Indonesia have faced difficulties with cost recovery as they are often initiated by donors or government agencies rather than as a response to a market demand. Consequently, they can be perceived as entitlements rather than commercial transactions (see more detailed BANPRES description below).

PV systems were first demonstrated in Indonesia in 1979 through a water-pumping project carried out by the German Aid Agency, GTZ, with the assistance of the Indonesian government. Since 1993, the Department of Health had installed 270 medical clinics with PV-powered lighting and refrigerators, requiring around 75,000 PV modules. Eight hybrid mini-grids had also been installed in eastern Indonesia (Nusa Penida). The hybrid generators used a meter prepayment system, which aimed to match customer consumption with ability to pay.

Additional major projects included the GTZ Eldorado Sun, a project funded by the German Aid agency GTZ that developed solar pumping projects on four islands, and a project funded by the Australian Aid agency, AusAid that aimed to install 36,400 50Wp SHS.

In 1997, the GOI set a target for 50 MWp of PV by 2005, to be installed across 6,000 of the 13,000 islands of Indonesia. In the same year, the World Bank and the Global Environment Facility (GEF) launched a project to assist the Government of Indonesia (GOI) achieve its one million SHS target, providing funds for the installation of 200,000 PV systems (10 MWp) for households and commercial establishments in West Java, South Sulawesi and Lampung, Sumatra. The plan was to concentrate on 50 Wp solar home systems. Solar equipment was to be exempted from import tax and duties if equivalent products were not manufactured in Indonesia.

Unfortunately, the financial crisis hit Indonesia starting in 1997 reducing the affordability of 50 Wp systems and although the program was modified, only $0.1 million of the $20 million had been used by December 2000 and the World Bank loan was closed early. The GEF grant was reconfigured. By 2003, a total of 8,054 solar home systems had been installed.

Promoting a Domestic PV Industry: In recognition of the potential market in Indonesia, all of the major international photovoltaic power system manufacturers, including BP Solar, Kyocera, Shell Solar, Siemens and Solarex have a subsidiary or local distributor in Indonesia. They seek to maximize the use of local components and employ local labor for installations in order to keep costs down. The primary weaknesses in the Indonesian solar industry are the lack of local manufacturing facilities for high quality batteries and for photovoltaic modules.

The government actively supports development of solar PV applications. The lead institution for PV testing and standards has been the BPPT. BPPY has developed several laboratories, including equipment to test electronic control devices and a computer-based data acquisition system, as well as PV pumping and battery test facilities. BPPT closely monitors the standards and performance of systems installed under the existing SHS projects and has worked with the private PV industry to develop standards for SHS. The BPPT lab has obtained ISO17025 accreditation for testing PV components and has carried out testing for PV systems used in other countries.

Evolving Financing Mechanisms: The Indonesian government identified the lack of appropriate financing as an impediment to increased use of photovoltaic systems for rural electrification. BANPRES was created to address this shortcoming by providing interest free loans through village level Local Cooperatives (KUDs) in 13 provinces. Purchasers were required to make an initial or down payment of 5 % of the 400 USD cost, followed by payments of approximately 3 USD per month for ten years. This was equivalent to the monthly fee if connected to the grid.

Although the program led to the purchase of around 3,300 systems, it did not succeed as a financing program. Consumers expressed the need to make the down payment by installments over several months and by 1993, BANPRES fee collection was in arrears by 40 %. A major problem has been the need to replace batteries, the high cost of which often resulted in the purchase of inferior technology and poor system performance further

hampering repayments. Defenders of the program maintained that the targeted end users did not have sufficient income for repayment

Subsequent government projects focused on end-users that could pay for the systems on a consumer-financing basis. Three major local dealers - Pt. Sudimara, Pt. Kyocindo and Pt. Walet - offered short term credit (3 years) at around 18 % interest with a 30 % down payment. Typical monthly fees of around 8 USD were required. In 1995, Sudimara reported system sales at 400 USD plus 10 % VAT. Around 10 % to 15 % of sales were cash. Credit terms were 140 USD down payment and 40 monthly payments of 10 USD interest at 1.5 % a month. These were being sold through regional service centers (with a potential market of approximately 10,000 to 20,000 families per service center) in three provinces. One PV manufacturers has focused on the outer provinces, where publicly funded programs usually do not reach. The company has sold thousands of units over the past decade. In general, payment plans lasting longer than two years do not seem to work because of the problems with battery failure, at which time collection rates fall sharply.

In general, successful companies emphasize the development of strong local dealers including the provision of supplier credit for dealers. as more crucial for successful marketing and distribution. Many systems have sold for cash, proving that lack of effective dealers may be more of an immediate constraint than the absence of special financing mechanisms to SHS users. Accelerating market growth will require mechanisms to expand affordability for lower-income customers

Biomass for Power Generation [1]

Biomass is the traditional and oldest energy source in Indonesia, accounting for around 35 percent of total energy consumption. Most biomass is used to meet energy needs for cooking and small rural enterprise. Many forest products and agricultural processing companies use their wastes to supply heat for process needs. Several also generate electricity with total installed power capacity of 302 MW (Agus 2006). New projects are being developed including a 30MW plant in east Kalimantan and a 10.3 MW plant in Northern Sumatera.

National studies estimate the potential electricity generation potential to be about 50 GW from the roughly 150 million tons of biomass residues produced per year equivalent to roughly 470 GJ/year. However, these studies estimate the main source of biomass energy in Indonesia to be rice residues with a technical energy potential of 150 GJ/year. Indonesian policy requires rice processing to occur close to where the rice is grown so most rice processing occurs in small decentralized plants. Rice husks have low bulk density and are expensive to transport so the technical potential from rice residues overstates the economically viable potential.

[1] Asia Pacific Energy Research Centre, "New and Renewable Energy in the APEC Region – Prospects for Electricity Generation" – Institute of Energy Economics, Japan – www.ieej.or.jp-aperc-pdf-nre_report2004.pdf.url

Other potential sources are rubber wood with 120 GJ/year, sugar residues with 78 GJ/year, palm oil residues, 67 GJ/year, and the rest with smaller than 20 GJ/year are from plywood and veneer residues, logging residues, sawn timber residues, coconut residues, and other agricultural wastes. Development of biofuels will likely expand planted areas for some crops and increase the use of residues to provide the heat and power needed for biofuel production.

Wood processing industry. Although there are over 400 sawmills producing wood residues ranging from 10,000 and 50,000 m^3/year, very little has been used to generate electricity. Most sawmills generate power with diesel generators. Plywood factories use wood wastes to generate process steam needed for dryers and hot presses so they are familiar with the operation of boilers but most do not generate power. An estimated 40 plywood factories produce less than 50,000 m3/year of wastes while 70 plants produce between 50,000 to 200,000 m3/year. The ASEAN COGEN programme supported development of a 5.5 MW wastewood power plant at T Siak Raya Timber in Pekanbaru, Sumatra. Earlier feasibility studies and demonstration projects show favorable returns on investment for biomass cogeneration. With the elimination of diesel subsidies, many of these projects will have very high rates of return.

Sugar industry. At present, there are 56 sugar mills in operation in Indonesia. with a large potential to produce excess electricity from bagasse. Three co-generation plants utilizing bagasse with a combined total capacity of 25 MW are planned in Java (18MW), Sumatra (6MW) and Sulawesi (1MW). Another 12 bagasse projects are planned with a total combined capacity of 104 MW. These plants are to be located in Sumatra (38 MW), Sulawesi (13MW), Kalimantan (4 MW) and Java (29 MW). Some 100 MW of (mostly biomass and bagasse co-generation) projects have been identified for power generation and supply to the grid, under the PSKSK (SPPA) arrangements with the utility purchasing the excess power at fixed rates.

The GOI has an active policy to relocate sugar cane fields from East Java to Kalimantan, Sumatra and Sulawesi. Setting up mill to process the newly developed sugar cane plantations outside Java offers an immediate opportunity to install new cogeneration systems, some in locations that currently depend heavily on diesel generators for power supply. In these locations, financial rates of return for investments in cogeneration will also be high.

Financing biomass cogeneration: Although financial rates of return will be high for cogeneration investments at plywood and sugar factories, it will be difficult to mobilize private capital for investment. Traditional lenders in these sectors are not familiar with energy investments. Capital requirements are high compared to the investment made in processing plant equipment and cost recovery normally occurs over longer time periods.

Geothermal Energy

The nearly 200 volcanoes and 100 geothermal fields make Indonesia a promising area for geothermal power generation. As of 2002, there had Geothermal development started in

Indonesia as early as the 1920s with its first shallow steam wells drilled at the Kamojang Province. The field, which produced 250 kWe in 1979, has been producing 140 MWe from dry steam since 1985. Expectations for geothermal power development were high in the early 1990's when independent power contracts were awarded for eleven projects with a total committed capacity of 3,417 MW. The financial crisis in 1997-98 led to the suspension of seven geothermal projects. As of 2005, Indonesia had developed 802 MW out of an estimated potential 30,000 MW.

The primary barriers to development of Indonesia's geothermal resource has been pricing for electricity and a shifting regulatory environment. Geothermal resources were managed by Pertamina until 2000 when they were transferred to regional authorities. In October 2003, the GOI passed a new Geothermal Law No. 27/2003 to promote a more favorable business environment for geothermal. Under the law, geothermal exploration and development are conducted under a license following competitive bidding on prospective sites. They have three years to conduct exploration (with a possible two-year extension) and then two years to complete a feasibility study.

Significant progress was made to develop geothermal projects in 2005 and 2006 with constructions started on a 110 MW plant being jointly developed by Pertamina and Cheveron Texaco and commitments made for 300 MW to a joint venture between PLN and Pertamina in North Sumatera. Several smaller plans also began development. Local company Star Energy announced in November 2006 that it had found what it claims is the world's largest geothermal steam well at its Wayang Windu concession in West Java. The company said the discovery would allow them to expand the Wayang Windu geothermal plant to 400 MW by 2010. The Wayang Windu geothermal power plant started operation in early 2000. Star plans to bring the second unit online in 2008, adding 110 MW to the power plant's existing capacity of 110 MW (US Embassy 2006).

The Blue Print projects geothermal capacity will grow to 9500 MW by 2025. Figure 3 shows the distribution of geothermal potential across Indonesia.

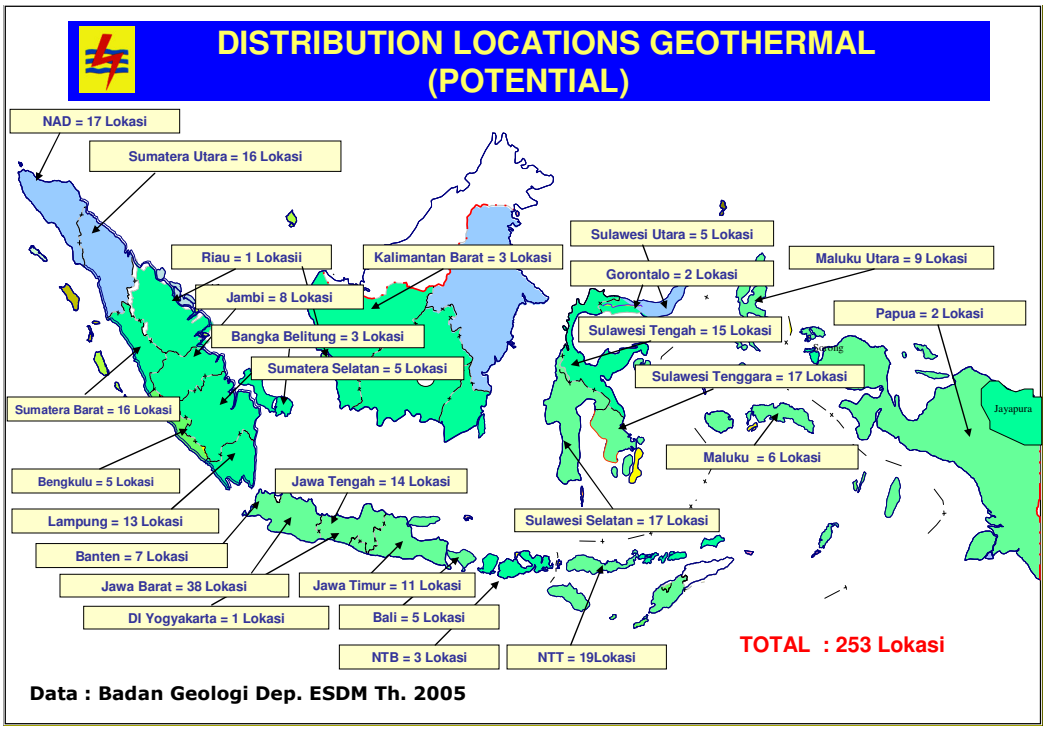


Figure 3. Distribution of Geothermal Potential Across Indonesia (Agus 2006)

Pricing will continue to be the biggest challenge for geothermal projects to overcome. The surge in development in the 1990s was stimulated by electricity prices between $0.069 and $0.085. PLN is seeking to pay prices under $0.05/kWh.

In general, geothermal projects require the more capital to develop than other projects. The project developer must invest in drilling to map and evaluate the quality of the resource prior to the investment in capital to build the plant. Of course, the higher capital costs are offset by the zero fuel cost (unless you treat the resource mapping as an up-front fuel cost) but it will be hard for private developers to move forward with these projects without greater confidence in the long-term pricing for electricity.

Small Hydropower

Indonesia has abundant hydro resources and success with development of micro. mini, small and large plants over the past decades. Hydro contributed 12.9 TWh to total electricity supply in 2005. Official data estimates the national hydro potential at about 75 GW with small hydro project accounting for only 500 MW. Because of the processes used for these estimates, the small hydro potential is likely larger than 500 MW although still a small percentage of total potential.

The current installed capacity for all hydro plants is about 4,260 MW of which small hydro makes up about 64 MW. There is a significant portfolio of small hydro projects in planning or under construction. Hydro sites under 10 MW will likely receive significant

private interest following the change in the law requiring PLN to purchase power from plants up to 10 MW. Financing will be the major challenge because of the difficulty in negotiating long-term power purchase agreements from PLN.

Hydro systems with capacities below 500 kW are an important component of community-led rural electrification efforts and for meeting power needs of small rural industries.

a) German-Indonesian Mini Hydro Power Project (MHPP)

The Mini Hydro Power Project (MHPP) is a continuation of German-Indonesian cooperation in the mini-hydro sector started in 1991. The first phase of MHPP (1991-96) focused on the introduction of MHP technology to local institutions and individuals active in micro hydro project development. In the second phase (1999-2002), the scope of intervention was broadened to include policy dialogue, scaling up MHP technology packages, and improving operation and management practices applied..

The project has developed a variety of MHP technology packages together with local manufacturers in Java and Sumatra, which have been applied in more than 100 installations over the past 10 years. These schemes presently supply over 20,000 families with a clean sustainable source of energy.

b) IBEKA Mini Hydro Projects

Institut Bisnis and Ekonomi Kerakyatan (IBEKA) or People Centered Business and Economic Institute is an NGO involved in renewable energy development, particularly micro-hydropower systems. IBEKA's goal for their micro hydro development projects is to empower the community. IBEKA has assisted communities to build small hydro power plants that produce excess electricity, which is sold to the national grid.

Community-Based Integrated Renewable Energy Projects

There have been initiatives to provide energy through RETs that integrate energy development with the overall rural development strategies in target communities. Table 7 lists several community-based projects.

Table 7. Community Based Projects

Program	**Activities**
UNDP-GEF-SGP Community Based RET Projects	Demonstrate use of renewable energy to generate rural income Technologies: biogas, solar dryers, pico- and micro-hydro, solar lanterns,
E7 AIJ Pilot Project	Implemented from 1997-2000 Technologies: solar home systems, micro-hydro Brought electricity to 4000 people in 8 communities

YBUL Renewable Energy Project	Technologies: Micro-hydro, solar dryers
WOMINTRA Village Level Energy Projects	Technologies: Micro-hydro, solar home systems, PV for telecommunications
Yayasan Dian Desa Biomass Energy Projects	Technologies: Improved stoves to reduce indoor air pollution

PROGRESS TOWARDS MEETING RE TARGETS

The key barrier to scaling up clean energy projects in Indonesia continues to be the difficulties associated with achieving acceptable rates of return on investment. Demand side energy efficiency must overcome the low cost of electricity, the limited buying power of the majority of energy consumers, and the lack of fuel efficiency standards for vehicles, all of which suppress investments to reduce power and fuel consumption. Supply side energy efficiency projects in the power sector are possible and can be scaled up by working with PLN, but they must compete for capital with investments needed to expand generating capacity to meet growing demand.

In the electric power sector, project developers continue to face challenges to negotiate and sign power purchase agreements with PLN. Projects that want to sell power to the Java-Bali grid must compete with relatively low power generation costs. Projects that sell power to the many mini-grids primarily supplied by diesel generators with high power generation costs must negotiate purchase agreements with PLN.

Despite policies that attempt to make the negotiation process more transparent, project developers face the underlying reality that the price for which PLN sells power is significantly lower than the cost of production. PLN loses money on almost every kWh sold in areas off the main grid so simply expanding supply with clean energy sources increases losses and must be budgeted. Theoretically, buying power from clean energy sources that are less expensive than current diesel plants allows available subsides to support expanded rural supply. However, long term contracts require careful planning because of the implied commitment of future subsidies and are challenging to administer in a volatile fuel market based on cross-subsidies from urban consumers for a decentralized system that necessarily involves multiple layers of government. The government continues to make progress in the clarification of policies to make the process of negotiation with PLN more transparent but the process is slow.

The fossil fuel sector faces the same return-on-investment barrier but decisions in this sector are driven by national economic and environmental considerations. With declining oil resources and high international oil prices, Indonesia has increased its use of coal and plans to dramatically expand coal use over the next three years adding 10,000 MW of new capacity with coal projected to supply more than 60% of primary electricity generated by PLN by 2010. Decisions made on the environmental standards for the new fleet of coal power plants will have major implications for emissions of SO_X, NO_X, particulates, and other pollutants associated with coal combustion. Decisions made on the efficiency of the new fleet of coal plants will have major impact on future CO_2

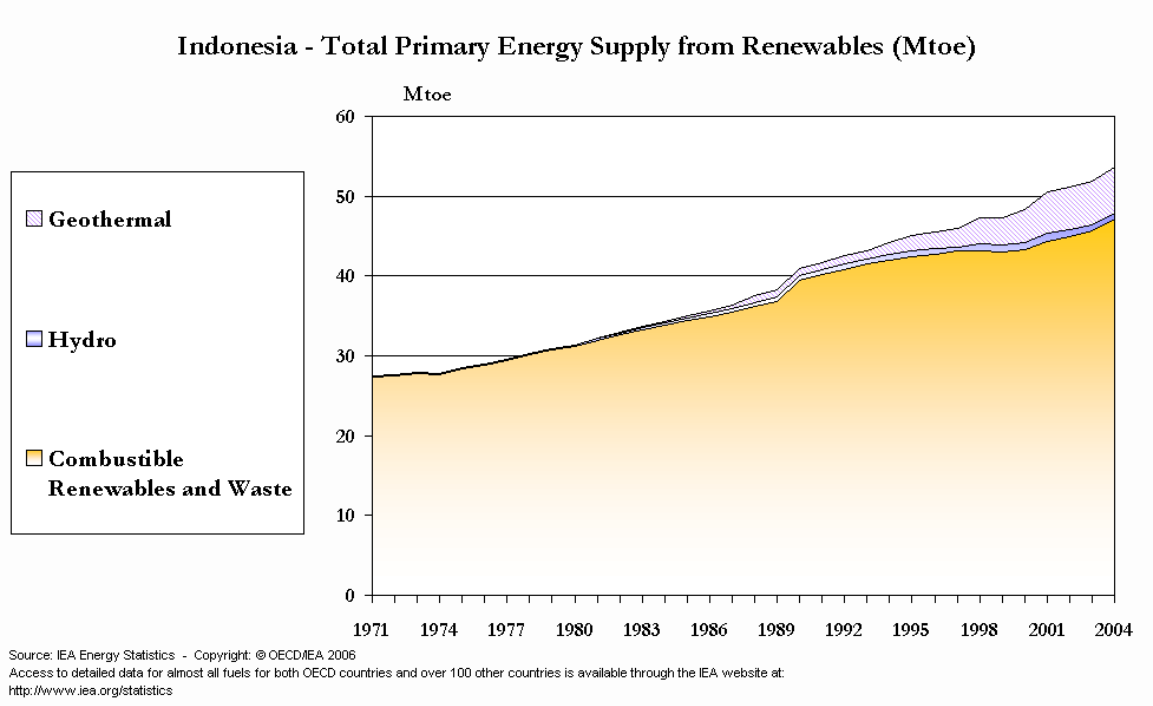
emissions. The government of Indonesia plans to seek international tenders and must decide what environmental standards to apply knowing that stricter standards will increase capital costs but produce measurable health benefits.

Low domestic prices for electricity and petroleum products has led to Indonesia's high energy intensity and created a significant burden on the government budget. In 2004, about $7.9 billion dollars went to fuel subsidies equal to 14 percent of government expenditures.

GROWTH RATE IN RENEWABLES DEPLOYMENT

Indonesia has a wide variety of abundant energy resources including fossil and non-fossil resources and has been a net energy exporter for many years. The primary energy source fueling Indonesia's economy continues to be oil although decreasing domestic production, increasing domestic consumption and global price hikes over the past few years have reduced oil consumption and prompted efforts to develop other domestic energy resources. Coal will be the primary domestic resource used for new power generation. The second most important fuel source for Indonesia's population is biomass although most of its use occurs in the informal part of the economy. Biofuels are planned to be the primary domestic resource developed to diversify transport fuels.

In addition to the role they play in the energy sector, oil and gas together continue to lead export earnings for Indonesia increasing to $19.2 billion in 2005 from $17.6 billion in 2004 compared with $15.2 billion in 2003. Despite being an exporter of crude oil, Indonesia is now a net importer of oil. Indonesia is the only Asian member of the Organization of Petroleum Exporting Countries (OPEC) outside of the Middle East, and the only OPEC member that is a net oil importer. Its fuel production has declined over the years, owing to aging oil fields and lack of investment in new equipment. Indonesia remained the world's leading exporter of LNG in 2005, with 18.8 percent of the world market allowing it to remain a net exporter when both oil and gas are considered. Oil and gas imports increased to $17.4 billion in 2005 from $12.1 billion in 2004, compared with $8.4 billion in 2003. Coal exports have grown dramatically exceeding $5 billion in 2006.



3. National Programs/Policies and Targets for Energy Efficiency

The movement by the government away from subsidies heightens the attractiveness of investments in energy efficiency. Higher prices for electricity and fuels naturally drive consumers in the industry, transport, commercial and residential sectors to more efficient options. Because past policies did not encourage efficient energy use, initial investments in energy savings can yield large benefits. In particular, demand-side impacts can be achieved quickly but support for standards and labeling can avoid confusion in the marketplace. Energy efficiency opportunities have received relatively little attention from government planners. Existing targets to reduce energy intensity by 1% per year are modest.

Energy Efficiency Programs

Although hampered by subsidized energy prices that make investments in many energy efficiency actions unattractive, Indonesia has undertaken several demand side management programs with some success. Four areas of activity have been:

- Establishment of testing labs within PLN, MEMR, BPPT, MOE and IT Bandung,
- Broad introduction of CFLs by PLN,
- Free energy audits for large industrial consumers, and .
- Testing of automobiles by the MOE

Globally, labeling and standards programs are among the most cost-effective market interventions because almost the entire cost is met either by manufacturers who produce more efficient products or the consumers who buy them. They include building codes,

automobile fleet standards, government purchasing standards, mandatory Minimum Energy Performance Standards (MEPS), and voluntary activities such as labeling or endorsement programs.

Investments in credible testing labs are required for labeling and standards programs to be effective. Several testing labs have been set up in Indonesia although they have not sought international accreditation. PLN's subsidiary PT PLN Electric Power Technical Services (LMK) has specialized equipment for testing CFLs and ballasts. The Institute of Technology at Bandung (IT Bandung) has equipment to measure efficiency of refrigerators, air conditioners and water pumps.

Beginning in 2002, PLN began to promote expanded use of CFLs based on analysis that showed lighting was a major component of PLN's peak load. PLN commissioned LMK to test the CFL product offerings of international and domestic manufacturers and used the test results to inform volume purchases of CFLs to help bring down the average retail price seen by consumers. They also made it easy for customers to obtain CFLs by making them available through payment points in targeted areas. Sales of CFLs have surged and prices have come down.

Within industry, the top energy-consuming segments are fertilizer (30%), cement (18%), metal including iron and steel (16%) and textiles (15%). The DGEEU has undertaken a program that provides free energy audits for industry. The state-owned enterprise PT. Koneba has carried out energy audits funded by MEMR in power, oil & gas, mining, steel, and cement. BPPT has also carried out audits in the cement, pulp & paper, iron & steel, and fertilizer sectors that quantified costs, expected energy savings and CO_2 emissions reduction for recommended action. (Winanti 2006)). The program identifies three categories of opportunities: no cost, low cost and requiring investment. Only a few industries have taken action to reduce energy use. Even no-cost items sometimes are not implemented because companies lack energy managers.

<u>Energy Conservation Policies</u>

- Presidential Decree No. 5/2006 on National Energy Policy
- Presidential Instruction No. 10/2005 on Energy Conservation. Instructs head of central and regional government to –
    1) Implement energy efficiency in their buildings including lighting, air conditioning, electric appliances, and vehicles
    2) Urge public to practice energy efficiency
    3) Monitor the implementation of energy conservation and report to the president through the MEMR

- Ministerial Regulation No. 0031/2005 on Energy Conservation Procedure. Regulates energy conservation in:
    1) commercial buildings – regulate room temp minimum 25C; regulate room lighting maximum 15 watt/m2; reduce equipment operation time
    2) government offices

4. National Programs/Policies and Targets for Other Clean Energy Technologies

Nuclear. Three research reactors are currently operated by the National Atomic Energy Agency (BATAN), the third of them being intended to support the introduction of nuclear power to the country. It is a 30 MW (thermal) unit at the Serpong Nuclear Facility near Jakarta, and started up in 1987. Following earlier tentative proposals, in 1989 the government initiated a study focused on the Muria Peninsula in central Java and carried out by the National Atomic Energy Agency (BATAN). It led to a comprehensive feasibility study for a 7000 MWe plant, completed in 1996, with Ujung Lemahabang as the specific site, selected for its tectonic stability. Plans for the initial plant on the Muria Peninsula in central Java were then deferred indefinitely early in 1997.

Then a 2001 power generation strategy showed that introduction of a nuclear plant on the Java-Bali grid would be possible in 2016 for 2 GWe rising to 6-7 GWe in 2025, using proven 1000 MWe technology with 85% capacity factor and investment cost $2000/kWe. The Java-Bali interconnected system accounts for more than three quarters of Indonesia's electricity demand. Late in 2003 BATAN was reported to have narrowed the choice of plant to two: a South Korean 1000 MWe pressurised water reactor or a Canadian 700 MWe pressurised heavy water reactor - probably the KSNP+ (OPR-1000) and ACR-700 respectively. Subsequent reports point to the Korean OPR-1000 option and suggest an increasing sense of urgency due to power shortages.

Under the 2006 Law on Nuclear Reactors the project may be given to an Independent Power Producer to build and operate, on one of three sites on the central north coast of Java. Plans are to call tenders in 2008 for two 1000 MWe units, Muria 1 & 2, leading to decision in 2010 with construction starting soon after and commercial operation from about 2017. Fuel services would be purchased from abroad and fuel would preferably be leased. Used fuel will be stored centrally in the medium term. Muria units 3 & 4 will be built later, for operation from 2023.

The government has said that it has $8 billion earmarked for four nuclear plants of total 6 GWe to be in operation by 2025. Under current plans it aims to meet 2% of power demand from nuclear by 2017. It is anticipated that nuclear generation cost would be about 4 cents/kWh (US) compared with 7 c/kWh for oil and gas.

In July 2007 Korea Electric Power Corp. and Korea Hydro & Nuclear Power Co. (KHNP) signed a memorandum of understanding with Indonesia's PT Medco Energi Internasional to progress a feasibility study on building two 1000 MWe OPR-1000 units from KHNP at a cost of US$ 3 billion. This was part of a wider energy collaboration. In addition, Batan has undertaken a pre-feasibility study for a small Korean SMART reactor for power and desalination on Madura. However, this awaits the building of a reference plant in Korea. Also the province of Gorontalo on Sulawesi is reported to be considering a floating nuclear power plant from Russia. The IAEA is reviewing the safety aspects of

both Muria and Madura proposals, with Indonesia's Nuclear Technology Supervisory Agency.

Indonesia has two established uranium mines as well as several nuclear facilities in operation. In addition to three research reactors, it has front-end capabilities in ore processing, conversion and fuel fabrication, all at a laboratory scale. There have been no experiments in reprocessing, but there is a radwaste programme for spent fuel from the research reactors.

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