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# Clean Development Mechanism and Joint Implementation

New Instruments for Financing Renewable Energy Technologies

**Thematic Background Paper**

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## Disclaimer

This is one of 12 Thematic Background Papers (TBP) that have been prepared as thematic background for the International Conference for Renewable Energies, Bonn 2004 (renewables 2004). A list of all papers can be found at the end of this document.

Internationally recognised experts have prepared all TBPs. Many people have commented on earlier versions of this document. However, the responsibility for the content remains with the authors.

Each TBP focusses on a different aspect of renewable energy and presents policy implications and recommendations. The purpose of the TBP is twofold, first to provide a substantive basis for discussions on the Conference Issue Paper (CIP) and, second, to provide some empirical facts and background information for the interested public. In building on the existing wealth of political debate and academic discourse, they point to different options and open questions on how to solve the most important problems in the field of renewable energies.

All TBP are published in the conference documents as inputs to the preparation process. They can also be found on the conference website at www.renewables2004.de.

## Executive Summary

The project-based Kyoto Mechanisms CDM and JI can improve financing of renewable energy projects but will not provide a panacea for large-scale renewables promotion as long as the market price for greenhouse gas reduction credits will remain at its current level of 3 €/t CO2. The incentive per kWh currently is below the feed-in subsidies in Europe, i.e. in the order of magnitude of 0.3-0.8 ct/kWh depending on the baseline and CER prices. This may however change if the US ratifies the Kyoto Protocol and a tendency arises to make future emissions targets more stringent. Thus, CDM and JI currently promote renewable energy technologies whose costs are not much above those of fossil fuel technologies. The Kyoto Mechanisms will definitely not be a vehicle to promote photovoltaics. In the best locations for wind, hydro and biomass, problems with additionality determination may arise as the renewables projects would have gone ahead even without the CDM revenues. For project developers, the lengthy CDM project cycle will generate transaction costs that make CDM projects only viable if they generate more than 20,000 CERs. The CDM can only be harnessed if host countries set up transparent and effective approval and promotion institutions. Moreover, a necessary condition is the provision of incentives to private companies from developing countries, e.g. by credit the emissions reductions against domestic instruments.

## About the Authors

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## 1. The need for climate policy, the Kyoto Protocol and its "Kyoto Mechanisms"

Anthropogenic climate change due to emission of greenhouse gases will be one of the major environmental problems of the 21st century. It is a daunting challenge due to several factors:

Climate change will have impacts on human health, terrestrial and aquatic ecological systems, and socio-economic systems (e.g. agriculture, forestry, fisheries, and water resources, IPCC 2001b). Whereas many regions are likely to experience the adverse effects of climate change - some of which are potentially irreversible - some effects of climate change are likely to be beneficial. Hence, different countries and segments of society can expect to confront a variety of changes and the need to adapt to them. Nevertheless, they can only be predicted with huge uncertainties and may be highly non-linear.

To make things worse, the effects of climate change seem to be unequally distributed. While northern regions could eventually benefit from global warming by the expansion of arable lands and a decreased need for heating, tropical zones will suffer most from droughts, loss of water resources and the expansion of epidemics. Higher sea levels due to the polar melting process will affect most low-lying developing countries like Bangladesh and small island states.

It is very difficult to distinguish anthropogenic climate change from natural variability even if the evidence has become clearer in the last years (IPCC 2001a). Moreover, there are huge time lags between emissions of greenhouse gases and the associated impacts due to natural buffer processes.

Greenhouse gases are no local environmental pollutants and thus there is no domestic incentive to reduce their emissions. They arise in all sectors of an economy, which means that an efficient climate policy has to be cross-sectoral. Due to global mixing of greenhouse gases, an efficient climate policy must be done on a global scale. Renewable energy does not lead to greenhouse gas emissions and thus is a crucial part of a strategy to reduce emissions.

Despite these challenges, the international community has embarked on the development of climate policy with an unprecedented speed. After difficult negotiations, a United Nations Framework Convention on Climate Change (UNFCCC) could be signed at the UN Conference for Environment and Development in Rio de Janeiro 1992. It remained rather general, though, and did not include specific emission targets or binding instruments of climate policy. The UNFCCC entered into force in 1994 and the first Conference of the Parties (COP 1) in Berlin 1995 decided to embark on negotiations of a Protocol with binding targets. The negotiations were crowned with success when in 1997 COP 3 in Kyoto achieved the negotiations of the Protocol, now called the "Kyoto Protocol". Until now, however, the Protocol has not entered into force as the US declared its unwillingness to ratify in 2001 and Russia, which is needed to pass the threshold set for entry into force, still hesitates.

It sets differentiated, legally binding emission targets for the industrialised countries and countries in transition (Annex B countries). The targets apply to a basket of six greenhouse gases. Each Annex B country is assigned an amount of emissions (the nation's "Kyoto Budget") based on varying proportions of 1990 emissions. During the "First Commitment Period" from 2008 to 2012, Annex B countries are required to reduce average annual emissions to a specified percentage of 1990 levels. Overall, Annex B is required to reduce emissions to approximately 95% of 1990 levels. Actual national limits range from 92% for the EU to an allowable increase of ten percent for Iceland. The emission targets can be reached via domestic emissions mitigation, by investment in emission reduction projects abroad or the acquisition of emission rights from another country. The latter two options are possible because four so-called "Kyoto Mechanisms" have been set up that allow transboundary cooperation in emission reduction.

A large part of the Kyoto Mechanisms rules was agreed in the 2001 Marrakech Accords as the Kyoto Protocol had only given a general framework. To participate in the mechanisms, countries have to ratify the Kyoto Protocol and fulfil certain reporting requirements. Whether all Annex B countries, particularly countries in transition will fulfil these rules, remains to be seen.

There are four Mechanisms: the Clean Development Mechanism (CDM), Joint Implementation (JI), International Emissions Trading (IET) and bubbles. CDM and JI are project-based whereas the latter two relate to transfers of parts of the national emission budgets. IET is only possible between Annex B countries and consists just of a transfer from one country to another, after 2008. Countries forming a bubble can redistribute their targets internally ex ante as long as the sum of the targets is not exceeded. The EU is the only country group forming a bubble; it has redistributed its target of –8% so that Portugal can increase its emissions by 25% while Luxembourg has to reduce them by 28%, to name the extremes

The CDM allows countries with emission targets to buy emission credits from projects in countries without targets. It also has the goal to further sustainable development in the latter. Due to the fact that CDM emission credits are added to the overall emissions budget of Annex B countries, their quality has to be guaranteed. Therefore, emission credits only accrue after independent verification through so-called “Operational Entities” (OEs), which are mainly commercial certification companies, and thus are called Certified Emission Reductions (CERs). The Marrakech Accords defined an elaborate “project cycle” that is overseen by the CDM Executive Board (EB), whose 10 members are elected by the UNFCCC Conference of the Parties. It has to check whether projects conform to the rules and formally register them. The “project cycle” is sketched in figure 1 at the end of this chapter. A more detailed figure can be found in the Annex.

Any institutional arrangement is possible to set up CDM projects – bilateral agreements, multilateral funds or even unilateral activity by the host country. This is helped by the full interchangeability of CERs with other types of emission rights under the Kyoto Protocol. Both host and investor country have to set up an official approval agency for CDM projects; the host country defines criteria to check whether the project leads to sustainable development.

To calculate the amount of CERs of a project, a baseline has to be fixed which shall describe the situation that would have existed in the absence of the project (OECD 2000). For a long time, it was unclear how baselines would have to be set up as the Marrakech Accords only define some principles. It was especially contentious whether to check whether the project is “additional”, i.e. would not have happened anyway. If business-as-usual projects are accepted, the CERs will create fictitious emission reductions (Greiner and Michaelowa 2003). Finally, it was decided that a “case law” would develop. Project developers have to submit a baseline methodology proposal to the EB. For case studies of possible baseline methodologies in the electricity sector see Bosi and Laurence (2002); for possible standardisation options Probase (2002). The EB has set up a Methodology Panel that evaluates the proposed methodology with the help of independent experts. Until November 2003, six methodologies had been accepted, one of which relates to renewable energy. The implications of the first decisions will be discussed below.

Projects can have a lifetime of ten or three times seven years. They are subject to an in-kind adaptation tax of 2% that is waived for projects in least developing countries. Another tax shall cover CDM administration costs but its rate remains to be specified. Until then, project participants will have to pay a fee for administration that is fairly stiff, ranging from 5000 \$ for the smallest projects to 30,000 for large ones.

Due to the fear that transaction costs will be prohibitive for small projects (Michaelowa et al. 2003, see also below), more lenient rules have been decided for renewable energy projects below 15 MW capacity, energy efficiency projects that save less than 15 GWh per annum and other projects that annually directly emit less than 15,000 t $CO_2$. They can use standardised baselines. However, even with the special rules, it is unclear whether small projects will be competitive.

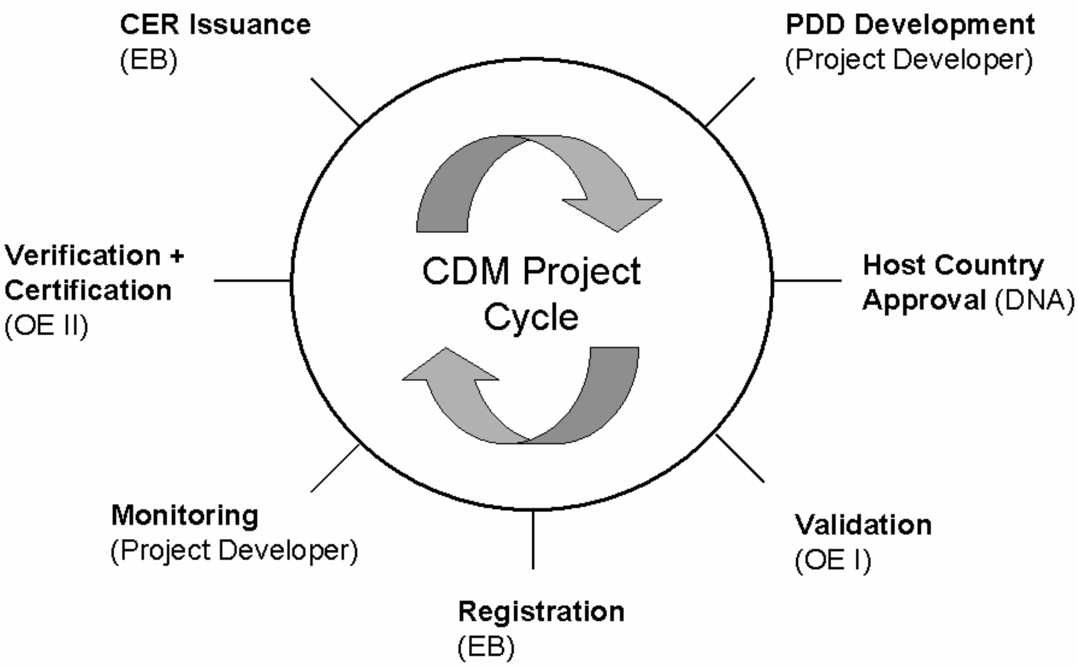
CDM projects shall not lead to "diversion" of development aid; however, the term is not defined and negotiations are ongoing in the Development Assistance Committee of the OECD how to interpret this rule.

Forestry projects under the CDM are limited to afforestation and reforestation and capped at 1% of Annex B country base year emission levels. Their rules are only decided in late 2003. Main issues discussed are the guarantee of permanence and the prevention of leakage.

Each country participating in the CDM has to have ratified the Kyoto Protocol and set up a "Designated National Authority" (DNA) for approval of the CDM projects it is involved in. Experience shows that it is difficult for many developing countries to put the institutional structures in place and provide the necessary know how for project preparation (Michaelowa 2003). Until November 2003, only 17 host countries had defined their DNA. It is thus likely that relatively advanced countries will profit most from the CDM.

The term "Joint Implementation" has got a narrow meaning through the Kyoto Protocol; formerly it was the umbrella term for all project-based reductions abroad. It now only applies to projects that take place in Annex B countries that are, according to the Kyoto Protocol, countries with binding targets. Emission credits ("Emission Reduction Units", ERUs) can only accrue from 2008. JI has two distinct "tracks". The first track is very liberal and leaves choice of baselines and project lifetimes to the participating countries. This is due to the fact that ERUs are deducted from the emissions budget of the host country and thus there is no incentive for baseline manipulation. The second track is similar to the CDM and applies if the host country does not fulfil the reporting requirements for Annex B countries; of course it can also be chosen voluntarily. It is overseen by a "Supervisory Committee" and the ERUs have to be certified by "Independent Entities". It is likely that the rules developed by the CDM Executive Board will be used under the second track. To garner the potential for emission reductions before 2008, some countries already now invite investments into "early JI" emission reduction projects and grant post-2008 emission rights from their budgets for the pre-2008 reductions.

**Figure 1: The CDM project cycle**




## 2. Renewable energy in the CDM and JI: initial experiences and market projections

There is increasing empirical data on CDM and JI projects. We start with an overview of a "test phase" from 1995 to 2001 and then look at the current market for CDM and JI projects and estimates on how it is going to develop in the future. The section closes with an overview on renewable energy CDM and JI projects that are currently developed. In the following analysis, energy generated from collection and burning of landfill and sewerage gas is not considered renewable.

### 2.1 Test run: how renewables fared during AIJ

As the idea of project-based emissions credits already came up in 1992, COP 1 in 1995 decided that the concept should first be tested without accrual of emission credits and called this test phase "Activities Implemented Jointly" (AIJ). AIJ started relatively slowly and did not lead to the desired convergence of methodologies (Chatterjee 1997, Dixon 1999). Reporting was uneven and it was totally unclear which projects were just on paper and which ones actually implemented (see Table 1 and Michaelowa 2002, Beuermann et al. 2000). So less experiences could be drawn than expected.

**Table 1: The AIJ pilot phase over time**

| | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|---|
| **Projects reported** | 10 | 16 | 61 | 95 | 122 | 143 | 152 |
| **Projects implemented*** | 0 | 3 | 13 | 60 | 86 | n.a. | n.a. |
| **Investing countries** | 3 | 3 | 5 | 8 | 11 | 12 | 12 |
| **CDM host countries** | 2 | 2 | 5 | 14 | 23 | 27 | 30 |
| **JI host countries** | 5 | 5 | 7 | 10 | 11 | 11 | 11 |
| **Share of JI countries in all projects (%)** | 60 | 50 | 74 | 72 | 65 | 58 | 56 |
| **Planned emission reduction (mill. t $CO_2$)**** | 23 | 111 | 140 | 162 | 217 | 366 | 442 |
| **Share of JI countries (%)** | 56.5 | 39.5 | 32.6 | 31.3 | 24.3 | 15.6 | 13.6 |

* These are estimates as no reliable information exists. The implemented projects tend to be small projects in countries in transition.

** The emission reduction actually implemented is much lower (see previous note).

Source: Michaelowa (2002)

In 1999 only 70% of the planned AIJ projects had been implemented. However, the number of projects implemented steadily increased over time despite the fact that no credits accrued. Hence it is reasonable to assume that Annex I country governments as well as the private sector that invested in these projects were eager to gain experience with the concept of credit-based trading. It should not go unnoticed that in 41 potential host countries projects have been planned and that those countries in which they have been actually implemented accumulated know-how with credit-based trading.

Generally, renewable energy development is hindered by relatively high costs and other significant barriers (Wohlgemuth and Missfeldt 2002, Sathaye 2001, Moomaw 2001). Despite this fact renewable energy projects contributed a considerable share in the total number of AIJ projects planned. It peaked in 1997 with 42.6% and decreased to 34.0% in 2001 (see table 2).

Table 2: **Project types as share of number of planned projects and of total emission reduction (in brackets)**

| | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|---|---|
| **Forest protection and reforestation** | 30 (84.5) | 25.0 (68.4) | 13.4 (58.5) | 11.6 (52.2) | 9.8 (64.8) | 9.3 (38) | 8.5 (33.3) |
| **Afforestation** | 10 (1.3) | 6.3 (0.2) | 1.6 (0.2) | 1.1 (0.2) | 1.6 (0.1) | 1.4 (0) | 2.6 (1.1) |
| **Agriculture** | 0 | 0 | 1.6 (<0.1) | 2.1 (1.8) | 1.6 (1.4) | 1.4 (1) | 1.3 (0.7) |
| **Fuel switch** | 20 (10.7) | 12.5 (2.2) | 3.2 (1.7) | 3.2 (1.8) | 5.7 (1.7) | 6.4 (2) | 6.6 (2.0) |
| **Methane capture** | 0 | 6.3 (27.0) | 3.2 (21.3) | 2.1 (18.6) | 3.3 (14.4) | 5.0 (30) | 5.9 (42.9) |
| **Energy efficiency** | 30 (2.5) | 25.0 (1.7) | 34.4 (2.6) | 37.9 (4.8) | 40.1 (3.5) | 41.4 (12) | 40.5 (11.3) |
| **Renewable energy** | 10 (1.0) | 25.0 (0.5) | 42.6 (15.6) | 42.1 (20.5) | 37.7 (13.9) | 35.0 (17) | 34.0 (8.7) |

Source: Michaelowa (2002)

On the basis of this data it is legitimate to assume that renewable energy projects will also play a lead role in CDM and JI in terms of number of projects carried through. However, one clearly sees that when considering the total emission reductions the average size of renewable energy projects was much smaller than the size of other project categories.

### 2.2 CDM and JI market size and prices: initial euphoria, hangover and growing optimism

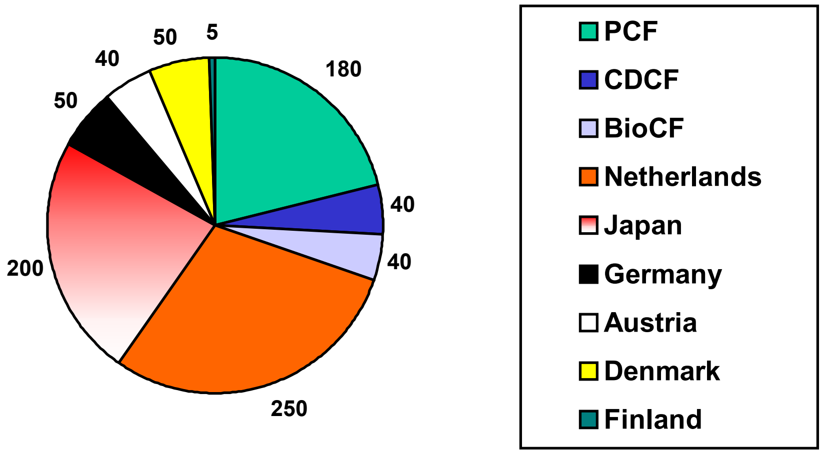
Before the US pullout from the Kyoto Protocol, estimates of Annex B countries' annual demand for emission reductions through the Kyoto Mechanisms during the period 2008-2012 ranged between 1.7 and 5 billion t (Austin et al. 1998, Figueres 1998). These estimates saw a CDM market share between 19 and 57%. Prices were estimated at 3.5 to 11 \$/t $CO_2$ and annual financial flows from 2.8 to 17.4 billion \$, i.e. 6 to 36 % of current ODA and 1 to 7 % of current FDI. Current estimates are much mores sanguine. Michaelowa and Jotzo (2003) estimate an annual demand of just 1.1 billion t of which the CDM could capture 33% and JI only 5%. The price would amount to 3.8 €/t. However, over a quarter of this would go toward transaction costs and taxes, leaving just around 2.5 €/t $CO_2$ for implementation of the project. Annual average revenue from CDM projects would be around 0.7 billion € until 2012. Energy sector projects account for 57 % of total CERs generated; the remainder comes from sinks, gas flaring and landfill gas projects. The share of CERs from renewable energy projects has not been modelled so far.

Currently, there are several programmes that purchase CERs and ERUs:

- The World Bank Carbon Finance unit hosts the Prototype Carbon Fund, the Community Development Carbon Fund, the Bio Carbon Fund, the Netherlands Clean Development Facility and the IFC-Netherlands Carbon Facility
- The Dutch government organised the CERUPT and ERUPT tenders and buys CERs through pipelines generated by banks (Rabobank)
- The Austrian, Danish, Finnish and Swedish governments are buying CERs

The current market size amounts to about 0.9 billion $ for both JI and CDM (see Figure 2).

**Figure 2: Current market size (million $)**




The major players are the World Bank and the Netherlands. Recently, Japan has announced major initiatives while some smaller EU countries started their own programmes. Demand should pick up once the possibility to import CERs and ERUs in the EU trading scheme is clarified.
Prices for CERs and ERUs tend to differentiate. The Prototype Carbon Fund (PCF) offers 2.5 to 3 € while the Community Development Carbon Fund (smaller projects with high development benefits) quotes 4 to 7 €. In the Dutch ERUPT/CERUPT differentiates, renewables get up to 5.5 €, bioenergy and energy efficiency up to 4.4 and other project types only up to 3.3 €. Japanese buyers have offered up to 12 € for renewable energy CERs from South East Asia.
It can be observed that the prices that can be achieved by renewable energy project developers under JI and CDM range from 2.5 to 12 € and depend on the buyer. It cannot be assumed that prices will increase before and during the first commitment period (Springer and Varilek 2004). In how far this potential revenue can contribute to the financing of renewable energy projects is discussed in chapter 3.

### 2.3 Supply of CERs and ERUs - Renewable energy projects currently in the pipeline

So far (November 2003) there is no single officially registered CDM project; the first registration is expected in early 2004. Some of the above mentioned programmes are very transparent and provide detailed project documentation (the World Bank, the Dutch Government). All project documentations submitted to the EB are available on the UNFCCC website. Some project developers submit project documentations to the CDM Executive Board without being engaged in one of the programmes.

Currently 62 project documents for renewable energy CDM and JI projects are publicly available. An analysis gives the following picture (Table 3) but it may change soon.
Generally, it can be seen that the CDM is the preferential mechanism for project developers as 53 potential CDM projects in contrast to 9 JI projects are being developed.
It can be observed that hydro and wind projects are attracting most attention under both JI and CDM, followed by biomass projects. Geothermal projects are only developed under CDM. These projects achieve on average significantly higher emission reductions (0.34 Mt) than the other renewable energy project types among which the range is 0.07 to 0.12 Mt.
In most of the host countries the CDM has spurred the development of renewable energy technologies as the share of CDM projects in the total capacity in the respective region ranges from 0.2 to 394%.

**Table 3: Shares of different renewable energy technologies in proposed CDM and JI projects**

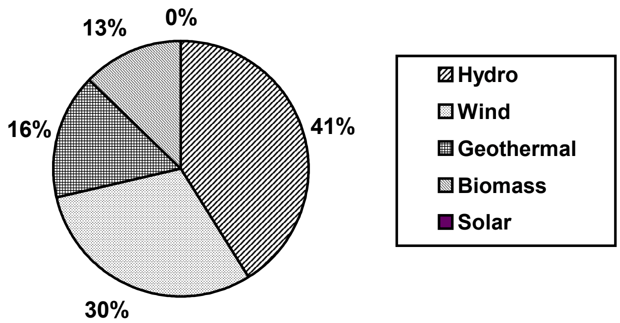
| Project type | No. of projects | Capacity (MW) | Expected CERs per year (Mt) | Av. CERs per project (Mt) | Share of capacity in respective region* |
|---|---|---|---|---|---|
| **Biomass CDM** | 12 | 269 | 0.82 | 0.07 | 2% |
| **Biomass JI** | 2 | 34 | 0.15 | 0.07 | NA |
| **Geothermal CDM** | 4 | 366 | 1.35 | 0.34 | 10% |
| **Hydro CDM** | 23 | 846 | 2.23 | 0.10 | 0.2% |
| **Hydro JI** | 3 | 115 | 0.36 | 0.12 | NA |
| **Solar CDM** | 1 | <0.1 | <0.1 | <0.1 | NA |
| **Wind CDM** | 13 | 491 | 0.91 | 0.07 | 21% |
| **Wind JI** | 4 | 213 | 0.46 | 0.11 | 394% |
| **Total CDM** | 53 | 1772 | 5.31 | 0.10 | 0.5% |
| **Total JI** | 9 | 562 | 0.97 | 0.11 | NA |

* For JI, only countries in transition are counted. Data for biomass, geothermal and hydro are for 2000 (Martinot et al. 2002), for wind for 2002 (AWEA/EWEA 2003).

Sources: Websites of UNFCCC, World Bank Carbon Finance, SENTER, Det Norske Veritas, own calculations

Figure 3 provides an overview on the share of the renewable energy technologies according to their expected amount of CERs generated each year.

**Figure 3: Share of renewable energy technologies in the overall CER volume projected from CDM and JI projects**




Box 1 gives an idea of the issues involved in CDM project development that are additional to conventional renewable energy project development. The project presented is one of six for which the baseline and monitoring plan methodologies have been approved by the EB.

**Box 1**

**The first to be registered renewable energy CDM project: Rice husk-fired plant in Thailand**

A 20 MW rice husk power plant in central Thailand managed to get the first approval of the CDM Executive Board for a baseline methodology of a renewable energy technology in October 2003. The project participants had previously submitted a methodology that was rejected but resubmitted a new methodology immediately afterwards.

The plant plans to generate 133 GWh per year that will be sold through a 25-year power purchase agreement (PPA) with the Electricity Generating Authority of Thailand (EGAT). Within the project's procurement area, it is estimated that there are over 1 million tonnes of rice husk, of which approximately 700,000 tonnes are unused. This large surplus rice husk represents almost five times the plant's requirement. 8-year fuel supply agreements have been concluded with about 30 rice millers, principally within 80 km of the proposed plant. CER volume is estimated at 83,000 per year. At a price of 7 $ per t of $CO_2$, the CER revenue will enhance the project's ROE by 7.2%. The project developers argue that it is additional due to investment and technology barriers. The technology used is state-of-the-art (suspension-fired boiler), much superior to the stoker boilers used by other rice husk power plants in Thailand. This technology has increased costs. Moreover, the absence of a core fuel supplier has made it impossible for the developer to find investors under business-as-usual. Another barrier is hostility of the neighbouring communities to any thermal power plant. Opinion surveys were conducted amongst 20 community leaders and 150 villagers. It remains to be seen whether the validator accepts these arguments for project additionality.

The baseline emission factor is EGAT's grid average emissions projected until 2012. It falls from 624 g $CO_2$/kWh in 2006 to 578 g in 2012 and has to be revised downwards if the actual emission factor lies below. As it could be the case that the plant prevents other biomass plants from coming on line due to competition for biomass supply, a test will be made to check whether the surplus supply of rice husk is at least twice as large as the amount needed to fuel grid connected rice husk power plants.

Source: Project Design Document NM0019: A.T. Biopower rice husk power project,
available at: http://cdm.unfccc.int/methodologies/process

## 3. Revenue from CDM and JI for renewable energy projects

The internal rate of return is most commonly used to determine the viability of any investment. It is usually calculated on the basis of a cash-flow analysis which rests on a considerable number of parameters that are project-specific. This chapter cannot cover all of those parameters comprehensively and therefore focuses on the following questions. First, on which factors does the additional revenue from CDM and JI projects depend on? Second, what does this mean for renewable energy projects under CDM and JI in particular? Finally, estimates for the magnitude of additional revenue from the project-based mechanisms are presented.

### 3.1 Factors the revenue from CDM and JI depend on – implications for renewable energy projects

Investment in renewable energy projects under JI and CDM is physically inseperable from the conventional investment in renewable energy projects (Laurikka and Springer 2003). In contrast to that the additional revenue generated from the "GHG mitigation component" of CDM or JI project can be distinguished from the conventional income stream of the project. The total revenue from the "GHG mitigation component" depends on the revenue from the sale of CERs and the transaction costs incurred by the project developer (see box 2).

**Box 2**

**Revenue from sale of credits and factors it does depend on**

Specific revenue "GHG mitigation component" (e.g. €/kWh or €/t $CO_2$)
= specific $R_{credits}$ – specific. *TACs*

Where:
- $R_{credits}$ is the revenue from the sale of credits/ value of credits
- *TACs* are the transaction costs that accrue from the "project cycle" and from potential market transactions (e.g. finding a buyer for the credits)

$R_{credits} = q_{credits} * p_{credits}$

Where:
- $q_{credits}$ is the total amount of credits generated until the end of the (last) crediting period
- $p_{credits}$ is the price of each credit/ value of each credit

**$q_{credits}$ depends on**:
- baseline emissions
- project emissions
- crediting period

***TACs* depend on:**
- project complexity
- host country
- maturity of the GHG market

It can be seen that the revenue from the "GHG mitigation component" of any project type will depend on a variety of factors.

$q_{credits}$ will be very project specific. The baseline emissions for example depend on the baseline option chosen as well as the project type as illustrated in box 3 (next page). They will also depend on the host country. $p_{credits}$ will depend on the price the buyer is prepared to pay for the CERs.

Although *TACs* in absolute terms depend on a variety of factors, specific transaction costs are mainly determined by the amount of CERs generated as most of the transaction costs are more or less fixed (Michaelowa et al. 2003). Table 4 shows the effect on projects of different sizes. At current market prices, all projects below 20,000 CERs per year are not viable, unless transaction costs are subsidised. There is indeed a tendency to subsidise development of PDDs and validation though public money.

**Table 4: Project size, types and indicative specific transaction costs**

| Size | Type | CERs (t $CO_2$/year) | Transaction costs €/ t $CO_2$ |
|---|---|---|---|
| **Very large** | *Large hydro*, gas power plants, large combined heat-power (CHP) plants, *geothermal*, landfill/pipeline methane capture, cement plant efficiency, large-scale afforestation | > 200,000 | 0.1 |
| **Large** | *Wind power*, *solar thermal*, energy efficiency in large industry | 20,000 – 200,000 | 1 |
| **Small** | Boiler conversion, demand side management, *small hydro* | 2000 – 20,000 | 10 |
| **Mini** | Energy efficiency in housing and small and medium enterprises, *mini hydro* | 200 – 2000 | 100 |
| **Micro** | *Photovoltaics* | < 200 | 1000 |

Source: Michaelowa et al. 2003

In order to sum up: the additional revenue from the "GHG mitigation component" of any project depend on a number of factors and is very project-specific. However, projects that generate large quantities of CERs will generate more revenue. First, the specific revenue from the sale of credits is mostly determined by the amount of CERs generated. Second, the specific transaction costs are considerably lower for projects that yield higher numbers of CERs as for those that generate low amounts of CERs. Transaction costs can make the latter projects unviable if they are higher than the revenue from CERs.

**Box 3**

**Calculating the baseline for small scale grid-connected renewable projects**

Baseline rules have been defined by the CDM Executive Board for renewable energy projects below 15 MW. The baseline here can be defined using one of two options:

- Average of the "approximate operating margin" and the "build margin", where: (i) The "approximate operating margin" is the weighted average emissions (in kg $CO_2$/kWh) of all generating sources serving the system, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation; (ii) The "build margin" is the weighted average emissions (in kg $CO_2$/kWh) of recent capacity additions to the system, defined as the lower of most recent 20% of plants built or the 5 most recent plants;
- The weighted average emissions (in kg $CO_2$/kWh) of the current generation mix.

A numerical example:
Your hydro plant of 10 MW generates 70 GWh p.a.. The grid it serves has the following characteristics:
5000 MW hydro generating 35 TWh p.a.
10000 MW coal generating 70 TWh p.a. with an emissions factor of 1.1 kg $CO_2$/kWh
3000 MW gas generating 15 TWh p.a. with an emissions factor of 0.5 kg $CO_2$/kWh
2000 MW oil generating 6 TWh p.a. with an emissions factor of 0.8 kg $CO_2$/kWh

The last 4000 MW built have the following characteristics:
1000 MW hydro generating 7 TWh p.a.
2000 MW coal generating 14 TWh p.a. with an emissions factor of 0.9 kg $CO_2$/kWh
1000 MW gas generating 6 TWh p.a. with an emissions factor of 0.4 kg $CO_2$/kWh

Option 1 is calculated as follows:

The approximate operating margin is $\frac{70 \cdot 1.1 + 15 \cdot 0.5 + 6 \cdot 0.8}{91} = 0.981$ kg $CO_2$/kWh

The build margin is $\frac{7 \cdot 0 + 14 \cdot 0.9 + 6 \cdot 0.4}{27} = 0.556$ kg $CO_2$/kWh

The average of the two is 0.769 kg $CO_2$/kWh.

Option 2 gives:

$$\frac{35 \cdot 0 + 70 \cdot 1.1 + 15 \cdot 0.5 + 6 \cdot 0.8}{126} = 0.709 \text{ kg } CO_2\text{/kWh}$$

To maximise CER volume, option 1 is chosen. Baseline emissions are 70 GWh*769 t $CO_2$/GWh = 53,830 t $CO_2$

In many countries, collection of these data will involve a certain effort.

Generally, the above findings apply to any type of GHG mitigation project, renewable or not. Apart from large hydro power installations no renewable technology has the potential to generate such a high amount of CERs so that transaction costs become negligible.

However, renewable energy projects can potentially achieve higher CER prices than other technologies. They come with a number of sustainable development benefits compared to conventional energy technologies. Evidence such as from prices paid in CERUPT and CDCF suggests that such projects achieve a premium due to their social and environmental benefits (see above, see Springer and Varilek 2004). Another chance to increase the CER price of a renewable energy CDM project is to validate it under the "Gold Standard" of the NGO community (WWF 2003). The Gold Standard was unveiled in July 2003 and shall define best practice CDM projects. It excludes fossil fuel generation, efficiency improvement and fuel switch projects and thus promotes renewable energy with the execption of large hydro.

### 3.2 Estimates for additional revenue for renewable energy projects from CDM and JI

As mentioned the revenue from CDM and JI is project-specific. Table 5 provides an overview on either the additional revenue generated by the sale of credits or the impact of the additional revenue on the IRR. The projects contained in table 5 are either case or desk studies. CER prices assumed usually range from 1 to 10 €/ t $CO_2$.

**Table 5: Additional revenue from CDM and JI**

| Project | IRR (%) | IRR with credits (%) | Additional revenue (ct/kWh) |
|---|---|---|---|
| **Wind farm (Brazil)** | 6.7 | 7.5-8.5 | -0.20 |
| **Wind farm (Morocco)** | 11.3 | 13.6-17.9 | 0.25- |
| **Wind (desk study)** | - | +1 | 0.25 |
| **Small hydro (Uzbekistan)** | 11 | 11.2-13.8 | - |
| **Small hydro (Uzbekistan)** | >12 | >12.4-14.8 | - |
| **15 MW hydro (desk study)** | - | - | 0.45 |
| **PV (Brazil)** | 8.4 | 8.7-10.2 | - |
| **PV (desk study)** | - | - | 0.50 |
| **Biomass (Zimbabwe)** | 18.3 | 18.4-21.7 | -0.40 |

Source: Langrock et al. 2003, Bode and Michaelowa 2003, Michaelowa et al. 2003

It can be seen that the sale of credits can lead to an increase in IRR by 1 to 2.4% and additional revenue in the order of magnitude from 0.2 to 0.5 ct/ kWh; in cases of extremely favourable baselines (1500 g $CO_2$/kWh) and premium CER prices (6 €/t $CO_2$) up to 0.8 ct/kWh. However, it should be highlighted that the figures do not factor in transaction costs.

## 4. Necessary conditions to generate new and additional funds for renewable energy projects through CDM and JI

### 4.1 Domestic instruments in Annex B countries

Without incentives, there will not be any investment in the Kyoto Mechanisms and thus also no promotion of renewable energy projects through them. A necessary condition for private involvement in CDM and JI is the existence of climate policy instruments in their home country. These instruments can take the form of emission trading, emission taxes, subsidies, or regulation. In a system of domestic emission trading, CERs/ERUs could be imported and used. Tax concessions could be granted and should be proportional to the emission credits achieved by a CDM/JI project. It would in principle also be possible to subsidise emission reduction projects at home and abroad in general

Also voluntary commitments can be combined with CDM/JI: A branch of industry, represented by a trade association, is prepared to implement an increase in its energy efficiency which has to be converted into a quantitative emission target. This target can be achieved by measures at home or abroad.

Latest estimates suggest that the current national climate policy instruments in most Annex B countries might not be sufficient to reach the GHG emission targets with domestic measures. For example, the Netherlands aim to reach 50% of the gap between business-as-usual emissions and the Kyoto target through CDM and JI.

Currently incentives to invest in CDM are limited. There are plans to allow imports of CERs and ERUs into the EU emissions trading scheme. However, governments have to approve these imports. A CDM tax credit is currently not possible in the countries with emission taxes (but discussed in some of them) and not even envisaged in the case of energy taxes. Voluntary agreements have been rather weak in most countries – unless they would be strengthened considerably, they will not be a relevant incentive for CDM investment. Thus only direct subsidies currently play a role – definitely not the way to generate broad private interest for the Kyoto Mechanisms.

### 4.2 Project additionality determination

The main challenge for the Kyoto Mechanisms is to avoid fictitious reductions, particularly in the case of the CDM where no cap exists for the host country and everybody would profit from an overestimate of reductions – the investor who gets more CERs and the host who can sell more. The problem is that there exist a lot of emission reduction opportunities which are profitable either for a company or for a country as a whole. The latter includes externalities such as the reduction of other pollutants. The question arises whether these so called micro- or macroeconomic "no-regret"-projects are additional or included in the baseline. Additionality can be seen on two levels – a macro and a micro level. Due to externalities, they will differ. A project that is clearly additional from a micro-economic point of view may not be macro-economically additional. Under fossil fuel subsidies, for example, a wind power plant might be clearly additional due to higher costs compared with the subsidised fossil fuel. If the subsidy was phased out, it could become non-additional. Thus non-additionality on a macro-level will enhance the supply of micro-level additional projects while strong macro additionality will reduce it.

Since the Marrakech Accords did not specify a specific additionality test, most project developers and analysts believed that any project could pass, provided its greenhouse gas emissions were lower than average emissions in the country for production of the same product. They were shocked when in April 2003 the CDM Executive Board rejected 8 proposed baseline methodologies outright and returned another six for revision (for a detailed analysis see Jotzo 2003). The EB cited lack of additionality tests as one of the main reasons for this result. In June 2003 the CDM Executive Board endorsed four general methods to assess additionality but the devil still lies in the detail:

- Flow-chart / series of questions that lead to a narrowing of potential project options
- Qualitative / quantitative assessment of different potential options and an indication of why the non-project option is more likely
- Qualitative/quantitative assessment of one or more barriers facing the proposed project activity. A list of "accepted" barriers can be defined (IEA 1997) which has been done by the CDM Executive Board in the case of small scale projects (UNFCCC 2003)
- Project type is not common practice in the proposed area of implementation, and not required by recent/pending legislation/regulations

UNIDO (2003) has made a sensible suggestion for a tiered additionality test that will hopefully be used by many project developers. Likewise, the "Gold Standard" promoted by the WWF (2003) suggests a procedure for additionality determination.
For JI projects of the first track, additionality determination is not mandatory but host country governments will make sure that the projects are additional. Every non-additional ERU sold has to be made up with reductions in other parts of the host country economy and that will cost money.

### 4.3 Capacity building plays a key role

The issue who pays capacity and institution-building in the CDM and JI context deserves attention. It has been rightly feared (Srivastava/Soni 1998) that ODA could be diverted to such uses as currently many industrialised countries fund capacity building up to the development of PDDs. All large CDM procurement programmes have a capacity building component and the UN organisations are competing against each other who can offer more capacity building activities. The past years have seen a proliferation of workshops and there has not been any coordination of these workshops. While in the beginning, workshops may have been useful to spread the general idea about the Kyoto Mechanisms, now their added value becomes lower, especially as there is no specialisation on sectoral and technology issues.
The importance of information, training, appropriate capacity and focal institutions for the development of CDM projects cannot be underestimated. Projects are concentrated in those Latin American and Central and Eastern European countries that already participated in AIJ, have developed targeted policies, made use of existing capacities to take on and manage projects and set up focussed institutions and regulation. This has helped them to gain first-hand practical experience while moving them up a steep learning curve. So these host countries created a *conducive enabling environment* which is a necessary, but not sufficient condition to attract investors. Experience from the most successful AIJ host countries shows that it is imperative to have a single unit responsible for the solicitation and approval of projects. It must have full decision autonomy and professional, permanent staff as it is the case in Costa Rica. Thereby, it can avoid a blockade through conflicting interests of different ministries that affected several AIJ projects in Eastern Europe and led to high transaction costs for project developers (Lile et al. 1998).
So far almost no investor country money has been used to fund institutions. The three person Costa Rican AIJ office which has done pioneering work concerning the implementation of AIJ projects and strongly influenced CDM negotiations did not receive

any capacity building money and had to survive by renting out consultancy services. UNIDO has done several studies on CDM institutional needs in African countries but nothing to spur actual implementation. The UNEP 12-country programme started in 2002 has learned from this failure and aims at concrete institution-building.

Of course, there are also positive examples from current capacity building. The National Strategy Study programme of the World Bank which started already in 1998 has managed to start know-how transfers between host countries by exchange of experiences in well-structured workshops. It has clearly been instrumental in getting host countries to have a clear view about sectoral priorities. The German capacity building programme in Indonesia, India and Tunisia takes a long-term view to develop CDM institutions, preferably by developing domestic capacity through provision of long-term domestic personnel resources.

Summing the experiences, host countries have to develop a national strategy as starting point to inform stakeholders about CDM potential and define priority sectors. Investor country consultants should only be used as "kickstarter". Donor funds have to be untied to select consultants in an open international tender procedure. Whereas capacity building linked with specific projects can play an effective role it needs to be complemented, and superseded by "programme capacity", i.e. focussed "host" country CDM programmes which can lead to a range of multi-sectoral projects. Even if capacity building has been successful in the institutional context, this does not assure that CDM proposals are developed by the host country´s private sector. This needs a motivational push through public policies and regulations; an information assessment support system and a pull provided by knowledge-based experts, who seek opportunities to exploit their skills. This is particularly important if small enterprises are to be reached.

## 5. Conclusions and policy recommendations

The project-based Kyoto Mechanisms can improve financing of renewable energy projects but will not provide a panacea for large-scale renewables promotion as long as the market price for greenhouse gas reduction credits will remain at its current level. The incentive per kWh currently is an order of magnitude below the feed-in subsidies in Europe, i.e. in the order of magnitude of 0.3-0.8 ct/kWh depending on the baseline and CER prices. This may however change if the US ratifies the Kyoto Protocol and a tendency arises to make future emissions targets more stringent. Thus, CDM and JI currently promote renewable energy technologies whose costs are not much above those of fossil fuel technologies. The Kyoto Mechanisms will definitely not be a vehicle to promote photovoltaics. In the best locations for wind, hydro and biomass, problems with additionality determination may arise as the renewables projects would have gone ahead even without the CDM revenues. For project developers, the lengthy CDM project cycle will generate transaction costs that make CDM projects only viable if they generate more than 20,000 CERs.

Policymakers in all countries should

- Quickly define domestic approval institutions
- Help in providing data for baseline calculation

Policymakers in Annex B countries should

- Link domestic climate policy instruments with CDM and JI to provide incentives for private investment
- Ensure that CDM capacity building is coordinated among donors and does not lead to a proliferation of short-term activities

NGO representatives and renewable energy project developers should

- Promote the Gold Standard. If it becomes a widely accepted standard such as the Forest Stewardship Council (FSC) standard, renewable energy projects will have a competitive advantage.

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### CDM and JI in general :

Foundation JIN is a node for information on the Kyoto Mechanisms with all issues of its Joint Implementation Quarterly available online.

The World Bank provides a wealth of information on its Kyoto Mechanism funds including all project documentation, background papers and discussion groups.

The NSS Programme provides in-depth studies on the potential for Kyoto mechanisms use of many developing countries and countries in transition.

The OECD has a rich lode of detailed documents on the project based mechanisms. The latter is particularly strong on baseline issues.

The Hamburg Institute of International Economics provides a lot of research papers on the Kyoto Mechanisms.

PointCarbon produces a daily e-mail newsletter and background information about the current situation on the international greenhouse gas market.

The CDM website of the UNFCCC Secretariat contains the officially adopted CDM rules, reports of the CDM Executive Board meetings and provides links to the Designated National Authorities, Operational Entities and information about registered projects.

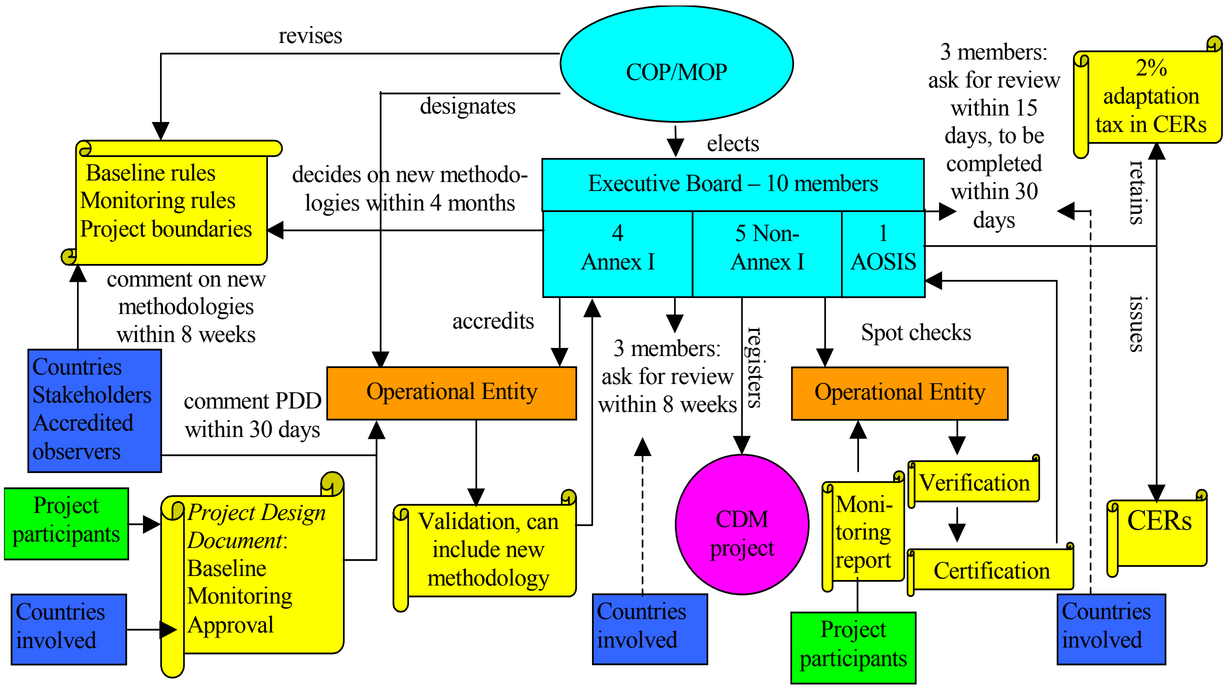
CDM Watch is a NGO that aims at critically assessing proposed CDM projects. The website contains a database on CDM projects.

CDM Connect provides discussion groups for business people and other persons interested in CDM.

UCCEE provides information about a large scale CDM capacity building programme

SouthSouthNorth is a developing country initiative that tries to develop CDM projects in four countries.

## 7. Annex



revises
COP/MOP
designates
elects
3 members: ask for review within 15 days, to be completed within 30 days
2% adaptation tax in CERs
Baseline rules
Monitoring rules
Project boundaries
decides on new methodologies within 4 months
Executive Board – 10 members
4 Annex I
5 Non-Annex I
1 AOSIS
retains
issues
comment on new methodologies within 8 weeks
accredits
3 members: ask for review within 8 weeks
registers
Spot checks
Countries
Stakeholders
Accredited observers
comment PDD within 30 days
Operational Entity
Operational Entity
Project participants
Project Design Document:
Baseline
Monitoring
Approval
Validation, can include new methodology
CDM project
Moni-toring report
Verification
Certification
CERs
Countries involved
Countries involved
Project participants
Countries involved

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