Carbon trading and investment in clean energy projects

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Summary

Concern about rising atmospheric concentrations of greenhouse gases has prompted the search for methods for reducing greenhouse gas emissions in cost effective ways. In this context, the deployment of clean energy technologies in order to displace the use of fossil fuel energy sources has great potential. This paper provides an overview of the evolution of the market for greenhouse gas emission reductions and clean energy projects.

1) Introduction

During the last ten years, carbon offsets have evolved from a theoretical idea towards being a market-based instrument for accomplishing the global environmental objectives of the United Nations Framework Convention on Climate Change (UNFCCC), signed in Rio in 1992 during the United Nations Conference on Environment and Development (UNCED). While we are still a long way from an organised market, the initial voluntary schemes and bartering transactions common in the early 90s have already given way to more sophisticated market mechanisms. According to a study of the MIT/World Bank (Ellermann *et al.*, 1998), if the emission reduction targets of the Kyoto Protocol were accomplished through an un-constrained international emissions trading market, this would generate a demand for GHG Emission Reduction Units (ERUs) in the order of US$ 20 billion a year. A sizeable proportion of this investment could flow to developing countries through the Clean Development Mechanism (CDM), one of the various carbon trading modalities introduced to meet the objectives of the Climate Convention.

One of the most favoured strategies for generating emission reduction credits for the purposes of the CDM is through the deployment of clean energy technologies in order to avoid the use of fossil fuels. Renewable energies (solar, wind, biomass, small hydro, etc.) and energy efficiency projects are all promising activities that could contribute to the reductions of greenhouse gas (GHG) emissions financed through the sale of carbon credits.

This paper describes the policy background of the Climate Convention and carbon trading, the main buyers and transactions that took place in the carbon market to date, the financial impacts of carbon trading on individual clean energy projects, and the impact of the nascent carbon market in the Brazilian clean energy sector.

A host of technical and non-technical terms have been used to describe carbon offsets including carbon credits, Emission Reduction Units (ERUs), and Certified Emission Reductions (CERs). Box 1 explains the technical differences between these terms. For the purposes of this report, carbon offsets, carbon credits, emission reduction credits and carbon offset projects are used as generic terms covering all the different technical formulations (including the outputs of those projects not explicitly related to international climate change policy).

2) Policy background

The UNFCCC and the concept of JI

In July 1992, representatives from 155 nations gathered in Rio de Janeiro for the United Nations Conference on Environment and Development (UNCED). Recognition that climate change was a reality led to the signature of the United Nations Framework Convention on Climate Change (UNFCCC), which resulted in a voluntary commitment by Annex 1 countries (industrialised countries) to reduce their emissions to the levels of 1990 until the year 2000 (see Grubb et al. 1993). Imbedded in the agreement was the concept of Joint Implementation (JI) of activities to reduce GHG emissions or promote the absorption of atmospheric CO_2. Investors engaged in these projects would be allowed to claim credits for the carbon emission-reduction (or carbon sequestration) activities financed. These credits should be equivalent to the carbon reduction or sequestration derived from the specific investment, and investors should be allowed to use them to lower GHG-related liabilities (e.g. carbon taxes, emission caps, etc.) in their respective home countries. The rationale of JI is that the marginal costs of emission reduction or CO_2 sequestration are generally lower in developing than developed countries.

The Activities Implemented Jointly Pilot Phase

Dissatisfaction between G77 countries over the concept of JI led to a growth in opposition to the JI model. Perceived problems included a feeling that this was a mechanism for industrialised countries to avoid addressing the real issues of reducing emissions at source. It was also felt that developing countries might be handing over all their cheap offset opportunities to industrialised countries during this initial phase, in which developing countries had no commitments to GHG emission reductions.

In the first Conference of the Parties (CoP 1) to the UNFCCC held in 1994, this dissatisfaction was voiced as a formal refusal of JI. Instead, a compromise was accepted in the form of a pilot phase during which projects were called Activities Implemented Jointly (AIJ). During the AIJ Pilot Phase, JI projects were conducted with the objective of establishing protocols and experiences, but without allowing the actual transfer of carbon credits between developed and developing countries (see Stuart and Moura-Costa 1998, for further discussion).

The Kyoto Protocol

In December 1997, 170 countries drafted the Kyoto Protocol during the CoP 3 of the UNFCCC. The most important aspect of the Kyoto Protocol is the adoption of binding commitments by 37 developed countries and economies in transition (collectively called the Annex 1 countries) to reduce their GHG emissions in an average of 5.2% below the year 1990 until the years 2008-2012 (Kyoto Protocol, 1997; web site http://www.unced.de). The commitments are differentiated by countries, with some required to reduce up to 8%, while others can even increase their emissions (see Table 1). At the same time, the Protocol approves the use of 3 "flexibility mechanisms" for facilitating the achievement of these GHG emission reduction targets. These are:

1) Emissions Trading, allowing the international transfer of national allotments of emission rights, between Annex 1 countries;

2) Joint Implementation, the creation of emissions reduction credits undertaken through transnational investment between industrial countries and/or companies of the Annex 1 (note that according to the new terminology, JI only includes participation of Annex 1 countries, which are OECD and the former Soviet bloc); and,

3) The Clean Development Mechanism (CDM), a new mechanism resembling JI, which allows for the creation of Certified Emission Reduction (CER) credits in developing countries, regulated by a newly formed central authority.

The Kyoto Protocol appears to be a real truly international step in the GHG emissions mitigation arena. Overall, what emerged was what business oriented climate activists have always hoped for; a compromise between substantial emissions reduction targets and a fluid market mechanism under which to achieve those emissions reduction requirements. The protocol opened for signature on March 16, 1998 and will become legally binding ninety days after the fifty-fifth government ratifies it, assuming that those 55 countries account for at least 55 per cent of the emissions of the developed countries in 1990.

Table 1: Emission reduction targets set by the Kyoto Protocol.

Country	**Agreed greenhouse gas reductions (% of 1990 level emissions)**
Australia	+8
Bulgaria	- 8
Canada	- 6
Croatia	- 5
Czech Republic	- 8
Estonia	- 8
European Community	- 8
Hungary	- 6
Iceland	+10
Japan	- 6
Latvia	- 8
Lithuania	- 8
Monaco	- 8
New Zealand	0
Norway	+1
Poland	- 6
Romania	- 8
Russian Federation	0
Slovakia	- 8
Slovenia	- 8
Switzerland	- 8
Ukraine	0
United States of America	- 7

Notes: 1) The EU target of -8% on 1990 emissions of greenhouse gases has been disaggregated into country targets; 2) The US has withdrawn from the Kyoto Protocol. The table shows the US's reduction target because the possibility exists that the US may rejoin the agreement in the future. Meanwhile, the US has committed itself to following an internal greenhouse gas reduction strategy.

Post-Kyoto negotiations

Disagreement over the extent of the use of flexibility instruments (as opposed to the use of domestic measures to reduce emissions), and the use of forestry activities (sinks) as an offset, have increasingly created a climate of discord, predominantly between the EU bloc and the Umbrella Group (US, Japan, Canada, Australia, New Zealand, and Iceland). While the former was strongly in favour of *'supplementarity'* (the requirement that approximately 50% of a country's targets are met through domestic action), and the exclusion of sinks in the CDM, the Umbrella Group supported the unrestricted use of flexibility instruments and the inclusion of sinks, as originally proposed in the Kyoto Protocol. After a series of negotiation rounds, this has eventually led to an impasse during CoP 6 (in November 2000), which was suspended until July 2001.

In March 2001, the newly elected American president Bush announced that his administration had reviewed the text of the Protocol and has decided that in its current form it did not meet the interests of the USA. This decision was heavily criticised throughout the world, particularly because of its unilateral form. Given that the US is responsible for about 36% of the emissions of Annex 1 countries, their non participation in the Kyoto process may considerably jeopardise the objectives of the Climate Convention.

It is uncertain what impact the US decision will have on the climate change process as a whole. One possibility is that there may be some renegotiation of the protocol, trying to accommodate some of the US requests with a view of having them re-joining the process. Given that the current terms of the protocol accommodates most of the points demanded by the US at CoP 6, it is not unlikely to see the US re-joining the negotiation process. Another possibility is that a parallel climate change initiative is promoted by the US, both domestically and internationally (with a likely focus on Latin America). Indeed, even in spite of Bush's announcement, a series of initiatives have been developed in the US for carbon trading., including the carbon purchase tenders backed by the states of Massachusetts, Oregon, Washington State, and the newly formed Chicago Climate Exchange voluntary market.

In June 2001, CoP 6 Part II took place, and a new negotiation text was drafted. With relation to the use of flexibility mechanisms it states that these were to be considered supplemental to domestic action, but there is no required supplementarity targets (i.e. no specific percentage). In CoP 7, November 2001, The CDM Executive Board was formed and work began with a view to beginning the implementation of the Clean Development Mechanism in 2002.

3) Market evolution

Investment in emission reduction projects began in the early 1990s, following the signing of the Climate Convention (UNFCCC) at the Rio Summit in 1992 (see Section 2). The first investors in this type of activities were American or Dutch electricity companies, in anticipation of expected policy changes penalising the high level of emissions of their coke-fueled plants. One of the first initiatives to be established was that of the Dutch Electricity Board (SEP), a consortium of five electricity companies in the Netherlands, through the creation of the Face (Forests Absorbing Carbon-dioxide Emissions) Foundation in the early 90's (Dijk et al. 1994). The mandate of the Face Foundation was to promote the planting of enough forests to absorb an amount of CO2 equivalent to the emissions of a medium-sized coal-fired power plant (400 MW) during its 40-year life time (Stibbe et al. 1994, Face 1994, Verweij 1997). In this way, SEP would be able to build a new power plant in the Netherlands, with no net emissions to the global atmosphere. A multi-year budget of US$ 180 million was allocated to Face, for the establishment of a portfolio of forestry projects in different parts of the world. The initial investment was a tropical rainforest rehabilitation programme in Sabah, Malaysia (Moura-Costa et al. 1996), followed by four more projects around the world (Verweij 1997): reforestation of degraded pasture land by small farmers in Ecuador (1992), rehabilitation of an acid-rain degraded park in the Czech Republic (1992), urban forestry in the Netherlands (1993), and rainforest rehabilitation in Uganda (1994).

A series of similar projects were funded by American utilities, such as the Innoprise-New England Power Reduced Impact Logging (RIL) project in Sabah, Malaysia (Putz and Pinard 1994; Moura-Costa and Tay 1996); the CARFIX project in Costa Rica (a precursor of the PFP project), established by Fundecor (a Costa Rican NGO, developed partially with USAID funding and supported by a group of Norwegian financiers); and the Rio Bravo Conservation and Management Area Carbon Sequestration Pilot Project, which combines land acquisition with a sustainable forestry programme to achieve carbon mitigation, financed by various US electric utilities. In parallel, a series of clean energy projects were also being developed, predominantly based in Eastern Europe (see Appendix for a list).

The model of these transactions consisted of investor companies paying upfront for the full costs of the carbon saving activities, in return for the promise of carbon credits generated as a result of these activities. In a way, it resembled equity investments, in which the investor took project risk, as opposed to demanding a pre-determined amount of carbon credits. In the post-Rio model, investing companies determined the direct costs of the carbon beneficial components of the project implementation, and directly claimed the resultant emission savings. The amount paid for carbon, therefore, almost invariably corresponded to marginal costs, accounted for through an open book approach that was requested for the competitive bidding process of project selection.

Investment was far from passive – indeed, it required a buyers fairly full engagement to a project, from beginning to end. Consequently, there was virtually no liquidity associated with these investments or their resulting “carbon credits”; each was uniquely valuable to its own investor, and such values were virtually non-transferrable to other parties. Projects that were designed and formulated by consultants, academics and NGOs, who did all the ground work of identifying partners, infrastructure and training needs, and negotiation with host country authorities, as well as quantification and monitoring of carbon savings. Little indigenous capacity for undertaking these types of proposals emerged. Development costs, consequently, were comparatively high, though often supported by a variety of agencies like international aid groups, multilateral organisations, foundations and the like.

The difficulty from the buying side was that there continued to be a great deal of uncertainty regarding carbon credit transfer arrangements. Given that CO_2 emissions were not yet penalised, companies wanted to be sure that their investments would be recognised under future regulatory regimes. While interim regulatory institutions were being established, they were not given the ability to accept or reject emissions credit aspects of projects, rather they could accept or reject them for inclusion in a national registry system. The first institution given a mandate to input such projects was the US Energy Information Administration, under Section 1605-b of the 1993 Energy Policy Act, and in late 1994 was followed by the United States Initiative on Joint Implementation (USIJI), a highly structured system of US government project evaluation for international projects (USIJI 1994).

While much progress was seen during the years following the Rio Summit, the launching of the AIJ Pilot Phase (see Section 2, above), has substantially dulled the appetite for investment among private sector parties. The direct statement from Berlin -- that current JI projects were not eligible for future crediting -- meant that these were unrecoverable costs. Because of this lack of real incentives for the private sector (which most observers believe have eventually driven the trading system), the results of the AIJ pilot phase were generally considered poorly representative of the full potential of JI. In this new environment, where companies were faced with even more uncertainty about the potential value of projects for their respective balance sheets, a great reduction in the level of investment in JI/AIJ-type projects was observed.

While few investments took place during this phase, the supply of "potential projects" continued to increase, as more parties perceived this to be a new source of capital for sustainable environment/development projects. In this context, calls for proposals were organised by various organisations including the World Business Council for Sustainable Development and the USIJI, which gathered dozens of project proposals to be considered for investment in the future. Potential investors included the Edison Electric Institute, and the E-7, a global association of mega-sized electric utilities. More JI/AIJ bodies were formed in many countries, including Canada, Netherlands, France, Germany, Switzerland, Norway, Australia and Japan. Several developing countries, including Costa Rica, Guatemala and Sri Lanka, developed domestic AIJ offices to regulate projects from the perspective of the host country.

Although few transactions occurred, there was a growing feeling that some form of JI with crediting would inevitably arise, if developed countries were to commit themselves firmly to real targets. This led to a great increase in the level of interest in the subject, which was manifested world-wide in many forms, capturing the imagination of many economists, policy analysts and scientists. Multiple journals and Internet sites devoted to nothing but joint implementation topics. Innumerable papers, monographs and books began being written on the subject during this period. A variety of consulting "experts" now worked with different clients, developing projects, products, positions, strategies and services. Various business enterprises got organised to look for investment opportunities and formulate lobby strategies.

In the year preceding the Third Conference of Parties of the Climate Convention (CoP 3), to take place in Kyoto, December of 1997, there was great anticipation that some changes were imminent. Discussions during CoP 2, in Geneva in 1996, determined that binding commitments were going to be a central point in CoP 3. The consequences of these commitments were unknown but could be manifested in the form of carbon taxes, quotas, caps, etc., all of which would entail hard costs to industrialised economies.

In this phase of uncertainty, interesting moves have been observed in many sectors previously not involved in this field. Among electricity companies, there has been seen a preference for less carbon intensive energy sources, such as gas. Manne and Richels (1994) estimated that this business was already imputing a value of US$17 per tonne of carbon. Several oil companies started to invest in a diversification of their energy matrix, pushing the flow of capital to the renewable energy industry. This can be illustrated by the rising of the solar energy sector and by specific investments such as British Petroleum's (BP) commitment to 1 billion dollars to the solar industry. Shell created its Shell Renewable International division, in the fifth core component of the organisation, with an initial investment budget of US$500 million for forestry, solar and biomass projects. Large car manufacturers, such as Toyota and Mercedes Benz, demonstrated numerous car models with lower GHG emissions, including fuel cell prototypes (Greenhouse Issues 1998). The International Automobile Association, the organisation responsible for Formula 1 competitions, decided to offset the GHG emissions of their events (Tipper 1997, Greenhouse Issues 1997a and b). The insurance and re-insurance sectors took climate change into consideration, and formed a group under the auspices of the UNEP. It became obvious that third-party certification was instrumental in the validation and credibility of these new transactions. The first international certification agency to offer a service of independent verification of carbon offset projects was developed by the UK-based GHG-advisory firm EcoSecurities and offered by the Swiss company Société Générale de Surveillance (Moura Costa et al. 1997, Moura Costa et al. 2000), and other auditing firms have subsequently began to offer similar services.

From 1992 until 1997, when the Kyoto Protocol was agreed, at least some 150 clean energy projects were initiated under the Activities Implemented Jointly Pilot Phase (see a list of projects in the Appendix). An estimated US$ 1.5 billion dollars were committed by companies in Annex 1 countries to the development of these projects, which were implemented in a wide range of developing countries. By definition, these projects were developed with the primary objective of "gathering experience", and were not allowed to claim emission reduction credits (Moura-Costa and Stuart, 1998). Given the nature of this pilot phase, there was a requirement of transparency and reporting of information on costs and prices of emission reduction transactions, as illustrated in the Appendix.

Since the launch of the Kyoto Protocol, the form of these transactions have changed, with a view to the ensuring the transfer of carbon credits to assist in the process of meeting the binding commitments set by the Protocol. This, in turn, has led to a more confidential nature of transactions, making it more difficult to determine market size and trading parameters.

In order to facilitate the market development, a series of carbon trading initiatives have been pursued, such as the International Emissions Trading Association, alongside the Emissions Market Association; the Chicago Climate Exchange, and country-level emission trading systems such as in the UK and Denmark. Electronic emissions trading platforms have been created (e.g. CO2e.com), and specialised carbon brokers became more active. A whole range of service providers have also entered this market, such as insurance companies, financial institutions, legal firms, etc., tailoring their services to the needs of the carbon market.

In this context, it is estimated that more than 60 private trades have taken place in the last few years, almost all involving forward trading contracts (i.e., pay on delivery of carbon credits). Most of these investor companies are from carbon intensive sectors such as oil and gas, coal-based electricity generation or transportation. Although there are few sectoral emissions reduction targets in place yet, these private sector trades suggest that businesses anticipate that these will come. Reasons for trading carbon include gaining a first mover advantage, the value of positive public relations and 'learning by doing'. BP and Shell are well known examples of companies that have established internal carbon trading systems and are already participating in the carbon trading market in different ways.

In parallel to individual bilateral trades, a series of carbon funds or tendering processes began to be developed. The most significant of these are The World Bank Prototype Carbon Fund (PCF) and the initiatives set up by the Dutch Government. The PCF was set up in 1999 with a fund value of US$150 million (World Bank, 1997; JIQ, 1997). Investors are a mix of government and the private sector, involved in the electricity, energy, oil, financial and manufacturing sectors. On average, the PCF has adopted a price of US$3 per tonne of CO2. A maximum of 25 per cent of the funds value may be committed to one technology type, and there are also geographical limits to ensure adequate portfolio diversification. The PCF has already committed to a fuel switching project in Brasil, and is currently negotiating a second investment, this time in the clean energy sector.

The Dutch government has recently committed to invest about U$ 600 million through a series of GHG mitigation programs and initiatives. Among these is the Dutch carbon purchasing programme (EruPT- Emissions Reductions Unit Procurement Tender). A total of €36 million was spent on the last tender, which focused on Central and Eastern Europe (see Box 2 for a case study). An average price of around €8 per tonne of CO_2 was paid. Two additional carbon purchasing schemes, under Eru-PT, have opened late in 2001. These will focus on:

- clean energy projects in developing countries (under the Clean Development Mechanism) - this includes a tender for mini energy projects, up to 15 MW, for on-grid and off-grid wind, solar, mini-hydro and geothermal energy, and a tender for larger-scale projects;
- clean energy projects in Annex 1 countries.

The Dutch government will also invest part of its resources with the assistance of the International Finance Corporation (IFC) and a specially-tailored version of The World Bank Prototype Carbon Fund (PCF).

Estimates of the total market for CDM, excluding participation from the USA, can reach around US$ 10 billion up until 2010. Should the USA pursue a trading mechanism similar to CDM, the market size is likely to double. While the price of carbon today ranges between U$ 1 to US$ 3/t CO_2, the PCF estimates that the price could rise to US$ 8/tCO2, without US involvement.

Apart from investors primarily interested in carbon credits, a series of funds specialized in clean energy technologies began to be formed (see Table 2). These are largely equity funds which invest in companies producing or using commercially available clean technologies, and in some cases specific projects. While this is not their primary objective, increasingly these funds are looking at carbon value when considering their choice of investment.

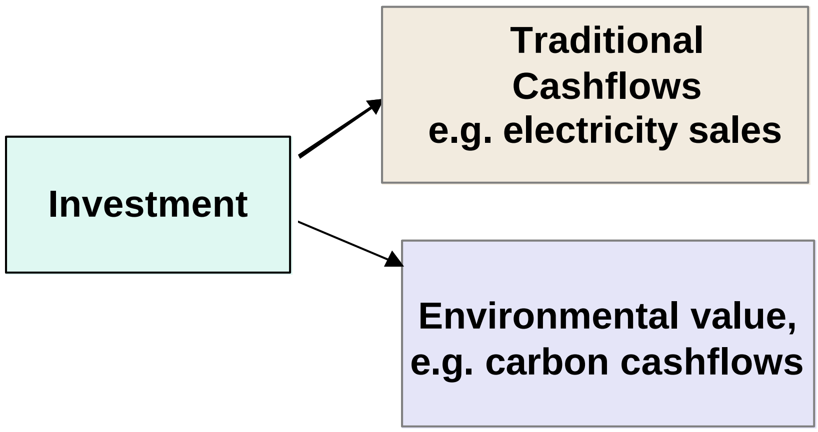
Table 2. Investment funds specialized in clean energy technologies and projects.

Fund initiator	Region	Technology type	Expected size
A2R Clean Technology Fund	Latin America	Renewable energy & energy efficiency.	US$35 million
Dexia-Fondelec and Emissions Reduction Fund	Eastern Europe	Renewable energy & Energy efficiency	€150 million
DB Capital Clean Energy Fund	Global	Renewable energy & Clean energy retrofitting	US$100 million
Fondelec	Brazil, Mexico	Energy efficiency & renewable energy	US$50 - 60 million
ASN milieufonds	Global	Environmental technology	US$5.7 million
Credit Suisse Prime New Energy Fund	N. America & Europe	Renewables and alternative energy	US$71 million
Merrill Lynch New Energy Technology Fund	Global	Renewable energy & energy technology companies	£200 million
Bank Sarasin (Swiss) New Energies Invest	Global	Commercial renewable energy	US$133 million
Sustainability Asset Management (SAM) Private Equity Energy Fund	N. America & Europe	Expansion-phase firms involved in energy generation and conversion, energy management systems, energy storage and power quality.	€65 million
CVC REEF Renewable Energy Equity Fund	Australia	Commercial and Renewable Energy Technologies	A$30 million

Source: UNEP Finance Initiatives: Inventory of sustainable energy funds, 2001; Environmental Finance Magazine, January 2000 - October 2001.

4) Carbon trading and profitability of clean energy investments

As and when a liquid emission reduction market begins to operate, certain investment opportunities will gain a premium value, because of their capacity to supply this new economic outputs in addition to their existing cashflows. One sector poised to make general gains is renewable energy, with similar situations in energy efficiency, sustainable forestry and material transformation industries, to name a few. For any given investment, there are now two possible revenue streams. Put graphically, consider the outputs of a commercial-sized renewable energy project investment (this model is equally valid for cogeneration, energy efficiency contracting, sustainable forestry, etc.).



The market value of a conventional project financing reflects future cash flows from the upper box exclusively. If the emission reduction impacts of these projects are monetized through carbon trading, the overall economic utility of these GHG-friendly investments will increase (for further discussion, see Stuart and Cook, 2001). Table 3 shows the increase in profitability of the additional revenue stream derived from emission reductions sales on clean energy projects.

Table 3. Impact of carbon sales on Internal Rate of Return (IRR) of clean energy projects.

Country	Project Type	% IRR without ERs	% IRR +ERs	IRR Increase (% points)	% IRR Increase
Romania	District heating	10.5	11.4	0.9	9
Costa Rica	Wind	9.7	10.6	0.9	9
Jamaica	Wind	17.0	18.0	1.0	6
Morocco	Wind	12.7	14.0	1.3	10
Chile	Hydro	9.2	10.4	1.2	13
Costa Rica	Hydro	7.1	9.7	2.6	37
Guyana	Bagasse	7.2	7.7	0.5	7
Nicaragua	Bagasse	14.6	18.2	3.6	25
Brazil	Biomass	8.3	13.5	5.2	63
Latvia	Methane	11.4	18.8	7.4	65
India	Methane	13.8	18.7	4.9	36

Source: The World Bank.

It is important to recognise that the amount of carbon credits generated by a given technology can be higher or lower depending on the location of the project. This is because the amount of credits generated by a project is defined as the difference between the emissions of the project and the emissions that would take place otherwise, i.e., its baseline. Consequently, the higher the carbon intensity of the baseline (e.g., an energy matrix comprised of coal and oil), the higher the amount of emission reductions generated by the introduction of a cleaner energy source. Table 4 illustrates these differentials and the typical levels of carbon revenue streams of a sample of clean energy projects that EcoSecurities developed in different parts of the world.

Table 4. Value of carbon sales for different projects in different parts of the world.

Technology	Cumulative t CO2/MW/year	Carbon sales (US$)	% of capital costs
Biomass	26,000	78,000	7.8
Wind	8000 - 32,000	24,000 - 96,000	2.4 - 9.6
Hydro	11,000	33,000	3.3
Geothermal	24,000	72,000	7.2
Co-generation	15,000	45,000	4.5
Waste	250,000	750,000	75

Source: EcoSecurities Ltd. Note: The table assumes a cost of $1 million per MW capacity installed. The range of emission reductions for wind technology reflects the range of different projects that EcoSecurities has worked on. Carbon price = US$ 3/tCO2.

5) Requirements for participation in the CDM

Not all projects that result in the reduction of GHG emission qualify for participation in the Clean Development Mechanism. For projects to qualify as valid mitigation activities in the context of the Kyoto Protocol, they have to fulfil a series of eligibility criteria. While these may still change, the most likely set of eligibility criteria based on current negotiation text are described below:

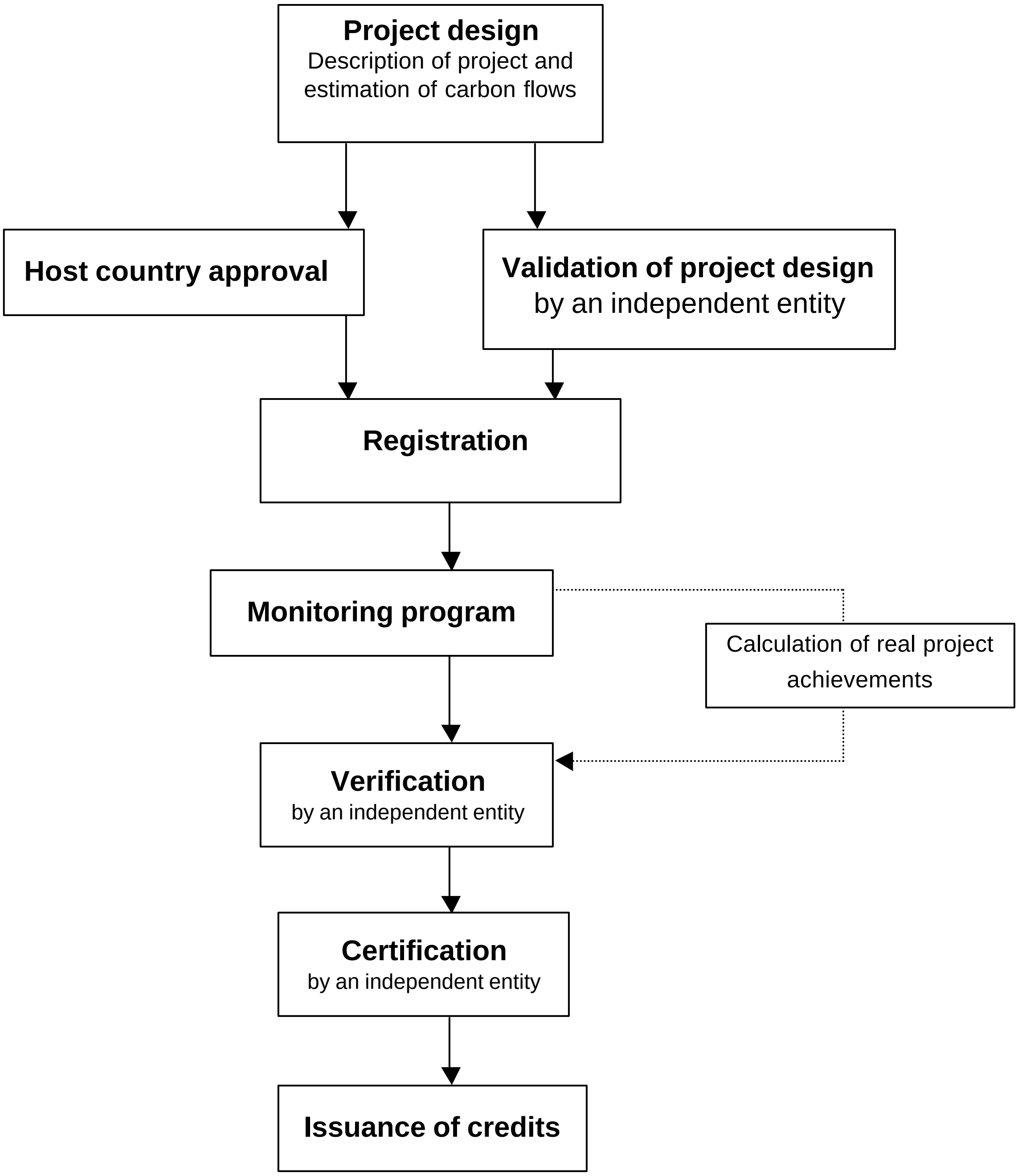
- Host country approval - a GHG mitigation project has to be acceptable and approved by the host country government under its respective sustainable development criteria (social, economic, environmental) and other developmental criteria.

- Contribution to sustainable development - under the CDM there is a specific objective to assist developing countries in achieving sustainable development. While international initiatives are trying to develop common guidelines, no outputs have been produced to date. Currently, country-level definitions are used for the analysis of eligibility of CDM projects in a given country.

- Emissions additionality - carbon credits are based on the difference in GHG emissions (or CO_2 sequestration) between projected or business-as-usual practices (known as the baseline or reference scenario) and practices occurring due to project activities (known as the project scenario). This behavioural difference in GHG emissions or CO_2 sequestration is called '*emission additionality*'. Emissions additionality is a requirement of both JI and CDM projects, as set out in Article 6(1b) and Article 12(5c) of the Kyoto Protocol respectively. It is designed to ensure that carbon credit projects result in real reductions in the current rate of GHG accumulation in the atmosphere. Not all projects that might appear to have positive GHG effects are additional. For carbon credits to be acceptable under the terms of the Kyoto Protocol, no project can claim GHG emission reductions unless project proponents can reasonably demonstrate that the project's practices are 'additional' to the 'business-as-usual' or *baseline scenario*. The baseline scenario is broadly described as the collective set of economic, financial, regulatory and political circumstances within which a particular project is implemented and will operate. The validity of any particular project rests upon the case made that environmental performance -- in terms of achieving GHG reductions -- exceeds historical precedents, legal requirements, likely future developments, or a combination of all three. Establishing the baseline scenario thus requires knowledge of long term trends in energy markets, the local socio-economic context, macro-economic trends that may affect the conventional outputs of a project, and other relevant policy parameters. However, in setting the baseline, these past trends and current situations must be projected into the future. Consequently, baseline scenarios are necessarily counterfactual, based on a range of assumptions. As a result, baseline setting is still a highly uncertain area.

?? Financial additionality - The financing of the GHG mitigation project should not be as a result of diversion of resources from any international development funding.

In addition to fulfilling the eligibility criteria described above, because of regulatory requirements, the development of a CDM project necessarily has to follow a certain order. The description of a typical CDM project cycle, according to the latest proposals submitted by the Parties, is given below. Because of the multiple steps involved, the effectives of dealing with each step will affect the transaction costs required for development of the project.


Project design
Description of project and estimation of carbon flows
Host country approval
Validation of project design by an independent entity
Registration
Monitoring program
Calculation of real project achievements
Verification by an independent entity
Certification by an independent entity
Issuance of credits

6) Carbon trading and Brasil

Policy framework

As a non-Annex 1 country, Brazil has no specific and legally binding stabilisation or reduction targets for greenhouse gas emissions. Brazil signed the UN Framework Convention on Climate Change on 4th June 1992, and subsequently ratified it on 28th February 1994. Brazil signed the Kyoto Protocol on 29th April 1998 but to date, and its ratification was approved by the Brazilian Senate in June 2002.

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 operating in Brazil.

Some perceived uncertainty surrounds the position of the Brazilian Government in relation to the CDM. Brazil's position has been of a “wait and see” approach, but has generally been positive on energy and technology projects. However, the lack of definition associated with the absence of a clear focal point or a dedicated CDM office or agency has led to a perception of uncertainty from an investor's point of view. Given the uncertainty concerning the operationalisation of the CDM in Brazil, few projects have been developed in the country to date. This situation is likely to change rapidly once the Kyoto Protocol comes in force, when the Brazilian Government should have in place internal procedures for processing applications for development of CDM projects.

Opportunities for the energy sector in Brasil

The potential for generation of emission reduction credits in Brasil is a function of the carbon intensity of the existing energy sources and the carbon intensity of the technology introduced by the GHG mitigation project. It is important, therefore, to understand the carbon intensity of the Brazilian energy matrix, and the expected changes over time.

As of today, hydro electricity accounts for an average of 97 per cent 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 it is expected that a series of the investments in new capacity will be based on fossil fuelled thermal plants. Table 5 highlights the relative importance of fossil fuel technologies to future capacity additions, according to the Brazilian 10-year expansion plan (2000/2009).

Table 5. Expected rate of fossil fuel penetration into the Brazilian electricity generation sector.

	2000	2001	2002	2003	2004	2005
Fossil fuel capacity additions as a % of total additions	28.00	3.00	53	79	86	0
Total MW addition	3,284	1,874	10,471	5,267	5,267	600
Average % fossil fuel addition as % of total additions	49.8					

Source: Eletrobras 2000: Ten-Year Expansion Plan 2000/2009.

The predominance of hydro in Brazil's electricity generation mix, together with the decentralisation of the power sector has important implications for the construction of an emissions baseline. The Carbon Emissions Factor (CEF) attached to the total grid technology generation mix is low: 43.9 tonnes CO_2/GWh in 1996 (OECD, 1999). On the other hand, the weighted average for marginal capacity additions, based on National Expansion Plan data, is around 300 tonnes of CO2/GWh, increasing the carbon intensity of the baseline.

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. Indeed, this baseline approach is one of the options authorised by the Climate Convention's official text (Paragraph 48b, Decision 17/CP.7 of the Marrakech Accords).

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, 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.

Another sector with huge potential for emission reductions is that of steel and iron industries. This is further explored in Box 3.

7) Conclusions

The international market for carbon emission reductions is growing at a fast pace. It is expected that in a few years all the rules, regulations, infrastructure and associated service 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 are orders of magnitude higher. As seen in the paper, carbon credits can contribute around 5-10% of the capital costs of clean energy projects. 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. 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.

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Box 1: A Glossary of Terms related to Carbon Credits:

Since the early 1990's, a variety of terms have been used to refer to different project-level climate change mitigation mechanisms and their outputs. The meanings of these terms have changed gradually. Below are some of the definitions that have been used. Most bear some relation to stipulations of the UN Framework Convention on Climate Change (UNFCCC) signed in 1992, whose provisions are fleshed out by the Kyoto Protocol, signed in December 1997.

MECHANISMS (1) --- EARLY PRE-KYOTO DEFINITIONS

Joint Implementation (JI)

The concept of joint implementation (JI) was introduced by Norway into pre-UNCED negotiations in 1991. This was reflected in Article 4.2(a) of the UNFCCC which gives Annex I countries (see below) the option of contributing to the Convention's objectives by implementing policies and measures jointly with other countries. The investing participants in these projects could presumably claim emission reduction 'credits' for the activities financed, and these credits could then be used to lower greenhouse gas (GHG) related liabilities (e.g., carbon taxes, emission caps) in their home countries.

Activities Implemented Jointly (AIJ)

In the first Conference of the Parties (CoP 1) to the UNFCCC held in 1995 in Berlin, developing country dissatisfaction with the JI model was voiced as a formal refusal of JI with crediting against objectives set by the Convention (see text for full discussion). Instead, a compromise was found in the form of a pilot phase, during which projects were called Activities Implemented Jointly (AIJ). During the AIJ Pilot Phase, projects were conducted with the objective of establishing protocols and experiences, but without allowing carbon credit transfer between developed and developing countries. The AIJ Pilot Phase is to be continued at least until the year 2000.

MECHANISMS (2) --- POST-KYOTO DEFINITIONS

The Kyoto Protocol of the UNFCCC created three instruments, collectively known as the 'flexibility mechanisms', to facilitate accomplishment of the objectives of the Convention. A new terminology was adopted to refer to these mechanisms, as detailed below. Note that because of the Kyoto Protocol's distinction between projects carried out in the developed and developing world, some AIJ projects may be reclassified as CDM or JI projects.

Joint Implementation (JI)

Set out in Article 6 of the Protocol, JI refers to climate change mitigation projects implemented between two Annex 1 countries (see below). JI allows for the creation, acquisition and transfer of "emission reduction units" or ERUs.

The Clean Development Mechanism (CDM)

The CDM was established by Article 12 of the Protocol and refers to climate change mitigation projects undertaken between Annex 1 countries and non-Annex 1 countries (see below). This new mechanism, whilst resembling JI, has important points of difference. In particular, project investments must contribute to the sustainable development of the non-Annex 1 host country, and must also be independently certified. This latter requirement gives rise to the term "certified emissions reductions" or CERs, which describe the output of CDM projects, and which under the terms of Article 12 can be banked from the year 2000, eight years before the first commitment period (2008-2012).

Emissions Trading (ET) or QUELRO trading (Quantified Emission Limitation and Reduction Obligations trading)

Article 17 of the Protocol allows for emissions-capped Annex B countries to transfer among themselves portions of their assigned amounts (AAs) of GHG emissions. Under this mechanism, countries that emit less than they are allowed under the Protocol (their AAs) can sell surplus allowances to those countries that have surpassed their AAs. Such transfers do not necessarily have to be directly linked to emission reductions from specific projects.

WHICH COUNTRIES IN WHICH MECHANISMS?

Annex 1 countries

These are the 36 industrialised countries and economies in transition listed in Annex 1 of the UNFCCC. Their responsibilities under the Convention are various, and include a non-binding commitment to reducing their GHG emissions to 1990 levels by the year 2000.

Annex B countries

These are the 39 emissions-capped industrialised countries and economies in transition listed in Annex B of the Kyoto Protocol. Legally-binding emission reduction obligations for Annex B countries range from an 8% decrease (e.g., EC) to a 10% increase (Iceland) on 1990 levels by the first commitment period of the Protocol, 2008 – 2012.

Annex 1 or Annex B?

In practice, Annex 1 of the Convention and Annex B of the Protocol are used almost interchangeably. However, strictly speaking, it is the Annex 1 countries which can invest in JI/CDM projects as well as host JI projects, and non-Annex 1 countries which can host CDM projects, even though it is the Annex B countries which have the emission reduction obligations under the Protocol. Note that Belarussia and Turkey are listed in Annex 1 but not Annex B; and that Croatia, Liechtenstein, Monaco and Slovenia are listed in Annex B but not Annex 1.

PROJECT OUTPUTS

Carbon offsets – used in a variety of contexts, most commonly either to mean the output of carbon sequestration projects in the forestry sector, or more generally to refer to the output of any climate change mitigation project.
Carbon credits – as for carbon offsets, though with added connotations of (1) being used as 'credits' in companies' or countries' emission accounts to counter 'debits' i.e. emissions, and (2) being tradable, or at least fungible with the emission permit trading system.
ERUs (emission reduction units) – the technical term for the output of JI projects, as defined by the Kyoto Protocol.
CERs (certified emission reductions) – the technical term for the output of CDM projects, as defined by the Kyoto Protocol.

Box 2: Joint Implementation and Hydro Projects in Eastern Europe

The Surduc-Nehoiasu Hydro Project in Romania is a typical example of a project developed under the Joint Implementation mechanism of the Kyoto Protocol. The Surduc Nehoiasu Hydro power plant is a partially built run-of-river plant with 55 MW of capacity and 152.7 GWh/year output. The project is located in the central part of Romania, about 150 km north of Bucharest with a drainage area covering the counties of Buzau, Vrancea and Covasna. The project harnesses the hydroelectric potential of the Bâsca Mare river. The estimated project costs are US$56.9 million. The project is considered the second stage of the originally planned 400 MW Siriu-Surduc project, which was stalled due to the changes in political regime in 1989 and the subsequent inability to raise finance in the following years. In May 1999, the Anglo-American project developer Harza International Development Company LLC signed an MOU with S.C. Hidroelectrica S.A., acquiring the rights to complete the development of the Surduc Nehoiasu project.

Based on the optimisation study, the Surduc Nehoiasu project was scaled down from 155 MW to 55 MW. The plant will sell its output to S.C. Hidroelectrica S.A. based on a 25-year Power Purchase Agreement. The project will be financed through a combination of sources of capital, including the sale of the carbon credits (Emission Reduction Units) generated by the use of hydroelectric power as opposed to the prevailing coke-based generation plants.

Quantification of emission reductions, development of the project's baseline and coordination of carbon credit (ERU) sales was conducted by EcoSecurities. The baseline was determined by assessing the business-as- usual trends in the energy sector. Due to the lack of foreign capital raising, the short term energy plan will involve rehabilitating existing power plants in Romania, predominantly coal-based. It was estimated that the project will lead to the reduction of over 2 million tonnes of CO_2 emissions during a 20-year timeframe, through the use of hydroelectric power to displace the prevailing coal-based generation plants operating in the country. The first carbon sale closed by the project was with the ERUPT (Emission Reduction Units Purchase Tender) program of the Dutch Government. A total of 612,631 tonnes CO_2 emission reductions were sold for over € 3 million euros, in an average of € 5 euros per tonne CO_2 (around US$ 4/t CO_2).

The ERUPT (Emission Reduction Purchase Tender) is a Dutch Government programme using the Joint Implementation mechanism to acquire Emission Reduction Units (ERUs) generated in host countries during the commitment period 2008 – 2012 as part of the Dutch obligations under the terms of the Kyoto Protocol. To that end, the Program buys claims on future ERUs from investors who are initiating and operating projects in a host country before the commitment period. In 2002, the Dutch Government extended this program to invest in CDM projects in developing countries, thought the CERUPT program.

United Power Company

Surduc – Nehoiasu Hydro Project

Romania

€3,063,155

Placement of Emission Reduction Units representing 612,631 tonnes of CO_2 under the Dutch Eru-PT Programme

EcoSecurities acted as Carbon Advisor to the Seller

HARZA ENGINEERING COMPANY

ECO SECURITIES

HIDROELECTRICA

Box 3: CDM and coal-to-charcoal fuel switch projects in Brazil

As part of the steel production process, large quantities of carbon feedstocks (thermo-reduction agents) are used. Internationally, the main source of carbon feedstock is coke, obtained from the dry distillation of coal, one the most carbon intensive fossil fuels. The Brazilian steel sector, however, it is the only one globally that uses charcoal as a reducing agent. Given that charcoal is a renewable fuel source, the charcoal-based steel can therefore be considered 'carbon neutral'.

During the last 10 years, however, economic trends related to both the industrial operations and the forestry sector in Brazil are leading to increased utilisation of imported coal, as opposed to locally produced charcoal. This, in turn, results in increases in greenhouse gas (GHG) emissions. Recently, a few companies have been trying to reverse this trend by selling carbon credits through the Clean Development Mechanism (CDM).

Economic trends affecting the steel & iron sector

The charcoal-based steel & 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, in 1967 the Brazilian Government introduced the FISET fiscal incentive program, 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. Associated investments in breeding and cloning helped to establish the Brazilian plantation forestry sector as one of the most advanced and productive worldwide. At the same time, the country grew to become the world's 8th largest producer of steel.

In 1989, however, the FISET program was discontinued. Following the end of the fiscal incentives, plantation establishment decreased while harvesting of existing plantations continued at the existing rate, leading to a reduction in the Brazilian plantation forest base from a total of 6.5 millions hectares in 1990 to 4.8 million in 1998. Replanting is a costly activity and investment is not taking place for a series of reasons, namely, lack of access to long term finance for investment in forestry, inherent low profitability of the forestry activity in Brazil, and the risks related to investments of long gestation in the Brazilian macro-economic context.

Adding to this scenario, in 1994 the Brazilian Government introduced the Plano Real economic plan, which resulted in the pegging of a new Brazilian currency (Real) to the dollar, on an equal level (1:1). This artificially high exchange rate has made the cost of imports relatively lower in relation to goods produced locally. In the steel and iron industries, it made the utilization of imported coal more cost effective than the use of locally produced charcoal.

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. Examples of this economic trend abound. A recent study by the Brazilian Steel Institute shows that the consumption of charcoal has been reduced from 8 million tonnes in 1993 to 4.2 million tonnes in 1999. Since 1999, the number of small independent pig iron producers (who sell this raw material to the larger steel producers) has halved, and it is expected that more firms in this market segment may be forced out of business. A general feeling among experts in this industry is that unless incentives are put in place to support either the forestry sector or the use of charcoal, the current trend of substitution to coal will persist. This will lead to a significant increase in GHG emissions in Brazil associated with the use of coke used for iron/steel production, as well as during the coking process (i.e., the transformation of coal in coke, through a dry distillation process).

New initiatives involving carbon trading

Within this context, EcoSecurities is involved in three projects making use of carbon finance through the Clean Development Mechanism (CDM) to tilt the balance towards the utilisation of charcoal. The extra income derived from the sale of carbon credits will increase the profitability of charcoal-based pig iron and steel production avoiding the decline of this industry.

The Plantar project consists of the maintenance of charcoal-based production of pig iron in its mills in Minas Gerais, Brazil, funded through the sale of carbon credits. This is the first investment of the World Bank PCF in Brazil, who retained EcoSecurities to determine the potential GHG emission reductions to be generated by the project. The project involves the planting of over 23,000 ha with sustainably managed (certified to the Forest Stewardship Council standards) forests of high yielding clonal *Eucalyptus* trees. Additionally, Plantar will initiate a pilot project of landscape-scale management of biodiversity based on the regeneration of native vegetation in an area previously covered with plantation forests. It was estimated that the project has the capacity to generate 12 million tonnes of CO_2 emission reduction equivalents over a 28-year timeframe. The PCF is particularly interested in the replicability of this investment, and its effect on the iron & steel sector as a whole. The project was independently validated by DNV.

EcoSecurities is also assisting two other companies on similar initiatives. One of the them is being developed by V&M Tubes do Brazil (a joint venture between the French group Vallourec and the German company Mannesmannrohren-Werke). 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 45 million tonnes of CO2 emissions during the next 27 years.

A third project has been developed by Cosipar, a Brazilian private company producing 330,000 million tonnes of pig iron in the state of Pará, in Northern Brazil. Cosipar's objective is to establish plantation forests to produce its charcoal needs, as opposed to other companies in the Amazon region that are either using charcoal from unsustainable degradation of natural rainforests, or are moving to coke. Being a leader in the region, and an important member of the association of pig iron producers, Cosipar hopes to catalyse a change by providing an example of a new source of financing for the sector. It was estimated that the project has the capacity to generate over 1,8 million tCO_2 credits during its lifetime.

These projects illustrate how CDM funding can promote potential changes in industrial sectors in developing countries.

Appendix: List of selected JI/AIJ energy projects carried out until 1998.

Project name	Date initiated	Investment committed (US$ M)	Cost of credits (US$/t CO2)	Volume of credits (1000 t CO2)	Host country	Investor country
Decin	1992	8.00	5.45	605.6	Czeck R.	USA
Balvi distric heating	1993	0.54	13.50	40.0	Latvia	Sweden
Birzai boiler conversion	1993	0.80	4.74	168.8	Lithuania	Sweden
Rural Solar Electrification	1993	4.80	0.16	17.2	Honduras	USA
Tartu-Aardla Heating Plant	1993	0.80	8.07	99.1	Estonia	Sweden
Valga boiler	1993	0.60	9.62	62.4	Estonia	Sweden
Adavere district heating	1994	0.21	57.22	3.7	Estonia	Sweden
Aluksne boiler	1994	0.80	3.16	253.2	Latvia	Sweden
Balvi energy efficiency	1994	0.40	3.03	132.1	Latvia	Sweden
Haabneme boiler conversion	1994	0.70	5.61	124.8	Estonia	Sweden
Janmuiza	1994	0.60	16.35	36.7	Latvia	Sweden
Jelgava energy efficiency	1994	0.50	136.24	3.7	Latvia	Sweden
Kazlu Ruda boiler	1994	0.40	9.08	44.0	Lithuania	Sweden
Mustamae energy efficiency	1994	0.56	5.18	16.9	Estonia	Sweden
Narva-Joesuu boiler	1994	0.90	111.47	8.1	Estonia	Sweden
Paldiski boiler	1994	0.90	11.15	80.7	Estonia	Sweden
Slampe	1994	0.50	12.38	40.4	Latvia	Sweden
Ugale	1994	0.30	6.81	44.0	Latvia	Sweden
Valga district heating	1994	0.40	54.50	7.3	Estonia	Sweden
Vandra district heating	1994	0.20	29.97	3.7	Estonia	Sweden
Viljandi Boiler	1994	0.73	7.37	99.1	Estonia	Sweden
Voru boiler conversion	1994	0.76	6.68	113.8	Estonia	Sweden
Voru district heating	1994	0.85	22.89	40.4	Estonia	Sweden
Ziegzdriai Boiler	1994	0.55	24.98	22.0	Lithuania	Sweden
Baisogale boiler conversion	1995	0.60	5.45	110.1	Lithuania	Sweden
Coal-to-gas, Poland	1995	48.00	2.11	2,407.5	Poland	Norway,GEF
Daugavgriva	1995	0.87	6.77	128.5	Latvia	Sweden
ILUMEX	1995	23.00	32.98	697.3	Mexico	Mexico, GEF, Norway
Jekaplis boiler conversion	1995	0.20	7.78	25.7	Latvia	Sweden
Jurmala	1995	0.90	9.43	95.4	Latvia	Sweden
Plantas Eolicas	1995	30.00	29.97	264.2	Costa Rica	USA
Rauna	1995	0.16	6.23	25.7	Latvia	Sweden
Saldus district heating	1995	0.02	5.45	3.7	Latvia	Sweden
Saldus energy efficiency	1995	0.02	5.45	3.7	Latvia	Sweden
Varena boiler conversion	1995	1.45	7.46	194.5	Lithuania	Sweden
Vienybe boiler conversion	1995	0.75	5.38	139.5	Lithuania	Sweden
Viesite	1995	0.20	7.78	25.7	Latvia	Sweden
Aeroenergia	1996	8.85	241.14	36.7	Costa Rica	USA
Ainazi windpower	1996	1.80	154.50	11.0	Latvia	Germany
Aluksne pipe line	1996	0.50	17.03	29.4	Latvia	Sweden

Bel/Maya Biomass Power	1996	na			Belize	IUEP
Bio-Gen Power (Ph. I)	1996	24.00	10.11	2,374.5	Honduras	USA
Brocenia	1996	0.95	11.25	84.4	Latvia	Sweden
Desi-Power (India)	1996	na			India	Switzerland
Dona Julia Hydroelectric	1996	28.00	133.85	209.2	Costa Rica	USA
El-Hoyo-Monte Galan	1996	260.00	13.17	19,744.6	Nicaragua	USA
Micro-Hydro Buthan	1996	0.40	15.57	25.7	Buthan	Netherlands
Orissae district heating	1996	0.15	20.44	7.3	Estonia	Sweden
Renewable Energy Systems	1996	3.30	74.93	44.0	Indonesia	USA
RUSAGAS	1996	na			Russia	USA
Staciunai district heating	1996	0.14	42.39	3.3	Lithuania	Sweden
Sventupe boiler	1996	0.30	8.17	36.7	Lithuania	Sweden
Tierras Morenas Windfarm	1996	27.00	144.25	187.2	Costa Rica	USA
Valka	1996	0.20	6.81	29.4	Latvia	Sweden
Burkina Faso (b)	1997	1.40	1.12	1,251.5	Burkina Faso	Denmark
Hungarian Municipal Project	1997	3.10			Hungary	Netherlands
Jarvakandi district heating	1997	0.20	54.50	3.7	Estonia	Sweden
Jelgava - district heating	1997	0.47	113.13	4.1	Latvia	Sweden
Mustamae - Vilde	1997	0.49	21.80	2.9	Estonia	Sweden
Mustamae tee	1997	0.58	21.80	3.7	Estonia	Sweden
Orissare	1997	0.12	14.22	8.4	Estonia	Sweden
Renel-SEP	1997	0.84	0.77	1,093.7	Romania	Netherlands
Romania – En.Efficiency	1997	0.94	0.86	na	Romania	Netherlands
Tyumen project	1997	3.30			Russia	Netherlands
Ushgorod Wolgotransgas	1997	0.70	3.13	223.9	Russia	Germany
Air conditionar energy	1998	0.07	0.40	14.7	Solomon Islands	Australia
APS/CFE Renewables	1998	0.14			Mexico	USA
Fossil to Bio-Energy – Slovakia	1998	0.50			Slovakia	Norway
Ignalia boiler	1998	1.70	14.57	116.7	Lithuania	Sweden
India Agriculture Project	1998	4.60	8.36	550.5	India	Norway
Kuressare - system project	1998	0.19	2.35	80.7	Estonia	Sweden
Liepa	1998	0.26	4.17	62.4	Latvia	Sweden
Limbazi	1998	0.90	6.34	142.0	Latvia	Sweden
Photovoltaic - Fiji	1998	0.08			Fiji	Australia
Saldus III, district heating	1998		18.17	2.1	Latvia	Sweden
Talsi Latvia	1998		16.89	na	Latvia	Sweden
Turi	1998	0.19	1.63	na	Estonia	Sweden
World Bank	1998	150.00	3.00	na	various	International
TOTAL		**1,008.31**	-	65,964.2		

Global New Investment in Clean Energy by Asset Class. 2004 â€“ 2017. Dollar investment via asset finance and small-scale solar projects has been affected by sharp reductions in PV costs. 7 January 16, 2018. Annual Trends, New Investment. New Investment in Clean Energy United States. 2004 â€“ 2017.Â Sectors Other low carbon tech / services. This sector covers clean energy service companies such as consultants, government agencies and policy makers, NGOs, financial service providers, investors, and clean energy information providers (such as ourselves). It also covers the corporate activity of organizations across the carbon market value chains. 72 January 16, 2018. Definitions and FAQs. Investment in capital intensive low-carbon technologies remains hampered by insufficient regulatory framework, challenging project development, persistent financial strain for utilities and a limited pool of public finance. 22 | World Energy Investment 2019 | IEA 2019. All rights reserved. Overview and key findings. Energy investment was mostly in high and upper-middle income regionsâ€¦ Energy investment and population by region, classified by current income level. Hig h-income.