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TERNA Wind Energy Programme

Energy-policy Framework Conditions for Electricity Markets and Renewable Energies

23 Country Analyses
Chapter Indonesia

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New Edition of the TERNA Country Survey

Since the first edition of the TERNA country survey appeared in 1999, there has been a distinct heightening of public and political awareness of the consequences of climate change and of energy provision as a key factor in sustainable development. In Germany and other industrialised countries, a political tailwind, effective promotion mechanisms and rising energy prices have created the conditions for a dynamic market in which renewable forms of energy are exhibiting high growth rates within the energy mix. In 2006, global new investment in renewables amounted to US$ 70.9 billion – an increase of 43 % over 2005.

Strong economic development in many emerging countries has triggered rapidly rising demand for energy and competition on the international oil market. Against the background of the rising cost of fossil fuels, supply risks and damage to the environment, the significance of renewable energy as a means of generating electricity is growing – also in developing and emerging countries: according to analyses conducted by the Renewable Energy Policy Network for the 21st Century (REN21), 39 countries have set expansion targets for renewable energy sources and introduced promotion mechanisms, nine of which are developing or emerging countries. Of total new investment in renewable energy around the world, US$ 15 billion was invested in developing and emerging countries. Nevertheless, the majority of countries still have a long road ahead of them before they overcome existing barriers to the successful introduction of renewable forms of energy.

The German and European market acts as the driving force for the wind energy industry and provides an indispensable background of experience. However, growth in the industry is also increasingly apparent in developing and emerging countries. It is the successes in countries such as India, China and Brazil which encourage commitment beyond the borders of industrialised nations. In those three countries there is a growing proportion of local content in the systems and equipment they produce – and not only for supply to their own domestic markets.

A number of other countries though, too, are erecting their first wind farms, thereby establishing the basis for gaining experience to be utilised in future markets.

To help interested players gain access to the new markets, this survey provides detailed descriptions of the framework conditions for electricity markets and renewable energy in 23 developing and emerging countries.

Latin America	Africa/Middle East	Asia
Argentina	Egypt	Bangladesh
Brazil	Ethiopia	China
Caribbean States	Jordan	India
Chile	Morocco	Indonesia
Colombia	Namibia	Pakistan
Costa Rica	South Africa	Philippines
Dominican Republic	Tunisia	Viet Nam
Mexico		
Nicaragua		

This latest country survey and the previous editions are available on our homepage: www.gtz.de/wind. For the first time, the publication is also available on CD-ROM. For information on how to obtain this, again, go to the homepage.

Our grateful thanks go to a large number of GTZ staff members and other experts in the field for their help in putting this information together.

Eschborn, September 2007

Legal Information

1. The data used in this study is based on both publicly accessible sources of information (publications, specialist articles, internet sites, conference papers etc.) and non-public papers (for example internal expert reports from promoting institutions), as well as personal interviews with experts (for example officials at energy ministries in the investigated countries and project staff at promoting institutions). Although all information has been checked as far as possible, errors cannot be ruled out. Neither the GTZ nor the authors can therefore provide any guarantee of the accuracy of the data included in this study; no liability can be accepted for any loss or damage resulting from use of the data included in the study.

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The TERNA Wind Energy Programme

There is great potential for generating electricity from renewable energy sources in many developing and emerging countries. Obstacles to the exploitation of such sources include a lack of knowledge of framework conditions in the energy industry and insufficient transparency with regard to the prior experience and interests of national actors.

The purpose of the TERNA (Technical Expertise for Renewable Energy Application) wind energy programme, implemented by GTZ on behalf of the Federal German Ministry for Economic Cooperation and Development (BMZ), is to assist partners in developing and emerging countries in planning and developing wind power projects. Since 1988 the TERNA programme has pursued the twin goals of laying the foundations for sound investment decisions while at the same time enabling partners to assess wind energy potentials, plan wind energy projects and improve energy-policy frameworks for renewable forms of energy.

The TERNA wind energy programme's partners are institutions in developing and emerging countries that are interested in commercial exploitation of wind power. These include, for example, ministries or government institutions which have the mandate to develop BOT/BOO projects, state-owned or private energy supply companies (utilities) and private enterprises (independent power producers).

TERNA offers its partners expertise and experience. In order to initiate wind power projects, favourable sites must be identified and their wind energy potential ascertained. To do this, wind measurements are normally taken over a period of at least twelve months and wind reports are drawn up. If promising wind speeds are found, the next step is to conduct project studies investigating the technical design and economic feasibility. TERNA also provides advice to partners on matters of finance, thus closing the gap between potential investors and offers of funding from national and international donors.

If required, CDM baseline studies can be prepared and advice can be offered to potential operators on setting up an efficient operator structure. In order to ensure as much transfer of know-how as possible, efforts are made to ensure cooperation between international and local experts, for example when preparing the studies.

In successful cases, TERNA initiates investment-ready wind farm projects by this method. TERNA itself is not involved in financing. In addition to the activities that are tied to specific locations, TERNA advises its partners on how to establish suitable framework conditions for the promotion of renewable energy sources.

Up until 2007, TERNA has been active in over ten countries around the world.

Further information on GTZ's TERNA wind energy programme, the application procedure etc. is available at www.gtz.de/wind or directly from:

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20 Indonesia

20.1 Electricity market

Installed capacity

At the end of 2005, the public power grid in Indonesia was being fed by an approximate total of 28 GW of installed generating capacity. The power plants operated by the state electricity company Perusahaan Listrik Negara (PLN) accounted for 87 % of power generating capacity. A large proportion of those plants (42 %) are oil-fired, although other types of plant also make important contributions to power generation, namely coal-fired (PLN: 20 %), gas-fired (PLN: 22 %) and hydropower (PLN: 14%).

Energy source	GW
Oil	10.04
Coal	4.78
Gas	5.26
Hydropower	3.35
Geothermal	0.48
Total	23.9

Tab. 1: Power plant capacities of the state electricity company PLN according to energy source; Indonesia; 2005[1]

Indonesia has numerous energy resources. Consequently, the national energy supply has enjoyed extensive independence based on indigenous deposits of petroleum, natural gas and coal[2] in such abundance that energy resources can even be exported.[3] At present, Indonesia is able to cover all demand for electricity within the country, though no electricity is being exported.

Power generation

Power generation has been expanding continuously in recent years. In 2005, power output reached 123 TWh, a 4 % increase over the previous year.

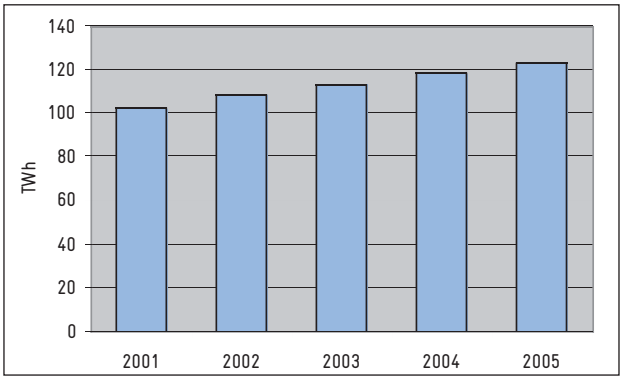

Fig. 1: Power generation [TWh]; Indonesia; 2001-2005[4]

Power transmission and distribution

In view of the highly subdivided national territory of Indonesia, consisting of some 6,000 inhabited islands, diverse approaches are taken to the supply of electricity. While the densely populated main islands of Java and Bali are almost fully electrified, the more remote islands have to contend with major supply gaps. Indonesia has two principal, mutually independent power grids: a high voltage grid on Java and Bali, and a "peripheral" medium voltage power grid for the other islands. Low technical standards cause periodical breakdowns on the one hand and, on the other, inefficiency and power losses of up to 12 % of all generated power, with attendant pecuniary losses totalling US $ 600 to 800 million annually.

1 Source: Association of the Electricity Supply Industry of East Asia and the Western Pacific; 2007.
2 A member of OPEC, Indonesia has more than 4.5 billion barrels of petroleum reserves (the largest of which are located on Sumatra), proven natural gas reserves totalling approximately 32 trillion m^2 (mainly in Aceh, East Kalimantan and off the coast of Java), in addition to 38 billion tons of coal resources.
3 Indonesia is the world's largest exporter of liquefied natural gas.
4 Source: BP Statistical Review of World Energy Full Report 2006.

The Indonesian power grids served more than 30 million households in 2004. That corresponds to a 53 % electrification level[5]. Two-thirds of all households without access to electricity are located in rural areas[6]. Indonesia has one of the lowest electrification levels of any country in Southeast Asia.

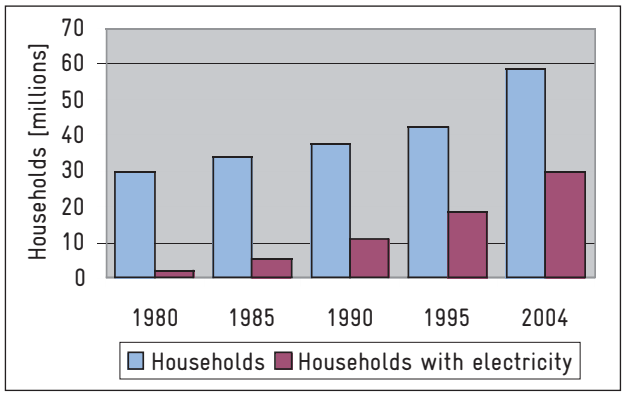

Fig. 2: Increasing access to electricity in Indonesia; millions of households; 1980-2004[7]

Despite the inefficiencies and the gaps in the grid, the electrification of Indonesia is a success story, considering that only 7 % of all households had electricity in 1980.

Power consumption

Nearly 80 % of all generated power is consumed on the main islands of Java and Bali. In 2004, energy demand totalled some 90 TWh there, in contrast with 24 TWh on all the remaining islands together. By 2006, overall power consumption had increased to 122 TWh. During periods of peak consumption, Indonesia's existing generating capacities no longer suffice. The Indonesian Ministry of Energy is anticipating an increase in demand for power to 122 TWh for Java and Bali alone by 2010, plus 36 TWh for the remaining islands. Average annual growth in demand for electricity through to 2012 is forecast to be about 9 %.

In 2006, per capita power consumption in Indonesia came to approximately 500 KWh. Despite significant increases in recent years, this is still one of the lowest rates of power consumption in the region. According to 2004 figures, the industrial sector accounted for 42 % of all electricity consumed, while private households used around 40 %, the services sector 13 % and the public sector 5 %.

Electricity prices

The state electricity company PLN enjoys an extensive monopoly in the sector and can therefore dictate the country's electricity prices. Following a sharp drop in electricity prices caused by devaluation of the Indonesian currency in connection with the Asia crisis, when the rupiah dropped from about 7 US ct/kWh to 2.5 US ct/kWh in the late 1990s, step-by-step increases since then have returned it to the equivalent of 6.2 US ct/kWh. With the aid of governmental subsidies, the PLN price structure is designed to provide the very numerous low-income households with electricity at reduced prices.

Despite ample domestic energy resources and governmental subsidisation of the electricity sector, Indonesia's electricity prices are higher than those of such countries as Thailand and Vietnam. The business practices of the state electricity company PLN are regarded as the primary factor in that connection. This is manifested by its production and provision costs among other things, which, at about 6.5 US ct/kWh, exceed the prices paid by ultimate consumers and which therefore have to be covered in part by state subsidies.[8] PLN presently has debts totalling some US$ 5 billion, which are hardly likely to be repaid at current electricity prices.[9] At the same time there is minimal room for raising prices – in a country in which nearly half the population, i.e. more than 110 million people, has to live on less than US$ 2 per day.

5 Source: National Committee on Infrastructure Policy and Investment, 2004.
6 The densely populated islands of Java and Bali, where 96 % of all villages have electricity, constitute an exception.
7 Source: Center of Energy Resources Development Technology; 2006.
8 Due to reduced fuel subsidies, this leeway is also shrinking.
9 The financial situation at PLN also leaves little room for new investments, and that, in turn, is making it difficult for PLN to find new customers.

Since 2006, to counter the existing power supply bottlenecks, bulk consumers in industry are having to pay higher prices for electricity during the peak hours of 6 to 10 p.m. Nevertheless, overloaded grids still regularly cause regional and broad-scale blackouts, particularly in remote rural regions, but also in metropolitan areas.

Expansion planning

Expansion plans in the electricity sector are largely determined at present by a noticeable dwindling of the country's once rich oil reserves.[10] Considering the combined effects of the increasing demand for energy, the dependence on oil of the country's power generating sector, the high world market prices for crude oil, and the substantially subsidised fuel prices on the domestic market, the avoidance of a repeatedly impending national energy crisis[11] takes absolute priority.

The Indonesian energy strategy, as described in the National Energy Management Blueprint, envisages a cutback in the use of oil for generating electricity from 55 % at present to between 15 and 20 % in 2025. Most of the resultant gap is to be filled by domestic coal and natural gas resources.[12] The intensified use of renewable energy resources is also envisaged within the scope of the upcoming transformation of the electricity sector.[13]

In response to countrywide increases in demand for electricity and the attendant worsening supply shortages, the Indonesian Government is planning to expand electricity generating capacity by 14 GW between now and 2012. The cost of investment for the provision of this new capacity is estimated at US$ 12 billion, most of which is supposed to be raised by the private sector.

20.2 Market Actors

The state electricity company PLN

Indonesia's electricity market is dominated by the state-owned[14] electricity supply company Perusahaan Listrik Negara (PLN). Nearly 87 % of all power plants feeding into the public power grid are run by PLN. As a fraction of the country's overall generating capacity, i.e. including autonomous suppliers, PLN's share is still above 50 %. As the sole certified operator of transmission and distribution networks, PLN enjoys a monopoly through its subsidiaries to the extent that the independent power producers licensed following partial privatisation of the electricity market are wholly dependent on the infrastructure of the state-operated company.

The publicly owned enterprise is undergoing a process of transformation in which subsidiaries engaged in power generation, transmission and distribution are being spun off. At present, the company as a whole comprises a holding company named PLN Pusat and two 100 % subsidiaries, namely the power producers Indonesia Power (IP) and Pembangkit Jawa Bali (PJB)[15], plus a total of six entities known as strategic business units (SBUs). One of the SBUs (P3B) is responsible for the transmission network, while the five others are concerned with the distribution of electricity to ultimate users.

The holding company, PLN, also includes a trading company which has the task of managing the power purchase agreements between private suppliers and the subsidiaries or SBUs. A third subsidiary – a joint venture between PLN and private investors – is in the process of being set up and will be responsible for the construction of new power plants in the future.

10 For several years now, Indonesia (a member of OPEC) has had to import crude oil due to insufficient domestic yields. Indonesia became a net importer for the first time in 2004, and this situation has since regularly jeopardised its membership of OPEC.

11 Around one-third of all government expenditures serve to support the domestic supply of power. Reductions in fuel subsidies in October 2005 caused an overnight jump in fuel prices of 120 % on average, and that, in turn, led to countrywide protests. The reductions largely brought the subsidisation of oil-fuelled power generation to an end.

12 The Government of Indonesia is presently endeavouring to convert national power production to a natural-gas basis, but is encountering difficulties, particularly in connection with the requisite infrastructure. While more brown coal (lignite) could be mined, a large proportion (40 %) of the existing deposits would necessitate above-average expenditures.

13 See section entitled Policy Promoting Renewable Energy Sources.

14 As a state-owned enterprise, PLN answers to three different ministries: the Ministry of Public Works in its capacity as the owner of PLN's corporate enterprises; the Ministry of Mines and Energy, which regulates the energy sector and defines energy policy; and the Ministry of Finance as the financial owner of PLN.

15 PJB generates electricity for the high voltage grid on Java and Bali. IP produces power for the "peripheral" medium-voltage grid.

Private actors

When the electricity sector was opened up for private activities in the late 1980s – due in part to the unreliability of the centralised supply of power – there was a substantial initial thrust in the development of autonomous power production. In the meantime, more than 10,000 companies in numerous sectors of the economy have gained the means to produce their own power. However, the autonomous commercial and industrial power producers have not yet begun to contribute anything toward the national power supply. Their opportunities in this regard are very much limited, above all else by infrastructural deficiencies in the power grid outside Java and Bali – problems that would be very expensive to rectify. Autonomous power generation by non-governmental actors (such as rural cooperatives) also plays a role in off-grid areas.

A number of contracts concluded in the mid-1990s between PLN and international power utilities were intended to provide an opening for independent power producers to feed into the national grid. Due in part to the Asia crisis, however, this IPP integration process is taking substantially longer than expected. PLN has been unable to meet its contractual obligations regarding the purchase of electricity.[16] Due to the fact that Indonesia is bound to a structural adjustment loan it was granted by the World Bank in 1998, PLN is obligated to fulfil the contracts as quickly as possible. Overall, international private-sector actors have shown little interest in investing in Indonesia. Independent power producers presently account for some 13% of the national power supply. As yet, no private actors have become active in the fields of power transmission or distribution.

Other Actors

Energy policy actors

The Ministry of Energy and Mineral Resources (MEMR) bears primary responsibility for the legislative structuring of the Indonesian energy sector and for decisions on energy policy. The Directorate General of Electricity and Energy Utilization (DGEEU) has specific competence regarding the systematic and ongoing development of the energy sector. The role of the DGEEU is therefore to:

- regulate and license independent (non-governmental) power producers;
- draw up the annual National Electricity General Plan (NEGP);
- publish yearly statistics on the national electricity and energy sector.

MEMR has bestowed upon PLN the responsibility for involving independent power producers in the national power supply systems.

16 Due to the Asia Crisis, PLN incurred a substantial debt burden. At the same time, electricity prices slipped well below the break-even point.

20.3 Legal Framework

Reform of the electricity sector

The Indonesian energy sector is in the early stages of transformation. The reform process was initiated by Electricity Law 20/2002 from the year 2002, which specified that:

- competition mechanisms are to be introduced into the electricity sector step by step and region by region;
- a regulatory authority, the Electricity Market Supervisory Authority (EMSA), is to be established for supervising independent power producers in the newly legally established "competition regions";
- electricity tariffs in the competition regions must be adequate to cover all costs and remain subject to regulation and supervision by EMSA;
- levies must be imposed on transmission and distribution in competition regions as a source of funding for the expansion of power grids in less developed regions;
- authority for the issuance of business and operating licenses must be decentralised, i.e. transferred to the regional and local authorities;
- power transmission and distribution must be recognised as natural monopolies that are to be made accessible to private enterprises in a non-discriminatory manner;
- private-sector activities in the energy industry[17] must be permitted in at least the following areas: power generation, transmission, distribution and sale;
- an annual National General Electricity Plan must be drawn up, in which the regional and national objectives stated in the National Energy Management Blueprint are concretised.

In December 2004, however, this first reform law was annulled by the constitutional court.[18] Hence, pending the enactment of a new electricity law[19], the electricity law of 1985 has regained validity. A number of regulations adopted since the end of 2004 also apply – one example being Government Regulation 3/2005 from 2005, which incorporates various provisions of Electricity Law 20/2002. All the same, the legal amendments have had a substantial influence on the reform process.

Private enterprises, for example, are presently limited to the generation of electricity, and the political steps taken in 2002 regarding the introduction of competition regions, the unbundling of the state electricity company PLN and the establishment of an independent regulatory authority have all been shelved.

National Energy Management Blueprint

The National Energy Management Blueprint identifies ambitious short- and long-term developmental objectives for the electricity sector. The current version 2005-2025 lists the following objectives:

- satisfaction of electricity demand: increase the electrification level to 90 % of all households by 2020 and to 100 % of all villages by 2010;
- reduction of subsidies: increase electricity tariffs to a level that covers the prime costs and enables a reasonable profit;
- raising the efficiency of electricity supply: implement a limited scope of competition in the power generating sector in Batam (from 2004), Java-Madura-Bali (JAMALI; from 2007) and on the remaining islands beginning in 2008, including strong participation by the private sector (non-governmental, independent power producers and semi-private enterprises) in Indonesia's power supply sector;
- expansion of the electricity infrastructure: the central and regional governments are to provide more funding for expanding the transmission and distribution networks;
- renewable energy: Indonesia's renewable energy resources are to be better utilised.

Foreign involvement in the electricity sector

With the support of the World Bank, MEMR has begun to convert the electricity sector from oil to natural gas on Java and Bali, the main point being to integrate the state gas supplier Perusahaan Gas Negara (PGN) into the power generating sector. In October 2003, Indonesia was granted a World Bank loan of US $ 141 million to help implement the pertinent measures.

17 Private-sector activities in the field of public power supply were first permitted in 1989 on the basis of an amendment to the 1985 electricity law.

18 Provisions on the introduction of competition on the electricity market and on the unbundling of the power provider were judged unconstitutional.

19 Planned for the second quarter of 2007.

In 1999, within the scope of the Energy Partnership Program (EPP) sponsored by the United States Energy Association (USEA) and the United States Agency for International Development (USAID), PLN entered into a partnership contract with the US electric utility company Portland General Operations Co. Inc. (PGO) for the purpose of modernising and/or rehabilitating the PLN-operated hydroelectric plants. The Asian Development Bank (ADB) has been promoting the energy sector since 1971 with loans totalling US$ 3.4 billion.

20.4 Policy promoting renewable energy sources

In connection with the political objective of reducing Indonesia's dependence on oil for generating electricity while simultaneously raising the household electrification level, the further development of renewable energy resources is becoming increasingly important. Within that context, the use of geothermal energy for generating electricity is receiving special attention.[20] According to Presidential Decree No. 5/2006, renewable energy resources – not including large-scale hydropower and geothermal energy – are supposed to be accounting for 5% of the public electricity supply by the year 2020.

Central actors

The promotion of renewable energy sources via the legal framework as a contribution to the national power supply sector falls primarily within the sphere of responsibility of Indonesia's Ministry of Energy and Mineral Resources (MEMR).

Within MEMR, DGEEU's responsibilities include the specific design of official promotion programmes in the renewable energies sector, improving energy efficiency, cutting CO_2 emissions, and the advancement of rural electrification.

The Directorate General of Mineral, Coal and Geothermal (DGMCG; department within MEMR) is responsible for expanding the basis of power generation by way of geothermal resources. To analyse and overcome political constraints in the development of geothermal power within Indonesia, the DGMCG has drafted a Geothermal Barrier Removal Programme.

The non-governmental organisation Indonesian Renewable Energy Society (METI) is particularly committed to training human resources for Indonesia's future renewable energy industry.

Promotion mechanisms

A number of specific regulations within the national energy legislation support the promotion of renewable energy resources. Examples include the Geothermal Law[21] and the Ministerial Decree on Renewable Energy Resources and Conservation.[22]

Concrete incentive mechanisms covering all renewable energy resources include:

- compulsory power purchasing by the grid operator PLN;
- promotion of on-grid plants and systems based on renewable energy sources: operators of small (< 1 MW) and medium-sized (between 1 and 20 MW) power plants receive 60% or 80% of their power generating costs for a period of at least 10 years;[23]
- tax breaks for semi-private enterprises;
- financing options for renewable energy projects by way of the Clean Development Mechanism (CDM);
- establishment of an institution for the financial promotion and development of renewable energy resources.

20 The Government of Indonesia is also investing much hope in the development of biofuels as a long-term substitute for dwindling mineral oil resources.

21 Geothermal Law No. 27/2003 seeks to expand the use of geothermal energy sources in the interest of promoting sustainable development, increasing government revenues and promoting the country's economic development.

22 Ministerial Decree No. 002/2004 pursues such objectives as optimising and improving the efficiency of renewable energy resources, securing sustainable, environmentally compatible forms of power generation, increasing public awareness and improving consumer behaviour with regard to energy conservation.

23 60% for injection into low voltage networks, and 80% for injection into medium voltage networks.

Clean Development Mechanism

Indonesia signed the Kyoto Protocol in 1997 and ratified it on 28 July 2004, by adopting Law No. 17/2004. As a developing country, Indonesia can take part in emissions trading with industrialised countries on the basis of the Clean Development Mechanism (CDM). According to the National Strategy Study on CDM in Energy Sector in Indonesia, as conducted by the Ministry of the Environment (Kementerian Lingkungan Hidup – KLH), the country has potential for a 2 % share of the global emissions trading volume. Theoretically, this could yield revenues ranging from US $ 81.5 million to US $ 1,260 million.[24]

Indonesia's Designated National Authority (DNA) was established in 2005 under the name National Commission on CDM, or Komisi Nasional Mekanisme Pembangunan Bersih (KN-MPB). ASEAN began promoting CDM project activities in Indonesia in 2001. Then, in 2005, Indonesia signed bilateral emissions trading agreements with the Netherlands, Denmark, Austria and Canada.

In 2006, the CDM Executive Board (EB) registered eight CDM projects in Indonesia with a total annual CO_2-reducing effect of 1.1 million tonnes. The project activities involve geothermal, biomass and solar thermal energy, and are being conducted in cooperation with companies based in the United Kingdom, Finland, the Netherlands, Japan and Germany.[25]

20.5 Status of Renewable Energy Sources

At the end of 2005, renewable energy sources were contributing just under 5 % (or 1,345 MW) to Indonesia's total installed power generating capacity of 28 GW. This does not include the power produced by large-scale hydroelectric plants, which themselves account for roughly 15 % (approx. 4,100 MW).

Type of renewable energy	Potential	2005	"Blueprint 2025"
Geothermal	27,000 MW	807 MW	9,500 MW
Small-scale hydropower	75,000* MW	84 MW	500 MW (on Grid) 330 MW (off Grid)
Solar energy	4.8 kWh/m^2	8 MW	80 MW
Biomass (power generation)	50,000 MW	445 MW	810 MW
Wind energy	9,290 MW	0.6 MW	250 MW (on Grid) 5 MW (off Grid)

Tab. 2: Potentials (* referred to the overall hydropower potential), installed capacities and the development-planning blueprint for renewable energy resources; MW; Indonesia[26]

24 Assuming 125 – 300 million tonnes of CO_2 for a CER yield of US $ 1.5 – 5/tCO_2, less project expenditures.

25 Further information on CDM activities in Indonesia can be found in the CDM country guide for Indonesia at www.iges.or.jp/en/cdm/pdf/countryguide/indonesia.pdf.

26 Source: bfai 2006, MEMR 2006, Center for Energy Resources Development 2006.

The development plans for the individual renewable energy sources are specified in the MEMR's 2005 National Energy Management Blueprint.

The following renewable energy system components are produced or assembled in Indonesia (= local content):

- small hydropower plants: turbines, speed governors, electric components (high local content), e.g. by CV Sampurna Energy;
- photovoltaics: local assembly of modules, e.g. by Microtech Indonesia;
- solar thermal: complete solar water heaters and solar dryers are manufactured locally;
- biomass: biomass gasifiers are made in Indonesia; they are, however, less reliable and efficient than those built in other countries;
- small wind energy conversion systems: except for the generators, all components are locally manufactured, e.g. by the Contained Energy company.

Hydropower

Indonesia has a theoretical hydropower potential of 75,000 MW. Small-scale hydropower plants, which as a rule can be accommodated to natural river landscapes more readily than can plants on a larger scale, presently account for 84 MW of installed, utilised capacity. In Indonesia a basic distinction is drawn between micro-hydropower plants with outputs up to 25 kW and mini-hydropower plants with outputs of up to 500 kW.

PLN is presently executing twelve micro-hydropower projects in Papua, Nusa Tenggara, Sulawesi and Kalimantan, all of which are being financed by the Asian Development Bank and scheduled for completion by 2006/07. Between 2008 and 2010 PLN plans to launch a further eight projects in these regions.

More than 200 mini-hydropower plants have been installed to date, most of them in rural areas with no grid access. Since both micro- and mini-hydropower plants are relatively inexpensive and easy to operate, they often make attractive opportunities for individual investors and local cooperatives. Their installation is facilitated by easy access to loans from the government and/or by development cooperation projects.

In the future, hydropower in the form of tidal and wave energy is also to be exploited. The theoretical potential in these fields is estimated at around 240,000 MW. The technologies required for tapping this potential, however, are still at the experimental stage: one pilot project with a capacity of 1.1 MW is ongoing at Baron Beach, Yogyakarta (Java).

Wind energy

Due to the minor influence of trade winds in Indonesia, the country has relatively little potential wind energy – amounting to 9,290 MW. The average wind speed is 3-5 m/s. In the eastern regions, however, it exceeds 5 m/s. Hence, the Indonesian wind regime is mainly suitable for small and medium-size wind power plants requiring wind speeds of 2.5-4 m/s and 4-5 m/s, respectively, for corresponding outputs of < 10 kW and 10-100 kW. At only a few locations is wind potential sufficient to power large wind energy conversion systems (> 100 kW) that require wind speeds in excess of 5 m/s.

DGEEU has identified three regions with 10 sites that are suitable for exploiting wind energy potential:

- Nusa Tenggara Barat (NTB) region: with wind speeds of 3.4-5.3 m/s;
- Nusa Tenggara Timur (NTT) region: with wind speeds of 3.2-6.5 m/s;
- Sulawesi: with wind speeds of 2.6-4.9 m/s.

Given the total installed generating capacity of 5 MW, only a small fraction of Indonesia's overall wind power potential is being utilised. Small aerogenerators are used in Indonesia for rural and/or decentralised electrification, for driving water pumps, for charging batteries, and for such mechanical purposes as aerating fish-farm ponds. The state electricity company PLN is presently constructing large-scale wind power installations on Bali (3 x 250 kW), Nusa Tenggara Barat (3 x 250 kW) and Nusa Tenggara Timur (6 x 250 kW), all of which are scheduled to go on line in 2007.

Biomass

Indonesia has major theoretical potential for generating energy from biomass, totalling some 50,000 MW. This is based on the energy content of more than 200 million tonnes of agricultural biomass, forestry and plantation residue and urban waste produced every year.

According to official estimates, 35% of all energy consumed in Indonesia, particularly in rural areas, stems from biomass – mainly unsustainably managed firewood. At the end of 2005, total installed capacity for power generation based on biomass had reached 445 MW. The construction of additional biomass-fuelled power generating installations is planned.

Energy source	Capacity (MW)	Location
Palm oil residue	12.5	North Sumatra
Palm oil residue	10.5	North Sumatra
Palm oil residue	10.5	Riau
Palm oil residue	15	Riau
Rice husks	10	Lampung
Rice husks	20	Bali
Bagasse	7	Lampung
Urban waste	60	Jakarta

Tab. 3: Biomass power plants in Indonesia, planned by private enterprises; MW; 2006 [27]

In addition to its use for generating power and heat, biomass is also and primarily of interest for producing biofuels such as vegetable oil and biodiesel in Indonesia. The requisite technologies are already available and disseminated. Pertinent development plans extend all the way to the establishment of a "Biofuel OPEC" in cooperation with Thailand, and have even given rise to a number of concrete promotion incentives. The Government of Indonesia regards biofuels as a potential substitute for petroleum-based fuels.

Use of landfill gas

According to expert opinion, twelve major Indonesian cities have a combined potential of 566 MW for generating electricity from communal waste.

Solar energy

As a tropical country with an average daily insolation rate of 4.8 kWh/m^2 and 300 days of sunshine in a typical year, Indonesia has major potential for solar energy.

Photovoltaics

Photovoltaic systems, especially solar home systems (SHSs), are used in rural areas in particular, generating power for such applications as lighting, water pumps, telecommunication equipment and medicine cooling systems at health centres. Since the early 1980s some 50,000 SHSs have been installed, and relatively large hybrid plants, for example in combination with diesel generators, are also in widespread use. In late 2005 the installed capacity totalled about 8 MW, over 1 MW of which was feeding into the central power grid.

27 Source: MEMR – Country Plans and Policies for Developing and Implementing Renewable Energies in Indonesia 2006.

Expansion plans

In the 1990s the Indonesian Government began to systematically promote the use of isolated photovoltaic systems for providing rural, off-grid regions with electricity, and since 2004 private banks have been offering loans for the purchase of PV systems. National plans envisage the transfer of additional links of the solar-system production chain to Indonesia in order to reduce the country's dependence on imports. The use of photovoltaics is to be promoted not only for rural, decentralised applications, but also for urban areas in which grid-infeed mechanisms can be utilised. The Solar Power Entrepreneur Association (APSURYA) is a national institution providing particular encouragement to the countrywide development of photovoltaics.

With a view to further developing photovoltaics in the country, the government in Jakarta is planning to install 15,000 photovoltaic systems (SHSs) in eastern Indonesia, each with a generating capacity of 100 W. Each unit will cost between US$ 500 and US$ 600 and is to be paid for with funding from the government and PLN.

Geothermal energy

The volcanic belt extending along the islands of Sumatra, Java, Nusa Tenggara, Sulawesi and Malaku has blessed Indonesia with abundant geothermal potential, roughly 40 % of the world's total geothermal resources. According to MEMR estimates, the country has 217 geothermally useful sites – mostly on Sumatra, Java und Sulawesi. Indonesia's theoretical geothermal potential is calculated at around 27,000 MW. As of late 2004, a mere 807 MW, or 3 %, of that potential had been harnessed.

Location	Operator	Installed capacity in MW (2006)
Sibayak	Pertamina	2
Salak	Unocal	330
Kamojang Darajat	Pertamina	140
Kawah Cibuni	Yala Teknosa	110
Dieng	Geodipa	60

Tab. 4: A selection of Indonesia's operational geothermal power plants; MW; 2006[28]

National expansion plans and incentive systems

The existing geothermal power plants are presently being operated by the state electricity company PLN and its contractual partners. In the future, however, independent power producers are supposed to play a larger role in the development and exploitation of new thermal sources. With a view to promoting that aim, the Indonesian Government is offering potential investors a number of tax abatements, such as the remission of property taxes on power plant premises and the exemption of principal plant components from value-added tax. In addition, foreign investment is also being disburdened.

In 2005 the government designated 28 new sites with a combined potential capacity of 13,500 MW and attracted the interest of several private-sector actors. In 2006 Medco Holding announced the construction of a new power plant with a generating capacity of 10 to 20 MW in Tangkuban Perahu, West Java. A joint venture embarked on by the Japanese company Sumitomo and the Indonesian firm PT Rekayasa won a contract to build a 20 MW geothermal power plant in Lahendongon, North Sulawesi.

Nonetheless, many of the designated sites are still reserved for government projects. PLN alone is planning to put up 16 geothermal power plants with a total capacity of 1,150 MW. The state-owned oil and gas provider PT Pertamina is also involved in the construction of several new plants.

28 Source: Center of Energy Resources Development Technology, 2006.

Additional large-scale geothermal power plants are planned for the following sites:

- Sarulla, North Sumatra: the biggest geothermal project in the world, with an output of 340 MW[29]
- Patuha, West Java (3 x 60 MW)
- Dieng, Central Java (2 x 60 MW)

20.6 Rural Electrification

Approximately 45 % of Indonesia's population of over 245 million live in rural areas. There are around 29 million rural households, of which 41.5 % (some 12 million) have no access to electricity, although the electrification rate varies widely from region to region.[30] The development-policy objective of raising the national electrification level includes substantial expansion of Indonesia's rural power supply infrastructure.

In the past, the foremost objective of rural electrification was to connect into PLN's central grids: some 96 % of all electrified households in rural Indonesia were successively tied into the gradually expanded power supply networks. Privately operated isolated grids and systems account for a mere 4 % of all rural electricity provision.

Rural electrification actors include MEMR and PLN, both of which work to expand the country's power generating, transmitting and distributing capacities by way of public-private partnerships in cooperation with private investors. Other actors include non-governmental organisations, community level groups, private actors and international donors.[31]

National activities

The strategy pursued by PLN for the future electrification of rural areas is based on the following principles:

- empowerment of the rural population to secure electricity according to their own conceptions
- utilisation of local energy resources, in particular renewables
- increasing the involvement of the private sector and of rural cooperatives

Part of that strategy is the "community-based rural energy development" concept, according to which cooperatives, municipal institutions, non-governmental organisations and/or private actors, with the technical assistance of PLN, serve as power providers or producers in rural areas. PLN provides assistance at two different levels: either for establishing a stand-alone (isolated) grid including power generation, or for establishing a village network for connection to the PLN-operated central power grid.

As a source of financial assistance for rural electrification, MEMR (acting through DGEEU) has devised a programme entitled Trust Fund Facility for Rural Energy Services. Its purpose is to involve local financial institutions in rural electrification, with the government providing appropriate credit-redemption guarantees.

The Community Empowerment through Micro Hydro Power Plant (MHPP) - Development in Rural Villages programme aims to promote agricultural production processes and micro-enterprises. Over the past few years, 20 micro hydropower projects have been implemented under the auspices of the Ministry of Cooperative and Small and Medium Enterprises. Four of the projects were financed by the Indonesian Government and the remaining 16 by international donors. All 20 projects are now being operated by rural cooperatives.

29 The total project investment is put at approximately EUR 470 million. The project will be implemented in 3 phases of 110–120 MW each. The first unit is scheduled to go online within 30 months and the last within 48. The power output is to be injected into the North Sumatra and Aceh grids. Once all units are in operation, the operators anticipate annual electricity revenues of the order of EUR 86 million.

30 According to PLN data, Yogyakarta and Bali have reached 94 % and 81 %, respectively. By contrast, the rural parts of Lampung have an electrification rate of only 22 % – and Nusa Tenggara a mere 13 %. Beyond the grasp of statistics – naturally – the high level of power theft in rural areas goes undocumented

31 One of most important external actors is the Asian Development Bank (ADB), which grants loans for the expansion of electricity supply infrastructure.

International cooperation: actors and programmes

One major actor is the ASEAN[32] Centre for Energy (ACE), which in particular works to promote projects devoted to the utilisation of small-scale energy systems based on renewable energy sources for rural electrification and productive activities.

The Deutsche Gesellschaft für technische Zusammenarbeit (GTZ), in cooperation with MEMR and the Netherlands development cooperation organisation Directoraat-Generaal Internationale Samenwerking (DGIS), has initiated a project entitled Mini-Hydropower Schemes for Sustainable Economic Development, the goals of which are rural electrification and the establishment and development of rural micro-enterprises.[33] To that end, the project cooperates with Indonesian universities and non-governmental organisations to communicate technical expertise in the planning, construction, maintenance and operation of micro hydropower plants. Since 1999, more than 100 power generating systems with capacities ranging from 7 kW to 250 kW have been installed and are now providing electricity for approximately 20,000 rural households, micro-enterprises and public facilities. More than 85 % of the system components are of local origin.

The German Federal Ministry of Education and Research began promoting the multisectoral project Water Resources Management of an Underground River in a Karst Area in 2002. The project focuses on supplying drinking water to the population during dry seasons through the use of renewable energy sources. The relevant technology consists of partially damming an underground stream to enable the generation of electricity in an underground hydropower plant, with the generated electricity being used for pumping water.

The World Bank and the Global Environment Facility (GEF) are helping to disseminate photovoltaics for decentralised power supply in rural, off-grid areas of Indonesia by way of the Solar Home Systems Project. The project is promoting the installation of 200,000 SHSs in four regions. In addition, the Indonesian Agency for the Assessment and Application of Technology (BPPT) is to be assisted in its measures for establishing photovoltaics in the energy sector.

Exchange rate (7 February 2007):
1000 Indonesian rupiah (IDR) = 0.08548 euro (EUR)
1 IDR = 0.0001106 US dollar (USD)

32 Association of Southeast Asian Nations.

33 The main point of interest is to generate additional income through hydropower while establishing a market for rural energy services.

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There is great potential for generating electricity from renewable energy sources in many developing and emerging countries. Obstacles to the exploitation of such sources and to the involvement of foreign investors include a lack of knowledge of framework conditions in the energy industry and insufficient transparency with regard to the prior experience and interests of national actors. This fourth, updated and expanded edition is aimed at overcoming barriers such as these.

The electricity markets and their respective actors are investigated for 23 countries in various regions: Latin America, Africa – Middle East and Asia. The country studies analyse the energy-policy framework conditions and closely examine the status of and promotion policy for electricity generation on the basis of hydropower, wind power, solar power, biomass and geothermal energy. The chapters on each country are rounded off by information about rural electrification.

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