The Clean Development Mechanism (CDM)

Introduction

The Clean Development Mechanism (CDM), a cooperative mechanism established under the Kyoto Protocol, has the potential to assist developing countries in achieving sustainable development by promoting environmentally friendly investment from industrialized country governments and businesses*. This document provides an overview of the CDM's background, structure, and project cycle, and examines the potential value and benefits for participating developing countries. The document also suggests steps for developing a national CDM strategy and provides examples of CDM projects. While the basic rules have been established, the CDM is a work in progress by participating governments. This document presents the latest available information and will be updated in the future to reflect important changes.

Background

The 1997 Kyoto Protocol, a milestone in global efforts to protect the environment and achieve sustainable development, marked the first time that governments accepted legally-binding constraints on their greenhouse gas emissions. The Protocol also broke new ground with

* The Kyoto Protocol does not exclude the possibility of unilateral CDM projects, where investors are developing country entities.

its innovative "cooperative mechanisms" aimed at cutting the cost of curbing these emissions. As it does not matter to the climate where emission reductions are achieved, sound economics argues for achieving them where they are least-costly. The Protocol therefore includes three market-based mechanisms aimed at achieving cost-effective reductions — International Emissions Trading (IET), Joint Implementation (JI), and the CDM.

The CDM, contained in Article 12 of the Kyoto Protocol, allows governments or private entities in industrialized countries to implement emission reduction projects in developing countries and receive credit in the form of "certified emission reductions," or CERs, which they may count against their national reduction targets. The CDM strives to promote sustainable development in developing countries, while allowing developed countries to contribute to the goal of reducing atmospheric concentrations of greenhouse gases.

> Kyoto Protocol Article 12.2 "The purpose of the clean development mechanism shall be to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under Article 3."

The UNFCCC & the Kyoto Protocol

Increasing scientific evidence of human interference with the global climate system, along with growing public concern about the environment, pushed climate change onto the political agenda in the mid-1980s. In 1988, the United Nations Environment Programme

(UNEP) and the World Meteorological Organization (WMO) established the Intergovernmental Panel on Climate Change (IPCC) to provide policymakers with authoritative scientific information. The IPCC, consisting of hundreds of leading scientists and experts on global warming, was tasked with assessing the state of scientific knowledge concerning climate change, evaluating its potential environmental and socioeconomic impacts, and formulating realistic policy advice.

Two years later in 1990, the IPCC published a report concluding that the growing accumulation of human-made greenhouse gases in the atmosphere would "enhance the greenhouse effect, resulting on average in an additional warming of the Earth's surface" by the next century, unless measures were adopted to limit emissions. The report confirmed that climate change was a threat and called for an international treaty to address the problem. Later that same year, the Second World Climate Conference echoed the same call. The United Nations General Assembly responded by formally launching negotiations on a framework convention on climate change and establishing an "Intergovernmental Negotiating Committee" to develop the treaty. Negotiations to formulate an international treaty on global climate protection began in 1991 and resulted in the completion, by May 1992, of the United Nations Framework Convention on Climate Change (UNFCCC).

The United Nations Framework Convention on Climate Change (UNFCCC)

The UNFCCC was opened for signature at the UN Conference on Environment and Development (the Earth Summit) in Rio de Janeiro, Brazil, in June 1992, and entered into force in March 1994. The Convention sets an "ultimate objective" of stabilizing atmospheric concentrations of greenhouse gases at safe levels. Such levels, which the Convention does not quantify, should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic

development to proceed in a sustainable manner. To achieve this objective, all countries have a general commitment to address climate change, adapt to its effects, and report their actions to implement the Convention. As of December 2001, the Convention currently has received 186 instruments of ratification.

The Convention divides countries into two groups: Annex I Parties, the industrialized countries who have historically contributed the most to climate change, and non-Annex I Parties, which includes primarily the developing countries. The principles of equity and "common but differentiated responsibilities" contained in the Convention require Annex I Parties to take the lead in returning their greenhouse gas emissions to 1990 levels by the year 2000. They must also submit regular reports, known as national communications, detailing their climate change policies and programs, as well as annual inventories of their GHG emissions.

The Kyoto Protocol

The Kyoto Protocol was adopted in December 1997. The Protocol creates legally binding obligations for 38 industrialized countries, including 11 countries in Central and Eastern Europe, to return their emissions of GHGs to an average of approximately 5.2 percent below their 1990 levels as an average over the period 2008-2012.

The targets cover the six main greenhouse gases: carbon dioxide, methane, nitrous oxide; hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); and sulphur hexafluoride. The Protocol also allows these countries the option of deciding which of the six gases will form a part of their national emissions reduction strategy. Some activities in the land-use change and forestry sector, such as deforestation and reforestation, that emit or absorb carbon dioxide from the atmosphere, are also covered.

Negotiations continued after Kyoto to develop the Protocol's operational details. While the Protocol identified a number of modalities to help Parties reach their targets, it does not elaborate on the specifics. After more than four years of debate, governments finally in 2001 agreed to a comprehensive rulebook—the Marrakech Accords—on how to implement the Kyoto Protocol. The Accords also intend to provide governments with sufficient clarity to consider ratification.

The Clean Development Mechanism (CDM) and the Cooperative Mechanisms

The Protocol establishes three cooperative mechanisms designed to help industrialized countries (Annex I Parties) reduce the costs of meeting their emissions targets by achieving emission reductions at lower costs in other countries than they could domestically.

- *International Emission Trading* permits countries to transfer parts of their 'allowed emissions' ("assigned amount units").

- *Joint Implementation* (JI) allows countries to claim credit for emission reductions that arise from investment in other industrialized countries, which result in a transfer of equivalent "emission reduction units" between the countries.

- *The Clean Development Mechanism*(CDM) allows emission-reduction projects that assist in creating sustainable development in developing countries to generate "certified emission reductions" for use by the investor.

The mechanisms give countries and private sector companies the opportunity to reduce emissions anywhere in the world—wherever the cost is lowest—and they can then count these reductions towards their own targets.

Through emission reduction projects, the mechanisms could stimulate international investment and provide the essential resources for cleaner economic growth in all parts of the world. The CDM, in particular, aims to assist developing countries in achieving sustainable development by promoting environmentally friendly investment from industrialized country governments and businesses.

The funding channelled through the CDM should assist developing countries in reaching some of their economic, social, environmental, and sustainable development objectives, such as cleaner air and water, improved land use, accompanied by social benefits such as rural development, employment, and poverty alleviation and in many cases, reduced dependence on imported fossil fuels. In addition to catalyzing green investment priorities in developing countries, the CDM offers an opportunity to make progress simultaneously on climate, development, and local environmental issues. For developing countries that might otherwise be preoccupied with immediate economic and social needs, the prospect of such benefits should provide a strong incentive to participate in the CDM.

Overview of the CDM

Participation

The CDM allows an Annex I Party to implement a project that reduces greenhouse gas emissions or, subject to constraints, removes greenhouse gases by carbon sequestration, or "sinks," in the territory of a non-Annex I Party. The resulting certified emission reductions, known as CERs, can then be used by the Annex I Party to help meet its emission reduction target. CDM projects must be approved by all Parties involved, lead to sustainable development in the host countries, and result in real, measurable and long-term benefits in terms of climate change mitigation. The reductions must also be additional to any that would have occurred without the project.

In order to participate in the CDM, there are certain eligibility criteria that countries must meet. All Parties must meet three basic requirements: voluntary participation in the CDM, the establishment of a National CDM Authority, and ratification of the Kyoto Protocol. In addition, industrialized countries must meet several further stipulations: establishment of the assigned amount under Article 3 of the Protocol, a national system for the estimation of greenhouse gases, a national registry, an annual inventory, and an accounting system for the sale and purchase of emission reductions.

Eligible Projects

The CDM will include projects in the following sectors:

- End-use energy efficiency improvements
- Supply-side energy efficiency improvement
- Renewable energy

- Fuel switching
- Agriculture (reduction of CH_4 and $N2_O$ emissions)
- Industrial processes (CO_2 from Cement etc., HFCs, PFCs, SF_6)
- Sinks projects (only afforestation and reforestation)

Annex I Parties must refrain from using CERs generated through nuclear energy to meet their targets. In addition, for the first commitment period (2008-2012), the only sink projects allowed are those involving afforestation or reforestation, and Annex I Parties can only add CERs generated from sink projects to their assigned amounts up to 1% of their baseline emissions for each year of the commitment period. Further guidelines for carbon sink projects will be developed to ensure they are environmentally sound.

In order to make small projects competitive with larger ones, the Marrakech Accords establish a fast track for small-scale projects with simpler eligibility rules—renewables up to 15 MW, energy efficiency with a reduction of consumption either on the supply or the demand side of up to 15 gigawatthours/yr, and other projects that both reduce emissions and emit less than 15 kilotons of CO_2 equivalent annually. The Executive Board has been tasked with defining modalities and procedures for the fast track, and will submit them to the Eighth Conference of the Parties (COP 8), to be held in New Delhi in October 2002.

Financing

Public funding for CDM projects must not result in the diversion of funds for official development assistance. In addition, the CERs generated by CDM projects will be subject to a levy–known as the "share of the proceeds"– of 2%, which will be paid into a newly-created adaptation fund to help particularly vulnerable developing countries adapt to the adverse effects of climate change.

Another levy on CERs will contribute to the CDM's administrative costs. To promote the equitable distribution of projects among developing countries, CDM projects in least developed countries are exempt from the levy for adaptation and administrative costs.

The Executive Board

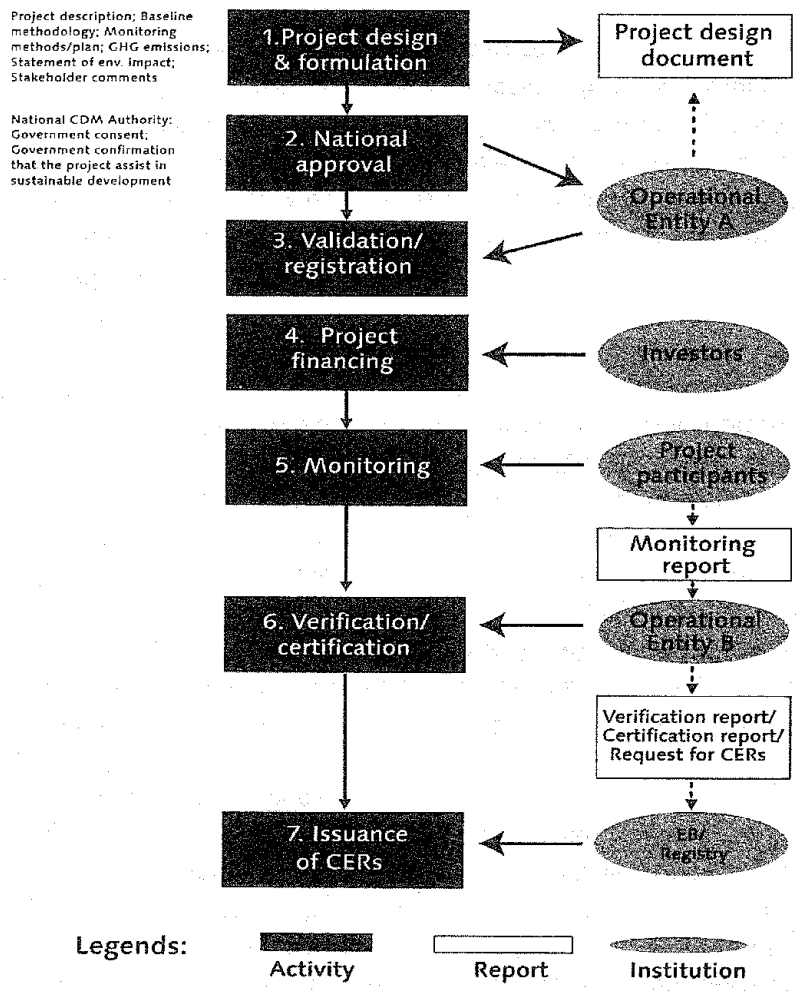
The CDM is supervised by an Executive Board, which itself operates under the authority of the Parties. The Executive Board is composed of 10 members, including one representative from each of the five official UN regions (Africa, Asia, Latin America and the Caribbean, Central and Eastern Europe, and OECD), one from the small island developing states, and two each from Annex I and non-Annex I Parties. The Executive Board held its opening meeting at the Marrakech talks in November 2001, marking the launch of the CDM.

The Executive Board will accredit independent organizations–known as operational entities –that will validate proposed CDM projects, verify the resulting emission reductions, and certify those emission reductions as CERs. Another key task is the maintenance of a CDM registry, which will issue new CERs, manage an account for CERs levied for adaptation and administrative expenses, and maintain a CER account for each non-Annex I Party hosting a CDM project.

Project Identification and Formulation

The first step in the CDM project cycle is the identification and formulation of potential CDM projects. A CDM project must be real, measurable and additional. To establish additionality, the project emissions must be compared to the emissions of a reasonable reference case, identified as the baseline. The baseline is established by the project participants according to approved methodologies on a project-specific basis. These baseline methodologies are being developed based on the three approaches in the Marrakech Accord:

Project cycle for the CDM



The CDM project cycle as shown on the figure has seven basic stages: project design and formulation, national approval, validation and registration, project finance, monitoring, verification/certification and issuance of CERs. The first four are performed prior to the implementation of the project, while the latter three are performed during the lifetime of the project.

- existing actual or historical emissions;
- emissions from a technology that represents an economically attractive investment; or,
- the average emissions of similar project activities under taken in the previous five years under similar circumstances and whose performance is among the top 20% of their category.

CDM projects must also have a monitoring plan to collect accurate emissions data. The monitoring plan, which constitutes the basis of future verification, should provide confidence that the emission reductions and other project objectives are being achieved and should be able to monitor the risks inherent to baseline and project emissions. The monitoring plan can be established either by the project developer, or by a specialized agent. The baseline and monitoring plan must be devised according to an approved methodology. If the project participants prefer a new methodology, it must be authorized and registered by the Executive Board. The project participants must choose whether the crediting period shall be 10 years or 7 years with a possibility to be renewed two times (a maximum of 21 years).

National Approval

All countries wishing to participate in the CDM must designate a National CDM Authority to evaluate and approve the projects, and serve as a point of contact. Although the international process has given general guidelines on baselines and additionality, each developing country has the responsibility to determine the national criteria for project approval. Together with the investor, the host country must prepare a project design document with the following structure:

- General description of the project;
- Description of the baseline methodology;
- Timeline and crediting period;
- Monitoring methodology and plan;

- Calculation of GHG emissions by sources
- Statement of environmental impacts;
- Stakeholder comments.

The National CDM Authority issues the necessary statements: that the government participates voluntary in the project and confirms that the project activity assists the host country in achieving sustainable development.

Validation and Registration

A designated operational entity will then review the project design document and, after public comment, decide whether or not it should be validated. These operational entities will typically be private companies such as auditing and accounting firms, consulting companies and law firms capable of conducting credible, independent assessments of emission reductions. If validated, the operational entity will forward it to the Executive Board for formal registration.

Monitoring, Verification and Certification

The carbon component of a mitigation project cannot acquire value in the international carbon market unless submitted to a verification process designed specifically to measure and audit the carbon component. Therefore, once the project is operational, participants prepare a monitoring report, including an estimate of CERs generated, and submit it for verification by an operational entity.

Verification is the independent ex-post determination by an operational entity of the monitored reductions in emissions. The operational entity must make sure that the CERs have resulted according to the guidelines and conditions agreed upon in the initial validation of the project. Following a detailed review, an operational entity will produce a verification report and then certify the amount of CERs generated by the CDM project.

Certification is the written assurance that a project achieved the reductions as verified. The certification report also constitutes a request for issuance of CERs. Unless a project participant or three Executive Board members request a review within 15 days, the Executive Board will instruct the CDM registry to issue the CERs.

National Value and Benefits

The basic principle of the CDM is simple: developed countries can invest in low-cost abatement opportunities in developing countries and receive credit for the resulting emissions reductions, thus reducing the cutbacks needed within their borders. While the CDM lowers the cost of compliance with the Protocol for developed countries, developing countries will benefit as well, not just from the increased investment flows, but also from the requirement that these investments advance sustainable development goals. The CDM encourages developing countries to participate by promising that development priorities and initiatives will be addressed as part of the package. This recognizes that only through long-term development will all countries be able to play a role in protecting the climate.

From the developing country perspective, the CDM can:

- Attract capital for projects that assist in the shift to a more prosperous but less carbon-intensive economy;
- Encourage and permit the active participation of both private and public sectors;
- Provide a tool of technology transfer, if investment is channelled into projects that replace old and inefficient fossil fuel technology, or create new industries in environmentally sustainable technologies; and,
- Help define investment priorities in projects that meet sustainable development goals.

Specifically, the CDM can contribute to a developing country's sustainable development objectives through:

- Transfer of technology and financial resources;
- Sustainable ways of energy production;
- Increasing energy efficiency & conservation;
- Poverty alleviation through income and employment generation; and
- Local environmental side benefits

The drive for economic growth presents both threats and opportunities for sustainable development. While environmental quality is an essential element of the development process, in practice, there is considerable tension between economic and environmental objectives. Increased access to energy and provision of basic economic services, if developed along conventional paths, could cause long-lasting environmental degradation---both locally and globally. But by charting a different course and providing the technological and financial assistance to follow it, many potential problems could be avoided.

In comparing potential CDM projects with what might otherwise take place, it is clear that the majority will entail not only carbon reduction benefits, but also produce a range of environmental and social benefits within developing countries. Sustainable development benefits could include reductions in air and water pollution through reduced fossil fuel use, especially coal, but also extend to improved water availability, reduced soil erosion and protected biodiversity. For social benefits, many projects would create employment opportunities in target regions or income groups and promote local energy self-sufficiency. Therefore carbon abatement and sustainable development goals can be simultaneously pursued.

Many options under the CDM could create significant co-benefits in developing countries, addressing local and regional environmental

problems and advancing social goals. For developing countries that might otherwise give priority to immediate economic and environmental needs, the prospect of significant ancillary benefits should provide a strong inducement to participate in the CDM.

Developing a National CDM Strategy

Evaluation of National Interests and Priorities

The CDM presents an opportunity to channel resources towards the projects that are most likely to further national sustainable development. Criteria for CDM projects should therefore be based on a country's sustainable development objectives, which may be identified by the goals and policies already established for social and economic development in related areas, such as energy, land-use change and transportation. At the national level, sustainable development programs or environmental plans may already be in place in related areas, such as policies on forests, renewable energy and clean technologies.

Building Support for CDM — A Participatory Approach

One of the most challenging aspects of building a national CDM strategy is enlisting the active support from all sectors of society (civil, NGOs, private and public sector) and different sectors of the economy (industry, energy, agriculture, forestry). A successful CDM strategy will require official governmental support, both in terms of ratification of the UNFCCC and the Kyoto Protocol, but also in designating a National Authority to approve CDM projects. However, governments will also play a key role in cooperating with the private sector to market the CDM proposals to prospective investors.

The private sector can help ensure an emphasis on efficiency and the development of clear and simple rules. Including the participation of

the private sector in the institutional building process encourages a less bureaucratic and more results-oriented approach in the procedure. The private sector is essential for driving the CDM, as investors seek cost-efficient means of mitigating their emissions.

Non-governmental organizations (NGOs) should also be incorporated in the development and implementation of the strategy, since they bring an environmental and social focus to the institutional agenda. NGOs can be repositories of valuable scientific expertise and technical know-how in developing and evaluating projects.

The integration of these sectors is seldom easy. Some governments may enjoy a good working relationship with NGOs and the private sector, allowing them to distribute responsibilities and work together. Other governments, however, may have a more distant relationship among the different sectors, making it more difficult to reach a common goal. In any case, the approach should match national circumstances.

National Institutional Structure to Implement CDM Projects

The National CDM Authority is the host country entity or body that evaluates potential CDM projects and provides written approval confirming that the project activity is voluntary, complies with national and international criteria, and assists in achieving sustainable development of the host country.

The National CDM Authority needs to have open communication with the government agencies of the sectors relevant to the CDM. The technical review of projects can often involve the ministries or bureaus of the relevant sector (energy, natural resources, environment, etc.). The approval of CDM projects could also involve foreign affairs ministries, since they often serve as the UNFCCC focal point.

Evaluation and Approval

A sound evaluation process will increase the probability of having projects successfully validated and certified as CDM projects, and reduce the perceived and real risks of national and foreign investors in developing and implementing carbon mitigation projects. It can also create incentives for specific project types or for priority sectors. The evaluation process also provides the main filter for ensuring that projects pursue CDM objectives consistent with relevant national policies, strategies and priorities.

International criteria: As a starting point in the evaluation process, a CDM project must first satisfy the internationally agreed criteria. Article 12 of the Kyoto Protocol stipulates three principal eligibility criteria for CDM projects:

- Projects must assist Non-Annex I Parties "in achieving sustainable development and contributing to the ultimate objective of the Convention".
- Projects must result in "real, measurable and long-term benefits related to the mitigation of climate change".
- Projects must result in "reductions in emissions that are additional to any that would occur in the absence of the certified project activity".

The Marrakech Accords stipulate more criteria that must be met by potential CDM projects. These international criteria focus mainly on technical aspects of the carbon mitigation activities of the project and are meant to ensure that the expected benefits related to the mitigation of climate change are real, measurable and additional.

National Criteria: The host country has the prerogative to decide whether a project assists in achieving sustainable development, and therefore should develop national criteria and requirements to ensure a coherent, justifiable and transparent assessment. Key elements could include:

compliance with existing political and legal frameworks; compatibility with local priorities; comments by local stakeholders directly and indirectly involved with the project; local availability of qualified human resources and adequate institutional resources; and the potential for local institutional enhancement and national capacity building.

In deciding which of these criteria are to be adopted, the host country should consider the direct relationship between requirements and transaction costs. The more requirements imposed on project developers, the higher the preparation costs. In a carbon market where the CDM already has many prerequisites, host countries should balance information requirements necessary for quality control with rising preparation costs.

Another key element for attracting CDM investments is the host country's application of quick and transparent procedures for screening, evaluating and approving projects. To achieve this goal, the National CDM Authority should implement a standardized system to screen, evaluate, and approve CDM projects. Host countries will need to establish guidelines for presenting projects. For validation and verification, CDM projects must be drafted in the format of a Project Design Document (PDD). The guidelines for the presentation of projects need to be consistent and transparent, so that project developers are not subjected to changing formats.

Project Supply, Identification and Formulation

To promote CDM investment, host countries can hold training sessions for project developers, during which they are shown how to identify potential projects, understand the context of the UNFCCC and the carbon market, and familiarize themselves with the PDD. Training sessions may also be necessary to understand the more complex aspects of CDM projects, such as generating proper documentation for the

establishment of baselines (including assumptions and methodologies used), as well as calculating project emissions, reductions and leakage; that is, the indirect effect of emission reduction projects that lead to a rise in emissions elsewhere. Participants in the training courses should include project developers, private companies, government agencies, bankers, NGOs and other stakeholders. Host countries can facilitate international investment by developing a portfolio of diverse high quality CDM projects that address the needs and interests of a wide spectrum of investors.

Conclusion

The full extent of potential benefits available to developing countries under the CDM is difficult to forecast, but its enormous potential to promote sustainable development and increase foreign investment flows is clear. With thoughtful planning and the development of a national CDM strategy, it can also assist in addressing local and regional environmental problems and in advancing social goals. The CDM allows developing countries to participate in the global effort to combat climate change at a time when other development priorities may limit the funding available for GHG emission reduction activities. The CDM's objective of advancing the development goals of developing countries recognizes that only through long-term sustainable development will all countries be able to play a role in climate protection.

CDM Projects Examples

For the following section, the acronym AIJ before the name of the host country signifies that the example is taken from the Actions Implemented Jointly (AIJ) pilot phase, a forerunner of the CDM developed under the UNFCCC.

End-Use Energy Efficiency

Energy Efficiency Measures in Industrial Boilers (Viet Nam)

This project, from the Asian Least-cost Greenhouse Gas Abatement Strategy (ALGAS), will improve boiler efficiencies in the industrial sector. The targeted improvements will have low investment costs and include the following measures: measuring devices, control devices, and insulating materials. The project will disseminate new technologies to industry and propose relevant measures for upgrades.

The project's primary goal is the reduction of energy consumption by industrial boilers per unit of product and, therefore, to reduce CO_2 emissions in the industrial sector. In Viet Nam the industrial sector is the highest CO_2 emitter, responsible for 40% of overall emissions.

The baseline for the project is the continued use of inefficient boilers in Viet Nam with an average efficiency of 45 percent. The proposed improvements will raise the average efficiency of industrial boilers to 60 percent. The project will lead to an estimated reduction of emissions of 150 kt CO_2 per year. It will also reduce the emissions of local airborne pollutants. This is important in Viet Nam since the industrial sector emits the highest share of the SO_2 emissions and is the second highest NO_x emitting sector.

Supply-Side Energy Efficiency

Combined Heat and Power (CHP) Project in Shangqiu Thermal Power Plant in Henan Province (AIJ-China)

For many developing countries, CHP could provide the basis for potential CDM projects. The aim of this project is to replace 24 small low-efficiency, coal-fired industrial boilers, which supply industrial process heat, with new coal-fired circulating fluidised bed combustion boilers (CFBC), coupled with co-generating units with 24 MW capacity. The plant will supply power to the Shangqiu Aluminium (Al) Refinery Plant and the project will enable it to meet its load demand for the newly increased refinery capacity of 15000 tons Al/year without suffering from reoccurring blackouts and shortages.

The project will save 965 TJ of coal per year, resulting in an emission reduction of 88 kt CO_2 per year. Local and regional pollution will be reduced, as SO_2 emissions will be reduced effectively by the desulphurisation rate of 85% in the CFBC boiler. Particles and dust will be reduced by 95%, and NOx emissions will also decrease.

Waste

Bio-Gen Biomass Power Generation Project, Phase I (AIJ-Honduras)

Power and heat production can be generated from agricultural wastes, such as peanut shells, rice husks, coconut husks, orange processing waste, palm oil production waste, logging residues, wood waste from sawmills etc. In many cases, a CDM project of this type will both reduce GHG emissions and reduce a local pollution problem.

One example is the 15 MW biomass waste-to-energy project in Guaimaca, Honduras. The plant will utilize wood wastes generated from forest products processing in the region. The waste, including sawmill and logging residues, are currently burned under uncontrolled conditions or disposed of in rivers or low-lying areas. The project will reduce the CO_2 emissions by 119 kt CO_2 emitted from the use of fuel oil in the baseline. The power produced by the plant will be sold to the national utility and will displace electricity and associated emissions that would have been produced by fossil-fuel facilities.

The plant will be able to operate as a base load plant operating 7500 hours per year. Therefore, since electricity demand is expected to increase at a high rate in Honduras, the capacity from this project will reduce the amount of fossil-fueled capacity otherwise expected. The new capacity from the project could also help reduce the present number of selective power cuts, which prevent local sawmills from operating efficiently. The project may also act as a catalyst for projects at other mills or within other industries, allowing more local facilities to become self-sufficient in their power supply.

Wind

Alizés Rural Electrification (AIJ-Mauritania)

This project seeks to install small 1 kW wind turbines in 150 rural villages that lack access to electricity. The wind turbines will supply power to battery-charging stations, which families will use as their source of electricity. The electricity from the wind turbine will replace kerosene, candles and batteries for most families. Those already using batteries will save long transport times to bring their batteries to the central grid and no CO_2 will be emitted when their batteries are charged. The total annual emission reduction from the 7500 families in the 150 villages is calculated to be 0.88 kt CO_2.

In Mauritania, only the main urban centers are electrified. The number of urban poor is rapidly increasing due to rural migration. This trend is likely to continue in the absence of basic rural amenities. To improve the quality of life in the rural area and stem the flood of migrants to

urban slums, high quality energy and electricity must be brought online as the foundation for social and economic development.

Mauritania is one of the windiest countries in West Africa, and the project builds on the successful experience of Programme Alizés, a cooperative initiative of the French NGO GRET (Technological Research and Exchange Group) and the Mauritanian Department of Energy. Programme Alizés transferred wind mechanical water-pumping technology to villages in Mauritania and Senegal. The new electricity-generating wind CDM project will build private sector capacity, establish credit lines and facilitate collaborative arrangements with foreign suppliers of equipment and services. A first phase of installing about 40 small wind turbines was completed with GEF financing.

Solar

Residential Solar Water Heating (South Africa)

South Africa is a dry country with one of the best solar regimes available, with solar energy radiation at approximately 2190 kWh/m²/year. The proposed solar water-heating (SWH) project is in a municipally-owned Hostels to Homes Development Project in Lwandle, a low-income area in Cape Town. The community chose SWHs with back up (either electricity or gas) as their preferred technology for water heating upgrades several years ago; but limited funds and no direct incentives have meant that the project has not been implemented. The project has been developed by the Energy & Development Research Center at the University of Cape Town.

This example illustrates that the GHG emission reduction potential of solar water heating projects is heavily dependent on the baseline. The residents at Lwandle are currently using kerosene stoves for water heating. However, given the push for electrification and the desire to upgrade the hostels, residents will probably have access to standard

electric storage geyser heaters in the near future. If the 341 households in the project were supplied with SWHs with electricity backup, the emission would be reduced with 4.7 $ktCO_2$/year, when the baseline is electric heaters. However, if the baseline is assumed to be kerosene water heating, the emission will increase by 0.7 $ktCO_2$/year. Since electricity is generated from coal, the GHG emission from the electrical backup is higher than the GHG emission from the kerosene heaters. In the latter case, the project will only reduce local air pollution from kerosene combustion.

The project is expected to create jobs and local economic growth through small-scale entrepreneurs undertaking installation and maintenance of the SWHs, the sale of hot water coupons and spin-offs, such as hot water use in activities like hairdressing and laundry.

Hydro

Chacabuquito 26 MW Run of River Hydropower Project (Chile)

Approximately 100 km north of Santiago, Chile, a hydropower plant will be built and connected to the central grid in Chile, where it will replace coal thermal power generation. The project, which is being developed under the World Bank's Prototype Carbon Fund (PCF), seeks Certified Emission Reductions (CERs) for three 7-year "renewal" periods, depending on baseline development. The total emission reduction in all the 21 years will be 2.8 million tons of CO_2. The total estimated costs are $37 Millions and will produce 175 GWh gross (160 GWh) net power annually.

The project will contribute to the sustainable development in Chile through:

- use of local renewable energy resources (small hydro to displace coal thermal power);

- increased commercial activity through clean and renewable source of power; and,
- generation of employment in the region where the project will be located.

The Environmental Impact Statement for the project showed no significant ecological or social impact on the watershed. The project has been endorsed by the National Environment Commission, which chairs the National Advisory Committee on Global Climate Change.

Biomass

Sustainable Fuelwood and Charcoal Production for the Pig Iron Industry in Minas Gerais, the Plantar Project (Brazil)

In this Prototype Carbon Fund (PCF) project, fossil fuel will be replaced by sustainable biomass. The significant mineral wealth, fuel wood and hydroelectric potential enabled the State of Minas Gerais to emerge as the Brazilian iron and steel center in the 1960s and 1970s. These industries were initially reliant on supply of charcoal from native forests. The pig iron production sector is now comprised of two sets of players: the large integrated pig iron mills using coke and the small independent companies with 25% of the total production.

This project is concerned with these charcoal-using producers, which have small blast furnaces with unit size of about 90,000 tons a year. Many of them are closing down because they cannot use charcoal from native forests (due to legal restrictions) and they do not have the resources to switch to charcoal from managed plantations. Some are moving to other regions with fewer restrictions on the use of native forest for charcoal production. Of the 67 firms in Minas in 1992, only 37 remain today. Therefore, the project would have significant positive impact on the rural economy of the State of Minas Gerais.

The project seeks to establish, between 2002 and 2009, 23100 ha of high yielding eucalyptus plantations to supply the wood for the charcoal production. The charcoal will be produced on the leading edge of carbonization technology currently deployed in Brazil. This technology will reduce the methane emissions by 70% from the charcoal production process and will capture the potential commercial value of pyrolytic oils and tars. This reduction in local pollution will improve the charcoal workers health. In the period up to 2010, when the eucalyptus plantation is mature, about 5 million tons CO_2 is sequestered. When the production of charcoal forms, the plantation starts. After which, the annual emission reduction due to lower coal consumption is about 0.4 million tons CO_2.