CDM Technology Overview
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Introduction

The use and provision of "cleaner technologies" is the core of climate change mitigation response. While financial investments in technology research and development have generated unprecedented improvements in the way, e.g., energy is consumed and clean energy sources are tapped, there remains considerable work to *transfer* these innovative technologies in both developing and developed countries.

If not in technology transfer itself, the Clean Development Mechanism (CDM) has been successful in not only boosting the application of diverse cleaner technologies that otherwise face financial barriers to be applied but also has facilitated the faster spread of technologies that reduce emissions of greenhouse gases, in many cases currently not available in host countries. As of May 2010, there are around 2216 registered projects in the pipeline, applying more than 100 technologies; reducing 1.795.000 KCERs (in 2012) or 357.000 KCERs/year of GHG emissions.

Building on the categorization of CDM Projects of the UNEP Risoe Centre CDM/JI pipeline data base, which categorizes 25 types and more than 100 subtypes of CDM projects; this publication provides snapshot information of selected technologies applied so far in each subtype of CDM projects. As a simple overview of CDM technologies for policy makers, this publication offers a short description of the technology, an example of application in the CDM context; the methodologies applicable to those technologies and its current status in the CDM Pipeline.

This publication is in support of the UNEP Risoe Centre's work on capacity development for the CDM (CD4CDM) and has the purpose of easing the access of information to policy makers and other CDM practitioners, interested in a handy and simple material for quick review and consultation for further decision making process. Government officials are not usually very much aware of the CDM technologies that they can apply according to their country's circumstances, capacities and potentials. The publication compiles information of existing application of technologies in the CDM context. This overview aims at facilitating decision making at a national context in terms of sector prioritization; CDM potentials and design of national strategies, e.g. in long term energy planning.

CDM technology overview is a publication developed by the Energy and Carbon Finance Program of the UNEP Risoe Centre. This initial compilation is not exhaustive of all CDM technologies so it is a work in progress source of information. Special acknowledgements go to URC colleagues for review and suggestions for improvements.

Hydropower

Hydro CDM projects are divided into small-scale (less than 15 MW) and large-scale projects. During 2008, small hydro installations grew by 28% to raise the total world small hydro capacity to 85 GW.

Worldwide, hydroelectric power (small-scale and large-scale) supplies 20% of world electricity. Given the right location, hydro power can be a low maintenance source of renewable energy.

Description of technology

The energy in falling water can be converted into electrical energy or into mechanical energy to pump water or grind grain. The main components of hydro systems are the turbine and the generator. Other components include the physical structures that direct and control the flow of water, mechanical and/or electronic controllers, and structures that house the associated equipment. Different types of turbines are available and the optimum choice depends greatly on the head and the water flow rate. Generally, a high head site will require smaller, less expensive turbines and equipment. For most hydro projects, water is supplied to the turbine from some type of storage reservoir, usually created by a dam or weir. The reservoir allows water to be stored and electricity to be generated at more economically desirable times – for example, during periods of peak electrical demand – when the electricity can be sold at a higher price. In these systems the amount of electrical power that can be generated is determined by the amount of water that is stored in the reservoir and the rate at which it is released.

The most environmentally-sound hydro systems do not impact the amount or pattern of water flow that normally exists in the river or stream. Such “run-of-the-river” systems may use a special turbine placed directly in the river to capture the energy of the water flow. A conventional plant may also operate as a run-of-the-river system if the natural variability of the river flow is maintained. However, this type of system may generate less power during times of low water flow.

Small-scale hydro systems are modular and can generally be sized to meet individual or community needs. However, the financial viability of a project is subject to the available water resource and the distance the generated electricity must be transmitted. Hydro systems do not create any pollution when they are operating, and generally offer highly reliable power. They also have very low running or maintenance costs, and can be operated and maintained by trained local staff. Hydro systems generally have a long project life. Equipment such as turbines can last 20–30 years, while concrete civil works can last up to 100 years. This is often not reflected in the economic analysis of hydropower projects, where costs are usually calculated over a shorter period of time. This is important for hydro projects, as their initial capital costs tend to be comparatively high because of the need for civil engineering work.

Hydro developers generally need to invest in detailed analyses before a project can proceed. Regulatory authorities may require structures or systems that prevent adverse effects on flora and fauna - particularly fish. Conversely, some hydro systems may enhance local environments through, for example, the creation of wetlands.

Example of application

Title: "Santa Cruz I Hydro Power Plant" (Ref. No. 2405)

The CDM project is a run-of-the-river hydropower plant, located north east of Peru's capital city of Lima at 1,985 metres above sea level, in the basin of the Blanco River (Santa Cruz) in the district of Colcas. The plant will have an installed capacity of 5.9 megawatts and a projected yearly average generation of 35,827 megawatt hours. The objective of the Santa Cruz I Hydroelectric Power Plant is renewable electricity generation to be supplied to the Peruvian National Inter-connected Electric Grid.

Project investment: USD 7,500,000

Project CO2 reduction over a crediting period of 7 years: 118,490 tCO2e

Expected CER revenue (CER/USD 10): USD 1,184,900

Methodologies

The methodologies presented here are the ones primarily used by project developers of the different hydro projects in the CDM pipeline.

ACM2 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources"

AM52 "Increased electricity generation from existing hydropower stations through Decision Support System optimization"

AMS-I.D. "Grid connected renewable electricity generation"

AMS-I.A. "Electricity generation by the user"

http://cdm.unfccc.int/methodologies/index.html
http://cdm-meth.org/

CDM status

CDM projects based on hydro represent 27.4% of all CDM projects in the pipeline and, as such, are the most common project type in the pipeline. The geographical distribution of hydro projects is concentrated around Asia and in particular China.

Type	Number of CDM projects (rejected projects excluded)		Estimated CERs (000) / year		Number of CDM projects with CERs issued		Issuance success1	CERs (000) issued	
Hydro	1351	27.4%	143082	21%	130	20%	93%	15335	4.2%
Total	4926	100%	680327	100%	650	100%	97%	372352	100%

1 The actual issuance of CERs divided by the issuance expected in the Project Design Document for the same period of time.

egion and “top3” countries	Number of hydro CDM projects in the pipeline		Region and “top3” countries	Number of hydro CDM projects in the pipeline		Region and “top3” countries	Number of hydro CDM projects in pipeline		Region and “top3” countries	Number of hydro CDM projects in the pipeline	
Brazil	**83**	**42.3%**	**China**	**876**	**77.5%**	**Uganda**	**3**	**23.3%**	**Armenia**	**7**	**58.3%**
Chile	**21**	**10.7%**	**India**	**137**	**12.1%**	**Kenya**	**2**	**18.2%**	**Georgia**	**4**	**33.3%**
Peru	**20**	**10.2%**	**Vietnam**	**66**	**5.8%**	**South Africa**	**2**	**18.2%**	**Azerbaijan**	**1**	**8.3%**
Other countries	**73**	**37.1%**	**Other countries**	**52**	**4.6%**	**Other countries**	**4**	**36.4%**	**Other countries**	**0**	**.**
Latin America	**197**	**100%**	**Asia and the Pacific**	**1131**	**100%**	**Africa**	**11**	**100%**	**Europe, Central Asia and The Middle East**	**12**	**100%**

Source: UNEP Risoe CDM/JI Pipeline Analysis and Database, February 1st 2010

Wind

Global wind capacity increased by an estimated 27,051 megawatts in 2008, ending the year at 120,800 megawatts. With cumulative installations up almost 29%, the growth rate exceeded the annual average of the past decade. The wind now generates more than 1.5% of the world's electricity, up from 0.1% in 1997. Around the world, 80 countries are now using wind power on a commercial basis.

Description of technology

Utility-sized commercial wind projects are usually constructed as wind farms where several turbines are put up at the same site. Wind projects have been successfully built to power a wide range of applications in diverse and often extreme environments. One such application is the placement of wind farms in shallow offshore areas where environmental impacts are often lower and the availability of a steady, nonturbulent wind flow allows turbines to operate more efficiently and generate more power. In off-grid applications, wind generators can be combined with other energy sources, such as diesel generators. Although the wind resource for any site is intermittent, it can be highly predictable and thus the output from wind turbines can be integrated into existing electrical grids with a high degree of confidence. A modern wind turbine's "capacity factor" (the percentage of time a wind turbine generates power) is in the range of 20-40%. Electrical utilities can generally absorb up to 20% of their generating capacity from intermittent sources such as wind.

Prime sites have average wind speeds greater than 7.5 metres/second (27 km/hr). Most common wind turbines in commercial operations average 600 kW in power capacity and have average wind speeds greater than 6 metres/second (m/s) or 22 km/hr. Wind turbines are rated by their maximum power output in kW or MW. The world's largest wind turbines are rated at 6 megawatts, but will most likely produce 7+ megawatts - enough to power approximately 5,000 households of four in Europe.

The newest variable speed wind turbines can also help to stabilize grids in remote locations. For off-grid and mini-grid applications, the combination of wind/diesel or other sources can provide a greater percentage of overall capacity. Wind turbines are also a modular technology, which means they can be installed as the capacity is needed.

Since the current phase of development began in the 1980s, the price for wind-generated electricity fed into major grids has reduced by an average of 3% per annum. The research and development trend among major manufacturers is towards even larger turbines on taller towers as wind speeds increase with greater height above the ground. Most manufacturers are developing or deploying variable speed turbines while continuing to improve the durability of components.

Example of application

Title: "KL Rathi Steels 1.5 MW Wind Power Project at Kutch District"
(Ref. No. 2706)

M/s KL Rathi Steels is a closely held Public Limited company, engaged in making TOR steel bars and steel wires. The work of the company takes place in the village of Chapraula, on the outskirts of Ghaziabad, near Delhi. M/s KL Rathi Steels have installed one 1.5 MW wind turbine generator (WTG) of Suzlon make, in Abdasa, Kutch District, Gujarat.

Project investment: USD 2,200,000

Project CO2 reduction over a crediting period of 7 years: 27,100 tCO2e

Expected CER revenue (USD 10/CER): USD 271,000

Methodologies

The methodologies presented here are the ones primarily used by project developers of the different wind projects in the CDM pipeline.

AMS-1D "Grid connected renewable electricity generation"

ACM 2 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources"

http://cdm.unfccc.int/methodologies/index.html
http://cdm-tech.org/

CDM status

CDM projects based on wind represent 17.3% of all CDM projects in the pipeline. Recent years have shown a tendency towards a more widening geographical dispersal of CDM wind projects, indicating that countries other than India and China observe the CDM as a tool to support wind projects.

Type	Number of CDM projects (rejected projects excluded)		Estimated CERs (000) / year		Number of CDM projects with CERs issued		Issuance success	CERs (000) issued	
Wind	877	17.4%	78016	11.5%	134	25.2%	83%	16842	4.5%
Total	4926	100%	680327	100%	650	100%	97%	372352	100%

Region and "top3" countries	Number of wind CDM projects in the pipeline		Region and "top3" countries	Number of wind CDM projects in the pipeline		Region and "top3" countries	Number of wind CDM projects in the pipeline		Region and "top3" countries	Number of wind CDM projects in the pipeline	
Mexico	16	36.4%	China	430	53.8%	Egypt	4	50.0%	Cyprus	6	85.7%

Brazil	**10**	**22.7%**	**India**	**351**	**43.9%**	**Morocco**	**3**	**37.5%**	**Israel**	**1**	**14.3%**
Chile	**6**	**13.6%**	**South Korea**	**13**	**1.6%**	**Cape Verde**	**1**	**12.5%**	**-**	**-**	**-**
Other countries	**12**	**27.3**	**Other countries**	**5**	**0.1%**	**Other countries**	**0**	**0%**	**Other countries**	**0**	**-**
Latin America	**44**	**100%**	**Asia and the Pacific**	**799**	**100%**	**Africa**	**8**	**100%**	**Europe, Central Asia and The Middle East**	**7**	**100%**

Source: UNEP Risoe CDM/JI Pipeline Analysis and Database, February 1st 2010

Biomass energy

Biomass accounts for approximately 15% of global primary energy use and 38% of the primary energy use in developing countries. More than 80% of biomass energy is used at low efficiencies for cooking, heating and lighting by more than two billion consumers, many of whom rely on traditional biomass fuels and/or have no access to modern energy services. Dependence on traditional biomass is far greater in sub-Saharan Africa than any other region of the world.

Description of technology

Biomass refers to non-fossilized and biodegradable organic material originating from plants, animals and microorganisms. Biomass also includes non-fossilized, biodegradable organic fractions of industrial and municipal wastes as well as products, by-products, residues and waste from agriculture and forestry related industries. The most common examples are sugar cane waste (bagasse), short rotation crops such as straw and husks, organic wastes from animal husbandry, energy crops, corn and trees grown in short-rotation plantations. Biomass is a widely distributed, but variable resource that can be converted to biomass energy in the form of heat and electricity.

The main processes for obtaining energy from these biomass sources include direct combustion, usually of solids, in boilers or furnaces and gasification via a physical or chemical conversion process to a secondary gaseous fuel. A biomass energy project can be designed to co-generate both heat and electricity, increasing its overall energy efficiency and financial viability. Such projects may also create a cost-effective solution to the disposal of agricultural or industrial wastes that may otherwise become potential environmental problems.

Biomass energy projects can be built in a wide range of sizes and for a wide range of applications. Projects can be as large as 100 MW power stations generating both electricity and heat. Biomass energy projects can also be small enough to produce the lighting and cooking energy for a single household or village. At this level, one of the most common technologies to utilise biomass energy is the cook stove.

In addition to potential greenhouse abatement benefits, biomass energy projects can address many other environmental issues such as decreasing soil erosion, controlling nitrogen run-off, and protecting watersheds. There is a great potential for biomass CDM projects based on bagasse, Palm oil solid waste as well as agricultural- and forest residues, which account for 84% of all biomass projects. The “Programmatic” CDM may conceivably be able to unlock this potential for small-scale biomass projects in Africa.

Example of application

<u>Title</u>: "35 MW Bagasse Based Cogeneration Project" by Mumias Sugar Company Limited (MSCL) (Ref. No. 1404)

Mumias Sugar is the leading sugar manufacturer in Kenya. It sells sugar through appointed distributors nationwide. The company has diversified into power production. The technology to be employed for the Mumias Cogeneration Project will be based on the conventional steam power cycle involving direct combustion of biomass (bagasse) in a boiler to raise steam, which is then expanded through a condensing extraction turbine to generate electricity. Some of the steam generated will be used in the sugar plant processes and equipment.

<u>Project investment</u>: USD 20,000,000

<u>Project CO2 reduction over a crediting period of 10 years</u>: 1,295,914 tCO2e

<u>Expected CER revenue (USD 10/CER)</u>: USD 12,959,140

Methodologies

The methodologies presented here are the ones primarily used by project developers of the different biomass projects in the CDM pipeline.

<u>ACM3 "Emissions reduction through partial substitution of fossil fuels with alternative fuels or less carbon intensive fuels in cement manufacture"</u>

<u>ACM6 "Consolidated methodology for electricity generation from biomass residues"</u>

<u>AM36 "Fuel switch from fossil fuels to biomass residues in heat generation equipment"</u>

http://cdm.unfccc.int/methodologies/index.html
http://cdm-meth.org/

CDM status

CDM projects based on biomass represent 13.6% of all CDM projects in the pipeline. Biomass projects have been the main driving force of CDM project development in many developing countries where agriculture is the main industry and agricultural wastes are abundant. Of the 277 registered projects, 168 are small-scale projects.

Type	Number of CDM projects (rejected projects excluded)		Estimated CERs (000) / year		Number of CDM projects with CERs issued		Issuance success	CERs (000) issued	
Biomass	668	13.6%	42944	6.3%	123	18.29%	87%	15057	4%
Total	4926	100%	680327	100%	650	100%	97%	372352	100%

Region and “top3” countries	Number of biomass CDM projects in the pipeline		Region and “top3” countries	Number of biomass CDM projects in the pipeline		Region and “top3” countries	Number of biomass CDM projects in the pipeline		Region and “top3” countries	Number of biomass CDM projects in the pipeline	
Brazil	97	62.6%	India	303	61.6%	South Africa	4	23.5%	Israel	4	100%
Chile	13	8.4%	China	81	16.5%	Kenya	2	11.8%	-	-	-
Honduras	8	5.2%	Malaysia	37	7.5%	Uganda	2	11.8%	-	-	-
Other countries	37	23.9	Other countries	71	14.4%	Other countries	9	52.9%	Other countries	-	-
Latin America	155	100%	Asia and the Pacific	492	100%	Africa	17	100%	Europe, Central Asia and The Middle East	4	100%

Source: UNEP Risoe CDM/JI Pipeline Analysis and Database, February 1st 2010

Methane avoidance - Composting

Methane is a highly polluting Greenhouse Gas (GHG), with a global warming potential 21 times that of carbon dioxide. Therefore, it has the potential to generate large amounts of Certified Emission Reductions through collection and treatment of different liquid and gas residues and waste. Common subtypes of CDM projects under Methane Avoidance category are composting, manure and wastewater.

Description of technology

Methane is produced through bacterial processes of organic waste under anaerobic conditions. Organic waste is a by-product from households and different industries. Composting can be used to avoid the production of methane by changing how organic waste is stored and decomposed, from anaerobic to aerobic conditions. Composting is essentially a technology where different kinds of waste and other materials are combined under aerobic conditions, whereby the waste gradually decomposes. In some cases the waste can be recycled or used in other parts of the industrial production line. The most basic form of composting, well known to most people, is simply an open bin where organic household waste is combined with worms and soil, which gradually turns into humus. Composting is commonly used in the agricultural sector where agricultural waste - both plant material and, to a limited extent, animal material - are being composted, thereby creating humus, which can be used as fertilizer. The key to successful composting is the correct combination of dry and wet waste combined with plenty of air to avoid the anaerobic stage where methane is produced.

A common example of methane production avoidance is the production of palm oil, which results in four types of biomass waste: empty fruit bunches, fibres, palm kernel shells and Palm Oil Mill Effluent (POME) - a liquid waste with a high content of Chemical Oxygen Demand (COD). In order to avoid methane production, high concentrations of oxygen are needed to create aerobic conditions. The most common (Business as Usual) way of treating POME has been to store it in open lagoons (ponds), where the waste sinks to the bottom and releases methane into the air. The water will gradually be released into a river, to keep a constant level in the pond. Composting POME is rather simple: the empty fruit bunches are collected and added together with the liquid POME, along with plenty of air, which initiates the composting process. The compost is ready in 10-12 weeks, depending on temperature, oxygen level, etc., at which time the compost can be used as fertilizer at a palm plantation. The composting typically takes place outside.

Example of application

Title: "Composting of solid biomass waste separated from the Palm Oil Mill Effluent through the use of AVC Sludge Dewatering System" (Ref. No. 2357)

The wastewater from the palm oil mill is treated through the conventional ponding system including cooling, anaerobic, facultative and settling ponds, followed by final discharge pond. With regular dislodging of the pond system and sufficient retention period, the treated water complies with the host country's environmental requirements. The CDM project activity will replace the existing anaerobic ponds with a co-composting of the POME and a smaller portion of the solid biomass waste from the palm oil mill. In order to obtain a better management of the water balance in the composting process, a mechanical separation of the POME, the AVC Sludge Dewatering System, is introduced. The POME will be separated into a water fraction and a sludge fraction with the sludge containing more than 80% of the organic material. The sludge fraction will be transferred to a compost site at the palm oil mill where it will be treated aerobically together with a smaller amount of solid biomass waste. The compost will be used as fertilizer at nearby palm plantations.

Project investment: USD 1,010,000

Project CO2 reduction over a crediting period of 10 years: 184,323 tCO2e

Expected CER revenue (USD 10/CER): USD 1,843,230

Methodologies

The methodologies presented here are the ones primarily used by project developers of the different methane avoidance (composting) projects in the CDM pipeline.

AMS-III.F. "Avoidance of methane emissions through controlled biological treatment of biomass"

AM0039 "Methane emissions reduction from organic wastewater and bioorganic solid waste using co-composting"

Source: http://cdm-meth.org

CDM status

Approximately 80% of the projects are located in either Malaysia or Indonesia, which should come as no surprise, since these two countries also host most of the global palm oil production. For an overview of the data on all methane production avoidance projects, see below.

Falta Cuadro

Methane Avoidance – Manure and Wastewater

Manure from livestock in the agricultural sector in developing countries is typically sprayed on the fields to make the soil more fertile, while excess manure will be stored in open ponds, producing damaging GHG. Industrial organic wastewater comes from various industries such as pulp and paper production, agriculture, distillery, etc. The damaging release of methane and carbon dioxide into the environment can be avoided through the installation of a biodigester.

Description of technology

A biodigester is essentially an enclosed tank where the waste is stored under anaerobic conditions, hence producing biogas. This can then be flared or used as fuel in a boiler for generation of heat or power. The biogas can also be distributed directly to households and industrial facilities through gas pipelines.

Some biodigesters are made very easily by digging a hole in the ground, which is then covered with plastic inside and on top, with a small piping outlet where the biogas can be released. This is typically used for treatment of manure from households and small farms. Larger farms and industrial facilities produce greater volumes of waste and therefore require larger storage capacity. Consequently, they will need to construct a storage tank to dispose the waste. These types of CDM projects can be implemented in practically all developing countries where farming takes place. They are particularly suited to countries with low development since a simple biodigester is easily built, has minimal maintenance, and significantly increases energy access - especially for rural households. Thus there is great potential for programmatic CDM in this sector. More advanced biogas systems are equally suited for developing countries, since the technology is widely available, well known and has been used successfully for several decades.

Example of application

Title: "Cervecería Hondureña Methane Capture Project" (Ref. No. 896)

The Cervecería Hondureña Methane Capture Project consists of the installation of a biodigester for treatment of wastewater from the production of beer and sodas. The wastewater contains yeast and other waste that must be eliminated before the effluents reach the rivers. The small-scale project activity reduces emissions in two stages: by avoiding the emissions of methane into the atmosphere, and by the substitution of thermal energy that would have been produced otherwise with the use of the highly contaminating Bunker C (residual fuel oil). In the absence of the project, the methane from the decomposition of wastewater from the beer factory would have found its way into the atmosphere.

Project investment: USD 1,400,000

Project CO2 reduction over a crediting period of 7 years: 51,116 tCO2e

Expected CER revenue (assuming USD 10/CER): USD 511,160

Methodologies

The methodologies presented here are the ones primarily used by project developers of the different methane avoidance (manure and wastewater) projects in the CDM pipeline.

Manure:

ACM0010 "Consolidated baseline methodology for GHG emission reductions from manure management systems"

AMS-III.D. "Methane recovery in animal manure management systems"

AMS-I.A. "Electricity generation by the user"

AMS-I.D. "Grid connected renewable electricity generation"

AMS-I.C. "Thermal energy production with or without electricity"

Wastewater:

AMS-III.I. "Avoidance of methane production in wastewater treatment through replacement of anaerobic systems by aerobic systems"

ACM0014 "Mitigation of greenhouse gas emissions from treatment of industrial wastewater"

AMS-III.H. "Methane recovery in wastewater treatment"

AMS-I.D. "Grid connected renewable electricity generation"

http://cdm.unfccc.int/methodologies/index.html
http://cdm-meth.org/

CDM status

CDM projects based on methane avoidance represent 11.3% of all CDM projects in the pipeline. Methane emission avoidance CDM projects based on composting and wastewater are mainly based in Malaysia and Indonesia, while most of the projects based on manure are based in Brazil and Mexico.

Landfill gas

Waste is a major problem in most developing countries, especially in major cities, where human, animal and in some cases industrial waste is dumped around the city. Some cities have dumping sites or landfills where waste is collected, but very few are equipped with modern facilities that can turn the waste into productive energy and reduce pollution.

Description of technology

Waste that is left at an unmanaged landfill produces highly polluting Landfill Gasses (LFG), the most common being methane gas and carbon dioxide. Furthermore, unmanaged landfills result in poor air quality, odour, and increase the risk of diseases and infection of neighbouring people. It is estimated that Municipal Solid Waste Management contributes to 13% of global methane emissions.

Methane is produced through natural processes of bacterial decomposition of organic waste under anaerobic conditions. Methane is a potent greenhouse gas with a Global Warming Potential (GWP) 21 times that of carbon dioxide. Therefore, it has the potential of generating a large amount of carbon credits.

Landfill gas projects can reduce damaging greenhouse gases through a modern technology where the waste is stored in a landfill that is completely sealed. The methane can be captured for power generation or used directly as natural gas. Any excess methane can be flared and thereby turned into carbon dioxide with a lower GWP.

Example of application

Title: Bandeirantes Landfill Gas to Energy Project (BLFGE). (Ref. No. 164)

BLFGE is a CDM project designed to explore the landfill gas produced in Bandeirantes landfill - one of the largest landfills in Brazil. It is located in the metropolitan region of São Paulo, Brazil's biggest city. With an estimated population of around 10 million citizens in 2000, São Paulo generates nearly 15,000 tons of waste daily. BLFGE's goal is to generate renewable energy through the use of 24 engines with a total of 22 MW in capacity. The methane extracted from the landfill will be flared to generate electricity, which will then feed the Brazilian grid. Thus, emission reductions will occur due to fossil-fuelled energy generation displacement at the margin of the electric system.

Project investment: N.A.

Project CO2 reduction over a crediting period of 7 years: 7,494,543 tCO2e

Expected CER revenue (USD 10/CER): USD 74,945,430

Methodologies

The methodologies presented here are the ones primarily used by project developers of the different Energy Efficiency-demand side projects in the pipeline.

ACM0001 "Consolidated baseline and monitoring methodology for landfill gas project activities"

ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources"

AM0025 "Avoided emissions from organic waste through alternative waste treatment processes"

AMS-I.C. "Thermal energy production with or without electricity"

AMS-I.D. "Grid connected renewable electricity generation"

AMS-III.E. "Avoidance of methane production from decay of biomass through controlled combustion, gasification or mechanical/thermal treatment"

AMS-III.F. "Avoidance of methane emissions through controlled biological treatment of biomass"

AMS-III.G. "Landfill Methane Recovery"

http://cdm.unfccc.int/methodologies/index.html
http://cdm-meth.org/

CDM status

The majority of the projects are located in Latin America, Asia & the Pacific. There are great possibilities for increasing the number of LFG projects, as the technology is well-known, and with cities all over the world growing so is the amount of waste. Furthermore, there are already a number of approved CDM methodologies that can be used for this type of project.

Type	Number of CDM projects (rejected projects excluded)		Estimated CERs (000) / year		Number of CDM projects with CERs issued		Issuance success	CERs (000) issued	
Landfill	284	5.8%	42037	6.2%	44	6.8%	34%	8798	4%
Total	4926	100%	680327	100%	650	100%	97%	372352	100%

Region and "top3" countries	Number of landfill CDM projects in the pipeline		Region and "top3" countries	Number of landfill CDM projects in the pipeline		Region and "top3" countries	Number of EE landfill CDM projects in the pipeline		Region and "top3" countries	Number of landfill CDM projects in the pipeline	
Brazil	38	32.2%	China	58	47.2%	South Africa	7	30.4%	Israel	8	40%
Mexico	26	22.0%	India	21	17.1%	Cameroon	2	8.7%	Uzbekistan	3	15%
Chile	17	14.4%	Malaysia	8	6.5%	Ivory Coast	2	8.7%	Syria	2	10%

Other countries	37	31.4%	Other countries	36	29.2%	Other countries	12	52.2%	Other countries	7	35%
Latin America	118	100%	Asia and the Pacific	123	100%	Africa	23	100%	Europe, Central Asia and The Middle East	20	100%

Source: UNEP Risoe CDM/JI Pipeline Analysis and Database, February 1st 2010

Type	Number of CDM projects (rejected projects excluded)		Estimated CERs (000) / year		Number of CDM projects with CERs issued		Issuance success	CERs (000) issued	
Methane avoidance	559	11.3%	25986	3.8%	57	8.8%	49%	5747	1.5%
Total	4926	100%	680327	100%	650	100%	97%	372352	100%

Region and "top3" countries	Number of methane avoidance CDM projects in the pipeline		Region and "top3" countries	Number of methane avoidance CDM projects in the pipeline		Region and "top3" countries	Number of methane avoidance CDM projects in the pipeline		Region and "top3" countries	Number of methane avoidance CDM projects in the pipeline	
Mexico	100	46.7%	Malaysia	76	23.0%	South Africa	3	75.0%	Israel	5	45.5%
Brazil	77	36.0%	Thailand	68	20.6%	Morocco	1	25.0%	Cyprus	4	36.4%
Chile	7	3.3%	Philippines	37	11.2%	-	-	-	Armenia	1	9.1%
Other countries	30	14.0	Other countries	149	45.2%	Other countries	0	0%	Other countries	1	9.1%
Latin America	214	100%	Asia and the Pacific	330	100%	Africa	4	100%	Europe, Central Asia and The Middle East	11	100%

Source: UNEP Risoe CDM/JI Pipeline Analysis and Database, February 1st 2010

Energy efficiency in households

Presently 1.9 $GtCO_2$ are emitted by electric lighting worldwide. A simple way of reducing emissions is to use energy efficiently. Consumption patterns can be changed by improving the energy performance.

Description of technology

Energy efficiency in a household context can be divided into insulation and lighting projects, and projects based on making cooking stoves more energy efficient.

Insulation projects aim to improve the thermal performance of the housing units. This will result in reducing current and future electricity consumption per household, significantly avoiding CO_2 emissions per unit. The technology can consist of the installation of insulated ceilings, walls and floors in houses, consequently reducing the temperature amplitude extremes.

Single energy efficient lighting projects do not contribute significantly to the reduction of carbon emissions. However, when packaged as part of a bigger project, they can make a significant contribution to the reduction of CO_2 emissions and result in cost savings to the household, as well as reduction in peak demand with all the associated electricity infrastructure savings. In terms of technology, lighting projects are replacing incandescent bulbs with CFLs (Compact Fluorescent Light) that are four times more efficient and last up to 10 times longer.

Deforestation and desertification have become a major concern in many developing countries, as wood demand for household energy largely exceeds the available renewable woody biomass. By reducing the fuel wood consumption, the energy efficient stoves projects help to reduce greenhouse gas emissions stemming from the use of non-renewable biomass. The negative impact can be reduced by using improved stoves.

Example of application

Title: Visakhapatnam (India) OSRAM CFL distribution CDM Project (Ref. No. 1754)

The "Visakhapatnam (India) OSRAM CFL distribution CDM Project" involves the distribution of approximately 450,000 to 500,000 OSRAM long life Compact Fluorescent Lamps (CFLs) in the district of Visakhapatnam, which numbers about 700,000 households. The CFLs used are OSRAM DULUX EL LONGLIFE, and have the capacity of 15,000 hours and 80% lower energy consumption than a conventional light bulb.

Project investment: USD 2,036,000

Project CO_2 reduction over a crediting period of 7 years: 51,116 tCO_2e

Expected CER revenue (assuming USD 10/CER): USD 511,160

Methodologies

The methodologies presented here are the ones primarily used by project developers of the different energy efficiency-demand side projects in the pipeline.

For lighting and insulation:
AMS-II.E "Energy efficiency and fuel switching measures for buildings"

AMS-II.C "Demand-side energy efficiency activities for specific technologies"

AMS-II.J "Demand-side activities for efficient lighting technologies"

AM0046 "Distribution of efficient light bulbs to households"

For stoves:
AMS-II.G "Energy Efficiency Measures in Thermal Applications of Non-Renewable Biomass"

http://cdm.unfccc.int/methodologies/index.html
http://cdm-meth.org/

CDM status

The energy efficiency household projects are currently representing 0.1% of the CDM projects in the pipeline. Presently, there are six CDM projects registered in energy efficiency for households - four of them are based on lighting/insulation and two on improved stoves. The lighting/insulation projects are located in India and one in South Africa. The improved stove projects are based in Zambia and Nigeria.

Type	Number of CDM projects (rejected projects excluded)		Estimated CERs (000) / year		Number of CDM projects with CERs issued		Issuance success	CERs (000) issued	
EE households	31	0.1%	1293	0.2%	0	-	87%	0	-
Total	4926	100%	680327	100%	650	100%	97%	372352	100%

Region and "top3" countries	Number of EE households CDM projects in the pipeline		Region and "top3" countries	Number of EE households CDM projects in the pipeline		Region and "top3" countries	Number of EE households CDM projects in the pipeline		Region and "top3" countries	Number of EE households CDM projects in the pipeline	
Ecuador	1	50.0%	India	20	80.0%	Zambia	1	25.0%	-	-	-
Brazil	1	50.0%	China	4	16.0%	Nigeria	1	25.0%	-	-	-
-	-	-	Nepal	1	4.0%	Rwanda	1	25.0%	-	-	-
Other countries	0	0%	Other countries	0	0%	Other countries (South Africa)	1	25.0%	Other countries	-	-
Latin America	2	100%	Asia and the Pacific	25	100%	Africa	4	100%	Europe, Central Asia and The Middle East	0	-

Source: UNEP Risoe CDM/JI Pipeline Analysis and Database, February 1st 2010

Supply side energy efficiency in households

Energy efficiency is considered one of the most accessible and cost-effective opportunities to mitigate climate change. The IPCC (2007) and the International Energy Agency show that there are substantial emission reduction potentials per sector that can be implemented by 2030 and energy efficiency could be one of the key mitigation technologies to achieve these reductions.

Description of technology

Single cycle to combined cycle
The technology uses previously unused wasted heat from a power plant with a single cycle capacity - be it a gas turbine or an internal combustion engine - to produce steam for another turbine, thereby making the system combined-cycle.

Power plant rehabilitation
The basic objective of this technology is to reduce energy consumption per kWh of energy generation through implementation of energy efficient measures and technologies in the power generation facility. It involves upgrading the originally designed furnace draft control system with more energy efficient technology. One example could be a retrofit activity aimed at energy loss reduction, improving the efficiency of the power generating station. The measures may replace, modify or retrofit existing facilities or be installed in a new facility.

Cogeneration
Cogeneration is the use of a heat engine or a power station to simultaneously generate both electricity and heat. In separate production of electricity some energy must be rejected as waste heat, but in cogeneration this thermal energy is put to good use. Examples include efficiency improvements at power stations and district heating plants. In the context of climate change mitigation, cogeneration has a considerable impact on emissions reductions and, therefore, offers a very positive perspective to CDM projects. These projects are generally larger than small manufacturing facilities.

Higher efficiency steam boiler
This measure improves the efficiency of fossil fuel generating units that supply an electricity or thermal system by reducing energy or fuel consumption. The objective is to implement measures, which would change the coal consumption patterns of the boiler system and result in direct Greenhouse Gas (GHG) emissions reductions. The technologies may be applied to existing stations, or be part of a new facility.

Example of application

Title: Construction of additional cooling tower cells at AES Lal Pir (Pvt.) Limited. (Ref. No. 2401)

The purpose of the project is to utilise the latest technology to improve the heat rate of the power plants, which entails construction of an additional cooling tower cell for each unit's cooling tower. A better heat rate will lower CO2 emissions by reducing in the quantity of fuel required to generate electricity. The efficiency improvement program under the project activity consists of the construction of additional cooling tower cells, installation of advanced technology and mechanical works including piping, connections, etc.

Project investment: USD 1.6 million

Project CO2 reduction over a crediting period of 7 years: 78,252 t-CO2e

Expected CER revenue (USD 10/CER): USD 782,520

Methodologies

The methodologies described below are those primarily used by registered Supply Side EE projects in the pipeline:

For single cycle to combined cycle:
ACM0007 "Methodology for conversion from single cycle to combined cycle power generation"

For cogeneration:
AM0014 "Natural gas-based package cogeneration"

AMS-II.B "Supply side energy efficiency improvements - generation"

AMS-II.H. "Energy efficiency measures through centralization of utility provisions of an industrial facility"

For power plant rehabilitation:
AMS II D "Energy efficiency and fuel switching measures for industrial facilities"

For higher efficiency steam boiler:
AMS-II.B "Supply side energy efficiency improvements - generation"

For higher efficiency coal power:
ACM0013 "Consolidated baseline and monitoring methodology for new grid connected fossil fuel fired power plants using a less GHG intensive technology"

For higher efficiency using waste heat:
ACM0012 "Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects"

For higher efficiency oil power:
ACM0013 “Consolidated baseline and monitoring methodology for new grid connected fossil fuel fired power plants using a less GHG intensive technology”

http://cdm.unfccc.int/methodologies/index.htm
http://cdm-meth.org/

CDM status

There are 68 supply side energy efficiency projects in the CDM pipeline, which corresponds to 1.4% of the total amount of CDM projects.

Type	Number of CDM projects (rejected projects excluded)		Estimated CERs (000) / year		Number of CDM projects with CERs issued		Issuance success	CERs (000) issued	
EE supply side	68	1.4%	26188	3.8%	1	0%	61%	395	0%
Total	4926	100%	680327	100%	650	100%	97%	372352	100%

Region and “top3” countries	Number of EE supply side CDM projects in the pipeline		Region and “top3” countries	Number of EE supply side CDM projects in the pipeline		Region and “top3” countries	Number of EE supply side CDM projects in the pipeline		Region and “top3” countries	Number of EE supply side CDM projects in the pipeline	
Argentina	2	16.7%	India	29	60.4%	Egypt	1	100.0%	United Arab Emirates	3	42.9%
Brazil	2	16.7%	China	11	22.9%	-	-	-	Iran	1	14.3%
Cuba	1	8.3%	Indonesia	4	8.3%	-	-	-	Albania	1	14.3%
Other countries	7	58.3%	Other countries	4	8.3%	Other countries (South Africa)	0	0%	Other countries	2	28.6%
Latin America	12	100%	Asia and the Pacific	48	100%	Africa	1	100%	Europe, Central Asia and The Middle East	7	100%

Source: UNEP Risoe CDM/JI Pipeline Analysis and Database, February 1st 2010

Energy efficiency – Own generation

One way of meeting the challenges of reducing GHG emissions is to implement energy efficiency for industries. An example of this is 'own generation' at production facilities, based on excess processed energy. This can be both generation of electricity and process heat.

Description of technologies

Energy Efficiency Own Generation:
Own generation can take place at production facilities with different types of input. Broadly categorised, these can be divided into projects utilising excess heat and excess gas.

Excess heat:
The excess heat can be in both the form of hot water or hot gas (non-flammable). To benefit from the excess heat it is necessary to recover and feed it, typically, to a steam turbine. Before the actual electricity generation, the waste energy carrying medium (WECM) is routed through a boiler system where superheated steam is generated. Less commonly mechanical energy, in the form of high-pressure gas or liquid, is utilised at the production facility.

Additionally, excess heat can always be recovered with the purpose of utilising it as process heat, thereby reducing energy consumption.

For projects generating electricity, the reduction of GHG emissions is achieved by the displacement of electricity supplied from the local grid, where fossil fuels are the primary source of energy.

Excess gas (combustible):
If the WECM is a flammable gas, combustion is possible as a means of utilising the excess energy.

This is frequently seen in CDM projects at petrochemical industries, e.g. refineries. Often, the waste gas of this type of project is identical to the so-called refinery gas or still gas, but is nevertheless considered waste gas, as the pressure is lower than still gas; therefore, the utilisation of the waste gas is more difficult. For own generation projects the waste gas is incinerated to supply process heat used at the production site, thereby reducing dependency on fossil fuels.
If the prevailing practice prior to the implementation of the CDM project has been to vent the waste gas into the atmosphere, the reduction of GHG emissions will still be greater because the incineration of waste gasses with a high content of methane (CH_4), for example, will reduce the greenhouse effect of the combusted gas.

Example of application

<u>Title:</u> Taishan Cement Works Waste Heat Recovery and Utilisation for Power Generation Project (Ref. No. 366)

The project involves utilisation of waste heat for electricity generation, on-site at a cement production facility. The recovery of the excess heat takes place at two different stages in both of the production lines, via four recovery boilers. The heat retrieved at the two different stages, is of different temperatures. The recovery boilers responsible for the higher temperature waste heat will produce superheated steam and feed it directly to the steam turbine. In the case of the recovery boilers retrieving the lower temperature excess heat, the output of these will be hot pressurized water, which in turn will be fed through a flash steam generator to produce saturated steam before feeding it through the steam turbine. Exhaust gasses from the steam turbine, will be utilised for the preheating of raw materials and other stages of the production line where process heat is vital. The electricity generating steam turbine has a capacity of 13.2 MW, generating 89,500 MWh annually, resulting in a reduction of 107,116 tonnes of CO2 emissions per year.

<u>Project investment:</u> N.A.

<u>Project CO2 reduction over a crediting period of 7 years</u>: 741,260 tCO2e

<u>Expected CER revenue (USD 10/CER)</u>: USD 7,412,600

Methodologies

The methodologies presented here are the ones primarily used by project developers of the different energy efficiency-demand side projects in the pipeline.

<u>*AM24 "Baseline methodology for GHG reductions through waste heat recovery and utilisation for power generation at cement plants"*</u>

<u>*ACM12 "Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects"*</u>

<u>*AM49 "Methodology for gas based energy generation in an industrial facility*: Applicability"</u>

<u>*AM55 "Baseline and Monitoring Methodology for the recovery and utilisation of waste gas in refinery facilities"*</u>

http://cdm.unfccc.int/methodologies/index.htm
http://cdm-meth.org/

CDM status

There are 463 energy efficiency (own generation) projects in the pipeline. The subtypes that dominate these projects are iron and steel heat and cement heat (48% and 25% respectively) - 96% of these are located in the Asia/South Pacific region (427 projects). Of these, China and India are the hosts of the vast majority (51% and 30% respectively).

Type	Number of CDM projects (rejected projects excluded)		Estimated CERs (000) / year		Number of CDM projects with CERs issued		Issuance success	CERs (000) issued	
Own generation	463	9.4%	60146	8.8%	24	3.7%	82%	15102	4.1%
Total	4926	100%	680327	100%	650	100%	97%	372352	100%

Region and "top3" countries	Number of EE own generation CDM projects in the pipeline		Region and "top3" countries	Number of EE own generation CDM projects in the pipeline		Region and "top3" countries	Number of EE own generation CDM projects in the pipeline		Region and "top3" countries	Number of EE own generation CDM projects in the pipeline	
Brazil	13	72.2%	China	290	65.8%	South Africa	2	66.7%	Israel	1	100.0%
Mexico	2	11.1%	India	131	29.7%	Egypt	1	33.3%	-	-	-
Argentina	2	11.1%	Thailand	8	1.8%	-	-	-	-	-	-
Other countries	1	5.6%	Other countries	12	2.7%	Other countries	0	-	Other countries	0	-
Latin America	18	100%	Asia and the Pacific	441	100%	Africa	3	100%	Europe, Central Asia and The Middle East	1	100%

Source: UNEP Risoe CDM/JI Pipeline Analysis and Database, February 1st 2010

Fossil Fuel Switch

Oil and coal have always been considerably cheaper energy sources than natural gas. This is why countries are currently counting on a large number of coal and oil plants. In addition to the cost of switching sources, the conversion from coal/oil to gas requires significant investment in new equipment.

Description of technologies

Different kinds of CDM projects have been, or are being, developed. These include retrofitting thermal power stations, as well as new power plants using only natural gas. Apart from generating emission reductions, those activities will also improve the work environment, particularly the environmental and health conditions at the plant. These improvements are mainly due to the reduction of airborne particulate levels at the plant resulting from the combustion of coal and oil.

<u>Coal/Oil to Natural Gas</u>

The purpose of fossil fuel switch is to replace the source of energy in different kinds of facilities, most currently in the thermal part of industry processes, such as cement, brickyard or papermaking industry. Presently, project activities primarily aim at reducing GHG emissions by switching the plant's thermal fuel from coal to natural gas or from oil to natural gas. The conversion requires the replacement of the coal burners on the kilns with gas burners, the replacement of boilers, the installation of an automated and integrated control system and the connection of the factory to the local natural gas network.

<u>New Natural Gas Plant</u>

The electricity generated by using natural gas, which is clean energy with less carbon content, displaces electricity that would otherwise have been generated by coal-fired thermal plants. This category also covers new natural gas plants using liquefied natural gas.

The purpose of the project activity is to set up a Natural Gas Plant. There are two kinds of cycles used: one is for the thermal power station in general, the Combined Cycle Power Plant, and the other is specific to Natural Gas Plant, the Natural Gas Fired Combined Cycle (NGCC). A combined cycle is characteristic of a power producing engine or plant that employs more than one thermodynamic cycle. Heat engines are only able to use a portion of the energy their fuel generates (usually less than 50%). The remaining heat (e.g. hot exhaust fumes) from combustion is generally wasted. The overall efficiency is improved by combining two or more "cycles" such as the Brayton cycle and Rankine cycle. The Natural gas based Combined Cycle Power Plant (CCPP) uses the Gas Turbine Generating (GTG) Unit, the Heat Recovery Steam Generator (HRSG) and the Steam Turbine Generating (STG) Unit. The cycle efficiency of natural gas based combined cycle power plant is in the range of 50-55% as compared to the average cycle efficiency of 36-42% for coal fired Rankine cycle based thermal power plants.

The NGCC technology consists of two phases of combined dynamic cycles: the first phase takes place in the gas turbine where the high temperature gas can provide power to rotate a generator to produce electricity - this is the Gas Cycle. In the second phase, the exhausted gas discharged from the gas turbine can generate steam in a heat recovery boiler, which then expands in the followed up steam turbine to generate electric power in the generator - this is the Steam Cycle.

The NGCC Power Technology is one of the advanced clean and efficient power technologies available on the market with multiple advantages. They can be summarised as having a much higher efficiency over conventional coal fired steam power generator units, a comparably low capital construction cost, a short construction period and fewer requirements for land and water resources than coal fired power plants.

Example of application

Title: Grid-connected Combined Cycle Power Plant of capacity 219.067 MW using Natural Gas/ R-LNG as fuels in Gujarat, India. (Ref. No. 1352)

The project activity involves development, designing, engineering, procurement, financing, construction, ownership, operation and maintenance of a 219.067 MW combined cycle power generation facility for generation and supply of electricity using Natural Gas/R-LNG & HSD as fuels. The project activity is being implemented in phases. Phase I of the project activity, involving capacity outlay of 106.617 MW, was completed in 2003. Simultaneously, the project developer was installing a new 112.45 MW Natural Gas/Re-Gasified Liquefied Natural Gas (NG/RLNG) (Phase-II). The CCPP in Phase I comprises of a gas turbine, HRSG and a Steam turbine.

Project investment: USD 250.7 million

Project's CO2 reductions over a crediting period of 10 years: 2,144,950 tCO2e

Expected CERs revenue (10 USD/CER): USD 21,449,500

Methodologies

The methodologies presented here are the ones primarily used by project developers of the different fuel switching projects in the pipeline.

For Coal to Natural Gas:

ACM0003 "Emissions reduction through partial substitution of fossil fuels with alternative fuels or less carbon intensive fuels in cement manufacture"

AM0008 "Industrial fuel switching from coal and petroleum fuels to natural gas without extension of capacity and lifetime of the facility"

For Oil to Natural Gas:

ACM0009 "Consolidated baseline and monitoring methodology for fuel switching from coal or petroleum fuel to natural gas"

ACM0011 "Consolidated baseline methodology for fuel switching from coal and/or petroleum fuels to natural gas in existing power plants for electricity generation"

AM0008 "Industrial fuel switching from coal and petroleum fuels to natural gas without extension of capacity and lifetime of the facility"

AMS-III.B "Switching fossil fuels"

For New Natural Gas Plant using or not using LNG:
ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources"

AM0029 "Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas"

http://cdm.unfccc.int/methodologies/index.html
http://cdm-meth.org/

CDM status

There are 109 fossil fuel switching projects in the CDM pipeline, of which 42 are registered. This category of project represents 2.2% of the total of the CDM projects and 1.1% of the CERs issued.

Type	Number of CDM projects (rejected projects excluded)		Estimated CERs (000) / year		Number of CDM projects with CERs issued		Issuance success	CERs (000) issued	
Fossil fuel switch	109	2.2%	43036	6.3%	20	3.1%	84%	3917	1.1%
Total	4926	100%	680327	100%	650	100%	97%	372352	100%

Region and "top3" countries	Number of fossil fuel switch CDM projects in the pipeline		Region and "top3" countries	Number of fossil fuel switch CDM projects in the pipeline		Region and "top3" countries	Number of EE fossil fuel switch CDM projects in the pipeline		Region and "top3" countries	Number of fossil fuel switch CDM projects in the pipeline	
Brazil	10	%	China	30	%	South Africa	4	%	Israel	3	%
Colombia	3	%	India	30	%	Egypt	3	%	Jordan	3	%
Peru	3	%	South Korea	5	%	Tanzania	1	%	Macedonia	2	%
Other countries	1	%	Other countries	7	%	Other countries	1	%	Other countries	3	%
Latin America	17	100%	Asia and the Pacific	72	100%	Africa	9	100%	Europe, Central Asia and The Middle East	11	100%

Source: UNEP Risoe CDM/JI Pipeline Analysis and Database, February 1st 2010

Destruction of nitrous oxide – N2O

Certain gases, which are used for, or are by-products of, industrial production have a large global warming potential (GWP) - Nitrous oxide (N2O) being one of these.

N2O, commonly known as laughing gas, has a GWP 310 times that of CO2. Consequently, actions that prevent the venting of N2O constitute a large potential for CDM projects.

Description of technology

To avoid venting N2O into the atmosphere, several procedures can be followed to either decompose the harmful gas or recycle it in other steps of production (Nitrous oxide is also used for phenol manufacturing).

Adhering to CDM projects and their approved methodologies, only catalytic decomposition is used to destroy this greenhouse gas (GHG). Nitrous oxide is an undesired by-product (waste gas) from the production of several chemical components, such as nitric acid, adipic acid and caprolactam. Nitric acid is used for production of fertilizers, explosives and for the etching and dissolution of metals. Both adipic acid and caprolactam are used for nylon production.

Although several steps can be taken at various stages of production to reduce or remove nitrous oxide, only the catalytic decomposition or catalytic reduction of N2O is relevant within the framework of CDM projects. The reason being that the only approved methodology for this type of CDM project is AM28. AM28 states that in order to qualify as a CDM project, a catalytic process is needed for the destruction of nitrous oxide. In this process the unwanted nitrous oxide is collected at the end of the production line, as a so-called tail gas.

This then leads to the catalytic process, where it is decomposed. In order for the decomposition to take place at the desired level of efficiency, a high temperature is needed for the process (approximately 500-550°C). It is, therefore, important that the tail gas be collected at the earliest point possible for it to maintain the highest possible temperature before the catalytic decomposition process commences. Nevertheless, it is often necessary for further heating of the nitrous oxide, in order for it to reach the required temperature. This obviously imposes auxiliary energy consumption, which has to be deducted from the CO2-equivalents reduced by the process. The fuel used for heating the tail gas is usually LPG, but can also be natural gas.

In certain cases it is possible to install a high efficiency DeN2O unit immediately after the tail gas turbine. The turbine ensures a lower pressure of the gas upon exit, which reduces the need for the previously mentioned high temperature, thus decreasing the energy consumption of the project activity. Furthermore, the installation of a tail gas turbine will allow the possibility of retrieving some of the auxiliary energy spent on the catalytic process, via electricity generation.

In terms of reliable technology, it is relevant to note that the catalytic decomposition of N2O is very similar to the catalytic process for reducing NOx as an end-of-pipe technology.

The DeN2O process will not interfere with the production of nitric acid, adipic acid or caprolactam; therefore, it does not affect the productivity of the production facility.

Methodologies

There is currently only one approved methodology used for CDM projects concerning N2O venting avoidance.

AM28 "Catalytic N2O destruction in the tail gas of Nitric Acid or Caprolactam production plants"

http://cdm.unfccc.int/methodologies/index.html
http://cdm-meth.org/

Example of application

Title: Catalytic N2O Abatement Project in the Tail Gas of the Nitric Acid Plant of the Hanwha (Ref. No. 922)

The project involves the removal and decomposition of N2O, thereby reducing the emission of GHG into the atmosphere. The plant in question produces explosives and nitric acid, the latter resulting in the unwanted by-product of nitrous oxide. The N2O abatement technology is to recover the waste gas and process it in a catalytic decomposition unit (DeN2O unit). The recovery of the tail gas takes place immediately after the tail gas turbine, since this reduces the need for pre-heating the tail gas before entering the DeN2O unit. As the pressure of the gas is lowered close to atmospheric level, it enables the construction of an especially efficient DeN2O unit, despite the lower gas temperature.

Project investment: N.A.

Project's CO2 reductions (tonnes) over a crediting period of 7 years: 1,968,901 tCO2e

Expected CERs revenue (assuming a 10 USD/CER): USD 19,689,010

CDM status

There are 69 N2O CDM projects in the pipeline. China is by far the leading country for N2O-abatement CDM projects, with a total of 29 projects in the pipeline. The remainder of the projects are evenly distributed in the other regions involved in CDM projects.

Type	Number of CDM projects (rejected projects excluded)		Estimated CERs (000) / year		Number of CDM projects with CERs issued		Issuance success	CERs (000) issued	
N2O	69	1.4%	49673	7.3%	19	2.9%	124%	78486	21.1%
Total	4926	100%	680327	100%	650	100%	97%	372352	100%

Region and "top3" countries	Number of N2O CDM projects in the pipeline		Region and "top3" countries	Number of N2O CDM projects in the pipeline		Region and "top3" countries	Number of N2O CDM projects in the pipeline		Region and "top3" countries	Number of N2O CDM projects in the pipeline	
Brazil	**5**	**%**	**China**	**30**	**75%**	**South Africa**	**4**	**80%**	**Uzbekistan**	**6**	**60%**
Colombia	**2**	**%**	**India**	**6**	**%**	**Egypt**	**1**	**20%**	**Israel**	**4**	**40%**
Chile	**1**	**%**	**South Korea**	**5**	**%**	**-**	**-**	**-**	**-**	**-**	**-**
Other countries	**1**	**%**	**Other countries**	**4**	**%**	**Other countries**	**0**	**0%**	**-**	**-**	**-**
Latin America	**9**	**100%**	**Asia and the Pacific**	**45**	**100%**	**Africa**	**5**	**100%**	**Europe, Central Asia and The Middle East**	**10**	**100%**

Source: UNEP Risoe CDM/JI Pipeline Analysis and Database, February 1st 2

Coal Mine/bed CH4

The extraction and mining processes in the global coal mine industry is currently responsible for approximately 8% of the total anthropogenic methane gas (CH_4) emissions. Moreover, coal methane emissions are expected to increase 20% from 2000 to 2020. Since CH_4 has a greenhouse gas warming effect 21 times higher than CO_2, methane emissions from coal mines contribute significantly to climate changes. Accordingly, CH_4 reduction efforts in coal mines constitute a key opportunity to reduce global emissions cost efficiently, owing to low marginal abatement costs. In addition, ancillary benefits may accrue from coal mine CH_4 reduction initiatives, including enhanced mine safety, improved productivity, reduced local air pollution, and increased revenues.

Description of technology

More than 90% of fugitive CH_4 emissions from the coal sector come from underground coal mining. Initiatives aiming to reduce emissions from these sources are especially important, although emissions from other sources, such as coal bed methane extraction sites (harvested as a natural gas resource), abandoned mines, open mining facilities, emissions from coal storage and transport, etc., are also relevant for methane recovery projects.

Methane is an integral component of underground coal and surrounding rock strata. It escapes into the atmosphere during coal mine operations due to lacking and/or inefficient methane drainage and ventilation systems. Methane capture and utilisation technologies relevant for applications in the coal mine industry may be broadly classified into two categories: Coal Mine Methane (CMM) and Ventilation Air Methane (VAM) systems. In most cases, mines have implemented CH_4 drainage or degasification systems in order to sustain a minimum level of worker safety. However, these systems are typically inefficient and inadequate not only in recovering CH_4 but also in generating a sufficiently consistent volume, quality, and flow of gas for utilisation purposes. Therefore, CMM and VAM technologies involve new installation or improvement of existing CH_4 gas drainage and recovery systems. As some mines are gassy and outburst-prone these are especially pertinent for deployment of CMM and VAM technologies.

There is a variety of profitable utilisation purposes and end–use options for recovered coal mine CH_4 emissions. In CDM project activities, captured coal mine methane may be utilised for electricity generation, motive power, and/or thermal energy, and may also be flared.

Example of application

Title: Yangquan Coal Mine Methane (CMM) Utilization for Power Generation Project (Ref. No. 892)

This CDM project is implemented in the Chinese province of Shanxi and involves the installation of a total of 90 MW of gas engines for power generation from CMM. Within the coal mining concession area operated by a Chinese company in this region, technology will be installed to recover and utilise CMM. The generated electricity will be used to meet the internal requirements of the mining area, which are currently met by a combination of captive coal fired power plants and electricity from the North China Power Grid. The project will, therefore, substitute electricity purchased from the grid. Additionally, the project has positive side effects, including reduction of SOx and NOx emissions, promoting more rational energy use, and improving local employment opportunities.

Project investment: USD 55,000,000

Project's CO2 reductions over a crediting period of 7 years: 2,136,174 tCO2e

Expected CERs revenue (assuming a 10 USD/CER): USD 21,361,740

Methodologies

There is currently only one CDM methodology specifically addressing GHG emission reduction projects in the coal mine industry.

ACM0008 "Consolidated baseline methodology for coal bed methane and coal mine methane capture and use for power (electrical and motive) and heat and/or destruction by flaring"

http://cdm.unfccc.int/methodologies/index.html
http://cdm-meth.org/

CDM status

As a consequence of the hitherto untapped potential, the CDM market has opted almost exclusively for coal mine methane projects in China. So far, a total of 23 coal mine/bed CH4 methane CDM projects have been registered and another 46 are in the pipeline. Except for a project in Mexico and one in India, all of these are implemented in China.

Type	Number of CDM projects (rejected projects excluded)		Estimated CERs (000) / year		Number of CDM projects with CERs issued		Issuance success	CERs (000) issued	
Coal bed/mine methane	69	1.4%	40973	6%	8	0.1%	46%	2739	0.1%
Total	4926	100%	680327	100%	650	100%	97%	372352	100%

Region and "top3" countries	Number of coal bed/mine methane	Region and "top3" countries	Number of coal bed/mine methane CDM	Region and "top3" countries	Number of coal bed/mine methane	Region and "top3" countries	Number of coal bed/mine methane

	CDM projects in the pipeline			projects in the pipeline			CDM projects in the pipeline			CDM projects in the pipeline	
Mexico	**1**	**100%**	**China**	**67**	**%**	**South Africa**	**.**	**.**	**Uzbekistan**	**.**	**.**
			India	**1**	**%**	**Egypt**	**.**	**.**	**Israel**	**.**	**.**
.	**.**	**.**	**.**	**.**	**.**	**-**	**-**	**-**	**-**	**-**	**-**
Other countries	**0**	**0%**	**Other countries**	**0**	**0%**	**Other countries**	**-**	**-**	**Other countries**	**-**	**-**
Latin America	**1**	**100%**	**Asia and the Pacific**	**68**	**100%**	**Africa**	**0**	**.**	**Europe, Central Asia and The Middle East**	**0**	**.**

Source: UNEP Risoe CDM/JI Pipeline Analysis and Database, February 1st 2010

Clinker replacement in the cement industry

The cement industry is responsible for approximately 5% of global man-made CO_2 emissions - 50% comes from the chemical process and 40% from burning fuel. For every 1000 kg of cement produced, there is nearly 900 kg of CO_2 emitted. Cement production is not slowing down and has a constant and rapid growth, particularly in Asia and the Pacific.

Description of technology

Cement is made by heating limestone with small quantities of other materials to high temperatures in a kiln, in a process known as calcination. The resulting hard substance, called 'clinker', grounded with gypsum, makes the Ordinary Portland Cement - the most commonly used type of cement (often referred to as OPC).
The clinker manufacturing process is an energy intensive process. Clinker consumes precious raw materials, depletes forests (limestone mine) and produces carbon dioxide emissions that contribute to global warming. Today, two kinds of CDM project in cement are implemented: optimizing the use of clinker in the cement (reducing the production of clinker by limiting its percentage in the final product) or using non-carbonated calcium sources (building a new dry precalcination cement clinker production line).

<u>Optimizing the use of clinker</u>
To optimize the use of clinker, the project developers reduce the production of clinker by blending the cement with other materials. The reduction of clinker percentage is done by adding fly ash, pozzolan or slag to the cement. This conserves natural resources like limestone and depleting fossil fuel coal, which are used to meet the thermal and electrical energy requirements of pre-processing and pyro-processing of cement manufacture. Fly ash can come from industrial waste, thus avoiding the problem of its difficult disposal (one of the major environmental problems of the coal based thermal power plant), or from volcanic ash.

There are different processes for producing the improved cement. First, the additives have to be transported and fed from the tanker to the silo. Next comes the handling and feeding system to the cement mill for the raw material mix. These projects, then, involve a reduced use of limestone and coal per unit of cement produced, limiting the quarry mining and its associated land destruction and emissions. To get optimal and quality cement, project developers must conduct research and development at the early stage of the activity.

<u>Use of non-carbonated calcium sources</u>
The activities consist of building a new dry pre-calcination cement clinker production line. This is done by using calcium carbide residue (CCR) to displace limestone as raw materials, while employing the technology of wet-grinding and dry-burning process (WDP) clinker production. Wet-grinding and dry-burning process clinker production technology is characterized by the adoption of CCR filters and special drier crasher.

The major component of the CCR is Calcium (OH), which contains a high quantity of Calcium Oxide. This element meets the quality requirements for cement production. CCR is a non-carbonated calcium source in the raw mix for clinker processing, since due to its chemical composition, no decarbonisation reaction occurs. Although there is slightly greater energy consumption (coal and/or electricity) involved in the proposed project, limestone decarbonisation reaction emits more CO2.

Up to now, the cement industry did not show its full CDM potential due to difficulties in applying the methodologies, finding sufficient quantities of other raw materials and demonstrating additionality.

Example of application

Title: Optimum utilisation of clinker by production of Pozzolana Cement at UltraTech Cement Ltd. (UTCL), Andhra Pradesh (Ref. No. 438)

UltraTech Cement Limited is one of India's largest cement producers with state-of-the-art dry process plants incorporating pre-calcination technology, advanced instrumentation systems, computerized process control and online quality control by X-ray - ensuring consistent production of high quality cement. The project activity entails a reduction of the clinker content by producing the Portland Pozzolana cement (PPC), thereby replacing an equivalent amount of clinker at UTCL's cement manufacturing units at Tadipatri, Andhra Pradesh & Arakkonam, Tamilnadu.

Project investment: N.A.

Project's CO2 reductions over a crediting period of 7 years: 418,382 tCO2e

Expected CERs revenue (assuming a 10 USD/CER): USD 4,183,820

Methodologies

The methodologies presented here are the ones primarily used by project developers of the different Cement projects in the CDM pipeline.

For optimizing the use of clinker:
ACM0005 "Consolidated Baseline Methodology for Increasing the Blend in Cement Production"

For Use of non-carbonated calcium sources:
AM0033 "Use of non-carbonated calcium sources in the raw mix for cement processing"

http://cdm.unfccc.int/methodologies/index.html
http://cdm-meth.org/

CDM status

There are only 33 cement projects in the CDM pipeline. One of the reasons for the small number of these projects is that the expected emissions reductions are relatively low, and do not compensate for the high transaction costs (i.e. research and development coupled with communication strategy and success uncertainties).

Type	Number of CDM projects (rejected projects excluded)		Estimated CERs (000) / year		Number of CDM projects with CERs issued		Issuance success	CERs (000) issued	
Cement	34	0.1%	6151	0.1%	7	0.1%	69%	1203	0%

Total	**4926**	**100%**	**680327**	**100%**	**650**	**100%**	**97%**	**372352**	**100%**

Region and "top3" countries	Number of cement CDM projects in the pipeline		Region and "top3" countries	Number of cement CDM projects in the pipeline		Region and "top3" countries	Number of cement CDM projects in the pipeline		Region and "top3" countries	Number of cement CDM projects in the pipeline	
Dominican Republic	**1**	**50%**	**India**	**16**	**%**	**Kenya**	**1**	**50%**	**Uzbekistan**	**.**	**.**
Jamaica	**1**	**50%**	**China**	**13**	**%**	**Nigeria**	**1**	**50%**	**Israel**	**.**	**.**
.	**.**	**.**	**Indonesia**	**1**	**%**	**-**	**-**	**-**	**-**	**-**	**-**
Other countries	**0**	**0%**	**Other countries**	**0**	**0%**	**Other countries**	**0**	**0%**	**Other countries**	**-**	**-**
Latin America	**2**	**100%**	**Asia and the Pacific**	**30**	**100%**	**Africa**	**2**	**100%**	**Europe, Central Asia and The Middle East**	**0**	**-**

Source: UNEP Risoe CDM/JI Pipeline Analysis and Database, February 1st 2010

Solar Energy - Thermal

Solar thermal energy is a technology for harnessing solar energy for thermal energy (heat) and is different from photovoltaics, which convert solar energy directly into electricity. In October 2009, 600 MW of solar thermal power was running worldwide, with another 400 MW under construction. There are approximately 14,000 MW of concentrated solar thermal projects being developed.

Description of technology

The sun's energy can be collected directly to create both high temperature steam (greater than 100oC) and low temperature heat (less than 100oC) for use in a variety of heat and power applications. High temperature solar thermal systems use mirrors and other reflective surfaces to concentrate solar radiation. Parabolic dish systems concentrate solar radiation to a single point to produce temperatures in excess of 1000oC.

Line-focus parabolic concentrators focus solar radiation along a single axis to generate temperatures of about 350oC. Central receiver systems use mirrors to focus solar radiation on a central boiler. The resulting high temperatures can be used to create steam to either drive electric turbine generators, or power chemical processes such as the production of hydrogen. Low temperature solar thermal systems collect solar radiation to heat air and water for industrial applications including: space heating for homes, offices and greenhouses, domestic and industrial hot water, pool heating, desalination, solar cooking, and crop drying.

The solar thermal technology includes passive and active systems. Active solar technology uses pumps and/or motors to circulate the solar-heated fluid while passive systems use the orientation and design of the solar collector to collect energy. The collectors used for active systems are most commonly made of copper tubes bonded to a metal plate, painted black, and encapsulated within an insulated box covered by a glass panel - or "glazing". For pool heating and other applications where the desired temperature is less than 40oC, unglazed synthetic rubber materials are most commonly used. For domestic applications, the solar hot water system is a mature technology that can provide hot water to meet a significant (in some cases all) of the hot water needs in a domestic building. Passive systems collect energy without the need for pumps or motors, generally through the orientation, materials, and construction of a collector. These properties allow the collector to absorb, store, and use solar radiation. Passive systems are particularly suited to the design of buildings (where the building itself acts as the collector) and thermosiphoning solar hot water systems. For new buildings, passive systems generally entail very low, or no additional, cost because they simply take advantage of the orientation and design of a building to capture and use solar radiation.

Example of application

Title: Federal Intertrade Pengyang Solar Cooker Project (Ref. No. 2307)

The Federal Intertrade Pengyang Solar Cooker Project is located on the dry land of southern Ningxia in northwestern China. Implemented by Ningxia Federal Intertrade Co., the proposed project will install 17,000 solar cookers for the poor rural residents in mountainous areas with a rural population of 92,331 (or 20,341 households). The project will cover 83.6% of the households in the project region. The rating power of each solar cooker is 773.5 W and the total capacity of the proposed project is 13.1 MW. The proposed project will enable the rural residents to efficiently substitute solar energy for the fossil fuel (coal) used in daily cooking and water boiling - avoiding CO2 emission that would be generated by fossil fuel consumption.

Project investment: USD 900,000 million

Project CO2 reduction over a crediting period of 10 years: 357,230 tCO2e

Expected CER revenue (USD 10/CER): USD 3,572,300

Methodologies

The methodologies presented here are the ones primarily used by the project developers.

ACM2 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources"

AMS- I.C. "Thermal energy production with or without electricity"

http://cdm.unfccc.int/methodologies/index.html
http://cdm-meth.org/

CDM status

As of 1 February 2010, there are 10 solar thermal projects in the CDM pipeline - 5 are registered and 5 are at the validation stage. See below for more data on CDM projects based on Solar.

Falta cuadro??

Solar Energy - Photovoltaic

Photovoltaic (PVs) are best known as a method for generating electric power by using solar cells to convert energy from the sun into electricity. The PV production has been doubling every two years, increasing by an average of 48% each year since 2002, making it the world's fastest-growing energy technology. At the end of 2008, the cumulative global PV installations reached 15,200 MW. Roughly 90% of this generating capacity consists of grid-tied electrical systems. World solar photovoltaic (PV) installations were 2.826 gigawatts peak (GWp) in 2007, and 5.95 GW in 2008 - a 110% increase.

Description of technology

There are about 30 different types of PV devices under development. The three main technologies in commercial production are monocrystalline cells, polycrystalline cells and thin-film cells. Monocrystalline – or single crystal – solar cells are manufactured from a wafer of high-quality silicon and are generally the most efficient of the three technologies at converting solar energy into electricity.

Polycrystalline solar cells are cut from a block of lower quality multi-crystalline silicon and are less efficient, but also less expensive to produce.

Thin-film solar cells are manufactured in a much different process that is similar to tinting glass. These solar cells are made of semiconductor material deposited as a thin film on a substrate such as glass or aluminium. Thin-film solar cells are generally less than half as efficient as the best cells, but far less expensive to produce. They are widely used for powering consumer devices.

All solar cells are encapsulated into modules, several of which are combined into an array. There is, however, a growing market of "building-integrated" PV devices that are manufactured as part of conventional building materials such as roof tiles or glass panelling. Building-integrated photovoltaics (BIPV) are increasingly incorporated into new domestic and industrial buildings as a principal or ancillary source of electrical power, and are one of the fastest growing segments of the photovoltaic industry. Moreover, PV is used for solar powered remote fixed devices that have seen increasing use recently, in locations where significant connection cost makes grid power prohibitively expensive. Such applications include parking meters, emergency telephones, temporary traffic signs, and remote guard posts and signals. Rural areas in developing countries where many villages are often more than five kilometres away from grid power have also begun using photovoltaics. In remote locations in India, a rural lighting program has been providing solar powered LED lighting to replace kerosene lamps.

Today, solar PV power stations have capacities ranging from 10-60 MW - although proposed solar PV power stations will have a capacity of 150 MW or greater. Physicists have claimed that the recent technological developments bring the cost of solar energy closer to that of fossil fuels.

Example of application

Title: D.light Rural Lighting Project (Ref. No. 2699)

The D.light Rural Lighting Project involves the introduction of solar lighting systems to rural Indian households. The solar lighting systems consist of one LED (Light Emitting Diode) lamp with a rechargeable battery and one photovoltaic module. LED lamps use a light emitting diode, which is a semiconductor diode that emits light when an electrical current is applied. LEDs are ideal for rural lighting purposes due to their efficiency, long life, ruggedness and associated low maintenance costs. Photovoltaic (PV) modules consist of solar cells, which can convert sunlight directly into electricity. In remote, off-grid areas PV modules are very useful for powering electric devices, like the lamps for this project. The target group of the project are rural households that use kerosene for lighting purposes and are located in the states of Uttar Pradesh (U.P.) and Bihar in India. Those households are in deep need of better, safer and cleaner light sources.

Project investment: N.A.

Project CO2 reduction over a crediting period of 10 years: 300,523 tCO2e

Expected CER revenue (USD 10/CER): USD 3,005,230

Methodologies

The methodologies presented here are the ones primarily used by project developers of the different biomass projects in the CDM pipeline.

AMS-I.A. "Electricity generation by the user"

AMS- I.D. "Grid connected renewable electricity generation"

AMS- I.E. "Switch from Non-Renewable Biomass for Thermal Applications by the User"

http://cdm.unfccc.int/methodologies/index.html
http://cdm-meth.org/

CDM status

As of 1 February 2010 there are 42 solar projects in the CDM pipeline, but only one has had CERs issued (a solar cooking project in Indonesia).

Type	Number of CDM projects (rejected projects excluded)		Estimated CERs (000) / year		Number of CDM projects with CERs issued		Issuance success	CERs (000) issued	
Solar	42	0.1%	830	0.0%	1	0.0%	18%	1	0.0%
Total	4926	100%	680327	100%	650	100%	97%	372352	100%

“Top3” countries and region	Number of solar CDM projects in the pipeline		“Top3” countries and region	Number of solar CDM projects in the pipeline		“Top3” countries and region	Number of solar CDM projects in the pipeline		“Top3” countries and region	Number of solar CDM projects in the pipeline	
Brazil	-	-	South Korea	21	%	Rwanda	2	50%	United Arab Emirates	2	100%
Colombia	-	-	China	7	%	Tunisia	1	25%	-	-	-
Chile	-	-	India	5	%	Morocco	1	25%	-	-	-
Other countries	-	-	Other countries	3	%	Other countries	0	0%	-	-	-
Latin America	0	-	Asia and the Pacific	36	100%	Africa	4	100%	Europe, Central Asia and The Middle East	2	100%

Source: UNEP Risoe CDM/JI Pipeline Analysis and Database, February 1st 2010

Fugitive emission from fuels

Fugitive emissions are emissions of gases from equipment or product processing arising primarily from industrial activities. There are different types of CDM fugitive projects such as emissions from charcoal production (traditional open pits), natural gas pipelines, non-hydrocarbon mining, oil and gas processing flaring and oil field flaring.

Description of technology

Charcoal production

Charcoal manufacturing is releasing methane - especially in the traditional open pits process. The project activities aim at reducing methane emissions during the carbonization process. There are three phases in the carbonization process: ignition, carbonization and cooling. CDM projects are implemented in two different processes: improvement of equipment, and utilisation of the energy of methane released to generate electricity.

Improvements in kiln design and operations of the activities (to reach suitable temperatures) allow for greater control of carbonization variables and enable the projects to reduce methane emissions.

The gases released from the constructed mechanized charcoaling plant are fully combusted to generate energy for producing steam, which would be further used to generate electricity.

Oil and gas processing flaring

The project activities aim at reducing oil and gas flaring from pressurized equipment due to leaks and various other unintended or irregular releases of gases. The gases coming from various flare control valves, pressure valves, purge points, compressors and expanders are compressed and put back into the system, thereby reducing the flaring to zero. The equipment is thus improved or replaced.

Oil field flaring reduction

During exploration and exploitation of hydrocarbons, natural gas is produced along with crude oil. Those associated gases are flared due to the absence of proper evacuation infrastructure and due to the project's remote location, with no available consumers. The flaring of those gases result in emissions of carbon dioxide (CO_2) and uncombusted methane (CH_4). The rest of the gas is consumed on-site for various purposes like fuel for gas engines or process heaters. The purpose of the project activities is to recover the associated gas, send it to a gas processing plant and then transport the dry gas through the pipeline to the natural gas grid. Activities then count numerous equipment/infrastructure constructions. In addition to the eventual construction of a gas plant and gas pipeline to the grid, projects involve the use of gas dehydration and compression technologies.

Example of application

Title: Al-Shaheen Oil Field Gas Recovery and Utilisation Project (Ref. No. 763)

The purpose of the project activity is the recovery and utilisation of associated gas produced as a by-product of oil recovery activities at the Al-Shaheen oil field, which is operated by Maersk Oil Qatar (the "Project Developer"), in partnership with Qatar Petroleum. Oil recovery from the Al-Shaheen oil field (Block 5) is located about 90 kilometres off the coast of Qatar, and commenced in 1994. As part of the recent development of the oil field, Maersk Oil Qatar has installed facilities for the gathering and delivery of associated gas (a blend of hydrocarbons that is released when crude oil is brought to the surface) to Qatar Petroleum's North Field Alpha platform, and its subsequent transfer to the Mesaieed gas processing plant (GPP). Prior to 2004, associated gas at the Al-Shaheen oil field was primarily flared, with the remaining gas utilised for onsite consumption (only ~3%).

Project investment: USD 260,000,000

Project CO2 reduction over a crediting period of 10 years: 17,497,540 tCO2e

Expected CER revenue (USD 10/CER): USD 174,975,400

Methodologies

The methodologies presented here are the ones actually used by project developers of the different fugitive projects in the CDM pipeline.

For charcoal production:
ACM0041 "Mitigation of Methane Emissions in the Wood Carbonization Activity for Charcoal Production"

AMS-III.K "Avoidance of methane release from charcoal production by shifting from traditional open-ended methods to mechanized charcoaling process"

For oil and gas processing flaring:
AM0037 "Flare (or vent) reduction and utilisation of gas from oil wells as a feedstock"

For oil field flaring reduction:
AM0009 "Recovery and utilisation of gas from oil wells that would otherwise be flared or vented"

http://cdm.unfccc.int/methodologies/index.html
http://cdm-meth.org/

CDM status

As of February 2010, there are 28 fugitive projects in the CDM pipeline, in which 10 are registered and 11 are at the validation stage, representing 0.4% of the CDM projects.

The number of fugitive CDM projects reflects the difficulty of implementing a technology that is still underused. Nevertheless, those kinds of projects are financially appealing. The amount of CERs from methane emissions in this sector is not negligible. However, given the economic importance of capturing flared gas and the associated political and regulatory pressure, it can be difficult to establish the additionality argument.

Type	Number of CDM projects (rejected projects excluded)		Estimated CERs (000) / year		Number of CDM projects with CERs issued		Issuance success	CERs (000) issued	
Fugitives	**28**	**0.1%**	**42944**	**6.3%**	**2**	**0.0%**	**114%**	**4600**	**1.2%**
Total	**4926**	**100%**	**680327**	**100%**	**650**	**100%**	**97%**	**372352**	**100%**

Region and "top3" countries	Number of fugitives CDM projects in the pipeline		Region and "top3" countries	Number of fugitives CDM projects in the pipeline		Region and "top3" countries	Number of fugitives CDM projects in the pipeline		Region and "top3" countries	Number of fugitives CDM projects in the pipeline	
Brazil	**3**	**60%**	**India**	**6**	**50%**	**Nigeria**	**4**	**80%**	**Uzbekistan**	**2**	**33.3%**
Mexico	**2**	**40%**	**Indonesia**	**2**	**%**	**South Africa**	**1**	**20%**	**Iran**	**1**	**-**
-	**-**	**-**	**Pakistan**	**1**	**%**	**-**	**-**	**-**	**Qatar**	**1**	**-**
Other countries	**0**	**0%**	**Other countries**	**3**	**%**	**Other countries**	**0**	**0%**	**Other countries**	**2**	**-**
Latin America	**5**	**100%**	**Asia and the Pacific**	**12**	**100%**	**Africa**	**5**	**100%**	**Europe, Central Asia and The Middle East**	**6**	**100%**

Source: UNEP Risoe CDM/JI Pipeline Analysis and Database, February 1st 2010

Geothermal

The use of geothermal energy has increased rapidly since 1970 and is now being used in more than 45 countries. About 10,000 MW of electricity is currently generated from geothermal resources, and an additional 28,000 MW is recovered for direct heating applications. Currently, Costa Rica, El Salvador, Kenya, the Philippines and Nicaragua generate more than 15% of their electricity from geothermal resources.

Description of technology

Geothermal energy is a well-proven energy resource that can be used to provide both heat and electricity using established and mature technology. Geothermal energy resources exist in many areas of the world for both high and low temperature applications. Useful geothermal energy for heating and cooling can be recovered almost everywhere with special heat pumps that utilise the heat of the earth from just below the surface.

Geothermal energy is the energy contained in the heated rock and fluid that fills the fractures and pores within the earth's crust. It originates from radioactive decay deep within the Earth and can exist as hot water, steam, or hot dry rocks. Commercial forms of geothermal energy are recovered from wells drilled 100–4,500 metres below the Earth's surface. The technology is well-proven, relatively straightforward, and involves extracting energy by means of conventional wells, pumps, and/or heat exchangers.

Geothermal energy can be used directly or indirectly, depending on the temperature of the resource. Geothermal resources are classified as low temperature (less than 90°C), moderate temperature (90°C-150°C), and high temperature (greater than 150°C). The highest temperature resources are generally used only for electric power generation and are found in volcanic regions. Low and moderate geothermal resources are found in most areas of the world. Geothermal energy can be used directly in temperatures ranging from about 35°C to 150°C to heat buildings, greenhouses, aquaculture facilities and to provide industrial process heat. Indirectly, high temperature geothermal steam can be used to drive a turbine and create electricity, or else in heat pumps. Using geothermal energy directly is 50-70% efficient compared to the possible 5-20% efficiency for the indirect use of generating electricity - although the waste heat from generating electricity can also be used, boosting the overall efficiency. Applications that use this energy directly can also draw from both high and low temperature energy resources, where useful energy can be produced for as low as USD 0.02/kWh. Low temperature geothermal energy can be recovered almost anywhere with special "ground source" heat pumps. These pumps can use the earth as either a heat source for heating or as a heat sink for cooling. Using resource temperatures of 4°C to 38°C, the heat pump transfers heat from the soil to the building in wintertime, and from the building to the soil in summertime.

Geothermal power is highly scalable and a large geothermal plant can power entire cities while a smaller power plant can supply a rural village. One single geothermal project can have a generation capacity that exceeds 1000 MW.

Until recently, geothermal electric plants have been built exclusively on the edges of tectonic plates where high temperature geothermal resources are available near the surface. The development of binary cycle power plants and improvements in drilling and extraction technology may enable enhanced geothermal systems over a much wider geographical range.

Example of application

Title: Amatitlan Geothermal Project by Ortitlan Limitada (Ref. No. 2022)

The Amatitlan Geothermal Project is a geothermal power plant in the Department of Escuintla, in Guatemala. Total installed capacity of the project will be 25.2 MW, with an actual net capacity of 20.5 MW. The plant will utilise three turbines (two with installed capacities of 12 MW each, and one at 1.2 MW) and has a predicted power generation of 162,000 MWh per annum. The purpose of the project is to utilise the geological resources of the Amatitlan Geothermal Field in a state-of-the-art geothermal power plant to generate renewable energy that will be dispatched to the grid.

Project investment: N.A.

Project CO2 reduction over a crediting period of 7 years: 580,849 tCO2e

Expected CER revenue (USD 10/CER): 5,808,490

Methodologies

The methodologies presented here are the ones primarily used by project developers of the different geothermal projects in the CDM pipeline.

ACM2 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources"

AMS-I.D. "Grid connected renewable electricity generation"

AMS I.C. "Thermal energy production with or without electricity"

http://cdm.unfccc.int/methodologies/index.html
http://cdm-meth.org/

CDM status

There are 14 geothermal projects in the CDM pipeline. Projects based on geothermal energy, therefore, represent a very small part of all CDM projects in the pipeline. It is worth noting that more than 1/3 of all projects are located in Indonesia.

Type	Number of CDM projects (rejected projects excluded)		Estimated CERs (000) / year		Number of CDM projects with CERs issued		Issuance success	CERs (000) issued	
Geothermal	14	0.0%	3272	0.0%	4	0.1%	37%	654	0.0%
Total	4926	100%	680327	100%	650	100%	97%	372352	100%

“Top3” countries and region	Number of geothermal CDM projects in the pipeline		“Top3” countries and region	Number of geothermal CDM projects in the pipeline		“Top3” countries and region	Number of geothermal CDM projects in the pipeline		“Top3” countries and region	Number of geothermal CDM projects in the pipeline	
El Salvador	2	50%	Indonesia	5	62.5%	Kenya	2	100%	Uzbekistan	-	-
Guatemala	1	25%	Papa New Guinea	1	%	-	-	-	Iran	-	-
Nicaragua	1	25%	Philippines	1	%	-	-	-	Qatar	-	-
Other countries	0	0%	Other countries	1	%	Other countries	0	0%	Other countries	-	-
Latin America	4	100%	Asia and the Pacific	8	100%	Africa	2	100%	Europe, Central Asia and The Middle East	0	-

Source: UNEP Risoe CDM/JI Pipeline Analysis and Database, February 1st 2010

Avoidance and incineration of industrial gases - HFCs

Certain gases that are used for, or are a by-product of, industrial production have a large global warming potential (GWP); two such gases are HFC-23 and HFC-134a.

HFC-23 (CHF_3), also known as fluoroform, a hydrofluorocarbon, has a very high GWP - 11,700 times that of CO_2 and an atmospheric lifetime of 260 years. HFC-134a has a lower, but significant GWP, equivalent to 1300 times that of CO_2. The reduction in emission of these gases, therefore, constitutes a large potential for CDM projects.

Description of technology

This section focus on CDM projects decomposing HFC-23 - in part because very few projects concerning HFC-134a have been initiated. Consequently, the base of knowledge is higher for HFC-23 projects. This of course does not suggest that HFC-134a projects are less relevant, but that the technology for HFC-23 projects is more intricate; HFC-134a projects merely adapt a raw material switch, for the gas in question. HFC-23 is an undesired by-product from the production of HCFC 22, a fluoric refrigerant. Although HFC-23 can be utilised for different purposes, and the by-product can sold in certain cases, this option is rarely used. In most cases, HFC-23 is vented directly into the atmosphere resulting in the worsening of global warming.

To prevent the venting of HFC-23, the gas can be recovered from the production of HCFC 22 and decomposed into harmless or less harmful components, in terms of GWP. The method for decomposing HFC-23 is incineration at high temperatures. For this incineration it is essential that oxygen be added, since the calorific value of HFC-23 is low.

Hydrogen is also added as a supplementary fuel for the process. The thermal oxidation of HFC-23 decomposition induces several chemical reactions, which in turn decomposes the gas and leaves several different components, e.g. CO_2, HCl, HF, nitrogen, oxygen. The waste gas from the incineration containing these components is fed into a neutralizer, where the acids are slaked with calcium chloride ($CaCl_2$). The remaining gas, containing the aforementioned gases, is vented into the atmosphere. Although some of these gases do have a GWP, they are far less harmful for the environment than HFC-23. The actual reduction in CO_2-equivalents (CERs) is thus the reduction in HFC-23, less the CO_2 released as a result of the auxiliary energy consumption for the incineration of HFC-23 and the amount of GHG released into the atmosphere after the destruction of HFC-23.

The thermal decomposition (oxidation) of HFC-23 is approximately 99.99% effective. The technology is well known and as such very reliable. HFC-134a is used as a blowing agent during production of polyurethane foam, used for example for production of different types of insulated panels. These panels can be put to use in different areas, such as industrial building panels, sound deadening, etc.

For CDM projects involving HFC-134a this blowing agent is replaced with another agent that is not harmful in terms of global warming.

The agent used can be pentane, an inflammable blowing agent, with no GWP. Since the agent is inflammable, precautionary safety measures must be taken at the production facility in order to ensure a safe production without fire hazards. The technology required to switch from HFC-134a to pentane, for example, is well established and known, and as such does not impose difficulty for the implementation of this type of project.

Example of application

Title: Shandong Dongyue HFC23 Decomposition Project (Ref. No. 232)

The project involves removal and decomposition (destruction) of HFC-23, thereby reducing the emission of GHG into the atmosphere. The plant in question produces HCFC 22, used mainly as a refrigerant. The plant is one of the largest manufactures of HCFC 22 in China.
The project activity is to collect the waste gas (HFC-23) and decompose it by means of thermal oxidation (incineration). The technology applied is from supplier Tsukishima Nittetsu Chemical Engineering Ltd. The technology requires the construction of the following: system for recovery of the waste gas to be treated, furnace for incineration and subsequent decomposition, neutralizer for the acidic end product of the decomposition, sufficient cooling installation.

Project investment: N.A.

Project CO2 reduction over a crediting period of 7 years: 70,770,000 tCO2

Expected CER revenue (USD 10/CER): USD 707,700,000

Methodologies

The Executive Board has limited the application of the approved methodology concerning this type of project only to existing production facilities that have been in operation for at least three years, between 2000 and 2004, and have had continuous production since 2005. This eliminates the possibility of CDM projects on newly constructed plants. It is important to note that construction of new plants producing HFC-23 is prohibited for Annex I countries.

AM1 "Incineration of HFC-23 waste streams"

AMS-III.N. "Avoidance of HFC emissions in Poly Urethane Foam (PUF) manufacturing"

http://cdm.unfccc.int/methodologies/index.html
http://cdm-meth.org/

CDM status

There are only 22 HFC projects in the CDM pipeline, however the CERs issued from *the HFC projects represent 54.3% of the overall CERs issued.*

Type	Number of CDM projects (rejected projects excluded)		Estimated CERs (000) / year		Number of CDM projects with CERs issued		Issuance success	CERs (000) issued	
HFC	22	0.4%	81715	12%	17	2.6%	107%	202096	54.3%
Total	4926	100%	680327	100%	650	100%	97%	372352	100%

“Top3” countries and regions	Number of HFC CDM projects in the pipeline		“Top3” countries and regions	Number of HFC CDM projects in the pipeline		“Top3” countries and regions	Number of HFC CDM projects in the pipeline		“Top3” countries and regions	Number of HFC CDM projects in the pipeline	
Argentina	**1**	**50%**	**China**	**11**	**%**	**-**	**-**	**-**	**Uzbekistan**	**-**	**-**
Mexico	**1**	**50%**	**India**	**8**	**%**	**-**	**-**	**-**	**Iran**	**-**	**-**
-	**-**	**-**	**South Korea**	**1**	**%**	**-**	**-**	**-**	**Qatar**	**-**	**-**
Other countries	**-**	**-**	**Other countries**	**1**	**%**	**Other countries**	**-**	**-**	**Other countries**	**-**	**-**
Latin America	**2**	**100%**	**Asia and the Pacific**	**20**	**100%**	**Africa**	**0**	**-**	**Europe, Central Asia and The Middle East**	**0**	**-**

Source: UNEP Risoe CDM/JI Pipeline Analysis and Database, February 1st 2010

Reduction of SF6 emissions in industrial processes

In terms of global warming potential (GWP), the most powerful greenhouse gas (GHG), according to IPCC, is Sulfur Hexaflouride (SF6) which has a GWP of 23,900 times that of CO2. Therefore, an obvious potential for GHG reductions lies within projects concerning this gas.

Description of technology

SF6 is often used in different industrial processes as a cover gas, for its unique chemical properties. Examples of these uses are cover gas for magnesium casting or the insulation of electrical components in high-voltage installations (e.g. for transformer and switching substations for electrical grids). SF6 is also used in production of LCD displays as an etching gas. Although some of the gas used for etching is consumed in the process, the rest is usually vented into the atmosphere in the baseline scenario prior to the implementation of CDM projects of this type. In short, projects concerning abatement of SF6 emission can consist of either recovering and recycling SF6, or thermal destruction of the gas.

For projects where SF6 is used as an etching gas the option of thermal destruction is usually chosen. The gas is collected after the etching stage of production and destroyed at temperatures of approximately 1300-1400°C. For projects where SF6 is used as a cover gas there are generally two different approaches. Where the gas is used as insulation for electrical components it is possible to recover and recycle the gas. This type of project often includes actions towards better detection of leakage, which also contributes to a reduction of GHG emissions.

For projects related to magnesium casting it is possible to replace SF6 with a different cover gas. The need for a cover gas is because magnesium is a very volatile metal, which easily reacts with other materials, as well as air. SF6 is replaced with HFC134a in these types of projects. Although HFC134a is also a potent GHG with a GWP of approximately 1300 times that of CO2, it is a substantial improvement over SF6 which, as already mentioned, is a much stronger greenhouse gas.

Example of application

Title: SF6 Switch at Ortal Diecasting 1993 Ltd. (Ref. No. 2394)

The project involves the replacement of SF6 as cover gas in the process of magnesium casting with HFC134a. Due to a lower global warming potential of the replacement gas, this constitutes a reduction in GHG emissions from the production line.
The staff at the plant has to adapt to the use of a new cover gas and, therefore, testing must be carried out to establish the right levels of concentrations between cover gas and carrier gas and appropriate flow rates in order to sustain the desired level of quality for the production.

Project investment: N.A.

Project CO2 reduction over a crediting period of 7 years: 110,250 tCO2

Expected CER revenue (USD 10/CER): USD 1,102,500

Methodologies

The methodologies presented here are the ones primarily used by project developers of the different biomass projects in the CDM pipeline.

AM35 "SF6 Emission Reductions in Electrical Grids"

AM65 "Replacement of SF6 with alternate cover gas in the magnesium industry"

AM78 "Point of Use Abatement Device to Reduce SF6 emissions in LCD Manufacturing Operations"

http://cdm.unfccc.int/methodologies/index.html
http://cdm-meth.org/

CDM status

As of February 2010, a total of nine CDM projects concerning SF6 reduction were in the pipeline. Approximately 80% of the global emission of SF6 originates from the use of the gas as insulation for high-voltage electrical equipment. Projects that involve SF6 abatement from this type of installations, therefore, constitute the largest potential for projects involving this particular gas. None of the three registered projects involve high-voltage electrical equipment, but do require replacement of SF6 as cover gas in magnesium casting. For an overview of the data concerning SF6 and PFCs CDM projects, see next page.

Reduction of PFCs emissions in industrial processes

Perfluorocarbons (PFCs) is a group of gasses that have a high global warming potential (GWP). Some of these gasses are emitted as an unwanted by-product during the production of aluminium. The two main gases are CF4 and C2F6, with a GWP of 6500 and 9200 times that of CO2, respectively. The Clean Development Mechanism allows for projects aiming to reduce the emission of PFCs to be credited as CDM projects.

The objective of these types of projects is to reduce the emission of perflourocarbons (PFCs), which can occur in the smelting process of aluminium production. Examples of PFCs being emitted by the process of electrolysis for production of aluminium are CF4 and C2F6.

Description of technology

The PFC emission takes place when the undesired anode effect occurs. The anode effect is essentially a sudden increase in voltage and corresponding decrease in amperage produced by the polarization of the anode in electrolysis. This takes place when the anode is effectively separated from the electrolyte by a layer of gas film. The anode effect can be quenched by tilting or pumping the anode system to keep the anode in direct contact with the electrolyte, thereby achieving a more efficient production of the smelting facility and mitigating the emission of PFCs. Normally the quenching of the anode effect is done manually, but in the case of projects qualifying for CDM registration, this is done by implementing different algorithms for control of the smelting procedures.

These algorithms consist of both methods of early detection of anode effect and a different pattern of feeding the alumina to the pot.

Example of application

Title: PFC emission reductions at ALUAR Aluminio Argentino (Ref. No. 1610)

The project involves the replacement of SF6 as cover gas in the process of magnesium casting with HFC134a. Due to a lower global warming potential of the replacement gas, this constitutes a reduction in GHG emissions from the production line. The staff at the plant must adapt to the use of a new cover gas, therefore testing needs to be carried out to establish the right levels of concentrations between cover gas and carrier gas and appropriate flow rates in order to sustain the desired level of quality for the production.

Project investment: USD 400,000

Project CO2 reduction over a crediting period of 7 years: 412,730 tCO2e

Expected CER revenue (USD 10/CER): USD 4,127,300

The algorithm detecting the early stages of build-up to an anode effect is based on specific patterns occurring in the pot prior to the actual anode effect. In order to prolong the time before the anode effect happens, a different feeding of the pot with alumina is used. When an anode effect pattern is detected, an increase in the feed-in of alumina, effectively over-feeding the pot, will increase the time before the anode effect actually occurs, giving the operator of the pot time to quench the anode effect.

Methodologies

There are currently two approved methodologies that apply to projects concerning abatement of PFC emission from aluminium production, namely AM30 and AM59.

AM30 "PFC emission reductions from anode effect mitigation at primary aluminium smelting facilities"

AM59 "Reduction in GHGs emission from primary aluminium smelters"

http://cdm.unfccc.int/methodologies/index.html
http://cdm-meth.org/

CDM status

There are 14 SF6 and PFCs projects in the CDM pipeline, but no project has had CERs issued yet.

Type	Number of CDM projects (rejected projects excluded)		Estimated CERs (000) / year		Number of CDM projects with CERs issued		Issuance success	CERs (000) issued	
SF6 & PFCs	14	0.0%	4021	0.1%	0	-	-	-	-
Total	4926	100%	680327	100%	650	100%	97%	372352	100%

Region and "top3" countries	Number of SF6 and PFC CDM projects in the pipeline		Region and "top3" countries	Number of SF6 and PFC CDM projects in the pipeline		Region and "top3" countries	Number of SF6 and PFC CDM projects in the pipeline		Region and "top3" countries	Number of SF6 and PFC CDM projects in the pipeline	
Brazil	4	80%	South Korea	3	%	-	-	-	Israel	2	100%
Argentina	1	20%	Indonesia	2	%	-	-	-	.	-	-
-	-	-	India	1	%	-	-	-	.	-	-
Other countries	-	-	Other countries	1	%	Other countries	-	-	Other countries	-	-
Latin America	5	100%	Asia and the Pacific	7	100%	Africa	0	-	Europe, Central Asia and The Middle East	2	100%

Source: UNEP Risoe CDM/JI Pipeline Analysis and Database, February 1st 2010

Energy distribution

In the context of climate change mitigation, there is a huge potential to improve the supply side energy efficiency by minimizing the transmission and distribution loss at its distribution network. The implementation of these measures can include upgrading the voltage of a transmission/distribution system, replacing existing transformers with more efficient ones, as well as increasing the amount of pipe insulation in a district heating system.

Description of technology

<u>District heating</u>
This type of technology is applicable to project activities that introduce a new primary district heating system to supply heat to residential and commercial consumers. Here, the heat comes predominantly from an existing grid connected power plant with no heat extraction, other than the required for the operation of the power plant auxiliary systems. The project may also involve introduction of new modern heat boilers to supplement heat from the existing power plant. The heat is normally obtained from a cogeneration plant burning fossil fuels, although heat-only boiler stations and central solar heating are also used. District heating plants can provide higher efficiencies and better pollution control than localized boilers.

<u>District heating boilers</u>
A district heating system works by heating water that is then pumped around an underground district heating ring-main pipe. The pipe carries this heated water into each building. Each building is fitted with a heat exchanger, which allows the heat it requires to be taken from the ring-main. For systems serving housing developments, the heat is used for both the living space and domestic hot water. This category comprises technologies to improve the efficiency of fossil fuel generating units that supply electricity system, by reducing energy or fuel consumption by up to the equivalent of 60 GWhe per year. Some examples include efficiency improvements at power stations and district heating plants and cogeneration. The technologies may be applied to existing stations or be part of a new facility. A total saving of 60 GWhe is equivalent to a maximal saving of 180 GWhth in the fuel input to the generation unit.

<u>Connection of isolated grid</u>
The technology consists of the expansion of an interconnected electricity grid to isolated systems, and in the displacement of power generation in these systems by more efficient, less carbon intensive power generation from the connected grid. In remote areas, technologies for off-grid rural electrification, in combination with proper financial engineering, promise environmentally friendly access to electricity at a lower cost than conventional technologies. One example could be a small hydropower acting as an isolated power generation systems. Use of such installations refers to the lower limit of micro applications.

<u>Efficient electricity distribution</u>
This technology consists of measures that reduce technical energy losses through improving energy efficiency of either an electricity transmission/distribution system (resulting in electricity savings of up to 60 GWh per year), or a thermal energy distribution system (which results in fossil fuel savings of up to 180 GWh per year). Examples include, upgrading the voltage of a transmission and distribution system, replacing existing transformers with more efficient ones, and increasing the amount of pipe insulation in a district heating system.

Example of application

Title: Celtins and Cemat grid connection of isolated systems (Ref. No. 1067)

The purpose of the project activity is the expansion of the Brazilian interconnected grid to isolated systems in the Brazilian states of Mato Grosso and Tocantins. The chosen methodology applicable here concerns the grid connection of isolated systems, as is the case of the Grupo Rede CDM Project. In this case, several isolated "mini-grids" (off-grid power generation) operating in communities in the states of Mato Grosso and Tocantins (midwest and north Brazil) are being connected to the national grid. All fossil fuel fired power plants in the isolated systems are displaced, while renewable energy based electricity generation in the respective isolated systems is not significantly affected. Historical data on power generation and fuel consumption in the isolated systems is available to accurately estimate the most likely scenario in the absence of the project activity.

Project investment: USD 1,800,000

Project CO2 reduction over a crediting period of 7 years: 382,211 tCO2

Expected CER revenue (USD 10/CER): USD 3,822,110

Methodologies

The methodologies presented here are the ones primarily used by project developers of the different biomass projects in the CDM pipeline.

For connection of isolated grid:
AM0045 "Grid connection of isolated electricity systems"

For efficient electricity distribution:
AMS-II.A. "Supply side energy efficiency improvements - T&D"

For district heating:
AM0058 "Introduction of a new primary district heating system"

For district heating boilers:
AMS-II.B. "Supply side energy efficiency improvements-generation"

http://cdm.unfccc.int/methodologies/index.html
http://cdm-meth.org/

CDM status

Improvement in transmission and distribution losses represents a good opportunity for carbon credits. However, it has been under-represented by the CDM pipeline. There are only 13 CDM projects currently submitted in energy distribution and no CERs have been issued.

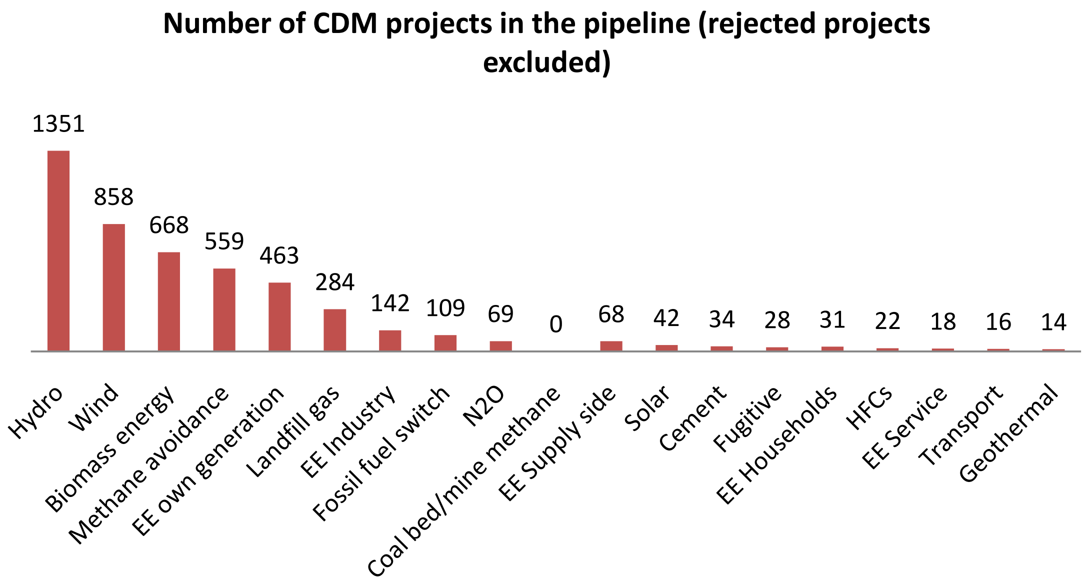
Type	Number of CDM projects (rejected projects excluded)		Estimated CERs (000) / year		Number of CDM projects with CERs issued		Issuance success	CERs (000) issued	
Energy distribution	13	0.3%	5219	0.8%	7	1.1%	77%	0	-
Total	4926	100%	680327	100%	650	100%	97%	372352	100%

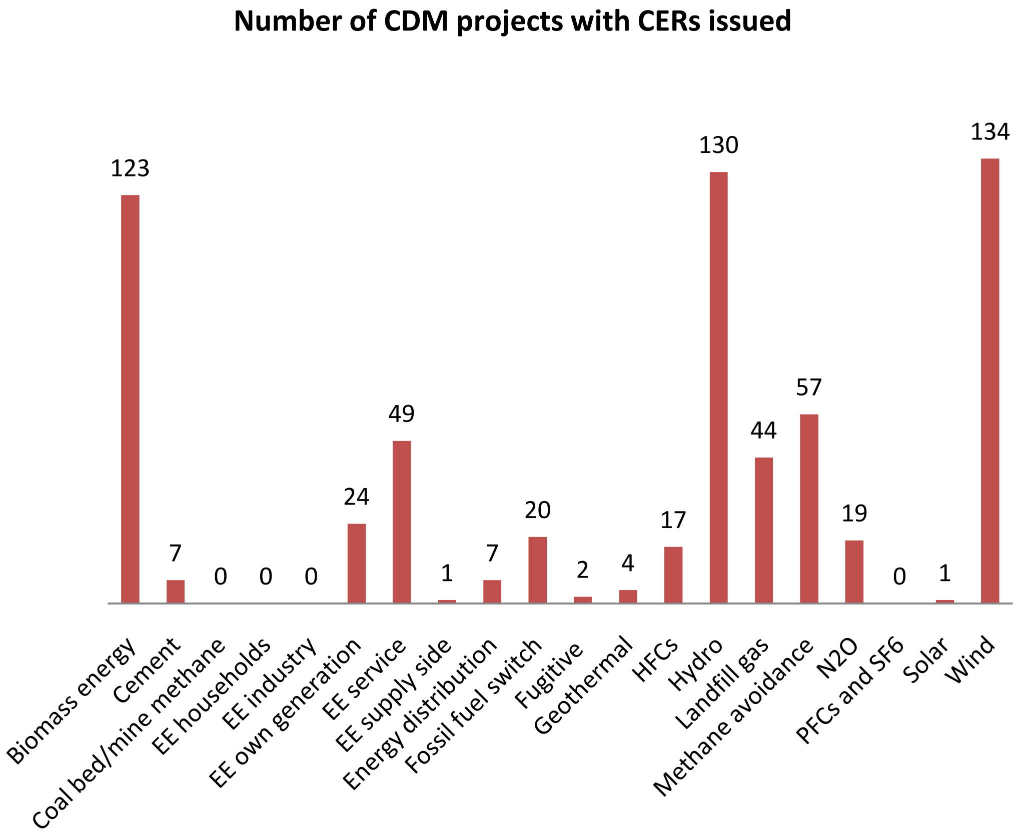
Region and “top3” countries	Number of energy distribution CDM projects in the pipeline		Region and “top3” countries	Number of energy distribution CDM projects in the pipeline		Region and “top3” countries	Number of energy distribution CDM projects in the pipeline		Region and “top3” countries	Number of energy distribution CDM projects in the pipeline	
Brazil	1	100%	China	9	%	-	-	-	.	.	.
.	.	.	India	2	%	-	-	-	.	-	-
-	-	-	Mongolia	1	%	-	-	-	.	-	-
Other countries	-	-	Other countries	1	%	Other countries	-	-	Other countries	-	-
Latin America	1	100%	Asia and the Pacific	12	100%	Africa	0	-	Europe, Central Asia and The Middle East	0	.

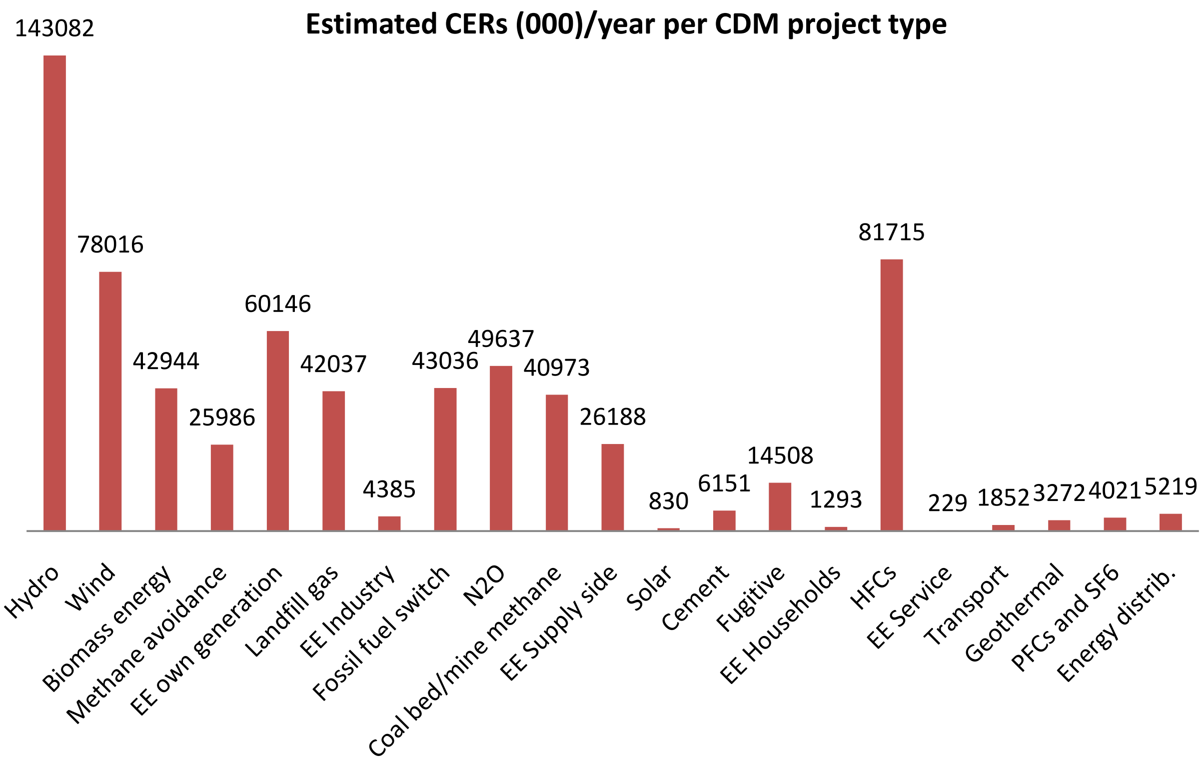
Source: UNEP Risoe CDM/JI Pipeline Analysis and Database, February 1st 2010

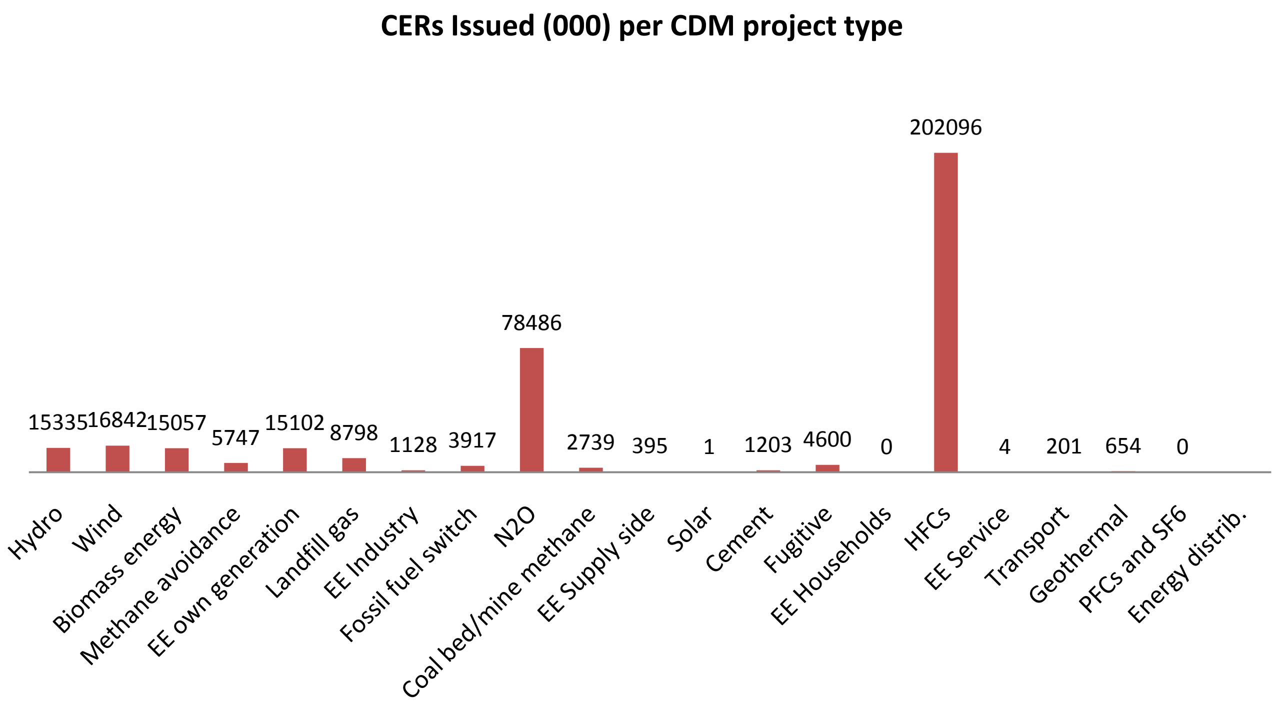
Data overview

Source: UNEP Risoe CDM/JI Pipeline Analysis and Database, February 1st 2010

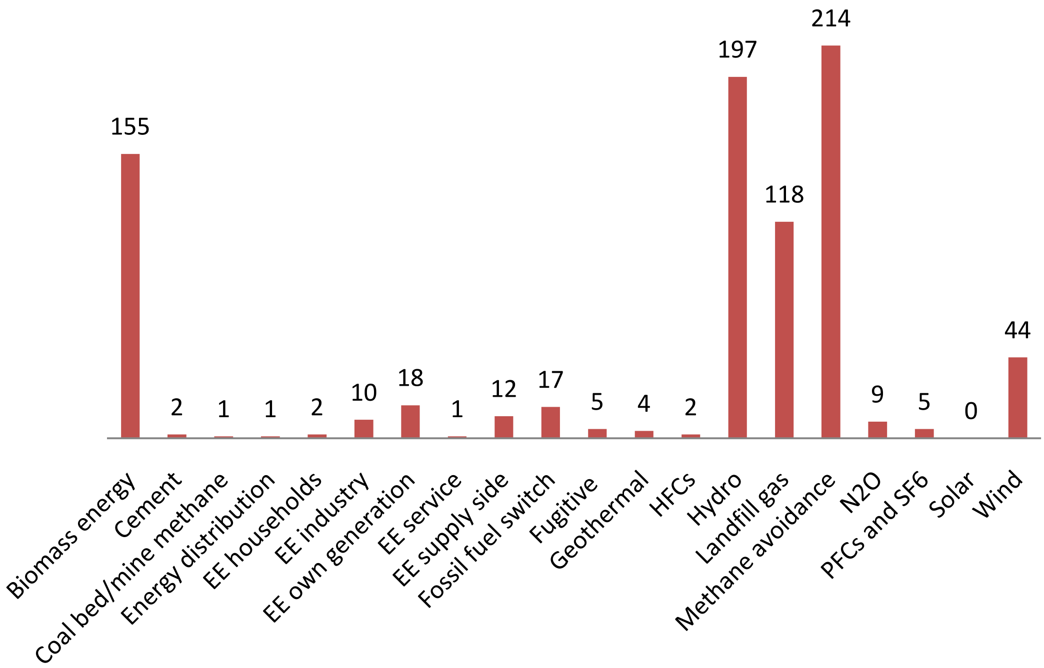




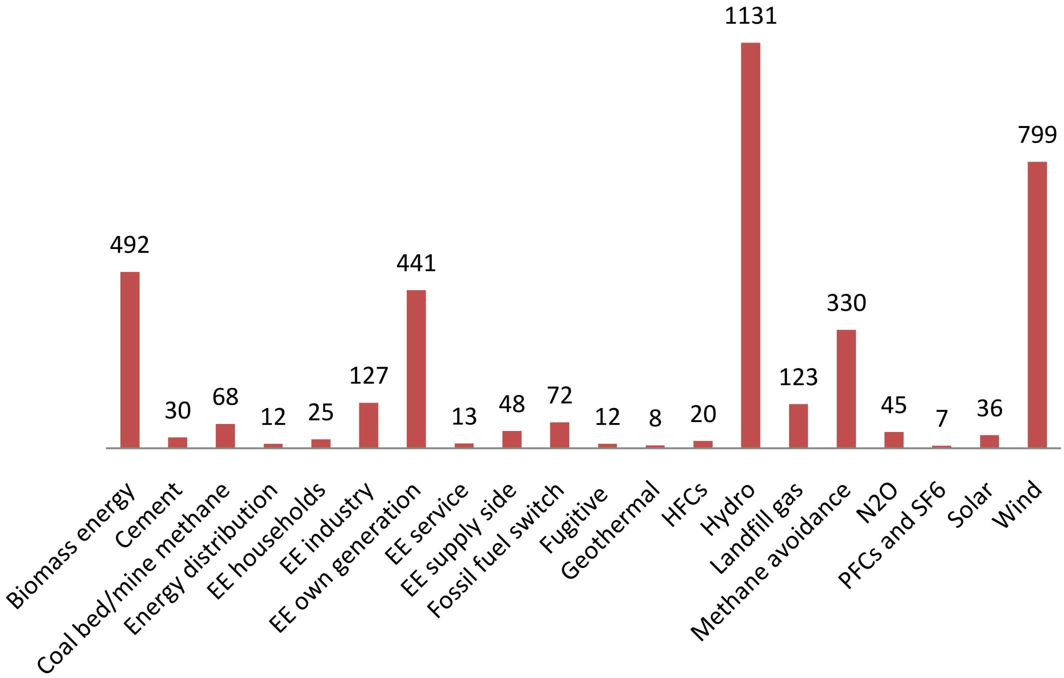

Estimated CERs (000)/year per CDM project type
143082
78016
42944
25986
60146
42037
4385
43036
49637
40973
26188
830
6151
14508
1293
81715
229
1852
3272
4021
5219
Hydro
Wind
Biomass energy
Methane avoidance
EE own generation
Landfill gas
EE Industry
Fossil fuel switch
N2O
Coal bed/mine methane
EE Supply side
Solar
Cement
Fugitive
EE Households
HFCs
EE Service
Transport
Geothermal
PFCs and SF6
Energy distrib.


CERs Issued (000) per CDM project type
15335
16842
15057
5747
15102
8798
1128
3917
78486
2739
395
1
1203
4600
0
202096
4
201
654
0
Hydro
Wind
Biomass energy
Methane avoidance
EE own generation
Landfill gas
EE Industry
Fossil fuel switch
N2O
Coal bed/mine methane
EE Supply side
Solar
Cement
Fugitive
EE Households
HFCs
EE Service
Transport
Geothermal
PFCs and SF6
Energy distrib.

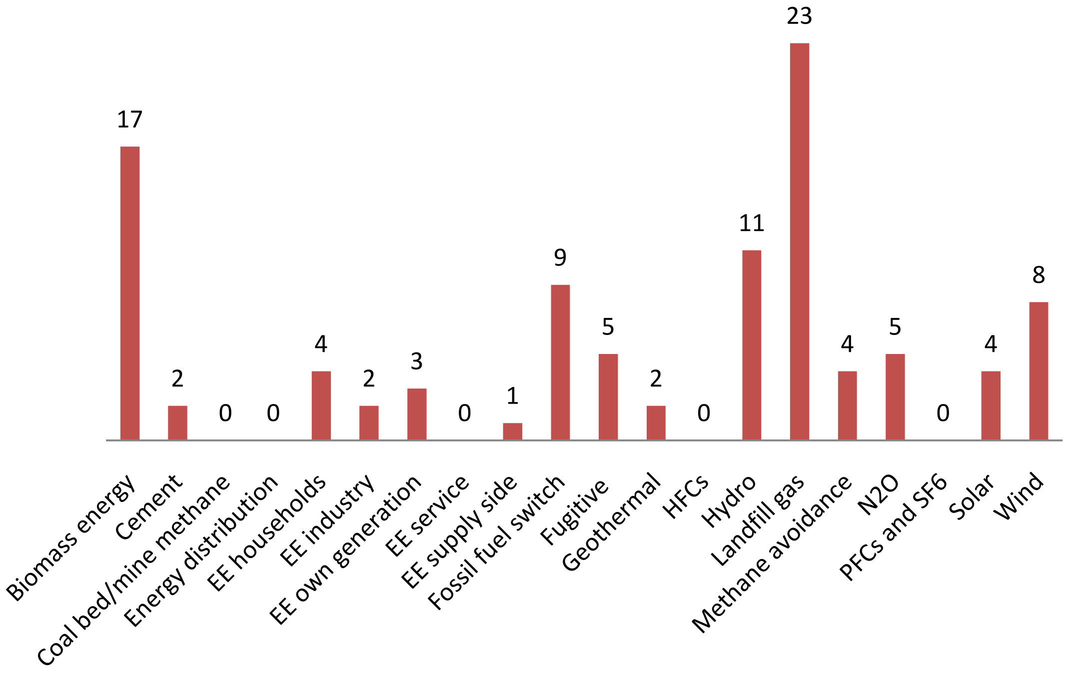
Number of CDM projects in Latin America in the CDM pipeline



Number of CDM projects in Asia & Pacific in the CDM pipeline



Number of CDM projects in Africa in the CDM pipeline



Number of CDM projects in Europe, Central Asia and Middle-East in the CDM pipeline