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FAST-TRACKING SMALL CDM PROJECTS: IMPLICATIONS FOR THE ELECTRICITY SECTOR

INFORMATION PAPER

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FOREWORD

This document was prepared by the IEA Secretariat in October 2001 at the request of the Annex I Expert Group on the United Nations Framework Convention on Climate Change. The Annex I Expert Group oversees development of analytical papers for the purpose of providing useful and timely input to the climate change negotiations. These papers may also be useful to national policy makers and other decision-makers. In a collaborative effort, authors work with the Annex I Expert Group to develop these papers. However, the papers do not necessarily represent the views of the OECD or the IEA, nor are they intended to prejudge the views of countries participating in the Annex I Expert Group. Rather, they are Secretariat information papers intended to inform Member countries, as well as the UNFCCC audience.

The Annex I Parties or countries referred to in this document refer to those listed in Annex I to the UNFCCC (as amended at the 3rd Conference of the Parties in December 1997): Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, the European Community, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom of Great Britain and Northern Ireland, and United States of America. Where this document refers to "countries" or "governments" it is also intended to include "regional economic organisations", if appropriate.

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Executive Summary

The Clean Development Mechanism (CDM) allows project developers to earn certified emission reductions credits (CERs) for projects that reduce emissions. The quantity of credits is determined by comparing project emissions to an estimate of what would have happened otherwise in the absence of the project activities. The environmental integrity and commercial attractiveness of CDM projects depend on making the process to obtain these CERs transparent, fair and equitable.

However there are concerns that the project approval process (which may be lengthy, and the outcome of which may be uncertain) might translate into high transaction costs. These costs could represent an insurmountable barrier by some legitimate projects, particularly smaller projects. While it is essential to minimise CDM-related transaction costs for all projects in order to provide sufficient incentives for the implementation of CDM projects, it is generally recognised that, typically, larger projects should be able to more easily absorb the transaction costs that might be associated with going through the CDM process to earn CERs. To help level the playing field for small projects, the Bonn Agreement, adopted in July 2001, includes a provision to "fast-track" small-scale CDM projects.

This paper outlines possible elements of a fast-tracking procedure, analyses the potential environmental impact that this could have, and explores the economic consequences for small electricity generation projects, focussing on renewables.

According to the Bonn Agreement, renewable electricity generation projects of up to 15 megawatts (MW), or "an appropriate equivalent" are eligible under the fast-tracking provision. The Agreement also allows other projects to benefit from the fast-tracking provision, as long as they directly emit less than 15 kilotonnes of carbon dioxide (CO_2). This would allow, for example, small natural gas plants of up to 5-6 MW to be eligible.

This paper presents information and insights that may be useful for the completion of negotiations on the CDM and, hopefully, the successful implementation of its fast-tracking provision. As a starting point for the analysis, the current situation for small power plants in developing countries is examined.

Analysis is based on a commercial database. Although the database under-represents small plants in developing countries, it nonetheless provides interesting insights. For instance, the data show the relative importance of small plants between different world regions. South Asia has the largest number of new plants of 15 MW or less, but it is in Africa where the proportion of very small plants is highest. While it is difficult to draw firm conclusions from the database, it seems that the fast-tracking process aimed specifically at small projects might help address some Parties' concerns about whether the CDM leads to an *equitable* distribution of projects between regions (although this issue merits further consideration).

Oil (mainly diesel) plants appear to overwhelmingly dominate the small (i.e. up to 15 MW) power plant picture in developing countries. Different sources and technologies used for electricity generation in small plants are not all perfect substitutes for one another. Nonetheless, the CDM fast-tracking provision could have a significant potential to help shift investment away from the GHG-intensive diesel option to cleaner facilities. Currently, other sources used in small electricity generation plants located in developing countries are renewables (especially hydro) and natural gas.

To successfully reduce CDM-related transaction costs for small projects, the fast-tracking provision would need to include a streamlined procedure. Such a procedure could build on existing environmental impact assessments (EIAs) and audits in the host countries, as well as include standardised baselines and a simplified standardised project description format.

Given the differences between typical sources of supply for off- and on-grid electricity, the fast-tracking provision should provide separate baseline standards for each. Off-grid electricity (normally at very small scales) may be particularly responsive to the fast-tracking provision. It is recommended that off-grid small CDM power projects generally be assessed against a diesel-based baseline. A possible exception to this off-grid baseline may be solar PV home systems, which might instead be assessed against an absolute baseline (per PV module) based on kerosene, which is typically the replaced source.

This paper examines four potential options for grid-based electricity baselines. These options reflect a broad range of possible country-based examples. The paper compares four different small projects (wind, small hydro, advanced oil, and advanced natural gas) to demonstrate the different volume of CERs that could be earned annually under different types of baselines.

The level at which the multi-project baseline is set is critical in affecting the relative economics of potential CDM projects compared to business as usual (BAU) alternatives (of course the value of CERs is also critical).

Not all small project investments would necessarily qualify as CDM projects. For example, they may still need to meet other screening criteria to obtain host country approval. However, as fast-tracking implies a simplified, “automatic” approval process for small projects, there might be concerns that it could lead to free-riding of non-additional projects projected under BAU scenarios. Small-scale hydro facilities could be considered to represent the greatest risk as these are commercially viable today in many locations around the world and they represent a relatively large proportion of small-scale power facilities installed globally. However, in terms of their contribution to overall hydropower generated electricity, small-scale hydro plants represent a very small share.

The maximum free-riding from fast-tracking small renewables power projects is estimated to represent only 3% of the required emission reduction from Annex I countries, including the United States, in 2010 to meet their Kyoto target (compared to BAU estimates). Without taking the United States into account, possible free-riding could represent a larger share of the remaining Annex I countries’ estimated emissions gap. Nonetheless, the estimated maximum free-rider risk from small-scale renewable electricity projects is quite small in absolute terms and so should not be a source of significant concern.

A fast-tracking provision for small projects should work to reduce overall CDM transaction costs. However, it is not certain whether reductions in transaction costs associated with an automatic crediting process (based on standardised baselines) is a sufficient incentive to encourage large numbers of additional small CDM renewables projects. It may, nonetheless, make a significant difference for some projects.

The paper considers the relative size of the offsets that CERs that could generate for a typical small wind plant. Although generation costs are difficult to generalise, as they are often very site-specific. It may take a high value of CERs accompanied by a high baseline level (i.e., low baseline stringency) to provide sufficient incentives to make a significant difference in the overall generation mix. For example, a small wind project using a diesel baseline would probably need be at least 1 MW in order to generate sufficient emission reductions and CERs to simply cover estimated annual CDM-related costs (e.g. reporting and monitoring).

Now that the international community has adopted a decision to go ahead with a fast-tracking provision for small CDM projects, simplified modalities and procedures for its implementation have to be developed. These will involve tradeoffs with other issues such as free-riders and the creation of incentives for investment in various GHG-reducing generating options. The choice of baselines is key. A review process, to learn from early experience, would be a useful addition to rules for the fast-tracking provision.

1. Introduction: Why do small projects need special consideration?

The Kyoto Protocol's Clean Development Mechanism (CDM) could stimulate greater greenhouse-gas friendly investments in developing countries, thereby helping address global climate change, as well as contributing to meeting developing countries' sustainable development priorities.

A clear and rigorous CDM "process" is thought to be necessary to ensure the environmental integrity of the CDM as a whole. There are concerns, however, that the CDM process (e.g. the approval, validation, monitoring, reporting, verification and certification of CDM projects) may end-up being a financial barrier that some legitimate projects, particularly small-scale projects, could not overcome. In fact, a lengthy project approval process and unpredictable outcomes could result in transaction costs that outweigh the potential added benefit of certified emission reductions (CERs) associated with CDM projects. The CDM process, if too costly and burdensome, could potentially jeopardise the successful implementation of the CDM.

As a response to this concern, the international community adopted, at the resumed Sixth Conference of the Parties (in Bonn, July 2001), an agreement which includes a decision to go ahead with a special streamlined administrative procedure to fast-track small-scale projects in the CDM. There are several justifications for such an effort, such as:

- Small CDM projects can be particularly well-suited to help improve socio-economic, as well as environmental, local conditions in some contexts (e.g. small off-grid electricity generation plant in a rural area without access to grid electricity);

- Small projects, although fully compatible with the CDM's dual objectives, may be at a disadvantage compared to larger projects because the total value of their emission reductions (compared to larger projects) may not be sufficient to cover the added transaction costs associated with getting a CDM project through the approval process.

- The potential impact of environmental error (e.g. if an incorrect baseline for fast-tracking is chosen) is likely to be smaller for small projects;

- It may be easier to get a greater number of small CDM projects implemented, which could then also become useful testing grounds for the further development of CDM rules and guidelines.

Literature on Experience Curves (e.g. IEA 2000a) shows the positive relationship between increased learning through increased market experience of a given technology (e.g. cumulative electricity production from PV) and reductions in the price of this technology. In turn, this price reduction influences the relative competitiveness of this technology, which results in further market growth and then again in additional price reductions. However, a technology that cannot penetrate the market because it is too expensive will not be able to go up the learning curve. Deployment support is viewed as important to increase learning investments in newer desirable technologies that are not yet competitive.

Implicitly, one of the objectives of setting up a process to fast-track small CDM electricity projects could be exactly that: to help GHG-friendly and sustainable development-friendly technologies, particularly renewables, to become more attractive to potential investors and thus be deployed faster and in greater volume than would otherwise be the case.

Although small projects can be undertaken in various sectors (e.g. energy, industry, transport, etc.), this paper examines what could constitute "small" electricity generation projects, along with their likely implications. It seeks to shed some light on the potential implication of "fast-tracking" small projects in the electricity sector (and renewables in particular) through the CDM approval process:

- Could it really help get more, small GHG-friendly projects underway than would have otherwise occurred? Could fast-tracking small projects through the CDM help countries meet their sustainable development priorities (e.g. rural electrification) faster than under BAU scenarios? (i.e. what kind of benefit can we expect from fast tracking small projects)

- Are there downsides to fast-tracking small projects? Does it encourage free riding and how significant is this risk?

This preliminary analysis is based on two main sources of data: the IEA 2000 *World Energy Outlook* and the UDI/McGraw-Hill (November 2000) *World Electric Power Plants Database*[1].

1.1 Estimated CDM transaction costs[2]

The success of the CDM and its fast-track provision to stimulate investments in small GHG-friendly electricity generation projects will depend on the economics of such projects. The main question is whether the CERs, along with the reduction in CDM transaction costs (obtained via the fast-tracking provision), make small GHG-friendly electricity projects more attractive to potential investors relative to other competing investment opportunities.

A rigorous, transparent and equitable CDM process is necessary to ensure environmental integrity and comparability. However, transaction costs to prepare CDM projects may become barriers to some legitimate GHG-reducing projects, particular smaller projects, which might work to discourage potential investors and project developers.

The World Business Council for Sustainable Development (2000) highlights the differences between theory and reality in assessing the CDM's potential. Top-down models seeking to analyse the potential volume of CERs that could be generated by CDM projects assume a theoretical frictionless market. By contrast, real-life projects will likely operate in a system with significant "friction", thereby restricting the supply of CDM projects. The greater the complexity of methodologies (e.g. to develop baselines) and processes (to obtain project approval), the greater will be the transaction costs and the lower the CDM deal flow.

Small renewables projects are believed to be particularly vulnerable to transaction costs. For instance, prior to the 2001 adoption of the fast-tracking decision, PWC (2000) commented on the possible financial implications of the CDM project cycle, describing the proposed CDM process as one that "undeniably favours large projects and that small projects could be priced out of the market". EcoSecurities Ltd. (2000) also suggested that the CDM-related transaction costs would be similar (in absolute levels) for large and small projects, thereby favouring large-scale projects, given lower proportional costs and their ability to deliver emission reductions at a lower cost per CER.

Several studies include estimations of the potential CDM transaction costs - without fast-tracking (Table 1). These costs typically take the form of cost of managerial time and other internal resources (pure

[1] The UDI/McGraw-Hill database under-reports small power plants. However, given that no more comprehensive database is available, it is considered a useful basis for this report.

[2] There are different types of transaction costs. For example, there are typical transaction costs associated with financing small projects (renewables) in developing countries; and transaction costs associated with the CDM process. This section focuses on the latter.

opportunity cost), as well as fees for any advice supplied by external consultants, and operational entities (OEs) during the design and implementation of the project. Depending on the market price[3] of each CER, estimates from Table 1 imply that a small project would need to generate a minimum of 20,000 CERs (at 5\$/tCO_2) or 5,000 CERs (at 20\$/tCO_2) simply to cover the initial transaction costs of putting a project through the CDM process. Then, about 2,000-3,000 additional CERs (at 5\$/tCO_2) or 500-750 CERs (at 20\$/tCO_2) would need to be generated annually to cover costs such as for reporting, monitoring and verification. In the case of power projects, it would mean that only CERs additional to that amount could help finance the building of a CDM project. As discussed later in the paper, the initial transaction costs could represent more than 10% of the CERs (at 5\$/tCO_2) that a 15 MW CDM wind plant could earn, under a diesel-based baseline, or even more under more stringent baselines. Subsequent annual CDM-related costs could represent between 7-10% of the annual CER revenues (at 5\$/tCO_2) from the same CDM wind plant. These costs may be too high for some small electricity projects. For example, the implication for small wind projects (with a 25% load factor) is that in order to generate enough emission reductions and CERs (under a diesel baseline) to cover the estimated annual CDM-related costs, they would need to have a capacity size larger than 1 MW.

In addition to CDM process-related transaction costs, the Kyoto Protocol's CDM article includes the provision for an adaptation levy, which could also contribute to upsetting the economics of small renewables projects. Some suggest exempting small renewables projects from such a levy. This issue is, however, not further discussed in this paper.

Most of the transaction cost estimates are most relevant for the "early" CDM market. But over time, as learning and experience in CDM projects is gained, combined with greater competition in the market, the CDM-related transaction costs should go down.

[3] With the 2001 announcement of the U.S. Administration's intention to withdraw from the Kyoto Protocol, the international demand for emission credits will be lower than that previously estimated. This will lead to a lower international price for emission credits (IEA, 2001).

Table 1: Overview of CDM transaction costs estimates

Studies	Estimated CDM Transaction Costs	Assumptions
PWC (2000)	- US$ 0.4m to $1.1m, i.e. representing between 2-23% of capital expenditures. (e.g. In the case of 0.1 MW PV project, involving only 1 operational entity, CDM-related transaction costs amount to $387,000)	- Total costs over project cycle (in 2000$) - Range depends on project size & type and number & nature of operational entities involved.
Walsh (2000)	- $40,000 (highly simplified project) to more than $80,000. Complex projects: $100,000 to $500,000. - Subsequent annual reporting and occasional auditing costs: 10-20% of initial costs.	- Includes initial costs of defining a CDM project, establishing the baseline, documenting project additionality, preparing registration forms, obtaining certification, government approval and submitting required documents - Assumes a blend of industrialised country and developing country professional fees
EcoSecurities Ltd. (2000)	- Total up-front costs: $57,000-$90,000. - Monitoring and verification: $3,000 – $15,000 per year	- Estimated costs of transacting a JI project, assuming JI requirements are similar to CDM project cycle.
PCF	- total costs: $200,000 - $400,000	- Half of the amount for baseline work; half for verification/certification work throughout the project
Martens et al. (2001)	- Transaction costs for small-scale solar home systems projects range around 20% of the total CER revenues, using a standardised baseline & streamlined procedures.	- Without the standardised baselines and streamlined procedures, project design costs could be almost 3 times higher and total transaction costs 50% higher.

2. Defining "small" in the electricity sector

The July 2001 Bonn Agreement's (FCCC/CP/2001/L.7) decision to develop a fast-tracking provision for small CDM projects specifies the eligibility criteria:

> *...the executive board shall develop and recommend to the Conference of the Parties, at its eighth session, simplified modalities and procedures for the following small-scale clean development project activities:*
>
> *(a) Renewable energy project activities with a maximum output capacity equivalent of up to 15 megawatts (or an appropriate equivalent);*
>
> *(b) Energy efficiency improvement project activities which reduce energy consumption, on the supply and/or demand side, by up to the equivalent of 15 gigawatthours per year; or*
>
> (c) *Other project activities that both reduce anthropogenic emissions by sources and directly emit less than 15 kilotonnes of carbon dioxide equivalent annually.*

The decision text also invites the CDM executive board to review the simplified modalities, procedures, as well as "*the definition of small-scale project activities ... and, if necessary, make appropriate recommendations*..."

The eligibility criterion for renewables energy projects is defined in terms of capacity size: 15 MW or "an appropriate equivalent", which has not been defined. Different interpretations are possible. Such language might be viewed as a recognition of the intermittent nature of wind energy, for example, leading to lower load factor (e.g. the actual electricity output of a 15 MW wind farm would be about equivalent to a 4 or 5 MW fossil fuel plant). If this were the case, some renewables plants larger than 15 MW could be eligible to the fast-tracking provision. Another interpretation is that "appropriate equivalent" was meant to apply to some types of non-electricity renewable energy projects that do not have a clear output capacity (e.g. some solar projects).

Option (c) of the Bonn Agreement text on fast-tracking also allows for non-renewables small electricity projects, as long as they do not emit more than 15,000 tonnes of CO_2 per year[4]. For example, this means that a natural gas combined cycle power plant of up to 5.7 MW (with a load factor of 75% and an emission factor of 0.396kgCO_2/kWh) could be eligible for fast-tracking. Another possible interpretation of this option is also possible: it could mean that a small project would need to (i) emit less than 15,000 tonnes of CO2 per year, and also (ii) reduce emission from sources by less than 15,000 tCO_2 per year (which would depend on the baseline).

[4] Walsh (2000) concludes that a standardised approach for small projects is considered highly desirable, as long as "small" is defined such that the "maximum eligible projects be no less than 10,000 tons CO_2 per year", given that for the CDM to become a real stimulus for clean projects, it must lead to an increase in the overall rate of return and *not* just lead to a "break-even activity".

2.1 Small electricity projects: location and type

It is useful to first examine what is actually happening in non-Annex I countries' electricity sectors for determining reference baselines. The UDI/McGraw-Hill (2000) database[5] is a good source of information on where various types of power plants are located, their primary energy source, as well as their size. Tables 2 and 3 examine the number of power plants installed recently (i.e. after 1997), currently under construction or planned[6], according to different sizes.

Table 2 presents the most recent electricity developments in non-Annex I countries according to geographic region, while Table 3 shows essentially the same information[7], but according to the primary energy source.

When examining Tables 2 and 3, it is important to keep in mind that the figures represent numbers of units[8] (and not generation capacity). Also, the figures presented in each column in both tables overlap, e.g. the plants included in the 5 MW category are also included in the 10 MW category, and so on up to 50 MW and "all sizes".

Box 1 – Database caveats

When considering the insights obtained from the UDI/McGraw-Hill database, it is important to keep in mind the strengths and weaknesses of this data source. It is a unique worldwide data source on individual power plants. However, its coverage is better for some types of plants than for others. Unfortunately, the smaller the plant capacity size, the greater the likelihood that the database is missing data. In fact, due to the difficulty in data collection, the UDI database may not necessarily include, for all countries, fully comprehensive coverage for all wind turbines, internal combustion engines (mostly diesel-fired), and mini- and micro-hydro units, mostly plants of small size. Data collection on very small solar installations (i.e. 1 to 10 kW) is also very difficult and most plants could be missing from the database[9]. All the coverage may not be comprehensive for some countries.

The results from this analysis must thus be caveated by the likelihood that the database underestimates small plants. It is not possible, without significantly more research, to quantify the percentage by which the database is off, and the variations in gaps for the different types of small plants. For example, it is currently not possible to assess if there are relatively more solar plants missing from the database than wind plants or oil-fired plants. Notwithstanding the important caveats, the database provides interesting insights.

[5] The UDI/McGraw Hill *World Electric Power Plants Data Base* includes information on individual electric power plants world-wide, except for two types of power plants: (i) most reciprocating engines or gas turbines identified in primary sources as "emergency", "standby", or "back-up"; and (ii) all gas turbines or internal combustion engines on offshore platforms.

[6] Some *planned* plants may be for beyond the first commitment period (e.g. 2015).

[7] Minor discrepancies are due to the fact that the electricity source was not specified for some small (planned) plants, but the size and location were specified.

[8] E.g., for hydroelectric plants, a "unit" is a turbine and a generator; for plants with internal combustion (reciprocating and diesel engines), a "unit" is an engine and a generator; for wind energy plants, a "unit" consists of wind turbine generators of the same model installed at the same time.

[9] For example, IEA 2000c notes that 10 projects of 500kW were being installed in India that year and that 15 were commissioned, while the UDI database only includes 3 solar plants under 15 MW.

Table 2 shows that the majority of power plants recently built or currently under construction or planned are located in Latin America (1347) and in South Asia (1204). However, it is in Africa where the proportion of very small plants is highest, with 26% of all the African plants being no larger than 5 MW and 39% of the plants being of 15 MW or less. At the other end of the range, the database indicates that in China, small plants of 5 and 15 MW represent only 3% and 8%, respectively, of the total number of plants recently built, currently under construction or planned.

Table 2: **Number of electricity power plants by region: recently (1998-2000) installed and currently under construction or planned capacity additions**

	5 MW or less # of units	10 MW or less # of units	15 MW or less # of units	50 MW or less # of units	All sizes # of units
China	26	45	71	223	933
South Asia	120	255	345	621	1204
East Asia	147	262	321	482	1043
Latin America	182	264	321	660	1347
Africa	135	186	200	292	512
Middle East	90	147	181	301	701
Other non-Annex B	25	37	42	72	142

Source: UDI/McGraw-Hill (November 2000).

Small projects appear to represent a greater proportion of all project activity in Africa and are particularly significant for smaller developing countries. If the data present an accurate picture of geographic distribution, there would appear to be a possibility that a fast-tracking provision for small projects might help address some Parties' concerns about an *equitable* distribution of projects among non-Annex I countries. However, this issue merits further analysis, including an examination of electricity investment trends in developing countries and whether the CDM fast-tracking provision could direct them more towards small and least developing countries.

The different sources and technologies presented in table 3 are not all perfect substitutes for one another. As indicated in Annex I, different technologies have different size optima: while some technologies are well suited to generate large amounts of electricity (e.g. nuclear or coal), others appear mostly appropriate for smaller-scale applications (e.g. wind or diesel). Different technologies are also best suited for certain applications (e.g. peak or base load) than others. Some technologies are also economic only in particular contexts e.g. off-grid[10]. Some technologies typically offer less reliability given lower load factors (e.g. wind) and thus often have to be combined with other sources of back-up generation capacity. Moreover, as

[10] Certain areas, such as small islands and geographically challenging terrains are typically not connected into the utility grid.

mentioned previously, with the same nominal power ("nameplate capacity"), some technologies offer more energy output than others.

Table 3: **Number of electricity power plants by source: recently (1998-2000) installed and currently under construction or planned capacity additions**

Electricity Source	1 MW or less	5 MW or less	10 MW or less	15 MW or less	50 MW or less	All sizes
Coal	0	4	10	20	74	875
Natural gas	1(0)	20 (0)*	39 (4)*	52(4)*	215 (50)*	836 (443)*
Oil[2]	246 (194)**	448(288)**	711 (320)**	852 (334)**	1121 (368)**	1397 (383)**
Geoth-ermal	0	3	6	8	58	100
Nuclear	0	0	0	0	0	60
Hydro	43	189	337	440	958	2197
Wind	6	28	46	55	80	86
Biomass	1	6	7	8	26	29
Solar	3	3	3	3	10	12
Waste	8	24	36	42	101	272
TOTAL	308	725	1195	1480	2643	5864

Source: UDI/McGraw-Hill (November 2000).
OIL: includes mainly diesel oil, crude oil, heavy fuel oil, distillate oil, petroleum coke, naphtha, and kerosene.
COAL: includes mainly bituminous coal, sub-bituminous coal, lignite, coke-oven-gas, blast furnace gas, and coal gas from coal gasification.
GAS: includes mainly natural gas and some liquefied natural gas
* Number in parenthesis refers to number of combined cycle natural gas units.
** Number in parenthesis refers to number of units that specified using diesel to generate electricity (for some oil-fired plants, there was no specification).

Table 3 shows that oil is the fuel of choice for electricity generation in small power plants in developing countries. Oil represents 80% of plants of 1 MW or less, and 58% of plants smaller than 15 MW. Diesel represents a large portion of oil-fired plants, especially in smaller plant sizes (i.e. more than half[11]). Small-scale hydro is the second most common source of electricity generation for small plants, but only at a size

[11] Maybe more, as the specific fuel type for "oil" plants was not always specified.

of 50 MW does it come closer to the number of oil plants. Together, oil and hydro represent the lion share of small plants (all size definitions) recently installed or currently under construction or planned in non-Annex I countries.

There are currently no small nuclear plants[12]. Small coal plants are also rare: only 10 plants in the database are of 10 MW or less, representing 1% of all coal plants in non-Annex I countries. Small gas-fired units of 15 MW or less represent about 3% of all plants of that size. They account for 6% of all natural gas units recently installed or currently under construction or planned in developing countries and small natural gas units using combined cycle technology are only a fraction of that.

Among the non-hydro renewables, Table 3 indicates that wind plants are most common, although still representing a rather small fraction of total small power plants in non-Annex I countries (i.e. 4% of all plants smaller than 5MW, 4% of all plants smaller than 10MW and 3% of all plants of 50 MW or less).

There are a number of particular contexts in which renewables, and even non-hydro renewables, are already an interesting option for investors and project developers. However, Table 3 clearly shows that the potential for improvements, in terms of lower GHG emission from the generation of electricity generation via small power plants is quite significant. Oil, and particularly diesel, plants dominate the "small" plant category. Although it is difficult to draw firm conclusions on small electricity plants from the UDI/McGraw-Hill database, a main objective of the fast tracking provision for small plants could be to generate incentives for project developers currently planning to build oil-fired plants to re-visit their plans in light of the CERs that could be obtained with lower-or non- GHG emitting power plant[13]. In this way, GHG emissions could be reduced significantly compared to what would have happened otherwise. For example, if 30% of the small oil plant (under 15 MW) were converted to non-GHG emitting renewables, this could represent more than 1300 MW of BAU oil capacity converted into renewables.

[12] However, UIC (2000) notes that there is an interest in developing smaller nuclear units to respond to concerns about high capital cost of large power reactors and to public perception. Notwithstanding, the 2001 Bonn Agreement stipulates that Annex I countries *are to refrain from using certified emission reductions generated from nuclear facilities*.

[13] Potential future work could examine what are the particular circumstances where diesel is currently the electricity source of choice, and how the CDM fast-tracking process for small projects might alter such a situation.

3. Fast-tracking: possible elements of an effective and low cost procedure

3.1 Fast-tracking: a streamlined procedure

The design of the steps of the CDM process, from obtaining host country approval to obtaining the corresponding CERs, is a matter of considerable discussion in the international community. The Bonn Agreement stipulates that the CDM executive board will be tasked with the responsibility for the development of standardised baseline procedures and simplified monitoring methodologies for small-scale CDM projects.

This section provides suggestions on elements of a fast-tracking procedure for small projects[14].

From an economic perspective, it is easy to see why streamlining would be necessary, given the limited capacity of small projects to absorb up-front transaction costs associated with a CDM process. Small projects will typically have fewer resources to devote developing a baseline and preparing a CDM proposal. If the fast-tracking process is to make any difference for small projects, it needs to have (or the option for) clearly pre-defined standardised baselines[15]. On environmental grounds, it can be argued that any "incorrect" baseline for small projects would only lead to small environmental implications and may thus not justify significant resources being devoted their assessment (e.g. organising and responding to a public consultation phase). Still, not all proposed small projects would qualify as CDM projects. There are other screening criteria. For example, a CDM project, small or large, would still need the approval, and meet the sustainable development objectives, of the host country.

While it will be up to the host country to determine how it provides its approval on a particular CDM project, including its assessment on the project's contribution towards achieving sustainable development, such approval can be expected to include an assessment of local environmental implications. In fact, typically, countries already require an environmental impact assessment (EIA) for electricity projects prior to deciding whether to authorise the construction of the project. Many national regulations include public scrutiny[16] (e.g. the opportunity to evaluate and comment on proposed projects) in the EIA process. However, it is not uncommon to have certain exemptions for particular types of plants (usually small) that are considered of minimal environmental risk and thus "benefiting" from lesser regulatory attention. For example, in Brazil, federal legislation exempts projects smaller than 10 MW from EIAs[17].

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[14] As it is important to reduce overall CDM-related transaction costs for all potential CDM projects, some or all these suggested elements could also form part of the project cycle for larger CDM projects.

[15] It may be possible to develop a fast-tracking provision without pre-defined multi-project baselines, but with simplified steps of the "normal" CDM process, e.g. through fewer steps in the approval process, shorter delays for approval, simpler forms, etc. This would work to help reducing transaction costs. However, automatic crediting, through standardised multi-project baselines, is likely to be a key aspect of any fast-tracking provision seeking to significantly reduce CDM transaction costs.

[16] It has been argued that public participation increases the successful implementation of a project (e.g. through avoiding costly delays and legal disputes). Baumert and Petkova (November 2000) also argue that the involvement of civil society will help the CDM deliver its objectives.

[17] However, EIAs may be deemed necessary at the state level, as some states' legislation can be more strict than the federal legislation. (Roberto Schaeffer, COPPE/UFRJ, personal communication, May 2001).

A provision to fast-track small projects in the electricity sector, which is aimed at minimising the CDM-related transaction costs, should stay as close as possible to the host country's EIA process, adding only the strict minimum elements necessary for the credibility of the CDM process. Fast-tracking will also need some automation in the process with likely default parameters[18]. Walsh (2000) estimates that standardising baselines and the additionality assessment could reduce CDM transaction costs by 50%. WRI (2000a) also recommends that a fast-tracking procedure include the automatic additionality of eligible projects (defined as 20-30 MW or smaller energy projects, on- or off-grid).

Box 2 presents possible features of a fast-tracking procedure for small CDM projects, in the context of the electricity sector.

While it is generally believed that a fast-tracking procedure with a streamlined process and standardised baselines will help reduce transaction costs associated with a developing a CDM project, it will not eliminate all costs[19]. For example, project proponents will still need to develop a proposal for a CDM project and seek host country approval.

3.2 Standardised baselines

The number of credits generated by fast-tracked small electricity projects will be determined by the baseline used. The revenue stream associated with emission credits from a project will therefore depend on both the baseline and the market value of these CERs, minus the CDM transaction costs. Using a standardised multi-project baseline to determine the emission reductions (kgCO_2/kWh) will help reduce transaction costs.

Several studies (e.g. OECD/IEA 2000 and Lazarus et al. 2000) have concluded that a distinction should be made between baselines for on- and off-grid power projects, to take into account the different technologies typically used in the two situations.

[18] Presumably, project proponents of eligible small projects could either adopt the fast-tracking route and use the pre-defined standardised baseline to generate CERs, or opt to choose the "normal" CDM process route to seek approval for using another baseline, for example.

[19] However, unlike other experts, EcoSecurities Ltd. (2000) expect that, in most cases, a more simplified approach would likely not significantly reduce transaction costs..

Box 2 - Possible features of a CDM fast-tracking procedure

1. PRE-REQUISITES: STANDARDISED BASELINES AND STANDARDISED PROJECT DESCRIPTION FORMAT

- These two pieces (i.e. standardised baselines and project description format) are necessary elements of a CDM fast-tracking procedure. These can be reviewed periodically, as greater experience is gained, but should not affect retroactively small CDM projects already implemented.
- They will likely need to be developed under the authority of, and receive the approval from, the CDM Executive Board.
- They would need to be widely accessible, e.g. via internet. Designated national CDM authorities would also have them on hand.

2. PROJECT VALIDATION

- Project proponents fill-in a brief project description (in a standardised format)
- Approval is sought from the host country CDM authority:
  - Normal EIA process applies.
  - Host country checks that the project description is complete and the calculations are correct, based on agreed standardised baseline values.
  - There is no need for 3rd Party validation, as CERs would be based on a standardised baseline.
  - (If there is no agreed standardised baseline value, a 3rd party (operational entity) would need to validate the project.)

3. PROJECT REGISTRATION

- Host country would report annually to the CDM Executive Board on the projects it has provided its CDM approval, providing relevant EIA documentation
- The project is registered by the CDM Executive Board as a CDM project.

4. PROJECT VERIFICATION AND CERTIFICATION

- An Operational Entity (OE) would verify and certify that the project is in place and operating.
  (If baseline is based on a kWh basis, the project proponent would need to submit records of operations and output).
- Building on existing administrative auditing procedures.
- The OE's findings are communicated to the host country and the CDM Executive Board

5. ISSUANCE OF CERS

The CDM Executive Board receives the verification and certification reports and issues the CERs.

3.2.1 Off-grid electricity

Off-grid or remote generation, in many developing countries, is pursued in rural areas where the grid is too distant and capital is not available to finance the construction of the transmission infrastructure. Off-grid projects tend to be smaller scale than those that are grid-connected, so may be particularly sensitive to any advantages brought by a CDM fast-tracking procedure. At the May 2001 UNEP/OECD/IEA Workshop on Baseline Methodologies, participants recommended that default values should be agreed upon for small off-grid renewable projects (UNEP/OECD/IEA, 2001).

Off-grid generation or remote power is often provided by diesel engines[20]. It thus seems appropriate to consider an oil-based electricity baseline to assess CO_2 reductions from small off-grid electricity projects. This approach has previously been considered by others, e.g. Lazarus et al. (2000). The carbon intensity of a small diesel generator operating at about 30% efficiency is calculated here to be equal to 0.88 $kgCO_2/kWh$[21]. This could be the default baseline for small off-grid projects submitted through a fast-tracking provision of the CDM.

Ybema et al. (2000) make the case that a different baseline might be appropriate to reflect the energy services from solar home systems (SHS), i.e. small photovoltaic (PV) systems used for stand-alone application in rural areas of developing countries. SHS projects could be considered a particular type of small power project, as they do not provide all the energy services that other off-grid power projects can provide. Typically, SHS generate modest amounts of electricity mainly used for lighting, and to power small appliances, such as radios and televisions (but not cooking, for example). According to Kaufman et al. (1999), as well as the case studies in Ybema et al. (2000), SHS's main CO_2 benefit results from substituting kerosene for lighting[22]. As a result of the particular features of SHS and on-the- ground observations, Ybema et al. (2000) recommend a conservative global value (per PV module), based on kerosene, for emission reduction of 200 $kgCO_2$/year for a typical 50 W_p system. This recommendation should be considered further.

3.2.2 Grid-connected electricity

A fast-tracking provision could also provide incentives to stimulate GHG-reducing small CDM electricity projects that would operate within a grid-connected system (e.g. wind). In such cases, diesel may not be an appropriate proxy for what would happen without the CDM project. Table 4 presents different baselines, reflecting a broad range of possible options, to illustrate the potential CERs (per kWh of electricity generated) that could be earned by various small grid-connected power projects:

- OECD/IEA (2000) concluded that electricity baselines ought to take into account national circumstances. A national baseline could be based on the weighted average of recent and planned

[20] For example, the electricity generation case study in OECD/IEA (2000) highlights the difference of a baseline for the North Isolated system of Brazil, which is based almost exclusively on oil-fired (diesel) electricity, and the other two systems that are dominated by hydropower.

[21] Depending on the type of diesel engine, the size and its use, emissions from small diesel generators will vary. The example used here is considered within the range observed in the literature and manufacturers' descriptions.

[22] This was the case in the eight country case studies examined in Ybema et al. (2000).

capacity additions (or "build margin"), including all electricity sources. Such a multi-project baseline for India, as calculated in OECD/IEA (2000): 0.565kgCO_2/kWh[23], is used here as an example.

- Another country-specific option may be to refer to a baseline based only on the weighted average of fossil fuel-fired units that have been recently built or are currently planned. For example, in the case of Brazil, such a baseline would be equal to 0.807kgCO_2/kWh.

- IEA projections can be used to derive an emission baseline representing the average CO_2 intensity of projected power capacity additions between 1997-2010 in OECD countries: 0.406kgCO_2/kWh.

- A likely efficient single technology and fuel could be used, e.g. natural gas in combined cycle: 0.396kgCO_2/kWh.

To gain a better perspective on the potential CER implications of fast-tracking small projects, Figure 1 presents the potential volume of annual credits, under various baseline scenarios, that could be earned by various 15 MW electricity projects (i.e. wind, small hydro, advanced natural gas, and advanced oil) – if they were eligible to the CDM. Although the text of the Bonn Agreement includes language allowing renewable projects larger than 15 MW, for comparability, all four different projects are assumed to have the same capacity size.

A higher load factor for the advanced natural gas plants leads to a larger volume of credits than for the other projects under the Brazilian fossil fuel baseline and the off-grid diesel baseline. Similarly, as small hydro plants typically have higher load factors than wind plants, they are able to obtain more CERs than wind plants of the same size.

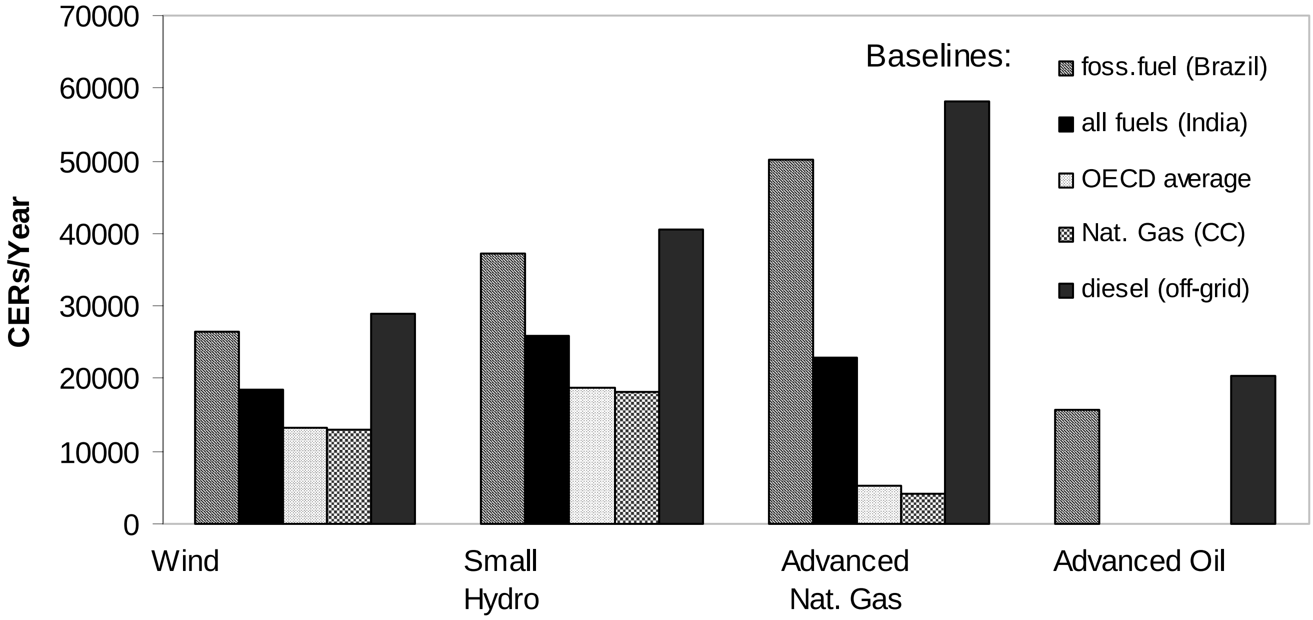
[23] This Indian baseline value is also very close to an emission baseline representing the average CO_2 intensity of projected power capacity additions between 1997 and 2010 in developing countries, based on IEA (2000b) projections: 0.563kgCO_2/kWh.

Table 4: **Potential emission reductions for small grid- connected projects under various multi-project baselines ($kgCO_2/kWh$)**

	Diesel: 0.88$kgCO_2$/ kWh	Brazilian multi-project baseline (recent & planned plants using fossil fuels): 0.807$kgCO_2$/ kWh	Indian multi-project baseline (recent and planned plants using all sources): 0.565$kgCO_2$/ kWh	Average CO_2 intensity of oil-fired capacity additions in OECD countries (IEA data): 0.406 $kgCO_2$/kWh	Natural Gas in Combined Cycle: 0.396 $kgCO_2$/kWh**
Adv. Coal[1]	0.158	0.085	0	0	0
Adv. Natural Gas[2]	0.521	0.448	0.206	0.047	0.037
Adv. Oil[3]	0.312	0.239	0	0	0
Nuclear[4]	n.a.	n.a.	n.a.	n.a.	n.a.
Hydro[5]	0.88	0.807	0.565	0.406	0.396
Non-hydro renew-ables	0.88	0.807	0.565	0.406	0.396

1 CER = 1tCO_2 reduced below the baseline
**Current technology; from Bernow et al. (2000)
[1] Advanced clean coal technology: 0.722$kgCO_2$/kWh (Bernow et al. 2000)
[2] Advanced combined cycle technology: 0.359$kgCO_2$/kWh (Bernow et al. 2000)
[3] Oil-fired electricity in combined cycle: 0.568$kgCO_2$/kWh (Bernow et al. 2000)
[4] Not applicable. Based on the findings obtained from an examination of power plants recently installed or currently under construction or planned (section 2.3), no nuclear project would be eligible under any of the "small" definitions considered.
[5] GHG emissions from hydro are assumed to be zero. This is how hydropower is currently treated in the IPCC inventory guidelines. However, there is growing evidence that this may not always be appropriate given the methane emissions generated by decaying biomass in reservoirs.

Figure 1: **Potential annual CERs generated by small (15 MW) electricity projects under different baselines**



Assumptions:

1CER = 1tCO_2 reduced below the baseline level.
Wind project: 15 MW; load: 25%
Small hydro project: 15 MW; load: 35%
Advanced natural gas project (in combined cycle): 15 MW; load: 85%; efficiency: 56%
Advanced oil project (in combined cycle): 15 MW; load: 50%; efficiency: 46%

3.3 Other possible elements of fast-tracking

In addition to a streamlined approval procedure and a standardised baseline, a number of other elements could help increase the attractiveness of the CDM for small projects. To achieve the objective to encourage the deployment of GHG-friendly small projects through the net benefits of CERs, further incentives could be provided through: (i) long crediting period; (ii) simplified monitoring procedures; and (ii) up-front crediting of CERs. They are briefly described below.

A long crediting period would increase the total volume of CERs for CDM projects, including small projects, and thus their CER revenues. However, the *value* of CERs obtained in later years would be discounted.

In order to keep overall CDM-related costs low, the international community is considering the possibility of allowing small-scale CDM projects eligible for fast-tracking to use simplified monitoring methodologies, compared to other CDM projects (FCCC/CP/2001/CRP.11, paragraph 53). This would help the economics of small-scale CDM projects.

Other incentives might be considered to boost interest in small CDM projects. For example, the possibility to obtain up-front all, or part of, the total CERs earned over a ten-year crediting period would increase the attractiveness of CDM-eligible projects.[24] By helping decrease the up-front investment costs, front-end crediting options could help to remove what is often a main financial barrier to the implementation of small GHG-friendly projects. Such a decision would likely need to take into account the evaluation of possible risks, e.g. risk of non-performance and the risk of CER price fluctuations. However, the CDM is generally considered as an *ex-post* crediting project-based mechanism. More analysis would be necessary to examine the full implications of such a proposal.

[24] This option has been further discussed by Martens et al. (2001) in their study on streamlined CDM procedures for Solar Home Systems.

4. Assessment of the environmental and economic implications of fast-tracking

4.1 Emission credits

Beyond transaction costs, the potential volume of CERs and their market price are absolutely critical in a decision to invest – or not – in a CDM project. Thus, the stringency of the standard baseline (and its level) to be chosen for the fast-tracking procedure is absolutely key. The CDM, and the implications of the baseline level, could be particularly important for technologies that are not yet fully competitive (e.g. small-scale renewables[25]).

It is difficult to provide a generic generation cost estimate for a "small" electricity project, as plant costs will vary according to, for example: technologies; fuel prices and fuel availability in different countries; political and economic risks associated with investments in different countries; credit-worthiness of project developers and guarantors; structures and terms of project finance; and location.

Nonetheless, PWC(2000) calculates that a highly carbon intensive baseline (e.g. an Indian power sector baseline) could make an average sized wind generation project begin to generate positive revenues from CDM credits (i.e. cover transaction costs) at low prices (1\$/tCO_2); but considerably higher credit prices (45\$/tCO_2) are likely needed to make such projects economic.

Table 5 below examines the implications of various baseline options and CER values on the levelised generating cost of a 15 MW wind project, which is assumed to be 4.9 cents/kWh[26]. Of course the value of CERs is highest under the least stringent baseline (i.e. diesel-based baseline) and under the highest CER value (20\$ per tCO_2 reduced). A one-cent difference per kWh in the generation costs could make wind relatively more attractive than possible alternatives, but taking into account the United States withdrawal from the Kyoto Protocol, 20\$/tCO_2 is now estimated to be at the high end of the expected credit price[27]. However, a 0.29-cent difference per kWh (which represents 6% of levelised generation costs) could be obtained under the diesel baseline with a CERs value of \$5/tCO_2. This would mean over \$1,000,000 (discounted at 7%) from CERs, over 10 years, that could be earned by a CDM wind plant. This may be sufficient, in some cases, to make a small CDM wind plant more attractive than the alternative (e.g. a diesel facility). Of course, it is important to keep in mind that up-front transaction costs (Table 1) could amount to about \$100,000 (i.e. 10% of the total discounted CER revenues) and an additional 7-10% of the annual CER revenues (at 5\$/tCO_2) after that if the CDM process is not significantly simplified.

[25] According to IEA (2000b), most of the projected growth in renewables is expected to require various forms of incentives.

[26] It is a representative value, as wind costs can be site specific, depending on wind speed. A levelised generation cost of 4.9 cents is likely at the lower end of the wind cost range.

[27] According to modelling results presented in IEA (2001), the international credit price could drop to less than 1\$/tCO_2 once US demand is eliminated.

Table 5: **Generating costs and CER revenues of a small (15 MW) wind CDM electricity project, using different baselines and CER values**

	Average CO_2 intensity of Projected Capacity additions in OECD countries	Weighted average all fuels baseline (India and developing country projected average)	Diesel (off-grid)
Baseline level ($kgCO_2/kWh$)	0.406	0.565	0.88
Levelised electricity generation cost[1] (per kWh)	4.9¢	4.9¢	4.9¢
Discounted CERs (@5$/$tCO_2$) revenue (per kWh)	0.13¢(2.7%)*	0.19¢(3.8%)*	0.29¢(6%)*
Discounted CERs (@10$/$tCO_2$) revenue (per kWh)	0.27¢(5.5%)*	0.37¢(7.6%)*	0.58¢(11.9%)*
Discounted CERs (@20$/$tCO_2$) revenue (per kWh)	0.54¢ (11%)*	0.75¢(15.3%)*	1.2¢(23.8%)*

[1] The following assumptions are made: Discount rate: 7%; Project lifetime: 20 years; Crediting Lifetime: 10 years; CDM transaction costs: nil
* Figures in parenthesis represent CER costs as a percentage of the levelised generation cost.

Some of the findings that others have obtained on the possible economic impact of the CDM's CERs on investment decisions in the electricity sector are of interest. Bernow et al. (2000) and Lanza (1999) have examined, from different perspectives, what could be the potential economic implications of CERs in the electricity sector, and in particular on renewables.

Based on a macro-economic analysis, Bernow et al. (2000) conclude that CER prices are likely to be the most important factor in helping stimulate greater investments in renewables-generated electricity. However, even at relatively high CER prices (i.e. 27$/$tCO_2$ or 100$/tC), the authors find that only 6% of BAU electricity generation changes to lower-emitting sources, with two-thirds of this shift going to renewables. At a more micro level, Lanza (1999) examines the economic contribution of CERs to a wind plant (compared to a coal-fired power plant). He finds that a relatively high CER price (also about 27$/$tCO_2$) is necessary to make the wind project viable.

Neither of these studies focuses on small electricity projects, and as a result, they may not be fully applicable to this analysis. Future work in the context of small electricity projects could focus explicitly on the off-grid context, where BAU options and costs are typically different from on-grid situations. The results of such a study could be very different from those mentioned above. Box 3 provides feedback from the SHS industry on its perspective of the economic attractiveness (if transaction costs are kept to a minimum) of the CDM.

Box 3 - SHS industry feedback on the potential attractiveness of the CDM

Solar PV home systems (SHS) respond to the dual objectives of the CDM by contributing to the sustainable development priorities of non-Annex I countries by improving living standards through increased quality of light and decreasing fire hazards and toxic fumes from traditional lighting. They also contribute to reducing GHG emission compared to the BAU alternatives.

It is estimated that the total CERs to be generated by SHS in developing countries would amount to a total of about 1 $MtCO_2$ per year.

Although the amount of the CER revenues per SHS may not seem very high (in the range of 5- 15% of total costs), stakeholders from the solar industry indicate that CDM could still have a considerable impact on the SHS market for a number of reasons:

- The impact of CERs on the profit margins of small-scale SHS companies is much higher, and may well make the difference between making SHS a profitable business or not, as one SHS entrepreneur indicated.
- It provides additional equity revenues, which may help to leverage additional finance such as micro-credit;
- Maintenance and consumer service infrastructures are in the range of 5 – 10% additional costs. CDM revenues could cover such additional expenses.
- The monitoring and verification obligations related to the CDM could generate a significant amount of empirical information as compared to what's currently available, which would provide useful feedback to SHS companies and SHS researchers and analysts.

Information provided by J.W. Martens, Energy Research Centre of the Netherlands (ECN), June, 2001.

4.2 Free-riding[28]

The decision to fast-track small CDM projects has clear advantages, but there are also possible downsides. One of the concerns raised when discussing emission baselines for the CDM, and their standardisation, is the potential risk of "free-riding." This refers to projects or CERs from projects that are not additional to what would have been achieved without the CDM, but that are nonetheless credited.

Some free-riding may be inevitable, given the inherent hypothetical nature of emission baselines. It is important to examine the extent of such a potential risk in the case of standardised baselines used for fast-tracking small electricity projects. Then, decision-makers will need to determine whether it is an acceptable risk.

Tables 2 and 3 provide some indications of the potential free-riding that could result from a CDM fast-tracking provision. One can consider the situation where all recently built and planned zero-emitting small plants were to seek eligibility under the fast-tracking provision. Of course, this is rather unrealistic, as even if the fast-tracking provision greatly reduced CDM transaction costs, it would not reduce them to zero. Furthermore, it is safe to assume that not all power plant investors would be aware of the CDM and the fast-tracking provision, especially in the shorter term. Each project developer's decision to submit his/her project through the CDM might, in fact, mostly depend on his/her knowledge of the mechanism and

[28] See OECD/IEA (2000) for more discussion on free riding and the environmental effectiveness of projects.

on the perceived benefits emanating from it. Project developers are not likely to evaluate the situation all in the same manner.

Rough calculations, based on projections from the IEA's *World Energy Outlook 2000*, are presented in Table 6 to seek to get a better quantitative picture of the estimated maximum free-riding potential from fast-tracking small power projects. Calculations of potential annual free riding (in million tonnes of CO_2) assume the *unlikely* scenario that *absolutely all* projected electricity generation by renewables would seek CERs under the CDM. It should be viewed as a sort of "maximum free-rider" scenario[29].

Maximum free-riding could thus range from 19 $MtCO_2$ if only non-hydro renewables are calculated and the most stringent baseline (i.e. average CO_2 intensity of projected capacity additions in OECD countries) is used, to 50 $MtCO_2$ when all BAU renewables are considered against the least stringent baseline (i.e. Brazil weighted average CO_2 emissions from recent and planned fossil-fuel plants).

The projected gap between Annex I countries' (including the United States) BAU energy-related CO_2 emissions and their Kyoto targets is just over 2100 $MtCO_2$[30] (IEA, 2000b, p.70) in 2010. Under a scenario whereby all projected small projects would be eligible to seek CERs under a fast tracking provision using the least stringent baseline in Table 6, maximum annual reductions that could be considered as free-riding would appear to be minimal. Assuming that *all* BAU small renewables projects from Table 6 could be CDM projects, this would lead to CERs amounting to under 3% of what Annex I countries were originally projected to need to meet their emissions targets in 2010.

While it is important to seek to minimise the risk of free-riding, it will be impossible to eliminate all risk of free-riding without killing the CDM through the use of overly stringent baselines. An overly stringent baseline might not generate enough CERs to make an economic difference, especially for many non-hydro renewables technologies with relatively high generation costs.

Of course, the importance of this potential maximum free-riding relative to the projected Annex I emission gap in 2010 increases, as we factor in the withdrawal of the United States. In fact models projected the United States to need to purchase emission credits from abroad to cover its emissions above its Kyoto target. So, without the United States, the remaining Annex I emission gap is smaller than originally estimated.

Nonetheless, the maximum free-riding risk estimated here, both in absolute and relative terms, is quite small and should not cause significant concerns for the fast-tracking provision for small-scale renewable electricity CDM projects.

[29] All IEA projected non-hydro renewables are included in the estimate. Given the importance of large-hydro plants, these are not included; only small-hydro plants are considered. However, IEA projections do not distinguish between small and large hydro. According to the UDI/McGraw-Hill database, the number of small-scale hydro of 15 MW or less (i.e. 440 units) is about 20% the number of total hydro plants of all sizes (i.e. 2197 units), but the total capacity of these small-scale hydro plants (in MW) represents about 1% of total hydro plant capacity recently installed of currently under construction or planned in developing countries. Given that the database underestimates small plants, this analysis assumes that the electricity generation from small hydro plants represents 2% of the total projected electricity generated via hydropower in developing countries.

[30] The United States withdrawal from the Kyoto Protocol will translate into a smaller overall gap in 2010 for the remaining Annex I countries.

Table 6: **Estimated maximum potential free-riding (2010): if all projected (2000-2012) new renewables capacity additions in developing countries were fast-tracked**

	Most Stringent Baseline: CO_2-intensity of projected OECD average	**Least Stringent Baseline: Brazilian fossil fuel-only**
Only non-hydro renewables**	~18.5 $MtCO_2$ (0.9%)*	~36.8 $MtCO_2$ (1.7%)*
Small hydro***	~6.4 $MtCO_2$ (0.3%)*	~12.7 $MtCO_2$ (0.6%)*
TOTAL (all small renewables)	~24.9 $MtCO_2$ (1.2%)*	~49.5 $MtCO_2$ (2.4%)*

Source: Based on IEA (2000b)'s *Reference Scenario*
Baselines:

- Average CO_2-intensity of projected OECD capacity (1997-2010): 0.406kgCO_2/kWh
- CO_2-intensity of Brazilian weighted average of recent & planned fossil fuel capacity additions: 0.807 kgCO_2/kWh

*Number in parenthesis is the percentage of free-riding compared to the IEA's projected Annex I energy-related CO_2 emission gap in 2010 (relative to the BAU reference emissions scenario) to meet the Kyoto target, including estimated pre-2008 BAU renewables capacity.
** Includes all projected non-hydro capacity
*** Small capacity is assumed to be 2% of total projected hydro electricity capacity.

4.3 Bundling

Multiple small-scale projects of the same type could be bundled together to form a single CDM project. It would make sense to seek to bundle small projects as much as possible, as it would likely reduce overall costs for the administration of the CDM[31]. For example, instead of submitting for approval fifteen 1 MW wind projects separately, these 15 projects could be bundled together and submitted through the CDM fast-tracking process as one single project (assuming that these projects in similar project contexts, e.g. fifteen 1 MW wind turbines installed in central America). This could significantly reduce transaction and administrative costs for the project[32]. The size limit defining the project eligibility for fast-tracking in the CDM could thus have implications on overall transaction costs, with a higher size limit allowing more bundling of projects and thus potentially lowering overall CDM transaction and administration costs.

[31] In fact, the Dutch ERU-PT (JI tender) procedure only considers projects that are larger than 100,000 tCO_2, reduced, as projects generating lower amounts of CO_2 reductions would not cover the transaction costs to the Dutch government (as the buyer) of evaluating the proposed projects.

[32] Jesse Uzzell and Michael Lehmann, DNV, also discussed the benefits of "multi-project" verification as a possible means to reduce CDM-related costs in their presentation, *Lessons Learned from the Pilot Multi-project Verification of Swedish AIJ projects*, made at COP6 bis in Bonn, July 2001.

5. Key insights, conclusions and recommendations

Initiating efforts to fast-track small CDM projects, as included in the July 2001 Bonn Agreement, is an implicit recognition that the transaction costs associated with the CDM process could effectively be a barrier to implementing small GHG mitigation projects[33]. Without streamlining the CDM approval process, CDM-related transaction costs (e.g. the development and approval of the baseline to calculate emission reductions) could easily add-up to significant portions of the capital costs for a project. In terms of CERs, it could mean that at a credit price of 5$/t$CO_2$, 20,000 CERs would be needed just to cover the initial CDM-related transaction costs.

Data on small projects in different non-Annex I regions show that the largest proportion of small plants is found in Africa, where 26% of all recently installed or currently planned or under construction were no larger than 5 MW and 39% of the plants were of 15 MW or less. Although it is difficult to draw firm conclusions, an interesting implication of fast-tracking focused on small projects might thus be its potential contribution to help address some Parties' concerns about the CDM needing to result in an *equitable* distribution of projects between regions, particularly in smaller developing countries (but this issue merits further consideration).

Not all electricity sources are perfect substitutes for one another, as some have relative economic and/or reliability advantages in particular circumstances (e.g. wind power is an intermittent source and cannot operate on baseload). However, there appears to be significant potential for the CDM fast-tracking provision to lead to a decrease in the GHG-intensity of electricity generated via small plants, as most small power plants commissioned under BAU conditions are oil-fired.

Even without the Bonn Agreement's provision recognising that Annex I Parties "are to refrain" from using CERs generated from nuclear facilities, no nuclear plants and very few coal plants would likely be affected by a fast-tracking process for small projects, as they are typically of much larger dimension. Among the small renewables plants recently built, or currently planned or under construction, small hydro plants are the most common technology, according to the database.

To be effective in reducing transaction costs, the fast-tracking provision will need to include a streamlined procedure that builds on existing environmental impacts assessments (EIAs) in host countries as much as possible. The process should be as standardised as possible in order to facilitate and speed-up the assessment of small projects. The fast-tracking provision should include standardised baselines and possibly a simplified standardised project description format, for example. Such a fast-tracking procedure should reduce CDM-related transaction costs. However, it cannot eliminate them, e.g. fast-tracked projects would still need to incur some costs, e.g. registration and monitoring of projects.

Given the specificity of projects supplying off-grid electricity, it is recommended that baselines for off- and on-grid small electricity projects be different. Off-grid projects tend to be of smaller scale than grid-connected projects. In fact, fast-tracking in the context of the electricity sector may be particularly important for greening off-grid electricity generation. Given the predominance of small diesel plants, a baseline based on diesel (0.88 kgCO_2/kWh) is generally recommended for small off-grid electricity generation projects. Given the particularities of solar PV home systems (e.g. in terms of the energy services they provide), compared to other small off-grid power projects, they might be considered as a particular type of small off-grid project, with a baseline based on CO_2 per PV module (instead of kWh) using mainly kerosene as a reference. This should be considered further.

[33] The focus of this study is on small electricity projects. However, it will also be important to seek to minimise CDM-related transaction for larger CDM projects as well.

It is not as straightforward to find a single baseline value for grid-connected small electricity (as diesel for off-grid), as national circumstances might need to be taken into account. A standardised formula with specified country data could be appropriate in many cases.

Lower transaction costs are very important to encourage investment in small CDM projects, but the decision of whether or not to invest in a small CDM project will largely depend on the overall CER revenues that can be expected from the CERs. It could take a high value of CERs accompanied by a high baseline level (i.e. low stringency) to generate enough CERs to make a significant difference in the investment in renewables. However, in some cases, particularly in isolated areas with difficult terrain, where the BAU cost of electricity generation is already relatively high, the CDM fast-tracking provision could potentially be quite successful in encouraging a switch to lower GHG-intensive modes of generation.

Given that baselines are by definition hypothetical, and that the current definition of "small-scale" encompasses all technologies (i.e. both new and mature technologies), some free-riding may be inevitable. However, the estimated risk of free riding associated with fast-tracking small renewable electricity generation CDM projects is quite small and is not expected to be a source of significant concern. A rough estimation based on a BAU electricity generation projections suggests that less than 50 Mt CO_2 per year (2010) could be claimed if absolutely all BAU projected renewable capacity between 2000 and 2012 were to seek credits under a CDM fast-tracking provision. This must be considered as an overestimate of the upper bound for free-riding, as all developers of BAU small renewables projects are unlikely to all submit their investments through the CDM process, even with the fast-tracking provision. The upper-bound estimate would correspond to less than 3% of what Annex I countries, as a whole, were originally projected to need to meet their emission targets in 2010 (energy-related CO_2 emissions only). However, the United States' withdrawal from the Kyoto Protocol translates into a lower overall gap for the remaining Annex I countries. In turn, this means an increase in the relative importance of the maximum free-riding risk compared to the remaining countries' gap.

It is clear that decisions on the further elaboration of the CDM fast-tracking provision will involve tradeoffs. It will be important to maintain environmental integrity while finding an appropriate balance between creating a sufficient economic incentive to developers so that they choose low GHG options when constructing small electricity generation facilities, and limiting the potential for free-riding. The baseline(s) will be key. While it is not possible to predict the exact impact of the fast-tracking procedure on the greening of small power plants, it does seem justified to go ahead and seek to provide small power projects with incentives to provide the same energy service with lower GHG emissions than the BAU alternative. Planning for a review, after a couple of years of experience, would be a means to assess whether the fast-tracking procedure was accurately designed or whether modifications are warranted.

Annex I – Typical size of different power technologies

Power Technology	Size	Notes
Hydro		(Cut-off sizes arbitrary)
-Micro/mini	300 watts -10 MW	-many smaller hydro plants are run by flowing river or stream
-Large	10 MW – 5,000 +MW	- most large hydro are in 30-800 MW range, but some very large hydro projects exist
Natural Gas		
- engines	50kW-5MW	-mostly in CHP applications
- microturbines	30 kW-100kW	
- turbines	20- 150 MW	- mostly for peak load
-combined cycle turbines	60-600 MW	- used for baseload
Solar		
Photovoltaics	50 watts-0.3 MW	
Oil		
- engines	0.005-16 MW	-smaller for single homes and larger (>4 MW) back-up generators for industry or small towns; off-grid
-gas turbines	1-150MW	- peakload
-steam turbine	5-200MW	-mostly heavy fuel oil
-combined cycle	100-600MW	
Wind	0.03- 1.5MW	- Range for individual units to wind farms of multiple units - Intermittent power
Biomass	5-50 MW	
Fuel Cells	50-1000 kW	- still not commercial
Nuclear	200-1,200 MW	
Coal	20-1200 MW	- Majority greater than 50 MW

Sources: UDI/McGraw-Hill, IEA and US EPA

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Glossary

AIXG	Annex I Experts Group on the United Nations Framework Convention on Climate Change (UNFCCC)
Baseload	The minimum amount of electric power delivered or required over a given period of time at a steady rate.
BAU	business as usual
CER	Certified Emission Reduction (obtained from CDM projects).
CDM	Clean Development Mechanism (project-based mechanism introduced in Article 12 of the Kyoto Protocol)
CO_2	carbon dioxide
Combined cycle	An electric generating technology in which electricity is produced from otherwise lost waste heat exiting from one or more gas (combustion) turbines. This process increases the efficiency of the electric generating unit.
Conversion efficiency	Efficiency at which a thermal power plant converts input fossil fuel (*i.e.* coal, gas, or oil) into electricity.
Free riding	A situation whereby a project generates emission credits from the CDM even if the project would have gone ahead in the absence of CDM, i.e. it is not “additional”.
Load factor	The proportion of total hours in a year (i.e. 8760 hours) during which a power plant is generating electricity.
PV	Photovoltaics
MW	Megawatt
Transaction costs	The costs associated with the process of obtaining CDM recognition for a projects and obtaining the resulting CERs
UNFCCC	United Nations Framework Convention on Climate Change (1992)
Wp	Watt peak: power unit for PV modules