# Developments under the CDM

## Project examples in the Brazilian Energy Sector

**Emission reduction mechanisms such as the Clean Development Mechanism (CDM) are rapidly becoming a real new source of finance for the development of clean energy projects worldwide. Robert Tippmann and Pedro Moura Costa, EcoSecurities Group, UK describe recent developments related to the international rules related to the CDM and the expected impact on the Brazilian clean energy sector. Some project examples in the Brazilian energy sector are presented which have interesting greenhouse gas mitigation potential.**

At the Earth Summit in Rio de Janeiro in 1992 the United Nations Framework Convention on Climate Change (UNFCCC) was launched to tackle the problem of global climate change which is caused by constantly increasing levels of greenhouse gases (GHG) in the atmosphere. In 1997 the Conference of the Parties (COP) to the UNFCCC decided to introduce binding emission reductions targets for industrialised countries in the so-called Kyoto Protocol. Apart from domestic measures the Protocol offers a second, additional way to achieve the emission reduction targets through the flexible mechanisms: Emissions Trading (ET), Joint Implementation (JI), and the Clean Development Mechanism (CDM). The Brazilian government made a major contribution to the inclusion of the CDM into the Kyoto Protocol by proposing a Clean Development Fund for the compensation of developing countries which are most vulnerable to the adverse impacts of global climate change.

*Pig iron mill in Minas Gerais, Brazil. A potential venue for a fuel switch project under the CDM.*

### CDM on an international level

The two project-based mechanisms, JI and CDM, differ mainly regarding the location of projects and the more complex modalities for the CDM. JI refers to projects implemented in industrialised countries or economies in transition whereas the CDM refers to projects in developing countries. ET offers industrialized countries and private sector companies the opportunity to sell surpluses or buy so-called Assigned Amount Units (AAUs) if needed to meet their emissions reduction targets. Projects developed under JI and CDM can generate Emission Reduction Units (ERUs) through JI and Certified Emission Reductions (CERs) through the CDM. CERs generated through CDM projects, for example in Brazil or other developing countries, can be acquired by industrialised countries or companies within these countries to meet their emission reduction targets or to compensate for the omission of domestic or internal measures. The Kyoto Protocol defines a twofold aim of the CDM as to assist industrialised countries to meet their emissions reduction targets under the Kyoto Protocol through project activities in developing countries while also contributing to sustainable development in these countries. COP 7 to the UNFCCC in Marrakech in 2001 finalized the decisions about the rules and regulations for the CDM.

A so-called CDM Executive Board and related expert panels have been established in the meantime to elaborate the further modalities for CDM projects. The first


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*Kilns used in the fuel-switch project of Vallourec & Mannesmann Tubes*

round of applicants to become a Designated Operational Entity (DOE) - these entities are responsible for the validation, verification and certification of CDM projects - is under way. Furthermore, simplified modalities and procedures for small-scale CDM project activities have been established and the work on guidelines for methodologies for baselines and monitoring plans is ongoing. A Project Design Document (PDD) as well as a CDM Projects Activities Registration Form, both necessary for the registration of CDM project activities, have already been developed and a series of project applications have been submitted. In summary: most of the ground rules for the CDM are in place, setting the scene for a more active carbon market.

## Brazilian mitigation strategies

Brazil has been aware of the benefits of the Convention on Climate Change for a long time. In 1992, it hosted the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro where the three major international environmental agreements were established, namely the UNFCCC, the Convention on Biological Diversity and the Convention on Combating Desertification. As a developing country party, Brazil has no specific and legally binding stabilisation or reduction targets for GHGs but it can participate in the market for emission reductions by hosting projects under the CDM scheme. Brazil signed the UNFCCC in 1992, and subsequently ratified it in 1994. Brazil signed the Kyoto Protocol in 1998 and ratified it in August 2002. More recently, the necessary national institutional infrastructure began to be put in place and the Brazilian market is getting better prepared for the implementation of CDM projects.

In order to deal with climate change issues, Brazil formed an Interministerial Commission on Climate Change in 1999, with participants from various ministries. The Chairman of the Commission is the Minister of Science and Technology and the Vice-Chairman is the Minister of Environment. Additionally, a Climate Change Forum was created in 2000, presided by the President of Brazil, and will have the participation of various sectors of the economy and civil society. To date, there is no official CDM agency or national authority operating in Brazil. Once the Kyoto Protocol comes in to force, it is expected that the Brazilian Government should have in place internal procedures for processing applications for development of CDM projects. In this context, a series of CDM projects in the energy sector have been developed in anticipation of this new CDM market. Three of these are presented below: an energy efficiency and cogeneration project in the sugar and alcohol industry, a landfill gas collection and utilization project, and a fuel-switch project in the iron and steel industry.

## CDM projects in Brazil

### The Brazilian energy picture

The potential for generation of CERs or emission reduction credits in Brazil is a function of the emissions intensity of the existing energy sources and the emissions intensity of the technology introduced by the GHG mitigation project. This refers to one of the basic requirements for projects to become eligible under the CDM, the development of an emissions baseline scenario. The baseline or business-as-usual case describes what would have happened in the area in the absence of the proposed project. Here different factors such as current sector policies, economic, technological, social conditions and future developments have to be taken into account as the basis to determine and quantify additional emission reductions through the project activity. The local, regional and at least up to the national scale should be taken into account for the baseline determination. It is important, therefore, to understand the emissions intensity of the Brazilian energy matrix, and the expected changes over time.

As of today, hydro electricity accounts for an average of 97% of national electricity production in Brazil. This high proportion in Brazil's electricity generation technology matrix was a consequence of a policy addressed at increasing Brazilian energy independence, as the country had few oil reserves and very poor coal reserves, but rich hydrology resources. In the mid 1980's, Brazil's power sector went through a serious financial crisis, leading to the interruption of construction of many power plants - mostly hydro. In 1993, Brazil initiated the process of decentralisation of its power sector, and according to the Brazilian 10-year national expansion plan 2000/2009 a series of investments in new capacity will be based on fossil fuelled thermal plants. Brazil's $CO_2$ emissions are among the lowest in the world relative to population and GDP. This situation is changing, however, and emissions have been growing in the last few years, with a tendency to accelerate in the future. In Brazil, there is also a tendency for energy demand to increase more rapidly than the economy.

The predominance of hydro in Brazil's electricity generation mix, together with the decentralisation of the power sector and the shift to fossil fuel based plants has important implications for the construction of an emissions baseline. A fundamental prerequisite for an emissions baseline is the determination of emission factors or carbon emission factors (CEFs) associated with the sources of electricity generation. A CEF indicates the amount of $CO_2$ or carbon emitted for each unit of fuel consumed, energy produced, or electricity output. CEFs are thus a measure of the 'carbon intensity' of different activities, and for electricity generation are usually expressed in units of $tCO_2/MWh$ or $tCO_2/GJ$. CEFs can also be expressed in terms of $CO_2$ equivalents, which means that emissions of other GHGs such as $CH_4$ or $N_2O$ are included in the measure of carbon intensity, by calculating the equivalent amount of $CO_2$. The CEF attached to the total grid technology generation mix for Brazil is low: 43.9 $tCO_2/GWh$ in 1996 (OECD, 1999). On the other hand, the weighted average for marginal capacity additions for the South/South-East Brazilian energy grid, where the project examples below are located is around 300 t $CO_2/GWh$.

The emission baselines of grid connected clean energy projects, consequently, must be based on the carbon intensity of the marginal additions to the grid in the future, given that these will be the technologies that these GHG mitigation projects will be competing with. At the same time, Brazil has vast opportunities in relation to off-grid electrification. A large number of municipalities in the Amazon region are not connected to the electricity grid, and are dependent on diesel generation units. In this case,

**EcoSecurities Ltd.** is an established environmental finance company which specializes in advising on strategies regarding global warming issues and in particular on projects aiming at the reduction of greenhouse gas emissions. With offices in five countries, the company, to date, has worked in more than 70 countries, in addition to providing advice to various United Nations agencies, national governments, project developers and major corporations on scientific, policy and commercial issues related to climate change including the development of CDM and JI projects. EcoSecurities also offers strategic advisory services, including the identification of business opportunities resulting from environmental policy shifts, carbon sequestration and emission mitigation quantification, policy analysis, project development services and financial structuring. EcoSecurities has structured and transacted many of the world's first certified emission reduction trades. In 2001 and 2002 EcoSecurities was recognized as the leading greenhouse gas advisory firm by the readers of "Environmental Finance" magazine. *Contact*: EcoSecurities Ltd., The Delawarr House, 45 Raleigh Park Road, Oxford, OX2 9AZ, United Kingdom. Tel: +44 (0)1865 202635, Fax: +44 (0)1865 251438, Email: Robert@ecosecurities.com;

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the baselines for clean energy projects is the use of diesel, and the amount of emission reductions generated per MWh is substantially higher than if compared to the baseline of the national grid.

## Energy efficiency and cogeneration

Cogeneration has been used by the sugar and alcohol industry in Brazil for a long time. In São Paulo State almost all industrial operations in the sector have been self-sufficient in energy terms, due to the huge volumes of sugar cane bagasse generated in the industrial processes. Approximately 30% of raw sugar cane volume is bagasse (i.e. the fibrous residue left after all the sugar cane juice is extracted). Currently in Brazil, this residue is burned in boilers to generate the steam required for manufacturing sugar and alcohol. Historically, disposal of bagasse has created operational problems to the sugar mills. Often, the goal for many sugar cane processing plants was to dispose all the bagasse as efficiently as possible and it was an added benefit if they could simultaneously generate enough steam for their operations. Therefore no investment has traditionally been made to increase the energy efficiency of boilers or steam use.

Cosan S.A. Industria e Comércio is one of the largest sugar and alcohol producers in the world today. Cosan grounds over 10 million tonnes of sugar cane a year, approximately 4.2% of the total sugar cane grinding undertaken in Brazil. Cosan's share in the sugar export market in 1999 was approximately 18%.

The first step of the Cosan – Da Serra Mill project involves efficiency improvements to the sugar production process. This will increase the sugar grinding capacity of the mill, and consequently the bagasse production. The second part of the Cosan – Da Serra Mill Project involves investments in a 15 MW steam-powered electricity generator and a new, more efficient, boiler. With greater volumes of bagasse being created the mill will subsequently be able to generate increased volumes of steam, and therefore electricity. The increased electricity generation capacity means that the Cosan – Da Serra Mill will become a net exporter of electricity to the regional grid. It is worth noting that the Da Serra Mill project is considered a pilot within the Cosan group and could be followed up with the implementation of similar projects in Cosan's other mills. This could result in an additional 300 MW of renewable energy generation.

Based on the projections of carbon emissions for the project it was estimated that the project has the capacity to generate 206,000 tonnes of $CO_2$ credits over a 21-year baseline period. With a current average market price of US$ 3 per $tCO_2$ the CERs generated by this project have a total value of US$ 619 881.

## Landfill gas

According to the National GHG Emissions Inventory conducted in 1994, Brazil has a large number of waste deposition sites, receiving over 60,000 tonnes of waste per day. According to the same study, 84% of Brazil's methane emissions came from the deposition of waste in uncontrolled rubbish dumps.

Currently, 76% of the total waste generated in Brazil is disposed in 'rubbish dumps' ("lixões") with no management, gas collection, or water treatment at all. The remaining 24% of waste is disposed in 'controlled' landfills, and subject to regulation by the environmental authorities. Current Brazilian legislation, though, does not require that landfills collect and dispose landfill gases, and no landfill in operation yet in Brazil has been designed to collect and utilise (or even flare) the full amount of gas generated; although there are some sites under planning, including the NovaGerar landfills (see project example below). In the few cases where gases are collected, this is done for safety reasons (to avoid explosions), and it is often the case that the amounts effectively collected are very low, due to high levels of leachate (which is often not drained or treated, as well) blocking the drainage pipes. For the reasons above it is estimated that less than 10% of the landfill gas generated from landfill sites in Brazil is actually collected and flared, resulting in large volumes of GHG emanated to the atmosphere.

NovaGerar is a joint venture between EcoSecurities and S.A. Paulista, a Brazilian civil engineering and construction firm based in the city of São Paulo, Brazil. In 2001, S.A. Paulista was granted a 20-year concessional licence by the Municipal Waste Collection Company, to manage a couple of landfills in the state of Rio de Janeiro, and to explore the landfill gas potential of these sites.

The objective of the NovaGerar joint venture is to explore the landfill gas collection and utilization activities of the landfills managed by SA Paulista. This will involve investing in a gas collection system, leachate drainage system and a modular electricity generation plant at each landfill site (with final total capacity of 12 MW). The generators will burn the methane in the landfill gas to produce electricity for export to the grid and reduce emissions of 14.63 million tonnes of $CO_2$ over the next 21 years. This is based on the projections of carbon emissions for the project scenario and its baseline through the technical analyses conducted. In addition, the project will lead to emission reductions attributable to the displacement of grid electricity. The NovaGerar landfill project will create emission reductions of 14.63 Mio $tCO_2$ over a crediting period of 21 years worth US$ 43.89 Mio at current market price. The project has already signed a letter of intention with the Netherlands Clean Development Facility which is administered by the Prototype Carbon Fund of the World Bank for the sale of 5 Mio $tCO_2$.

## Fuel-switch

The Brazilian steel sector is the only one globally that uses charcoal as a reducing agent, as opposed to coal. Given that charcoal is a renewable fuel source, the charcoal-based steel can therefore be considered 'carbon neutral'. During the last 10 years,

*A landfill site in Brazil. CDM projects may lead to generation of electricity from methane on sites like these preventing significant GHG emissions.*

however, economic trends related to both the industrial operations and the forestry sector in Brazil are leading to increased utilization of imported coal, as opposed to locally produced charcoal. This, in turn, is resulting in increases in GHG emissions. The charcoal-based steel and iron industry in Brazil has developed in parallel with the plantation forestry sector, its main source of raw fuel material. In order to support the development of these sectors, the Brazilian Government ran a fiscal incentive program from 1967 until 1989, to encourage investment in afforestation for use in the pulp, paper and charcoal-based pig-iron and steel industries. By 1990, over 6 million hectares of forest plantations had been established in Brazil under this program. At the same time, the country grew to become the world's 8th largest producer of steel.

Following the end of the fiscal incentives, a significant reduction in the Brazilian plantation forest base was observed in a few years. In addition, the utilization of imported coal became more cost effective than the use of locally produced charcoal for the steel and iron industry, as a consequence of Brazilian macroeconomic trends. The combination of these factors has led a series of steel manufacturers to move away from charcoal back to coal, leading to a substantial increase in GHG emissions. The current trend of substitution to coal will persist unless incentives are put in place to support the production of charcoal for industrial uses.

Vallourec & Mannesmann Tubes – V & M do Brasil (V&M Tubes) is a joint venture between the German company Mannesmannröhren-Werke (45%) and the French Vallourec (55%). V&M Tubes is the only steel pipe manufacturer in the world to use 100% renewable energy for the production of pig iron and steel. Its forestry division, V&M Florestal, is responsible for the production of all charcoal required by its mills, from its 120,000 hectares of plantation forests (certified as sustainably-managed according to the standards of the Forest Stewardship Council). The project consists of investments to ensure the use of sustainably produced charcoal for steel manufacture in Brazil, avoiding the use of coal. It is estimated that this will result in the reduction of 21.86 million tonnes of $CO_2$ emissions during the next 21 years. The CERs of this project have a market value of US$ 65.58 Mio over a 21 years crediting period at current market price. 5 Mio tonnes $CO_2$ reductions will already be acquired by the IFC-Netherlands Carbon Facility (INCaF) and a private investor.

## Conclusions

All of the projects described above illustrate the use of a new financial mechanism for funding of the renewable energy sector, i.e. the Clean Development Mechanism. These projects would not take place without the additional value provided by the generation of CERs. Consequently, they generate additional emission reductions to what would not happen otherwise. The financial returns derived from the sale of carbon credits therefore, is sufficient to enhance the attractiveness of these new, more environmentally clean technologies or approaches.

As the international policy framework becomes better defined, the international market for carbon or GHG emission reductions is growing at a fast pace. It is expected that in a few years all the rules, regulations, infrastructure and associated services will be in place so that a fully-fledged, liquid market can operate. The size of the primary market (i.e., that based on the origination of carbon credits) is expected to reach some U$ 20 billion a year.

Estimates for the secondary market (i.e., re-selling of credits) are orders of magnitude higher. Carbon credits can contribute around 5-10% of the capital costs of most clean energy projects, in some cases even higher. It can be expected, then, that the total investment leveraged by the sales of carbon credits should be much larger than the estimated size of the primary market for credits.

Brazil's $CO_2$ emissions are among the lowest in the world relative to the population and GDP. In a way, this has reduced the attractiveness of environmental technologies for electricity generation, since the existing energy matrix was already very clean. This situation is changing, however and emissions have been growing in the last years, with a tendency to accelerate in the future. In Brazil, there is also a tendency for energy demand to increase more rapidly than the economy. In this context, it can be inferred that there are large opportunities for carbon finance to leverage a faster deployment of clean energy technologies in Brazil.