



CDM OPPORTUNITIES IN INDONESIA

Prepared by:

Center for Research on Material and Energy
Institut Teknologi Bandung

Postal address: Jalan Ganesha 10, Bandung 40132, Indonesia
Tel: (62-22) 2501238; 2504558; Fax: (62-22) 2504558;
e-mail: ppeitb@attglobal.net or ppeitb@bdg.centrin.net.id
website: <http://www.creitb.or.id>

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Preface

The Pembina Institute for Appropriate Development and the Tata Energy Research Institute have explored the application of the Clean Development Mechanism (CDM) in Asia through a series of publications and workshops, including:

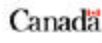
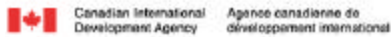
- A background report on the CDM.
- Country reports on CDM potential in four Asian countries.
- A study on the potential role of Canadian industry in the CDM.
- A North-South NGO perspective on the emerging CDM rules.
- Workshops on the CDM for potential Canadian investors and technology providers as well as potential Asian partners.

For more information on this project visit the following web sites:

- www.teriin.org
- www.pembina.org

The participants are working in collaboration with: The Bangladesh University of Engineering and Technology; The Global Climate Change Institute at Tsinghua University (China); and the Centre for Research on Material and Energy at the Technology University in Bandung, Indonesia.

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Team Leader: **Dr. Tatang H. Soerawidjaja**

Senior Adviser: **Prof. Dr. Saswinadi Sasmojo**

Members: **Ir. Nasrullah Salim; Ir. Achmad P. Nugraha, M.Eng; Iwan Hendrawan, ST**

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Selected Abbreviations and Acronyms

AIJ – Activities Implemented Jointly
ALGAS – Asia Least-Cost Greenhouse Gas Abatement Strategy
BOE – Barrels of Oil-Equivalent
CDM – Clean Development Mechanism
CERs – Certified Emissions Reductions
CNG – Compressed Natural Gas
COP – Conference of the Parties
CRE – Center for Research on Energy
GEF – Global Environment Facility
Gg – Gigagrams (= kilotonnes)
GHG – Greenhouse Gas(es)
IBEKA – Institut Bisnis Dan Ekonomi Kerakyatan (The People Centered Economic and Business Institute)
INAGA – Indonesian Geothermal Association
IPCC – Intergovernmental Panel on Climate Change
IRES – Indonesian Renewable Energy Society
NGO – Non-Governmental Organization
TCE – Tonnes of Coal-Equivalent
TOE – Tonnes of Oil-Equivalent
UNDP – United Nations Development Programme
UNFCCC – United Nations Framework Convention on Climate Change
WB – World Bank
YBUL – Yayasan Bina Usaha Lingkungan

1 Introduction

The Clean Development Mechanism (CDM) is one of the instruments set up by the 1997 Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC), to allow industrialized countries and countries with economies in transition, collectively known as Annex I countries, to gain credit for greenhouse gas (GHG) emission reductions achieved through projects undertaken abroad. As defined by Article 12 of the Protocol, the CDM has two purposes: to assist Annex I countries in complying with their Kyoto commitments, and to help non-Annex I countries achieve sustainable development. Thus, under the CDM, an Annex I country or private company may engage in projects in non-Annex I countries that reduce emissions of GHGs and help non-Annex I countries achieve sustainable development. The certified emissions reductions (CERs) generated through CDM projects may be used by Annex I countries to help them meet their Kyoto commitments.

Even though the sixth Conference of the Parties (COP 6) in The Hague, Netherlands, 13-24 November 2000 failed to decide the interim rules of the CDM, many parties and stakeholders believe that the CDM could be an effective tool to start the transition towards truly sustainable energy systems and that some agreements will, therefore, be achieved in the not-too-distant future. Consequently, developing countries should be prepared to participate properly in the CDM and, when the time comes, to take advantage of CDM projects in their own countries. This step will allow them to gain a sense of contributing to the global achievement of sustainable development as well as giving them a real economic return.

This report provides information for potential investors in developed countries to assess CDM opportunities in Indonesia by analyzing the country preparedness to implement the CDM and proposing a set of projects that would most likely be accepted by the Government of Indonesia and other stakeholders in the country. The report describes the attitudes of the government and other stakeholders towards the CDM, as well as the country's emission inventories and projections. Subsequently, it reviews potential mitigation options within the country, including the experience to date in undertaking international climate change mitigation projects. The final chapter identifies a set of potential CDM projects and presents a brief evaluation of each project.

2 Government Stand and Country Preparedness with Respect to the Clean Development Mechanism (CDM)

2.1 Climate change policy

The Government of Indonesia is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and ratified the Convention on August 1, 1994 (Act. no. 6, 1994, on the ratification of the UNFCCC). The Ministry of Environment is the nodal ministry for coordinating the Climate Change Policy. To oversee the implementation of its obligations under the Convention, provide inputs to policy formulation on climate change, and enlarge feedback mechanisms, the government has set up a consultative committee—the National Committee on Climate Change—whose members include representatives from various ministries and government agencies.

Recognizing that climate change is caused primarily by the excessive use of fossil fuels, the government has announced five initiatives as follow-up to UNFCCC ratification:

- Promoting the utilization of renewable energy;
- Promoting the utilization of clean energy and energy-efficient technology in industrial and commercial sectors;
- Promoting the efficient use of energy;
- Gradually eliminating energy market distortions through stepwise removal of various subsidies; and
- Restructuring the energy sector to allow more participation of private entities.

2.2 Government and other stakeholder views on the CDM

Although the Government of Indonesia is a signatory to the Kyoto Protocol, the country's economic and socio-political crisis during 1997-1999 meant that meaningful follow-up actions related to the Protocol have been considerably delayed. Thus, despite being an active participant in all COPs and other UNFCCC meetings, the Indonesian authority has not yet fixed formal policies or national criteria, nor has it prioritized sectors with respect to the CDM. Government's approach to the issue seems to be cautious, implying that national CDM set-up would have to wait until controversial issues surrounding the CDM are resolved. Nevertheless, through funding and technical assistance from the German development agency GTZ and the World Bank, a

national task force for “Indonesia National Strategy Study on CDM” was established in February 2000 to advise the government on Indonesia’s negotiating position on the CDM, benefits that could be gained from hosting CDM projects, CDM potential in the country, and policies and institutions required to participate effectively and efficiently in the CDM. Through several workshops and roundtable discussions, the task force has gathered input from various stakeholders in the country. The major opinions that have arisen from those activities include the following:

- ◆ Neither public institutions nor private sector entities are allowed to sign agreements and execute implementation of CDM projects before the rules and modalities for the CDM are internationally agreed to.
- ◆ Renewable energy generation should become a strong focus of CDM.
- ◆ Sinks and nuclear energy projects must not be included in CDM.
- ◆ CDM activities must include national capacity building and technology transfer.
- ◆ A pilot phase must precede any CDM project.
- ◆ AIJ (Activities Implemented Jointly) projects could later become CDM projects.
- ◆ Baselines should be determined on a case-by-case basis.

In view of the above, the statement made at COP 6 by Indonesia’s Minister of Environment as Head of the Indonesian Delegation has been questioned by many stakeholders in the country, for it indicated that Indonesia would accept sinks in the CDM.

2.3 Recent initiatives on CDM

To respond to the Kyoto Protocol, particularly to the CDM component, various activities such as seminars and roundtable discussions have been conducted by government organizations, NGOs, and industrial and professional associations. These activities were initiated individually by each stakeholder and/or through collaboration between them.

These multi-stakeholder initiatives have created a better understanding of the CDM and how it relates to global environmental issues as well as opportunities for capacity building at the national, community and individual levels.

Various stakeholders hold different points of views about CDM. However, they share the same view of the CDM objectives: (a) to reduce GHG emissions, and (b) to create sustainable development.

From the government's point of view, as reported in National Strategic Studies, possible CDM project activity would come mainly from energy sectors, followed by forestry "sink" projects. Stakeholders share similar views about undertaking CDM projects but specific criteria for implementation are still under debate. Because AIJ projects are not intended to gain CERs, all AIJ projects except a new cooling system for cement clinker plants can be nominated as potential CDM projects.

Several stakeholders have been asked to propose CDM project opportunities. Most of these projects are from the energy sector. The stakeholders include the Center for Research on Energy ITB, Pelangi, Yayasan Bina Usaha Lingkungan, Indonesian Renewable Energy Society, Indonesian Geothermal Association, the People Centered Economic and Business Institute (Institut Bisnis Dan Ekonomi Kerakyatan - IBEKA) and other institutions.

Center for Research on Material and Energy, Institut Teknologi Bandung

The Center for Research on Material and Energy of the Institut Teknologi Bandung, abbreviated as PPE ITB (Pusat Penelitian Energi, Institut Teknologi Bandung), is a research center under The Institute for Research ITB. The Center's major area of activity is to carry out studies on energy, material, and mineral resources, focusing on the study and development of planning methodologies, policy analysis studies, technology implementation studies and development of an information base for transfer and exchange processes that include publications, training, and conferences.

The mission of the Center for Research on Energy (CRE) is to lead a national effort to develop innovative, market-driven new energy for producing fuels and chemicals from renewable resources. The Center works in close cooperation with industry on these activities.

The vision of the Center is to be recognized as an international leader in developing biologically-based technologies for the production of renewable transportation fuels and related products. As a result of the Center's work and leadership, new Indonesian businesses will be established that will improve the environment and reduce Indonesian dependence on imported petroleum.

Goals:

- Facilitate the development and use of renewable fuels and chemicals through the application of renewable energy.
- Work with government laboratories, universities, and industry to insure that innovative and cost effective solar energy to fuels, chemicals, and materials technologies are evaluated, developed, and commercialized.
- Provide technical support to DOE to insure success of their fuels, bio-based products and energy programs.
- Heighten the awareness of decision-makers in both government and industry about the advantages of energy technologies in addressing economic development and environmental and energy problems.
- Build a scientific and engineering infrastructure within the Center for Research on Energy while helping to develop and expand the capabilities of the research staff

PELANGI

Pelangi (which means, literally, “rainbow”) was established in 1990. Today in 2001, Pelangi has established its superb role as a respectable policy research institution rooted in the NGO community. Pelangi houses the best possible human resources that an NGO can have.

The network of experts to whom Pelangi has easy access is similarly impressive. Those who helped found Pelangi currently hold top management positions in various influential institutions, or are in the process of acquiring higher academic degrees. The experts who once undertook some of Pelangi’s research are still readily available on call. Although the government has been constantly in limbo, Pelangi’s contact with key bureaucracies remains strong. Indeed, the 1970s is characterized as the era of developmental groups, the 1980s as the era of environmental and advocacy groups, and the 1990s as the era of policy research and think tank groups. The next decade will most likely be the era of public policy influence and lobbying. With its ample resources as a research institution—highly educated staff and associates, a wide network of experts available on call, and close relationships with decision-makers—Pelangi strives to demonstrate its best in advancing high quality research products and policy recommendations.

Yayasan Bina Usaha Lingkungan

Formed in 1993 as an NGO working on environmental issues, Yayasan Bina Usaha Lingkungan (YBUL) has focused on increasing private sector participation in the development of

environmental business in Indonesia. YBUL is active in six sectors: renewable energy, energy efficiency, sustainable agriculture and forestry, eco-tourism, pollution mitigation, and recycling.

YBUL is committed to establishing itself as an independent, professional and innovative organization that will continue to play an active role in the development of environmental business. This organization is also working on programs aimed at improving environmental awareness within the business community, and continuing to raise the level of concern within the global community.

Indonesian Renewable Energy Society

The Indonesian Renewable Energy Society (IRES) is a group of people interested in the development of renewable energy. The vision of this society is to be an effective vehicle supporting renewable energy development to meet energy demand sustainably.

The objectives of IRES are: (a) to play a bridging role in communication, consulting, and collaboration among stakeholders or IRES members, and (b) to accelerate the role of renewable energy in meeting national energy supply.

The Indonesian Geothermal Association

The Indonesian Geothermal Association (INAGA) is a group of geothermal experts and persons interested in the development and utilization of Indonesian geothermal energy.

The objectives of INAGA are:

1. to support the policy of the Government to expand the development of geothermal energy in the framework of increasing the state's revenues;
2. to assist the Government in the expansion of geothermal industry in general and geothermal technology in its broadest sense;
3. to promote activities of geothermal industry in Indonesia;
4. to unite entrepreneurs in the geothermal sector with experts who have the potentialities related to geothermal industry to improve the views, capabilities, and proficiency of its members, and to foster the feeling of familial relationship of its members; and
5. to establish and develop cooperation that is mutually beneficial in attempting the expansion of the geothermal industry by means of mutually making the best of information, infrastructure, and means, or other methods that support the achievement of the objectives within the country and abroad.

The People Centered Economic and Business Institute (Institut Bisnis Dan Ekonomi Kerakyatan)

The People Centered Economic and Business Institute's (IBEKA) main objective is to work with villagers to establish an environment more conducive to the growth of a people-centered economic system in their area. It assists community development by improving and promoting entrepreneurship to enhance the economic system and infrastructure, particularly by implementation of appropriate technology in the villagers' daily activities.

IBEKA has three main activities: (1) planning, engineering and constructing micro hydro power plants (MHP) in many provinces of Indonesia; (2) planning, engineering, and constructing water supply systems for villages; and (3) assisting with palm sugar distribution through a "mutual business system." It also gives MHP training courses and drinking water pumping system seminars.

3 Country's GHG Emissions Inventory and Projections

Based on the status of energy use and forestry and agricultural activities in 1990, and following the IPCC guidelines on national GHG inventories, estimates were made for 1990 on GHG emissions for Indonesia (Table 3.1).

Table 3.1: Summary of the 1990 GHG emissions inventory of Indonesia

Sources and Sinks	Emission (Gg)							CO ₂ Equivalent
	CO ₂ Emission	CO ₂ Removal	Net CO ₂	CH ₄	N ₂ O	NO _x	CO	
Total (Net) National Emission								
1 All Energy (Fuel Combustion + Fugitive)	140,396.40	0.00	140,396.40	213.19	2.52	312.84	28.80	146,426.64
A Fuel Combustion	140,396.40	0.00	140,396.40	2.42	2.52	312.84	28.80	141,262.77
1 Energy and Transformation Industries	53,501.32	-	53,501.32	0.19	0.08	250.43	13.81	53,531.50
2 Industry	32,073.94	-	32,073.94	0.87	2.44	47.85	11.02	32,876.06
3 Transport	34,917.64	-	34,917.64	-	-	0.26	0.35	34,918.39
4 Small Combustion in Residential and Commercial	19,903.50	-	19,903.50	1.36	-	14.30	3.62	19,936.82
5 Traditional biomass burned for energy	98,662.70	-	98,662.70	533.75	3.67	132.63	-	112,913.97
B Fugitive Fuel Emissions	-	-	-	210.77	-	-	-	5,163.87
1 Solid Fuel	-	-	-	32.61	-	-	-	798.9E
2 Oil and Natural Gas	-	-	-	178.16	-	-	-	4,364.92
2 Industrial Processes	17,843.77	-	17,843.77	-	-	-	-	17,843.77
3 Agriculture	-	-	-	3,387.52	13.53	1,071.00	30.96	75,332.22
A Livestock	-	-	-	798.39	-	-	-	16,766.19
B Rice field	-	-	-	2,543.00	-	-	-	53,403.00
C Agricultural Soils	-	-	-	-	12.67	-	-	3,927.70
D Prescribed Burning Savanna	-	-	-	19.52	0.24	512.00	8.74	484.3E
E Burning of Agricultural Residue	-	-	-	26.61	0.62	559.00	22.22	751.01
4 Land Use Change and Forestry	26,846.59	686,490.63	(347,042.57)	524.74	3.61	4,591.51	130.39	(334,903.93)
A Changes in Forest and other Woody Biomass Stocks	26,846.59	575,390.63	(548,544.04)	-	-	-	-	(548,544.04)
B Forest and Grassland Conversion	312,601.47	-	312,601.47	524.74	3.61	4,591.51	130.39	324,740.11
C Abandonment of Managed Lands	-	111,100.00	(111,100.00)	-	-	-	-	(111,100.00)
5 Waste/Landfill	-	-	-	287.59	-	-	-	6,039.39
INDONESIA	185,086.76	686,490.63	(188,802.40)	4,413.04	19.66	5,975.35	190.15	(89,261.91)

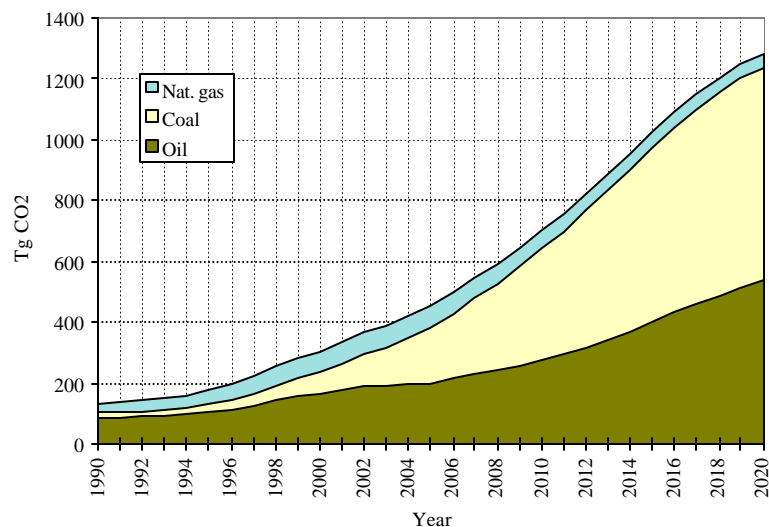
A breakdown of the emission inventory for 1990 is given in Tables 3.2 and 3.3. The projected baseline emission (i.e., when there is no particular mitigation initiative is undertaken) is given in Figure 3.1 and Figure 3.2.

Table 3.2: GHG emission inventory for the energy sector, top-down approach (Gg)

GHG sources	CO ₂	% of total CO ₂
Coal	17,477.39	11.70%
Oil	123,203.71	82.49%
Gas	8,682.62	5.81%
Total	149,363.72	100%
Biomass	98,662.70	

Table 3.3: GHG emission inventory for the energy sector, bottom-up analysis (Gg)

GHG Sources	CO ₂	CH ₄	N ₂ O	NO _x	CO	CO ₂	% of total
	Emission					Equivalent CO ₂ Equiv.	
1 Fuel Combustion	140,396.4	2.39	2.5	312.8	28.8	145,655.3	89%
a Energy and Transformation Industries	53,501.3	0.2	0.1	250.4	13.8	53,530.0	33%
- Electricity and Heat Production	22,184.6	0.1	0.08	113.0	4.1	22,212.1	14%
- Petroleum Refining	9,831.2	0.002	0.00001	4.7	0.3	9,831.2	6%
- Solid Fuel Transformation and other Energy Industries	21,485.5	0.05	0.0006	132.7	9.4	21,486.7	13%
b Industry	32,073.9	0.9	2.4	47.9	11.0	32,848.6	20%
c Transport	34,917.6	0.005	0.002	0.3	0.4	34,918.4	21%
d Small Combustion in Residential and Commercial	19,903.5	1.4	-	14.3	3.6	19,932.1	12%
2 Fugitive Fuel Emissions Fuels	-	210.8	-	-	-	4,426.2	3%
a Solid Fuel	-	32.6	-	-	-	684.8	0%
b Oil and Natural Gas	-	178.2	-	-	-	3,741.4	2%
3 Industrial Processes	17,843.8	0.0	0.0	0.0	0.0	17,843.8	11%
Total	158,240.2	213.2	2.5	312.8	28.8	167,925.3	100%


Figure 3.1: Projection of CO₂ emissions by fuel type

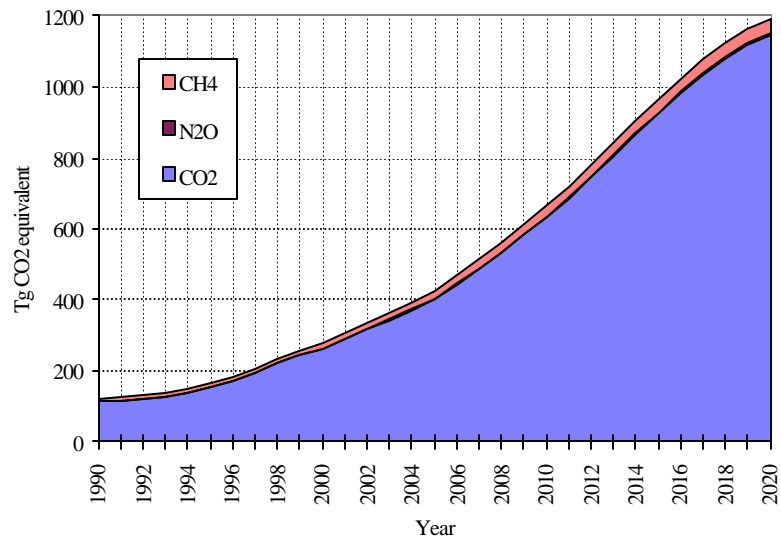


Figure 3.2: Projection of GHG emissions by type, in CO₂ equivalent

4 Potential Mitigation Options

4.1 Sector options

From a technological point of view, GHG emission reductions can be achieved through:

- (a) Energy efficiency and conservation measures and practices, namely through better energy housekeeping practices and by the deployment and functioning of more efficient energy technological systems;
- (b) Shifting the energy mix towards higher shares of lower or zero GHG emitting fuels—for example, fuels having low C/H ratios, or zero carbon content, such as hydrogen; and
- (c) Increasing the deployment of renewable, or near-renewable, energy technology systems, such as solar photovoltaic, solar thermal, water turbines for mechanical energy and power generation, wind turbines, geothermal base heat supply and power generation, biomass-based systems, waves and ocean thermal energy conversion system, etc.

In identifying which technological systems have better opportunities to reduce GHG emissions, a study was done in the ALGAS project (1) that produced a list of proposed priority technological systems (see Table 4.1).

The list was produced by first scanning possible technological systems, many of which have mitigative effects in the demand and supply sectors that are major contributors of GHG emissions—namely the household, industry, power generation, and transportation sectors. These technological systems were then ordered according to their economic attractiveness. The ordered set was screened by applying qualitative criteria that are considered to be critical for the choice of technology, such as the level of investment needed, operational accident risks, and scarcity of natural resources.

The economic attractiveness of each technology was determined by estimating the incremental costs of the particular technology with respect to a selected reference technology—that is, one that is already in place to deliver the same function.

It must be pointed out that energy efficiency and conservation through better housekeeping and retrofit, although not listed in Table 5, are to be included as major undertakings that have to be pursued in realizing GHG emission reduction initiatives, as such undertakings will

result in a win-win situation. A policy climate to support such undertakings has to be established. The most important one is the removal of subsidized prices for petroleum products and electricity. Since April 2000, the government has taken steps to gradually accelerate schemes for the removal of those subsidies. Subsidies on most refinery products have been removed and electricity tariffs have been increased to reduce the subsidy to these sectors.

Table 4.1: Technology options for greenhouse gas mitigation/abatement

No.	Sector and category	Technology Options	Base case or Reference Technology	GHG reduction potential, kg CO ₂ eq./MWh	Incremental cost per unit output, US\$/MWh	Incremental cost per reduced GHG, US\$/kg
1.	Home water heating technology	♦ Solar Water Heater	LPG-fired water heater	1250	-22	-0.018
2.	Add-on and end-of-pipe technology for fired furnaces	♦ Combustion-Air Preheat	No air-preheating	133	-1.38	-0.010
		♦ Flue gas utilization for micro algae cultivation	Release to the atmosphere	1000	50	0.050
		♦ CO ₂ recovery and disposal to reservoir	Release to the atmosphere	1000	50	0.050
3.	Improved technology for power generation	♦ Geothermal Power Plant	Pulv. coal power plant	946	-27.69	-0.029
		♦ Micro/small hydropower plant	Pulv. coal power plant	1000	-24.15	-0.024
		♦ Biomass Cogeneration Power Plant	Pulv. coal power plant	1000	-10.12	-0.010
		♦ Gas-Fired Combined-Cycle Plant	Pulv. coal power plant	550.4	-4.53	-0.008
		♦ IGCC* Power Plant	Pulv. coal power plant	61.5	6.73	0.11
		♦ Solar Photovoltaic Power Plant	Pulv. coal power plant	1000	149.39 (-24.74)**	0.15 (-0.025)**
4.	Improved technology for road transport systems	♦ Ethanol Vehicles	Gasoline car	1693.6	45	0.0266
		♦ Electric Cars	Gasoline car	967.8	151	0.156
		♦ Fuel Cell Vehicles	Gasoline car	2080.7	450	0.216
		♦ Compressed Natural Gas Vehicles	Gasoline car	483.9	120	0.248

* Integrated (Coal) Gasification Combined-Cycle. ** parenthetical values are predicted costs after 2005

4.2 Experience to date

Quite a number of climate change mitigation projects have been undertaken, some funded by the GEF, others within the realm of the AIJ scheme. Table 4.2 lists completed activities, as well as those that are in progress or still at the proposal stage.

Table 4.2: List of AIJ projects in Indonesia

Project title and description	GHG abatement target	Energy saving	Status	Complementary Funding
100 tonnes/day paper sludge and solid waste incinerator-steam boiler unit at Fajar Surya Wisesa Ltd., Bekasi, West Java.	91 Gg/yr CO ₂ equivalent.	9000 TOE/yr for 16.8 tonnes per hour steam production	Procurement	NEDO
Cement clinker cooling system at PT Semen Cibinong, Narogong, West Java.	52 Gg/yr CO ₂ equivalent.	418 MJ/tonne of clinker	Engineering design	NEDO
159 kWh/day hybrid power generation system (PV-micro hydro-wind turbine) for rural electrification at Waimena, West Irian.	0.086 Gg/yr CO ₂ equivalent.	-	September 1998: Completed and functioning.	Australia
175 units of 10 kW Solar Home System, 3 mini hydro units of 130 kW each, 2 units of 32 kW hybrid system at East Nusa Tenggara.	1.23 Gg/yr CO ₂ equivalent.	-	Under construction	WB/E-7
Solid waste and wastewater treatment and utilization at 200 tonnes/day tapioca starch plant at Ponorogo, East Java.	not available	-	Feasibility study completed	NEDO
Heat recovery unit at PLN Suralaya Power Plant, West Java.	30,000 Gg/yr CO ₂ equivalent	9.5 million tonnes/yr coal drying	Submission of application to conduct feasibility study	?
Heat recovery unit at PTBA power plant, Tanjung enim, South Sumatera.	2000 Gg/yr CO ₂ equivalent.	0.7 million tonnes/yr coal drying	Submission of application to conduct feasibility study	?
40 tonnes/day solar desalination unit at Tanjung Priok, Jakarta.	0.8 Gg/yr CO ₂ equivalent	-	Preparatory activity and data collection	Denmark
CNG for transport (36 fueling stations and 10,000 conversion kits) at 8 major cities	Not available		Submission of proposal	?

Except for two projects listed in Table 4.2—the third (in Irian Jaya) and the fourth (in East Nusa Tenggara)—all AIJ projects are undertaken with the participation of private enterprises. However, initiatives to undertake the AIJ projects came mostly from the corresponding donor agencies.

The GEF/SGP activities have been carried out in a sequence of three phases: pilot phase, phase I and phase II. The pilot phase and the phase I activities have been completed, and phase II is just commencing. The pilot phase covers 21 projects, none of which are climate-change related (that is, all the projects deal with biodiversity). Of the 62 projects being undertaken in phase II, only 6% deal with climate change; the rest deal with biodiversity (82%), multiple focal areas (10%), and international waters (2%).

The GEF/SGP activities are handled and administered by a national committee commissioned by the UNDP with the concurrence of the government of Indonesia. It operates under the UNDP operation in Indonesia, in collaboration with Yayasan Bina Usaha Lingkungan, a foundation that promotes and provides financing support to small and medium sized business enterprises that are environmentally oriented. So far, only NGOs are eligible to submit proposals and undertake GEF/SGP activities; the participation of university research centers is currently under consideration.

As a general observation, efforts to promote and initiate GEF and AIJ projects have been far from adequate, leading to poor information dissemination and consequent lack of awareness, not only among the business community, but also among government agencies.

5 Priority Projects for the CDM

5.1 Criteria for selection of CDM opportunities

The energy sector in Indonesia, particularly oil and gas, has been a dominant factor in the overall economic development of the country. In addition to providing for domestic energy needs, oil and gas exports contribute significantly to government income and to generation of foreign exchange revenue. It should be noted, however, that the role of the oil sector in securing foreign exchange revenue will soon be declining, because of (a) the increase in domestic oil consumption, and (b) oil resource constraints. Present estimates indicate that if no prudent policy measures are implemented, Indonesia may become a net oil importing country in 2010.

For the past 25 years, the energy supply mix has been dominated by oil, and this is expected to continue into the immediate future. In absolute terms the domestic consumption of oil is increasing, but the percentage share is slowly declining. The share of natural gas and coal is starting to pick up rapidly, particularly in the industrial and power sectors. In future, coal is expected to be the dominant component of the energy supply mix. The exploitation of geothermal energy resources for power generation can also be expected to emerge; an appropriate policy climate is still to be developed. Among the countries endowed with geothermal energy resources, Indonesia ranks second or third in terms of resource availability.

In the demand sectors, the consumption pattern has shifted considerably from the household sector to the industry and transport sectors. Energy demand in the transport sector is rising fastest.

5.2 List of priority CDM projects

At least, ten projects have been identified as potential CDM projects, mainly in the energy sector. These projects will cover energy efficiency in the industrial, renewable energy, transportation, and power generation sectors. Table 5.1 summarizes potential CDM projects.

Table 5.1: Potential identified CDM projects in Indonesia

Emission Reduction Option	Price Range¹	Quality of GHG Offset²	Emission mitigation potential Tonnes CO₂/yr
Industrial Sector Energy Efficiency			
1. Salt production from desalination effluent of fossil-based power plant	Medium	Medium	4.37E+05
Renewable Energy			
2. Rice husk-based small power generation units (each ≤100 kW)	High	High	8.72E+04
3. Geothermal power plant	High	High	1.95E+06
4. Micro-hydro power generation	High	High	1.58E+06
5. Utilization of low level geothermal heat for agricultural activities	Medium	High	2.98E+04
Transportation Sector			
6. Gasohol fuel ³	Medium	High	3.35E+06
7. Biodiesel ⁴	Medium	High	3.46E+06
8. PV-based small vehicle	High	High	1.62E+05
9. CNG vehicles (Buses) ⁵	High	Medium	1.92E+05
Power Generation			
10. Coal drying using power plant waste heat	Low	Low	1.79E+04

Industrial sector energy efficiency

Salt production from desalination effluent of fossil-based power plant

The land area of Indonesia covers 1.9 million square kilometers. The surrounding sea area that is within the exclusive economic zone is around 7.9 million square kilometers. Nevertheless, Indonesia is the sixth largest salt importing country and intends to increase imports to meet salt demand in the future.

There is a great opportunity to reduce salt imports through the desalination of seawater. However, by using heat recovery from steam power plants as the heat source for desalination instead of oil (ADO)-fired heaters, significant reductions in CO₂ emissions could also be achieved. For example, if salt were extracted from water using heat recovered from a steam

¹ Low: up to US\$5/tonne; Medium: \$5-20/tonne; High: Above \$20/tonne.

² Contribution to Sustainable Development, Additionality, Measurable, Quantifiable, Creditability.

³ 10% by volume absolute bio ethanol

⁴ 5% blend in petroleum-based diesel fuel

⁵ Compressed Natural Gas

power plant in Suralaya instead of using an oil-fired heater, 161 million liters of oil would be saved and emissions reduced by 0.44 million tonnes of CO₂ a year.

Renewable Energy

Rice husk-based small power generation units (each £100 kW)

As an agricultural country, Indonesia produces a large amount of rice-husk waste. Rice-husk gasifiers have been installed mainly as pilot projects. Several problems occurred during operation, pointing out both technical and economic barriers. For example, lack of experienced technicians meant that plant operations were frequently disturbed and, in some cases, the plants became inoperable.

Although the direction of national development has moved from agriculture to industry, food production (i.e., rice) still has a major role in meeting domestic consumption needs. According to the Center for Research on Energy (1992), 1990 rice production was 36.63 million tonnes, yielding about 8.85 million tonnes of rice husk. Therefore, rice husk-based small generation will benefit local people by providing electricity for milling their rice and it will also reduce emissions.

If diesel power generation is assumed to be the baseline for national electricity planning, and if a rice-husk gasifier project were implemented with approximately 100 units of 100 KW installed capacity, this project would reduce emissions by about 87 kilotonnes of CO₂ per year and would save 32.2 million liters of diesel oil per year.

Geothermal power plant

Indonesia has the world's largest share of geothermal energy reserves (about 40%), only 2% of which have been developed to generate electricity.

Although geothermal energy is considered a priority power source in Indonesia, it has faced problems and obstacles in terms of electricity pricing, and has become more difficult to develop since the recent economic crisis.

The CDM could potentially eliminate barriers to implementing geothermal power plants in Indonesia. For example, a benefit of emissions trading could be reduced electricity prices for geothermal, enabling it to compete effectively with other electricity sources

A CDM project consisting of six units of 155 MW installed geothermal capacity would represent only 2.2% of known geothermal potential (42.6 GW). However, taking coal power generation as the baseline power source, geothermal power plants could potentially reduce emissions by 1.95 million tonnes of CO₂ per year.

Micro-hydro power generation

Indonesia is endowed with sizable energy resources, including oil, natural gas, coal, hydropower, geothermal, biomass, and a variety of less important renewable energy resources such as wind, ocean thermal, wave and tidal energy.

According to DGEED, micro-hydro power potential amounts to 7,500 MW, excluding large hydro dams. A micro-hydro CDM project consisting of 5,000 units of 100 KW each would contribute about 3% to household electrification, reducing annual emissions by 1.58 million tonnes of CO₂ and affecting 900,000 households.

As well as its household electrification benefits, micro-hydro generation also supports rural community development.

Utilization of low-level geothermal heat for agricultural activities

Use of a small geothermal heat plant for producing and processing agriculture products in Indonesia has been implemented on a pilot scale. Collaboration between the Agency of Technology Assessment and Application (BPPT) and Industry Engineering Co. (REKIN) promoted the project entitled “Direct Use of Small Geothermal Plant in Pangalengan, Bandung.” The project is being evaluated for its potential to provide heat for local farmers to use in growing mushrooms, tea, and seedling potatoes.

A three-unit CDM project would reduce annual emissions by about 30 kilotonnes of CO₂.

Transportation Sector

Bio-ethanol (gasohol) fuel

Bio-ethanol blended with gasoline (gasohol) is used as a fuel in several countries. Bio-ethanol is often labeled a “green” fuel with zero emissions due to its derivation from renewable resources. As a tropical country, Indonesia has plenty of agricultural land and almost any plant can grow in most of the country. At least three plants are regarded as having the most potential for bio-ethanol products—sugarcane, cassava, and yam. Sugarcane has been used as a source of bio-ethanol since the 1970s in Brazil and the United States.

Yam has been identified as a good source of bio-ethanol, yielding 7,812 liters per hectare per year. Table 5.2 compares bio-ethanol production from sugarcane, cassava, and yam.

Table 5.2: Bio-ethanol production from sugarcane, cassava, and yam

Sources	Harvesting yields	Ethanol yields	
	(tonnes/ha/yr)	l/tonne	l/ha/year
Sugarcane	75	67	5025
Cassava	25	180	4500
Yam	62.5	125	7812

Source: Soerawidjaja, 1999

If 5% of the predicted 2005 gasoline demand of 9 billion liters is filled by bio-ethanol from yam, and if a bio-ethanol plant produces 5 million liters, then approximately 136 units of bio-ethanol plants will be needed to meet this demand. This project would reduce greenhouse gas emissions by 1.67 million tonnes of CO₂ a year.

Bio-diesel

Bio-diesel is a fuel oil derived from plants and is combustible in a diesel engine. Sources include palm and oilseed oils. Liquid fuel for the transportation sector is one of the major concerns in Indonesia. In 1999, fuel consumption of the transportation sector was 51% of total oil consumption, amounting to 299 million BOE. Increased fuel consumption can have harmful environmental effects and some studies indicate that five large cities in Indonesia may be at a critical point in terms of their ambient air quality. Shifting to greener fuels (i.e., bio fuels) and improving road transport management are important options in an emission mitigation strategy.

If 5% of the 25.5 billion liters of ADO demand in 2005 is replaced by bio-diesel, this would require 639 units of bio-diesel plants with yearly production capacity of about 1.280 million liters. Yearly emission reduction potential would be 3.46 million tonnes of CO₂.

PV-based small vehicle

According to Central Bureau Statistics, in 1995 there were 14,612 small three-wheeled public vehicles called Bajajs operating in Jakarta. With long operating hours, Bajajs are blamed for causing traffic jams at several points in Jakarta, and add to air pollution problems. Some policies have been introduced at the regional house of representatives and by the governor to restrict the use of Bajajs.

A small vehicle powered by photovoltaic cells could be a major option to replace Bajajs. Assuming that a PV-based small vehicle has zero emissions, then the emission mitigation potential of replacing the Bajajs could amount to 1,620 kilotonnes of CO₂ per year.

CNG vehicles for public transport

Shifting from diesel fuel to compressed natural gas (CNG) for bus transportation is a real option in Indonesia. Emissions from public transport are normally expressed in terms of emissions per unit output (tonnes/km or tonnes/passenger-km). Assessments of the emission mitigation potential of different options are determined by comparing emission factors from selected alternative options with existing conditions. Emission reductions, however, will also depend on the total number of vehicles in use. Past experience with fuel-shifting to CNG-fueled taxis and minibuses in major cities of the country has shown that in many cases, users revert to the original fuel after a short time. The main reasons are lack of infrastructure (e.g., filling stations for LPG and CNG), and poor public promotion.

Converting 10,000 buses to CNG in five big cities in Indonesia would save about 180 million liters ADO and reduce emissions by 192 kilotonnes of CO₂ a year.

Coal drying using power plant waste heat

Indonesia has huge coal reserves of 38.01 billion TCE, most of which are classified as low-rank coal. Domestically, coal is used mainly for electricity generation and in the cement industry. In 1999, installed capacity of coal steam power plants was 4,385 MW. Because the

price of coal-generated electricity is relatively lower than electricity from other sources, coal steam power plants are expected to have a major role in Indonesia's national electricity development planning.

There are several ways in which coal utilization efficiency can be increased and emissions reduced. One is coal enrichment, which involves drying low-rank coal to yield a higher grade of coal before burning.

Power plant coal normally has a moisture content of 10%. If waste heat is used to dry, for example, 693 kilotonnes of coal, 17,936 tonnes of CO₂ can be saved when the fuel is burned in a power plant

6 References

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