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# **An Overview of Carbon Transactions**

General Characteristics and Specific Peculiarities

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## Acknowledgement/Preface

This report provides selected background information to the current portfolio of carbon transactions. The study has a special focus on an analysis of the JI and CDM projects that have been submitted in this early stage of the development of a market in CO<sub>2</sub> credits. It aims at providing insight in the project portfolio with regard to technology and geographical distribution. With the usual disclaimer on remaining errors, the authors acknowledge the stimulating exchange of ideas with Remko Ybema and Alexander Gijsen. The ECN project number is 7.7513.03.01.

## Abstract

Throughout the past years, the frontrunners in the field of carbon trading have started establishing their businesses. Some market actors took action towards achieving their emission targets under the Kyoto Protocol, such as the Dutch government, and others commenced establishing a market not for own use but for general market start-up purposes, such as the World Bank's Prototype Carbon Fund. Also smaller businesses started to explore the possibilities of trading in carbon credits in different fields. Several smaller voluntary initiatives are also reported, mainly aimed at individual consumer activities, households or small companies. Carbon accounting for emissions resulting of air travel or household energy use and individual transport is in place in both Europe and the United States. With an increased consciousness of organisations and the general public of the problems associated with greenhouse gas emissions, voluntary agreements like these may gain a significant market share.

This report gives an overview of general preferences of technology, type of project and other characteristics of projects. Only projects approved by all parties involved are reviewed. It can be concluded that projects under CDM have a preference for large-scale hydro, gas capture and fuel switch projects, which each constitute almost 25% of the total CDM emission reductions. Latin America, in particular Costa Rica, Panama and Brazil, have managed to attract most investments. For Joint Implementation, in Eastern Europe, the countries Czech Republic, Poland and Romania dominate the list. The project type is more diverse here, and slightly biased towards energy efficiency-type projects. In total about 100 MtCO<sub>2</sub>-eq is traded via project-based Kyoto mechanisms. Other emissions trading systems, on a country level or in a company, are briefly reviewed.

Only a small fraction of the total greenhouse gas abatement potential for CDM and JI projects, which has been estimated to amount to some 4.400 MtCO<sub>2</sub>-eq, has been realised so far. This picture will most likely change as soon as the Kyoto Protocol enters into force and Annex B countries feel a real obligation to meet their Kyoto targets. It is expected that towards the commitment period of Kyoto en in the next commitment periods the role of flexible instruments will be more substantial and large energy efficiency and fuel switching options will be realised.

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## INTRODUCTION

Climate change will most probably be facing the world with costs and irreparable damage due to changes in fertility and agricultural suitability of land, rise of sea level and increased incidence of natural disasters. The estimated costs of climate change readily exceed the costs of mitigating the damage by the reduction of the emission of greenhouse gases. In order to achieve a concentration of greenhouse gases to a level not leading to dangerous interference with the climate, the international community gathered in the Conference of Parties to the United Nations Framework Convention on Climate Change (UNFCCC) and agreed on the Kyoto Protocol in 1997.

### *Flexible mechanisms*

The Kyoto Protocol provides for the establishment of an emission trading system in order to reduce the emission of greenhouse gases in a way that allows flexibility and more cost-efficiency. The world has to get accustomed to a newly emerging market: the carbon market. A waste stream is becoming a commodity. The Kyoto Protocol allows several ways to canalise the cash flows in this market. It allows for project-based transactions in the form of Joint Implementation (JI) in Annex B countries, and for the Clean Development Mechanism (CDM) in non-Annex B countries. It also allows for direct emission trading between Annex B countries. In addition to the obligations of the Kyoto Protocol, many stakeholders were inspired by trading opportunities and started voluntary initiatives, for companies to argue their corporate responsibility, and for individuals for instance to compensate for their polluting activities, such as flying or driving cars.

### *Emission trading*

There is not much experience on emissions trading for achieving environmental targets. In the United States, an emission trading system was set up to reduce NO<sub>x</sub> and SO<sub>2</sub> emissions. This worked very well, but there are lessons to be learned from this system, which can be summarised in one word: transparency. In order to make an emission trading system work, players will have to know exactly who is involved (the full sector or only parts of it?), what is the cap, what are the future plans and what is the price level. Making all kinds of rules and exceptions blurs the picture and makes the system less efficient. The limitations and rules for emission inventories and accounting must be clear, but within these limitations, there should be a level playing field and essential information must be easily accessible.

### *Project-based mechanisms*

For project-based mechanisms, this picture changes. The project must serve a special goal, since the funding is based on the exact amount of emissions avoided. This means that per project, rules for accounting must be followed and monitoring and certification must be arranged. The extra effort this takes is thought to be compensated by the additional revenues generated by the mechanism and other goals that are served by the project, such as more inspection on beneficiaries for the involved community, a better contribution to sustainability and technology transfer, and more influence on the type of project or technology that is implemented. In addition, via a project-based mechanism, projects can be done in developing countries, which do not have a cap on their emissions and therefore, theoretically in a cap-and-trade system, have an excess of supply of emission credits and cannot participate in the normal emission trading.

### *Voluntary agreements*

Voluntary agreements are of increasing importance. The reluctance of several countries, such as the United States and Australia, to take up a cap on their greenhouse gas emissions, has stirred the discussions on the second commitment period; the time period after the expiration date of the Kyoto Protocol, in 2012. There are many small voluntary initiatives to reduce greenhouse

gas emissions, which can be used as pilot learning programmes for a bigger system, possibly even as the main constituent in post-Kyoto climate policy.

*This study*

Emerging markets call for a learning period. Several parties have established early emission trading systems or are experimenting with CDM and JI. In Section 1, the status of the ratification of the Kyoto Protocol is given and the viewpoint of several relevant countries is summarised. This report also summarises a number of initiatives that are currently in operation or under construction (Section 2). In Section 3, a screening of the known JI and CDM projects is done, on the basis of region, technology and size. In Section 4, finally, conclusions are drawn regarding the market development, the preferences for projects, and future expectations. This report gives a current overview of the carbon market as it is emerging.

## 1. CURRENT STATUS OF THE KYOTO PROCESS

During the third session of the Conference of the Parties to the United Nations Convention of Climate Change (UNFCCC), held in December 1997 in Kyoto, Japan, reduction targets for greenhouse gas emissions for the period 2008-2012 (compared to the reference year 1990 or 1995) were agreed for the US (7%), the EU (8%) and Japan (6%). The Kyoto Protocol was open for signature from March 1998. The Protocol will enter into force ninety days after the following two conditions have been fulfilled:

1. not less than 55 parties to the UNFCCC should have ratified the Protocol,
2. the Annex I countries that ratify the Protocol account for not less than 55% of the carbon dioxide emissions for 1990 of the total Annex I group.

The Fiji Government was the first to ratify the Kyoto Protocol in September 1998. As of 31 January 2003, 104 parties have ratified the protocol, including all Annex I countries except Australia, Croatia, Liechtenstein, Monaco, Russian Federation, Switzerland, Ukraine and the USA. This means that the first condition is fulfilled but the 55% of the second condition has not yet been reached (43.9% have been achieved so far). An account on recent developments with regard to the Kyoto process is given below.

*The European Union* member states have agreed to establish a mandatory EU emission trading system in the year 2008 to minimise the costs of meeting the Kyoto target. The trading system will be introduced in 2005 on an experimental basis. Because a big market with sufficient number of sellers and buyers is one of the preconditions for a well functioning trading system, the EU proposes a mandatory system without opt-outs. Another condition is clear rules and a strong framework to ensure compliance. The EU emission trading proposal allows for links to be made with trading systems in other countries which might emerge over time and also takes into account the linking of credits from JI and CDM mechanisms. Finally, the EU hopes that in the future the EU trading scheme can be incorporated into an international trading scheme. In October 2002, the European Parliament voted on the EU emission trading system and although 73 amendments were adopted the key features of the system were endorsed. The European Commission expects that 4.000-5.000 companies will participate in the scheme by 2010. Several EU countries, notably the Netherlands and Italy, have indicated that they will adopt measures with the lowest costs and highest efficiency to meet their Kyoto target, including the use of the flexible mechanisms to deliver 50% of the required emission reduction.

*The United States* have decided not to ratify the Kyoto Protocol because of serious economic harm but to develop their own greenhouse gas emission reduction policy. In October 2002, the US department of State officially released the US Global Climate Change Policy. The main elements of the policy are:

1. a reduction of the CO<sub>2</sub> intensity, emissions per unit of economic activity, by 18% over the next ten years (from 183 metric tons per million dollars of GDP in 2002 to 151 metric tons per million dollars of GDP in 2012),
2. increased funding for climate change-related programmes such as the Global Environment Facility,
3. working together with other nations to develop an effective and efficient global response.

On the state-level, there are ample initiatives in the United States to reduce greenhouse gas emissions, despite of the reluctant commitment from the federal Administration. California has imposed strict limitations on the efficiency of transport vehicles for 2006, which due to the large market share of this state will most likely result in an overall increase of fuel efficiency in cars in the United States. Several cities have announced carbon dioxide reduction programmes (see the section on Chicago Climate Exchange in Chapter 2). On the federal level, in January, the

senators McCain and Lieberman have proposed an emission trading system, resulting in an emission level of the US industry and transport sector to 2000 levels by 2010, and to 1990 levels by 2016. In addition, they demanded more research on climate change and on the effects of the Kyoto Protocol on the US market position.

*Russia* was expected to ratify Kyoto in October 2002 before the eighth Conference of the Parties (COP8) held in Delhi, India. However, The Russian government announced that ratification of the Protocol is postponed until October 2003 to allow the Russian Parliament more time to duly analyse and evaluate the Protocol. It has been suggested by some that the real cause of the postponement is related to the intention of the Russian Government to increase the use of coal domestically in order to make available more gas for lucrative exports to Western markets.

*Canada* has ratified the Kyoto Protocol on December 17, 2002 after a long internal struggle. In November 2002, the Government of Canada released the Climate Change Plan for Canada. The plan outlines how Canada can meet the greenhouse reduction target that was set under the Kyoto Protocol. The Plan contains measures to support action by individual Canadians, industrial emitters and governments.

*New Zealand* has ratified the Kyoto Protocol on December 10, 2002. The proposed policy package went through a round of public consultation and has been approved by the cabinet. Agriculture, the main economic sector, has been exempted from charges on its emissions and emission reduction in this sector will be tackled through research.

*Australia* signed the Kyoto Protocol on 29 April 1998. On June 5, the Prime Minister announced that Australia would not ratify the Kyoto Protocol unless its analysis shows that it is in Australia's national interest to do so. At present the Government of Australia believes that it is not in the national interest to ratify the Protocol because of the absence of the United States and commitments for developing countries. Instead Australia has established a Climate Action Partnership with the US and several GHG emission reduction projects are being implemented under this partnership.

*India* ratified the Protocol in August 2002 but India has also indicated, through the Minister for Environment and Forests, that it will not take up any target commitments, not for the second commitment period or even not for the following periods. The Government of India has endorsed six projects under the CERUPT programme (3 biomass projects and 3 wind projects).

*Thailand* has indicated that it rejects the Clean Development Mechanism under the Kyoto Protocol. The Government of Thailand has defended its decision by saying that the country now will be able to stockpile carbon credits for the second and later commitment periods. Several Thai experts have suggested, however, that this government viewpoint will not hold long and will be subject to change as soon as other segments of the government start interfering with this issue.

*Norway* has ratified the Kyoto Protocol in May 2002. Norway is now considering increasing the domestic use of natural gas for power production. This is subject to the development of technology to filter out and store the greenhouse gases. At present, nearly all electricity is produced from hydropower and a switch to natural gas, although a relatively clean fuel, would result in an increase of the emissions compared to the baseline. Whether CO<sub>2</sub>-free gas fired power plants are financially viable remains to be seen.

## 2. OVERVIEW OF CURRENT INITIATIVES REGARDING THE IMPLEMENTATION OF THE FLEXIBLE MECHANISMS

After the signing of the Kyoto Protocol and the agreements reached in Marrakesh on the modalities of the flexible mechanisms, a global greenhouse gas emission market is slowly but steadily emerging now. Several initiatives have already been taken that aim to begin the implementation of the Protocol although formally the Protocol has not yet entered into force. The development of projects under these mechanisms is going so rapidly, that much of the information is probably already outdated on the publication date of this study. However, we mean to give an overview of the projects known in an early stage of the market development.

This chapter provides an overview of recent developments regarding the flexible instruments Joint Implementation, Clean Development Mechanism and emission trading. Both the Clean Development Mechanism and Joint Implementation are project-based mechanisms under the Kyoto Protocol.

*Joint Implementation (JI)* allows Annex B countries to achieve part of their Kyoto target by implementing greenhouse gas reducing projects in other Annex B countries, mostly in Eastern Europe. The emission reductions need to be certified by means of a baseline in order to ensure additionality and the project needs to be approved under the UNFCCC. The emissions reduced during the project are only accountable in the commitment period of the Kyoto Protocol: 2008 through 2012.

*The Clean Development Mechanism (CDM)* is a means for Annex B countries to implement greenhouse gas reducing projects in non-Annex B countries, usually developing countries. The main difference with JI is that the emission reductions can be banked to be used in the commitment period of Kyoto, which means that if a project starts in 2003, the credits earned from 2003 until 2007 can be used to achieve the Kyoto target of the donor country. A prerequisite for a CDM project is that it should contribute to sustainable development in the host country. The exact extent of this is determined by the host country's government, and is therefore different for each country. The CDM has an Executive Board under the UNFCCC, which approves the projects if they meet the requirements.

The procedures of the project-based mechanisms are very extensive, in order to ensure additionality. This involves considerable extra costs for project developers and therefore tends to encourage large-scale projects. Small-scale projects, such as rural electrification schemes by means of solar home systems, therefore stand little chance of being implemented under the CDM. The CDM Executive Board has designed simplified procedures for small-scale projects to increase their feasibility. Freeriders (i.e. projects that have a high degree of (emission) leakage or are not additional) have a greater chance of approval under a simplified and less inspective system, but the scale of this fraud is probably negligible.

*Emission trading*, the third flexible mechanism under the Kyoto Protocol, works by a free trading of emissions among Annex B countries. Since no baseline is required for this type of trading, the emission reductions not necessarily require additional efforts. This observation is the basis of the so-called hot air issue: Eastern Europe countries will achieve their Kyoto targets without extra efforts because of the economic crisis after the democratisation of this region. The difference between their actual emissions and the Kyoto target can be sold for low prices to countries that have a deficit of carbon credits. Many argue that the climate change issue is not helped by this kind of trading and the European Union is reluctant to use this pathway to achieve its targets.



This section will go into existing programmes of project based flexible mechanisms: the most important being the Prototype Carbon Fund established by the World Bank and the ERUPT and CERUPT programmes developed by the Dutch Government. The emissions trading initiatives include the BP emission trading scheme and the UK emissions trading scheme.

## 2.1 Project-based mechanisms

### 2.1.1 World Bank: The Prototype Carbon Fund (PCF)

The PCF was established in July 1999 by the World Bank with the objective to invest in CDM and JI projects that generate greenhouse gases emission reductions that could be registered with the United Nations Framework Convention on Climate Change (UNFCCC).

The PCF is a public-private partnership consisting of six governments (Canada, Finland, Norway, Sweden, Netherlands, Japan) and seventeen private sector companies (thirteen energy companies, two financial institutions, two trade companies), with a total budget of US\$ 180 million.

The PCF participants provide guidance on the type of projects and the regional distribution of the projects in the PCF project portfolio. The regional composition of the portfolio as agreed upon on the annual meeting in June 2002 is as follows:

- No more than US\$ 35 million should be allocated to Latin America.
- US\$ 25 million should be set aside for countries in East Asia and the Pacific.
- US\$ 25 million is meant for Central and South East Asia.
- US\$ 20 million is provided for projects in Africa.
- US\$ 75 million will be allocated for JI projects.

In addition, the PCF participants indicated specific objectives regarding the technology mix of the project portfolio:

- Up to US\$ 15 million can be allocated for LULUCF projects. The Marrakesh Accords do include a maximum for LULUCF projects in one country of five times 1% of the donor country's emissions of 1990.
- PCF should increase efforts to identify and develop energy efficiency projects. The goal is to achieve a 3:2 ratio between renewable energy and energy efficiency projects.

The World Bank hosts several other programmes for trading in carbon credits under CDM. The Dutch government has signed a contract for 32 MtCO<sub>2</sub>-eq under the Netherlands Clean Development Facility (NCDF). The characteristics are not much different as for the Dutch government CERUPT programme (see next section). In addition, the World Bank is establishing the Community Development Carbon Fund (CDCF), aimed especially at small-scale CDM projects in collaboration with the International Emissions Trading Organisation (IETA), and it has launched the BioCarbon Fund in November 2002, to demonstrate projects that sequester carbon in biosinks.

Given the current project portfolio (see next chapter), achievement of the above objectives requires that the number of projects in Latin America and Africa must be limited and that the East Asia portfolio must be actively developed. Also the mix of technologies must become more balanced. This can be achieved by limiting the number of wind and hydro projects.

### 2.1.2 Dutch government: ERUPT and CERUPT

The Dutch government has started early with purchasing emission reduction units via project-based mechanisms. It uses several paths to achieve the emission reductions under JI and CDM:

via multilateral organisation such as the World Bank and its PCF, via bilateral country contracts, such as contracts with the governments of Panama and Costa Rica, via banks (a contract with the Rabobank for 10MtCO<sub>2</sub>-eq reduction has recently been signed) and via its own tenders, ERUPT and CERUPT. Though a significant part of the Dutch target for Kyoto has already been achieved via contracts, it is not clear which exactly is the project portfolio and what are the terms of the emission reductions under the contracts with banks and the bilateral contracts (apart from the requirements given by the UNFCCC). In Section 3, the known projects are included. In this section, attention is given only to the specific Dutch programmes: ERUPT and CERUPT.

### *The ERUPT Programme*

The Emission Reduction Unit Purchasing Tender (ERUPT) programme was set up by the Dutch government with the aim to purchase carbon credits through the implementation of JI projects. JI is aimed at countries that also have a reduction under the Kyoto Protocol, mainly Central and Eastern European countries. ERUPT generates ERU's (Emission Reduction Units) that can be traded on the Kyoto market.

The ERUPT programme is implemented by Senter, the agency responsible for the implementation of programmes on energy, environment, technology and exports developed by several Dutch Ministries. The ERUPT programme is implemented on a tender basis. Based on the expression of interests received Senter draws up a short list of companies, which are invited to submit a detailed proposal according to predetermined guidelines.

The host country of the proposed project must give a letter of approval for the investment. The Dutch government has signed a Memorandum of Understanding (MoU) with several countries, which facilitates obtaining a letter of approval. The minimum amount of credits is 100.000 tCO<sub>2</sub>-eq per MoU.

The first ERUPT tender was launched in 2000. Of the many applicants, Senter selected 4 projects with a total emission reduction of 3.9 MtCO<sub>2</sub>-eq. The second tender was launched in 2001 and resulted in at least 6 projects, aiming at a total reduction of 5 MtCO<sub>2</sub>-eq. Not all projects in the ERUPT2001 are known yet, but the characteristics of the traceable projects will be gone into in the next section.

The third tender has recently been launched and has been open until 30 January 2003. 31 Companies have sent in Expressions of Interest for a total of almost 40 MtCO<sub>2</sub>-eq. The reduction per project ranges from 260.000 to 6.3 MtCO<sub>2</sub>-eq. The average price per tCO<sub>2</sub>-eq is expected to be in the range of €3 to 5. The total value of capital investment for all of these projects is € 1.090.212.000.

Table 3.1 *ERUPT-3: General data of submitted Expressions of Interest*

Country	[%]	Technology	[%]
Russia	25	Energy efficiency	30
Romania	19	Landfill recovery	16
Hungary	19	Biomass	13
Czech Republic & Slovakia	13	Wind	7
Bulgaria	10	District heating	7
Other (e.g. New Zealand, Ukraine, Estonia)	14	Other (e.g. fuel switch, hydro, biogas, CHP, gasification)	27

It is hard to say how much CO<sub>2</sub> will actually be reduced as a result of this tender. The initial assessment is scheduled for completion at the beginning of May, when the selected companies will be invited to submit tenders.

### *The CERUPT programme*

The CERUPT programme under the Clean Development Mechanism aims to purchase carbon credits through investments in projects in the area of renewable energy, energy efficiency, fuel switch and waste management in non-Annex B countries. It has been established by the Dutch government in parallel with the ERUPT tender and has a lot of characteristics in common in terms of procedural matters. In principle no specific project portfolio has been defined for the CERUPT programme but different prices are accepted for different technologies. The highest price accepted by Senter for CERUPT projects is €5. The price for renewable technology forms the reference price. The accepted price for clean sustainably grown biomass (excluding waste) is 25 % lower; the price of energy efficiency improvements is also 25 % lower and the price of other technologies, among which fuel switch and methane recovery is 67 % lower.

The CERUPT tender was launched in 2001. Senter received 80 Expressions of Interest for projects in 27 different host countries and a total reduction of 90 MtCO<sub>2</sub>-eq. After the first evaluation round 26 projects in 13 host countries and with a total emission reduction of 32 MtCO<sub>2</sub>-eq have been invited to prepare a detailed proposal. The average price for these 26 projects amounts to €4.7 per tCO<sub>2</sub>-eq. In March 2003, the Dutch Ministry of Environment declared that 18 projects with a total reduction of 16 MtCO<sub>2</sub>-eq have been selected for contracting. It also declared that no new CERUPT round will be opened.

### 2.1.3 Singapore-ASEAN Carbon Fund

The Singapore-ASEAN Carbon Fund 2003 has been established, to be administered through Electric Eye Pte Ltd in Singapore. It is an independent initiative that seeks to kick-start CDM projects under the Kyoto Protocol. The fund will be a 5-year closed-end investment fund, with a target capitalisation of US\$120 million. It will target energy efficiency and renewable energy in the ASEAN countries, and aims at 200.000 tCO<sub>2</sub>-eq in carbon credits per year. If successful it will function as model for a larger Asian carbon fund.

### 2.1.4 Government of Finland

Finland has a commitment of 8% reduction of greenhouse gases according to the burden sharing agreement under the EU as a result of the Kyoto Protocol. The Ministry of Foreign Affairs (Development Cooperation) is currently exploring the possibilities of purchasing certified emission reductions via small-scale CDM projects. The guidelines for small-scale projects are simplified, reducing transaction costs, and small-scale projects are in general more beneficial for sustainable development than large-scale CDM projects. Small-scale projects are defined in the simplified modalities and procedures adopted by COP8 in New Delhi, in November 2002. The government of Finland has published an invitation to submit project proposals. Unclear is how many and which kind of proposals will be granted.

## 2.2 Emission trading schemes

### 2.2.1 UK Emissions Trading Scheme

In April 2002, the UK Government (Department for Environment, Food & Rural Affairs) launched the UK Emissions Trading Scheme. The scheme is voluntary and so far 34 organisations in the UK have expressed their willingness to enter the scheme. The Government will set five year CO<sub>2</sub> emission targets for each participating organisation. Organisations can meet their target by reducing their emissions or by purchasing reduction units from other organisations. The main objective of the scheme is to reduce the compliance cost (estimates indicate that compliance cost are 80 times less costly than other possible compliance measures, see UK Emission

Trading Scheme internet reference). An additional advantage is that the trading scheme will give the UK a head start in the international and EU carbon trading market.

The scheme will run for 5 years: from 2002 until 2006. The government provides a financial incentive for the participating organisations (with a maximum of GBP 43 million per participant over the 5-year period) that agree to take on emission reduction targets. Each participant has a direct cap on its emissions. The total claimed emission reduction by the 34 participating organisations amounts to some 4 MtCO<sub>2</sub>-eq, or 5% of the UK's yearly obligation under the Kyoto protocol. The scheme is also open to the 6.000 companies that have a climate change agreement with the government. These voluntarily agreements have set energy-related targets for businesses, and companies are allowed to purchase allowance from the scheme to meet their target or to sell any over-achievements of their target.

## 2.2.2 Large oil companies

### *Shell*

Shell has set up a cap and trade system called STEPS (Shell Tradable Emission Permit System) that aims to reduce Shells own emission in a cost effective way. The system commenced in January 2000 and will continue until the end of 2002. Participation is voluntary and trade is done only in the two main greenhouse gas emissions, namely CO<sub>2</sub> and CH<sub>4</sub>.

Six business units contributing to about a third of Shell's total emissions participated in the system. The overall goal set is a reduction by 2 % in 2002 compared to the base year 1998. Permits have been allocated to the participating units in proportion to the units 1998 baseline emissions for the three-year period and resembling 98 % of the 1998 emissions. A permit has a value of 100 tCO<sub>2</sub>-eq. Each company is free to determine its individual strategy for compliance, whether through abatement projects or through trade. The trade is done through the web and is handled by Shell Energy.

The objectives of the STEP programme are to:

- gain experience with the Kyoto mechanisms,
- identify least cost options within Shell for greenhouse gas emission reduction,
- assess the costs in Shell for abatement of greenhouse gas emission,
- demonstrate the feasibility and merits of international emission trading as a low-cost way to reduce greenhouse gas emissions.

The STEP programme eventually was abandoned because of lack of success. Probably, the voluntary participation was part of the problem; the supply greatly exceeded the demand of credits and not healthy market could was therefore established.

### *BP Amoco*

BP implemented a voluntary emission trading system in September 1998. In 2000, this was transferred into a system comprising every business unit in the company. The annual reduction target was 2% in 2001, in order to comply with the reduction target that BP Amoco imposed upon itself of 10% reduction in 2010 (baseyear 1990). The trading volume in 2001 was 4.55 MtCO<sub>2</sub>-eq, with an average price of almost \$40 per tCO<sub>2</sub>-eq. The price per tCO<sub>2</sub>-eq showed a big variation, from \$7 to 99. The traded volume and the average price in 2000 were much lower (2.7 Mt at \$7.6 per tonne), due to a less strict emission target in that year. Parts of BP will take part in the UK Emissions trading where appropriate. In 2002, BP intended to include CDM projects in its internal emission trading system.

## 2.3 Voluntary emission trading schemes

There are many voluntary systems in place where individuals and companies can account and trade in their greenhouse gas emissions. Several are listed below. This list may not be complete. To date, there is no central point where the credits earned through one of the programmes below are registered, because all programmes are on a voluntary basis. In the future, it is expected that the registration will be more thorough, and if the emission reductions actually count as emission reduction under the Kyoto Protocol, registration is necessary via the UNFCCC.

Several of the programmes below are in the United States. Since the carbon market in the United States is still very small, the country is not intending to ratify the Kyoto Protocol or implement any other restrictive climate policy, the programmes will probably remain on a purely voluntary basis for the years to come. It is expected that relatively to other market instruments not much volume will be traded under this kind of programmes, though the total traded volume will probably increase substantially.

### 2.3.1 Carbon compensation programmes

#### *Chicago Climate Exchange*

The Chicago Climate Exchange (CCX) is the first US voluntary pilot programme for trading of greenhouse gases. The programme was established by grants of several foundations, and is administered by Environmental Finance Products, LLC. Its goal is to design and implement a voluntary pilot programme for trading of greenhouse gases in North America, which will later also be compatible with international programmes. Many companies and public organisations are taking part in the programme, among which the municipalities of Chicago and Mexico-City, industry, energy companies, forest production companies and other offset providers.

(Internet: [www.chicagoclimatex.com/html/about.html](http://www.chicagoclimatex.com/html/about.html))

#### *International Carbon Bank and Exchange*

The International Carbon Bank and Exchange (ICBE) offers both individuals and companies the chance to account and compensate their CO<sub>2</sub> emissions. They have a separate programme for both customer groups. Once a CO<sub>2</sub> account is generated, the client can offset his emissions by obtaining credits from sellers of credits. In this way, a price is established. In the carbon exchange available on the internet, only the price of micro-hydro energy in North America was shown at the date of this research, which was US\$5 per tCO<sub>2</sub>.

(Internet: [www.icbe.com](http://www.icbe.com))

#### *Cantor Fitzgerald Environmental Brokerage Services*

This emission brokerage service trades mainly in VOC, SO<sub>2</sub>, NO<sub>x</sub>, CO and PM10, but includes greenhouse gas trading as well. CO2e.com, Cantor Fitzgerald EBS' sister company, assists companies to hedge their greenhouse gas exposure and potential limitations on their ability to emit greenhouse gases. Transactions include simple purchases and sales to structured options transactions. CO2e.com currently represents a diverse family of reductions including:

1. Renewable energy, energy efficiency and land-use projects expected to be eligible for credit under the Clean Development Mechanism in South and Central America, Asia, and Africa.
2. Renewable energy, energy efficiency, methane capture and recovery, and land-use projects in Australia, Canada, and Europe.
3. Renewable energy, land-use, and methane capture and recovery projects in the United States.

Prices range from US\$ 1 per tCO<sub>2</sub>-eq and increase up to US\$ 8 depending on vintage year, risk guarantees, volume, and contract structure (Internet: [www.emissionstrading.com](http://www.emissionstrading.com)).

### *Trexler and Associates Inc.*

Trexler and Associates (TAA) Climate Services trades in greenhouse gas reduction units. The company has been part of the team that carried out the feasibility study for the Prototype Carbon Fund of the World Bank (see above). It has procured for over US\$10 million in climate change mitigation projects. It also carries out studies on future carbon markets and prices. It is also involved in brokering, which has involved almost US\$5 million. TAA is focusing on the development of standardised portfolios and tries to minimise transaction costs for its customers. Generally, the different portfolios have a different degree of sustainability and of reducing greenhouse gas emissions. The portfolios include:

- *Climate Neutral Portfolio*: This portfolio conforms to the criteria of the Climate Neutral Network, an independent organisation that certifies companies and their products as being 'climate neutral'. This portfolio provides an efficient and cost-effective approach to taking a company or a product through the Climate Neutral Network's certification process.
- *Carbon Offset Portfolio*: This portfolio includes offset projects in multiple sectors, ranging from renewable energy to forestry. Companies can fund pre-screened mitigation activities.
- *Customised Portfolios*: These portfolios are customised to the interests of the funding company or group. Different organisations may be interested in very different types of mitigation activities, whether in the forestry, agricultural, energy efficiency, renewables, or other sectors.

Examples of projects that are offered on the TAA website are: rural electrification by means of PV in Vietnam, feed replacement for cattle in Uganda (reducing methane emissions), boiler replacement in US schools, and an energy efficiency in Chinese housing by means of straw bale home construction (Internet: [www.climateservices.com](http://www.climateservices.com)).

### *Business for climate*

Triodos Bank and the FACE Foundation in the Netherlands started the 'Business for Climate' programme, where the opportunity is offered to companies to compensate their CO<sub>2</sub> emissions in order to achieve 'climate-neutral entrepreneurship'. After a CO<sub>2</sub> meter is filled in, the actual emissions of the company are calculated and compensated via sustainable forestry projects, implemented by the FACE Foundation. The Climate Clearing House of the Triodos Bank functions as the financier and calculates how much credits are needed. 'Cool flying', a programme to compensate air travel emissions, is part of the Business for Climate programme (Internet: [www.businessforclimate.nl](http://www.businessforclimate.nl)).

### 2.3.2 Travel compensation

Air traffic is not included in any international treaty or national climate policy in the world. Nevertheless, the emissions of this activity are to such an extent harmful for the environment, that there are several programmes in place to address these emissions. Some examples are listed below. They are aimed at both individual clients and larger companies.

#### *Trees for Travel*

Trees for Travel is a Dutch foundation that gives companies and individuals the opportunity to compensate for the greenhouse gas emissions (CO<sub>2</sub>, but also including emissions of N<sub>2</sub>O) of their air travels by buying standardised certificates. Compensation of one tCO<sub>2</sub>-eq costs €13,32. For this money, the FACE Foundation performs sustainable forestry in developing countries, such as Uganda and Ecuador. The emission reductions are certified by certification organisations, such as the Swiss SGS.

Trees for Travel started in 2001, and has grown with a factor 15 in 2002. It has about 50 business clients and about 600 individual clients, and in 2002, it traded for about 30 ktCO<sub>2</sub>-eq. The foundation plans to expand its activities to an international level and to purchase credits from other organisations than the FACE Foundation (Internet: [www.treesfortravel.nl](http://www.treesfortravel.nl)).

### *Climate Ticket*

As part of the association myclimate, Climate Ticket is based in Switzerland and has a similar set-up as Trees for Travel in the Netherlands. The major difference is that Climate Ticket compensates not by planting of trees, but by small-scale renewable energy and energy efficiency projects. Its aim is to give projects that have little chance of gratification under CDM a chance. These projects often have more substantial sustainability benefits than larger scale projects. Their compensations projects up to now comprise of a solar and energy efficiency project in Costa Rica, and for 2003, the organisation plans to implement small-scale biomass gasifiers in India and energy from methane at a waste water plant in South Africa. During crediting periods, the projects should achieve 650, 10.000 and 580.000 tCO<sub>2</sub>-eq reduction annually. Larger projects than the methane project in South Africa will not be allowed in the project portfolio because of the aim of including only small-scale projects. Climate Ticket has advertised much during the Earth Summit in Johannesburg and the Annual Meeting of the Alliance for Global Sustainability in Costa Rica, which inspired many participants to compensate their trip. Customers of Climate Ticket involve about 100 members of the association myclimate. Negotiations are ongoing with companies, travel agencies, NGO's and academic institutions. The turnover of the company since its start in April 2002 was US\$ 20.000, with an expected turnover US\$ of 100.000 in 2003 (Internet: [www.climateticket.com](http://www.climateticket.com)).

### 3. EVALUATION OF APPROVED CDM AND JI PROJECTS

The Dutch Government, through the ERUPT and CERUPT Programmes, and the Prototype Carbon Fund (PCF) have already started purchasing emission reduction units by means of developing CDM and JI projects which could be registered with the UNFCCC. The PCF was established in 1999 by the World Bank with the objective to mitigate global change by investing in projects that will produce greenhouse gas emission reductions. The Dutch Government launched the ERUPT 2000 tender, the ERUPT 2001 tender and the CERUPT tender with the aim to purchase emission reduction units by means of CDM and JI projects.

As of February 2003, 49 projects have been identified, prepared and approved by PCF/ERUPT/CERUPT with a total greenhouse gas reduction of some 100 MtCO<sub>2</sub>-eq. This is a small amount given that for example the in absolute terms relatively small emitter the Netherlands alone have decided to purchase 100 MtCO<sub>2</sub>-eq over the period 2000 to 2012. However, the experiences gained with these 49 projects is very useful for the further development of the CDM/JI framework and for getting more insight into the potential of these flexible mechanisms.

Although the projects implemented by the PCF and the Dutch Government are fully consistent with the Kyoto Protocol and the emerging framework for JI and the CDM, it must be emphasised that the UNFCCC has not yet certified any organisation to verify and monitor CDM/JI projects. Therefore none of the 45 projects can be considered as validated projects under the CDM/JI rules and procedures.

Tables 4.2 and 4.3 present the key information for each CDM/JI project. The main observations from these tables are given below.

#### 3.1 Regional distribution of the projects

37 CDM projects in 17 non Annex I countries have been approved by PCF/CERUPT, including 6 projects in Costa Rica, 7 projects in India, 6 projects in Brazil and 3 projects in Panama. Total greenhouse gas emission reduction by these 37 CDM projects amounts to approximately 90 MtCO<sub>2</sub>-eq. Some 6 % of total reduction is being realised in Asia, 23 % in Africa and 71 % in Latin America. The average emission reduction per project amounts to nearly 2 MtCO<sub>2</sub>-eq. Two very large projects significantly influence the average reduction size: a fuel switch project (21 MtCO<sub>2</sub>-eq) and a project on sinks in Brazil (12.9 MtCO<sub>2</sub>-eq) and a project on hydro in Uganda (7.6 MtCO<sub>2</sub>-eq).

12 JI projects in 6 Eastern European countries have been approved by PCF/ERUPT, including 3 projects in Poland and 4 projects in Romania. Total greenhouse gas emission reduction is 9.6 MtCO<sub>2</sub>-eq, implying an average reduction per project of approximately 0.8 MCO<sub>2</sub>-eq.

*Table 4.1 Contribution of JI and CDM projects to project portfolio*

Geographic region	Projects [#]	Greenhouse gas reduction	
		[MtCO <sub>2</sub> -eq]	[%]
CDM total	37	90.4	
Latin America	21	64.3	71.2
Africa	6	20.6	22.7
Asia	10	5.5	6.1
JI	16	12.2	
Total	53	102.6	



Table 4.2 *Key information on approved CDM projects*

Country	Program	Type	Description	Greenhouse gas reduction [tCO <sub>2</sub> -eq]
Bolivia*	CERUPT	Energy efficiency	Efficient gas plant.	319.392
Brazil	PCF	Sinks & fuel switch	Charcoal from mono-culture plantation used in stead of coal.	12.041.356
Brazil*	CERUPT	Biomass	Retrofit CHP bagasse sugar mill; 15 MW.	259.506
Brazil*	CERUPT	Gas capture	Landfill gas recovery.	700.000
Brazil	NCDF, Japan	Fuel switch	Charcoal based steel production.	21.000.000
Brazil	NCDF	Gas capture	Combustion and flaring credits.	11.800.000
Brazil	VEGA	Gas capture	8MW power from landfill gas.	5.208.344
Chile	PCF	Hydro	26 MW run-of-river.	2.812.000
China*	CERUPT	Wind energy	30.6 MW new capacity.	600.248
Colombia	PCF	Wind energy	19.5 MW new capacity.	1.168.000
Costa Rica	PCF	Wind energy	9.6 MW new capacity.	327.000
Costa Rica	PCF	Wind energy	8.4 MW new capacity.	300.000
Costa Rica	PCF	Wind energy	25 MW new capacity.	204.000
Costa Rica	CERUPT	Hydro	7.5 MW new capacity.	184.360
Costa Rica*	CERUPT	Hydro	35.4MW hydroelectric project.	806.800
Costa Rica*	CERUPT	Gas capture	3 MW landfill gas.	97.850
India*	CERUPT	Wind energy	14.4 MW new capacity.	308.000
India*	CERUPT	Biomass	7.5 MW biomass plant.	378.324
India	CERUPT	Wind/biomass	13MW wind/2MW biomass.	411.000
India*	CERUPT	Biomass	20MWbiomass plant.	1.150.000
India*	CERUPT	Wind energy	15MW new capacity.	360.000
India	vacant	Biomass	19.55 biomass project.	1.009.741
India	vacant	Wind energy	15 MW wind farm.	378.400
Jamaica*	CERUPT	Wind energy	20.7MW wind farm.	522.500
Kenya	CERUPT	Hydro	39MW new capacity.	2.000.000
Mauritius	PCF	Biomass	waste incineration.	2.800.000
Morocco	PCF	Wind energy	200MW new capacity.	1.590.000
Nicaragua	CERUPT	Biomass	electricity production.	212.395
Panama*	CERUPT	Hydro	120MW new capacity.	3.575.927
Panama*	CERUPT	Hydro	in total 100MW new capacity.	366.923
Panama*	CERUPT	Hydro	increase capacity.	261.000
Peru	CERUPT	Hydro	90.6MW new capacity.	2.158.917
South Africa	PCF	Gas capture	20MW by use of landfill methane.	4.720.000
Thailand	Japan	Biomass	6MW rice husk-fuelled power plant.	335.700
Thailand	Japan	Biomass	23MW Rubber wood waste plant.	600.000
Uganda	PCF	Hydro	6.6MW.	1.884.000
Uganda	CERUPT	Hydro	200MW new capacity.	7.561.000
<i>Total</i>				<i>90.412.683</i>

\* Selected by Dutch government for contracting under CERUPT.

Table 4.3 *Key information on approved JI projects*

Host Country	Program	Project Type	Project Description	Greenhouse gas reduction [tCO <sub>2</sub> -eq]
Czech Republic	ERUPT	Biomass portfolio	28 biomass projects.	1.200.000
Hungary	ERUPT	Biomass	90 MW fuel switch coal to biomass.	710.000
Latvia	PCF	waste management	Methane capture.	368.101
Poland	PCF	Geothermal	Replace coal for district heating.	364.553
Poland	PCF	Biomass	Use of biomass waste.	190.630
Poland	ERUPT	Wind energy	60MW new capacity.	583.500
Romania	PCF	Afforestation	6.728 ha of public land.	1.018.000
Romania	ERUPT	Hydro	55MW.	612.631
Romania	ERUPT	Co-generation	26 MWe CHP.	1.536.140
Romania	ERUPT	Energy efficiency	2 cement plants.	800.000
Romania	ERUPT	Hydro	19.5 MW additional capacity though modernisation.	1.673.844
Slovakia	ERUPT	Waste management	Methane capture.	550.203
<i>Total</i>				<i>9.607.602</i>

### 3.2 Technology differentiation in CDM and JI projects

Twelve *Hydro* projects (new plants or rehabilitation of existing plants) have been approved by the PCF/CERUPT/ERUPT resulting in a total greenhouse gas emission reduction of 23.9 MtCO<sub>2</sub>-eq, or on average 2 MtCO<sub>2</sub>-eq per project. The capacity of the proposed new plants or expansions is in the range of 6.6 to 200 MW.

Two *sinks and sequestration* projects have been approved by the PCF: a project in Brazil involving the replanting of 23.100 ha of Eucalyptus plantations to produce wood for charcoal which will then be used in pig iron production instead of coal. Total estimated emission reduction is 12.0 MtCO<sub>2</sub>-eq; and a project in Romania involving afforestation of 6.728 hectares of public land, which will result in a reduction of emissions of 1 MtCO<sub>2</sub>-eq.

Eleven *biomass* projects, including the umbrella project in the Czech Republic consisting of 28 smaller biomass projects, result in a reduction of some 8.8 MtCO<sub>2</sub>-eq. Biomass projects include the smaller projects (up to 20 MW) mainly combustion of crop residues and wood and straw and a large waste incineration (2.8 MtCO<sub>2</sub>-eq) project in Mauritius.

In total eleven CDM *wind* projects and one JI project have been approved resulting in some 450 MW of new wind capacity and a reduction of greenhouse gas emissions of approximately 6.7 MtCO<sub>2</sub>-eq. Remarkable observation is that for the PCF 20 years can be crediting time for CDM projects, whereas for CERUPT the crediting period is fixed at 10 years.

Six *landfill gas capture* projects that aim to substitute landfill gas for coal for electricity and heat production have been submitted to PCF (Latvia and South Africa), CERUPT (Brasil and Costa Rica) and other initiatives (Brazil). Total claimed emission reduction of these projects is almost 22.5 MtCO<sub>2</sub>-eq, of which half is covered by one project from the Netherlands Clean Development Facility under the World Bank in Brazil. On average, gas capture projects a very large size in terms of emission reduction: 4.5 MtCO<sub>2</sub>-eq reduction per listed project.

Two *energy efficiency* projects have been approved, one project in Bolivia and one project in the Romania. Total estimated emission reduction amounts to approximately 1.1 MtCO<sub>2</sub>-eq.

*Fuel switch, geothermal and co-generation* technologies are applied once each under the currently known JI and CDM projects. Notably, the one fuel-switch project planned in Brazil anticipates to obtain a total emission reduction of 21 MtCO<sub>2</sub>-eq. Alone, this would account for one year of emission reduction by means of flexible instruments in the Dutch policy targets for Kyoto.

### 3.3 Small-scale CDM projects

Fourteen projects have been submitted that could count as small-scale projects. This would mean that simplified procedures would apply for the baseline and the monitoring regulations. The idea behind this is that small-scale projects generally qualify better as contributing to sustainable development, one of the prerequisites of the CDM, but they are discouraged because of the relatively high transaction costs. The Marrakesh Accords of November 2001 contains an agreement specifying small-scale project activities as:

- renewable energy project activities with a maximum output capacity equivalent of up to 15 MW,
- energy efficiency improvement activities which reduce energy consumption by up to the equivalent of 15 GWh per year,
- other project activities that both reduce anthropogenic emissions by sources and directly emit less than 15 kt CO<sub>2</sub> per year.

The projects that qualify as small-scale in the portfolio given above are all in the first category. It is unclear if the possibility of streamlining the procedures has made a significant difference in the submitting of the projects. The small-scale projects are dominated by wind and biomass projects. There are no solar or rural electrification projects listed until now.

### 3.4 Price of emission reduction units

The average price of a credit for the ERUPT 2000 tender was US\$ 8.3 per tCO<sub>2</sub>-eq reduction. The average price for the ERUPT 2001 tender dropped significantly to US\$ 4.8 per tCO<sub>2</sub>-eq reduction. The average price of CDM credits is in the range of 3-4 US\$ per tCO<sub>2</sub>-eq. Notably, for PCF the crediting period is 20 years and for CERUPT only ten years.

### 3.5 Controversial projects

Among the list of 49 projects submitted to the programmes, several projects are controversial in the sense that comments were received not to validate these projects as a CDM/JI project because the basic validation requirements, mainly with regard to project additionality, are suspected not fulfilled. The main critiques to CDM projects come from CDMWatch, and NGO with the aim of monitoring CDM activities under the Kyoto Protocol, and Climate Action Network.

The Bayano hydro project in Panama is considered by some as a non-additional activity because the project will be completed before the public comment period for validation is finished. A similar comment was given for the Esti hydroelectric project in Panama.

The Plantar project in Brazil also faces strong opposition because it concerns credits from sequestration of carbon in mono-culture plantations and because the baseline for the Plantar project is regarded highly questionable. The credits obtained from this project are partly from the sequestration, and partly from the fuel-switch part of the project. CDMWatch, an NGO serving as a critical panel for CDM projects, regards this as double-counting.

The Bujigali project in Uganda, which was nominated by CERUPT as a possible CDM project, has even led to official parliamentary questions in the Dutch parliament. There were serious doubts whether the baseline was conservative enough and the planning of the project which started in 1991 was considered by some in conflict with the requirements of additionality. Eventually, the project was not selected by the Dutch government in its CERUPT portfolio.

## 4. MAIN OBSERVATIONS AND FUTURE DEVELOPMENTS

### 4.1 Current status Kyoto Protocol

As of February 2003, 104 parties to the Convention (31 Annex B countries and 73 non-Annex B countries) have ratified the Kyoto Protocol accounting for 43.9% of the 1990 greenhouse gas emissions. Entry into force of the Protocol now solely depends on the ratification of the Russian Federation (responsible for 17.4% of 1990 emissions) which is still pending and is not expected to occur before autumn 2003. However, in anticipation of the ratification by the Russian Federation a global greenhouse gas emission market is slowly but steadily emerging now.

### 4.2 Existing programmes established to implement the flexible mechanisms

At the present moment, three project-based programmes for greenhouse gas reduction are operational: the Prototype Carbon Fund established by the World Bank and the ERUPT and CERUPT programmes developed by the Dutch Government. Recently, Finland also launched a programme to purchase certified emission reductions from small-scale Clean Development Mechanism projects, but no proposals are known from this tender yet. The total greenhouse gas reduction realised so far by these programmes amounts to some 100 MtCO<sub>2</sub>-eq, of which 90 Mt is from CDM projects and 10 Mt from JI projects. The total realised reduction is small compared to the potential of the market (the Netherlands alone intends to purchase some 100 MtCO<sub>2</sub>-eq over the period up to 2012). However, this should be seen in the context of a new market with a high degree of reluctance among the major players to act before the Kyoto Protocol formally enters into force, the issues on hot air trading and sinks are resolved, and the specific modalities of the flexible mechanisms have been agreed upon. Because of these reasons, the market now depends on some frontrunners, that are willing to take the risks of buying uncertified credits at an early stage, in exchange for future benefits in experience and obtaining the most cost-effective options.

In addition to the project-based programmes, several other programmes have been established that aim to minimise the costs of greenhouse gas emission reduction by trade in emissions. The Shell emission trading scheme which ceased to exist and turned out not to be successful due to the lack of obligatory participation, the BP system, which was more successful, and the UK mission trading scheme which commenced in 2002 and appears to be very successful, are the three main examples. There are also many voluntary emission schemes in place, which in general are successful, indicating that there is an increasing awareness among the public and business regarding global climate change issues.

### 4.3 Evaluation of characteristics of early CDM/JI projects

The current project portfolio nominated for approval by the UNFCCC consists of 37 CDM projects and 12 JI projects. In terms of CO<sub>2</sub> reduction, the project portfolio is dominated by renewable energy and bio-sequestration of carbon. The share of energy efficiency projects is small and only one (in reduction very big) fuel switching type of project has been approved. This is remarkable considering the fact that energy efficiency and fuel switching in most mitigation studies conducted in the framework of the National Communications were among the most cost-effective options to reduce CO<sub>2</sub> emissions (Jansen et al, 1999). An explanation could be that at least for the ERUPT and CERUPT tenders, a higher price is paid for carbon credits generated by renewable energy project than for energy efficiency and fuel switch projects. The table below presents an overview of the current CDM/JI project portfolio by technology. The high share in

CDM of sequestration of carbon is somewhat biased because it involves only one (controversial) project in Brazil. This project alone generates 12 MtCO<sub>2</sub>-eq reduction by replanting of 23.100 ha of Eucalyptus plantations to produce wood for charcoal which will then be used in pig iron production instead of coal. The same goes for the fuel switch project under CDM.

Table 5.1 *Distribution of projects under CDM, JI and among technologies*

Project type	CDM		JI		Total	
	[MtCO <sub>2</sub> -eq]	[%]	[MtCO <sub>2</sub> -eq]	[%]	[MtCO <sub>2</sub> -eq]	[%]
Hydro	21.6	24	2.3	24	23.9	24
Wind	6.2	7	0.6	6	6.8	7
Energy efficiency	0.3	0.4	0.8	8	1.1	1
Biomass	6.7	8	2.1	22	8.8	9
Sequestration of carbon	12.0	13	1.0	11	13.0	13
Co-generation	-	-	1.5	16	1.5	2
Fuel switch	21.0	23	-	-	21.0	21
Gas capture	22.5	25	0.9	10	23.4	23
Geothermal	-	-	0.4	3	0.4	-
<i>Total</i>	<i>90.4</i>	<i>100</i>	<i>9.6</i>	<i>100</i>	<i>100</i>	<i>100</i>

The general preference is biased towards hydro and gas capture. It is remarkable that so far no solar projects have reached the final project cycle stage despite the fact that considerable experience has been gained with these projects in programmes such as GEF and AIJ. The reason may be the generally small emission reductions of PV projects, resulting in relatively high transaction costs. Several initiatives have been initiated to address this problem, including:

- The UNFCCC recently has adopted specific streamlined monitoring, verification and certification procedures for small-scale projects that aim to reduce the transaction costs.
- At the World Summit on Sustainable Development in Johannesburg, in 2002, the World Bank in collaboration with the International Emissions Trading Association launched the Community Development Carbon Fund. This fund is administrated by the World Bank and supports projects that benefit the poor and focuses on small-scale projects.

These initiatives will facilitate small-scale projects (including PV projects) participation in the CDM.

#### 4.4 Regional distribution of CDM/JI projects

Over the past years a lot of effort has been put in developing capacity in the non-Annex I countries and the Eastern European countries within programmes such as the AIJ-programme, GEF facility, climate change studies programme by the US, the Netherlands and others and bilateral co-operation programmes. These efforts have resulted in an enhanced awareness and increased local capacity for identifying, evaluating and developing CDM/JI projects. In particular countries such as India, Costa Rica, Brazil, Poland, Czech Republic and Romania are the frontrunners in this respect. In addition to the existing capacity to identify and evaluate CDM/JI projects other aspects such as politically stable environment, attitude of the central government towards the UNFCCC process and signing of an Memorandum of Understanding with the donor countries play an important role.

Other countries such as China, Bolivia, Uganda and Peru also have shown keen interest in participating in the CDM and are now rapidly developing CDM capacity building programmes. It is therefore expected that the number of countries participating in the CDM/JI mechanisms will increase significantly over the coming decade.

## 4.5 Future developments

The total greenhouse gas abatement potential for CDM and JI projects has been estimated to amount to some 4.400 MtCO<sub>2</sub>-eq, (2,000 Mt in Eastern Europe and 2.400 Mt in the non-Annex B countries). Only a small fraction of the identified potential has been realised so far. Due to the decision of the US not to ratify the Kyoto Protocol the total Annex I reduction requirements have decreased significantly from 2.800 MtCO<sub>2</sub>-eq to some 1.200 MtCO<sub>2</sub>-eq. In addition, the agreements achieved in Marrakesh on the use of sinks (in general a very cheap option to meet the greenhouse gas reduction target) further reduced the prospects for CDM/JI mechanisms. In fact, total Annex B reduction requirements (excluding the US) could be met for 70% by purchasing hot air and sequestration of carbon in the Annex B countries (Van der Linden and Sijm, 2002). This observation is confirmed by institutions involved in buying and selling of emission reduction units. According to these organisations the present supply of emission reduction units already exceeds current demand.

This picture most likely will change as soon as the Kyoto Protocol will enter into force and Annex B countries will really feel the obligation to meet their Kyoto targets. Although in the short term (up to the end of the first commitment period) the realised greenhouse gas emission reduction through CDM and JI projects will be limited, it is expected that for the next commitment periods their role will be more substantial and large energy efficiency and fuel switching options will be realised.

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- UNFCCC site for Kyoto barometer: <http://unfccc.int>.



## LIST OF ACRONYMS

CDM	Clean Development Mechanism.
JI	Joint Implementation.
AAU	Assigned Amount Unit; non-CO <sub>2</sub> reductions calculated according to the Global Warming Potential.
ERU	Emission Reduction Unit; generated under ERUPT.
CER	Certified Emission Reduction; generated under CERUPT.
CERUPT	Certified Emission Reduction Units Procurement Tender.
ERUPT	Emission Reduction Units Procurement Tender.
PCF	Prototype Carbon Fund.
GEF	Global Environmental Facility.
AIJ	Activities Implemented Jointly: try-out system for project-based flexible mechanisms under the Kyoto Protocol.
UNFCCC	United Nations Framework Convention on Climate Change.
US	United States.
PV	Photovoltaic.
STEPS	Shell Tradable Emission Permit System.
MtCO <sub>2</sub> -eq	Million tonnes CO <sub>2</sub> equivalents.
tCO <sub>2</sub> -eq	tonne CO <sub>2</sub> equivalents in terms of Global Warming Potential