CLEAN DEVELOPMENT MECHANISM.
GEOTHERMAL PROJECT EXPERIENCE WITH CDM.

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SUMMARY
The Clean Development Mechanism (CDM), together with Emissions Trading and Joint Implementation are the three flexibility mechanisms of the Kyoto Protocol under the United Nations Framework Convention on Climate Change (UNFCCC). CDM offers a potential financial incentive to geothermal projects in developing countries though the realisation of income from trading in Certified Emission Reductions (CERs). Several geothermal projects have already been approved and registered as CDM projects by the Executive Board of the UNFCCC, and several others are currently in the approval pipeline. This paper discusses the incentive that CDM offers, describes recent experience gained through involvement in two geothermal CDM projects and looks to the future.

1. WHAT IS CDM?

CDM is an abbreviation of Clean Development Mechanism. It is an implementing mechanism under the Kyoto Protocol of the United Nations Framework Convention on Climate Change. It allows new projects[1] which result in reduced anthropogenic (manmade) greenhouse gas emissions in developing countries to trade these emissions reductions with countries that have made a commitment to reduce their carbon emissions under the Kyoto Protocol. This latter group are developed countries and include the established European economies, Canada, Japan and New Zealand. Both countries must be Parties to the Convention, have ratified the Kyoto Protocol and have in place both a national CDM authority and a national greenhouse gas inventory. The trading window is defined by the First Crediting Period which covers 2007 to the end of 2012 (for some projects, emissions reductions starting from 2000 may be eligible). Debate is ongoing as to whether further crediting periods should occur (ie. should the Kyoto Protocol be extended).

2. HOW DOES CDM WORK?

Projects must be additional. The exact wording of this requirement is: "A CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered CDM project activity."

This means it must be demonstrated that a project's emissions reductions would not have occurred except for the fact that it was registered as a CDM project activity at the time the decision to invest was made. If it was not actually registered at the time the decision to invest was made (a common situation given the timing of events related to the Kyoto Protocol coming into effect, and the timing of the first CDM project registrations) then it must be demonstrated that there was a strong possibility of it being registered and this was a significant factor in the investment decision being made. To pass this test there must be at least one demonstrated barrier to its existence which was reduced or removed by its registration or potential registration as a CDM project activity. It also means that projects which are required by law, or which are "business as usual", or which are already more financially attractive than their feasible alternatives, or which have already had their investment decision made without considering CDM, are not likely to pass this additionality test. It is to be noted that the additionality requirement has been the most controversial element of the CDM process. This has mainly related to the financial aspects of additionality. Given the significant (and current) risks associated with the CDM process and the realisation of CDM revenues, project sponsors will generally only proceed if a project is financially viable without CDM revenues. According to some observers, this does not make them additional.

CDM projects must reduce greenhouse gas emissions. But reduce them by comparison with what? A baseline is therefore necessary - this determines the emissions which would have occurred in the absence of the CDM project. A methodology must be available to calculate this baseline. This baseline methodology can be project-specific, industry-specific or activity-specific. Methodologies must be vetted by the

Methodology Panel of the CDM and approved by its Executive Board.

In addition to the methodology to determine the baseline it is also necessary to have a monitoring methodology to determine the project emissions (actual greenhouse gas emissions) and any project leakage (effectively baseline emissions directly attributable to the project activity eg. imported electricity, displacement of low or zero emissions by other baseline emitters).

In summary:
Emissions reductions = Baseline emissions *less* project emissions *less* project leakage

Emissions reductions under the Clean Development Mechanism are expressed as tonnes of CO_2 equivalent reductions and given the title Certified Emission Reductions (CERs). Under Joint Implementation, the equivalent term is Emission Reduction Unit (ERU). One CER is one tonne of carbon equivalent reductions.

Each approved methodology for determining the baseline must include an approved test for additionality.

The country in which the project is located (the host Party) must have a national CDM authority in place. This authority (the Designated National Authority), must review the project and confirm that it meets the country's sustainable development criteria. The project proponents must also undertake a formal socialisation of the project as a CDM project activity with the community living in areas affected by the project and any concerns relating to the project raised by the community must be identified and addressed. This must occur before the project is submitted for registration.

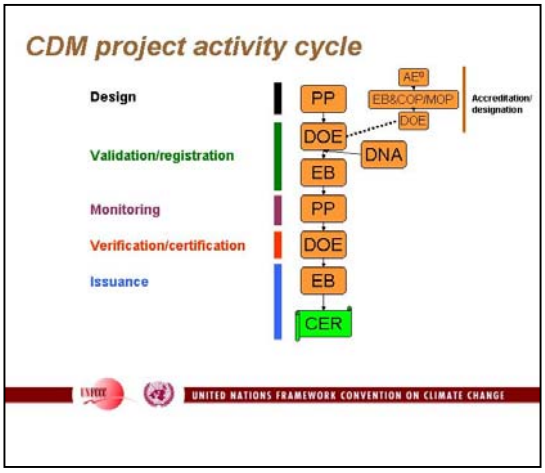
The Project Participants must demonstrate that they have met all the Host Country requirements for environmental review and approval of the proposed project activity.

The CDM process is depicted in Figure 1[2]. The various steps are discussed in more detail in Appendix 1.

3. HOW IS CDM APPLIED TO RENEWABLE ENERGY PROJECTS DESPATCHING ELECTRICITY ONTO AN INTERCONNECTED GRID?

There are several approved CDM methodologies which can apply to renewable energy projects, including geothermal. These depend on whether the energy is supplied directly to the user or whether it is supplied indirectly, such as electricity via an interconnected electricity grid. The methodologies are further split between small-scale (total energy output capacity is less than 15 MW (as electricity, or its equivalent in other energy forms)), and large-scale.

Figure 1. CDM Project Activity Cycle



Details of abbreviations.

PP	=	Project Participant
DOE	=	Designated Operational Entity (Project Validator or CERs Verifier)
DNA	=	Designated National Authority (a country's official CDM body)
EB	=	CDM Executive Board
CER	=	Certified Emission Reduction
AE	=	Applicant Entity (a DOE candidate)
COP/MOP	=	Conference of the Parties/Meeting of the Parties (official meeting of the Parties to the Kyoto Protocol)

Approved methodology ACM0002 applies to large-scale renewable energy projects (the CDM definition of renewable energy includes geothermal), producing electricity that will be despatched onto an interconnected electricity grid. This methodology was first issued in April 2004 and has now reached version 6. It is accompanied by a Tool for Additionality, which is currently at version 2[3].

For small-scale renewable energy projects producing electricity that will be despatched onto an interconnected electricity grid, approved methodology AMS-1.D[4] applies. This methodology was first issued in April 2004 and has now reached version 9. Additionality must also be demonstrated[5]. Although the procedure requires fewer steps than the large-scale Tool for Additionality, the intent is the same.

If the interconnected electricity grid is initially balanced (supply = demand), and demand is growing, then during the balanced part of the Crediting Period some existing generation capacity is not operated (it is displaced by the CDM generation). At some point during the Crediting Period, the construction of new generation capacity will be required, but this will

be delayed because of the recently added CDM project capacity.

The impact of a CDM Project on operating plant during the balanced period is captured through an Operating Margin whereas the impact on the delay in new plant construction is captured through a Build Margin. The total impact of the CDM Project is captured by a Combined Margin (CM), also known as a Baseline Emission Factor. It is intended to reflect what happens on a grid when electricity from a new generator is added.

Further details of the application of these methodologies are provided in Appendix 2.

4. HOW IS CDM APPLIED TO GRID-CONNECTED GEOTHERMAL ELECTRICITY PROJECTS?

Applying the methodology described in Appendix 2 generally leads to CM equivalent values in the range 0.6-0.9 tonne CO_2equ/MWh for a grid with a mix of thermal and non-thermal power plants. Baseline emissions are calculated as Project MWh x CM, and CERs as:

Project CERs = Project MWh x CM - project emissions (if any) - project leakage (if any)

5. CURRENT CDM STATISTICS

Current statistics for all CDM Projects (to end 2012):

CERs issued as of mid October 2006 (86 issuances)	16,800,000
Total estimated CERs from CDM Projects that have been registered as of mid-October 2006 (350 projects)	590,000,000
CDM Pipeline to 2012	1,400,000,0000

Current statistics for geothermal CDM Projects:

Geothermal CERs issued as of mid October 2006	0
Total estimated CERs from Geothermal CDM Projects that have been registered as of mid October 2006	5,000,000

6. TRADING OF CERS

All CERs will be tracked through an International Transactions Log (ITL). CERs will not be able to be retired (allocated to a particular Annex I Party to offset their Kyoto Obligations) until the ITL is in place. The EB has recently awarded a contract to create the ITL by the end of March 2007. CERs are also tradeable in some other markets and countries (eg. EUETS) and this may expand in future (California, RGGI in NE USA, proposed Australian ETS).

Trading of CERs has been happening for several years and is gathering momentum. Both a primary and a secondary market exist. Of course, this has been mostly based on CERs which will only be 'created' during the Kyoto Protocol's first Commitment Period 2007 – 2012.

Point Carbon (2006, p. 25) has identified 4 categories of contracts with corresponding risks and rewards:

1 Non-firm volume. Buyer buys what seller delivers even if emissions reductions turn out not to qualify as CERs. Does not need to be a CDM Project. Recent trades: € 3-6/t CO_2e
2 Non-firm volume. Contract contains preconditions, e.g. that the underlying project qualifies as a CDM Project. Recent trades: € 5-10/t CO_2e
3 Firm volume. Contract contains preconditions (as above). Usually strong force majeure clauses and high credit rating clauses and high credit rating. Recent trades: € 9-14/t CO_2e
4 Firm volume. No preconditions. Forward spot trades will in the future fit this category. Currently only the Johannesburg Stock Exchange's Carbon Credit Notes fit under this category. Recent trades: € 12-16/t CO_2e

7. WHAT ARE THE POTENTIAL BENEFITS OF CDM TO GEOTHERMAL?

The aim of CDM is to remove barriers to investment in greenhouse gas reducing projects in developing countries. For renewable energy projects such as geothermal, this frequently aligns with an improvement in the economics of geothermal electricity production coupled with an improved willingness to surmount institutional and negative perception (of renewable energy) hurdles.

According to Quinlivan and Batten (2006), at typical net values of 0.7 CER/MWh of project generation and $US20/CER for delivery in 2007-2012, CDM CERs have the potential to increase project income (or reduce electricity cost) by 0.7 USc/kWh for projects generating six years of credits commencing in late 2007. If the ability to obtain CERs is extended beyond the current expiry of the Kyoto Protocol, for example to the full life of a project, project income (or electricity cost reduction) could reach 1.4 USc/kWh at $US20/CER (levelized). For greenfield geothermal projects, the potential for this additional revenue may be the incentive required to tip the balance between proceeding or not proceeding with a particular project.

8. WHAT IS THE CURRENT STATUS OF GEOTHERMAL PROJECTS WITHIN CDM?

As of mid-October 2006, more than 350 projects have been registered by the UNFCCC. However, only three of these are geothermal:

- Lihir Geothermal Power Project, Papua New Guinea
- Berlin Geothermal Project, Phase Two, El Salvador
- San Jacinto-Tizate Geothermal Project, Nicaragua

Four other geothermal projects are known to be seeking registration:

- Darajat Unit III Geothermal Project, Indonesia
- Nasulo Geothermal Project, Philippines
- Amatitlan Geothermal Project, Guatemala
- Berlin Binary Cycle Power Plant, El Salvador

Of the three geothermal projects which have been registered, one has already made application for CERs. This is the San Jacinto-Tizate project.

9. WHAT ARE THE LESSONS LEARNED SO FAR?

CDM is new, is evolving and everyone is "learning by doing". A major impetus occurred when Russia ratified the Kyoto Protocol on 18 October 2004. This caused the 55% threshold to be passed (of the total 1990 emissions of at least 55 Annex I Parties to the UNFCCC who have ratified the Kyoto Protocol) and the protocol (and thus its implementing mechanisms) came into effect 90 days later on 16 February 2005. Until then, no-one was really sure that the CDM was actually going to come into operation.

General Lessons Learned

Methodology Approval

In the early days (2003-2004) a lot of new methodologies were proposed. Frequently many of these were similar, prompting the Methodology Panel and Executive Board to seek consolidation. This added considerable time to the approval process of many projects. As noted by the Marceu and Dorneau (2005, p. 91), "The total time needed to get a project though the process is unpredictable, introducing uncertainty, which inevitably increases resources required and associated costs."

PDD Preparation

There are many lessons learned in the preparation of PDDs. Archer and Kamel (2005) summarise the top 20 pitfalls that they have observed. Their list is reproduced alongside.

Long time for the first projects to be registered

Funding for the EB has been problematic over the years and this has caused delays in the consideration and approval of new methodologies and in the processing of registering projects once validated. During 2005 the industry was waiting for the first few projects to be registered. This finally occurred on in November 2004 through April 2005 and the logjam has essentially been cleared. A total of 350+ projects have been registered as of mid Oct 2006, with a further 80+ in the application for registration phase.

Table 1: The 20 Top PDD Pitfalls (from Archer & Kamel (2005))

	Delay more than 1 month	Delay more than 1 week
Frequency more than 20%	- Evidence of EIA and/or required construction/ operating permits/ approvals not provided. - Letter of approval insufficient or delayed.	- Lack of logic and consistency in PDD. - Deviations from selected calculation methodology not justified sufficiently or incorrect formula applied. - Compliance with legal requirements not sufficiently covered. - Insufficient information on the stakeholder consultation process.
Frequency less than 20%	- Small scale selected for a large project. - No written confirmation that funding will not result in a diversion of official assistance. - Non-compliance with the applicability conditions of the applied baseline methodology or compliance not explained sufficiently.	- Project participants not identified clearly. - The modalities of communication with the Executive Board in terms of CERs issuance and allocation instructions not stated clearly, or signed by all project participants. - Insufficient description of the technology. - Insufficient explanation of baseline scenarios and project additionality. - Baseline information not sufficiently supported by evidence and/or referenced sufficiently. - Major risks to the baseline not identified/described. - The project boundary not defined clearly. - Project and/or crediting start date unclear. - Deviations from monitoring methodology not justified sufficiently. - Monitoring and project management procedures not defined.

Don't underestimate the importance of the monitoring phase

Once the project is registered and production has begun, it is important that the Monitoring Plan be put into action correctly. It appears some CERs have been declined due to inadequacies in the collection and reporting of data. An early Verification should be considered in order to

draw attention to any inadequacies in the Monitoring Plan and the Monitoring Procedures. Refer to IETA (2006) for suggested Verification templates which give a good guide on what to address in a Monitoring Plan/Programme. Refer to other Verification reports on similar projects for the same reason.

Lessons Learned on two geothermal projects

Darajat Unit III, Indonesia

Chevron Geothermal Indonesia Ltd. has been developing the 110MW Darajat Unit III Geothermal Project as a CDM Project, the largest geothermal CDM project to date. This started with the development of an application for a new baseline and monitoring methodology application. The application was turned down by the CDM Executive Board because, along with many other similar applications from other organisations, a consolidated methodology was being prepared. The geothermal-specific monitoring methodology prepared for the proposed new methodology was incorporated into consolidated methodology ACM0002. Gathering the data for calculating the operating and build margins on the Java-Madura-Bali interconnected grid was a significant undertaking where several other organisations had previously tried but had not been successful. This grid comprises more than 200 individual generators. The project has progressed through preparation of the PDD, DOE Validation and the Application for Registration. Numerous consultations with and presentations to the stakeholders were necessary to arrive at DNA approval. This project has completed the Validation phase, has been approved by the Indonesian DNA, is currently in the Application for Registration phase and is expected to be registered in December 2006 now that the Application for Registration has been accepted in October 2006[6].

Lessons learned, as inferred from information posted on the UNFCCC CDM website:

- It has taken three years from preparing a PDD supporting a new methodology to reaching the last lap to registration. Do not underestimate the time it takes to work through a CMD application. Conversely, building on the lessons of others, seek the most direct path to registration as this will conceivably shorten the time from project inception to CDM Registration.
- Proposing a new Methodology for a grid-connected renewable energy project takes time and is unlikely to be successful - choose an approved methodology.
- Additionality can be demonstrated by a relative improvement in project financial indicators rather than an absolute improvement, in conjunction with a non-financial barrier analysis.
- CM data gathering for the preparation of a grid Baseline Emission Factor, if this has not been carried out and blessed by a DNA, can be a time-consuming undertaking. For the JAMALI grid this took almost two years and a lot of intensive interaction with the grid operators, generation companies and the government regulatory authorities.
- DNA approval is relatively straightforward if the DNA exists. For Indonesia, significant support by Project Participants was required to reach the point where Indonesia formally ratified the Kyoto Protocol and incorporated a Designated National Authority.
- Maintain an active engagement with the DNA and be prepared to assist it in meeting its objectives.
- Err on the side of conservativeness when undertaking calculations of emissions reductions (ie, if a choice of more than one path is available, choose that path which gives the lesser amount of emissions reductions).

San Jacinto-Tizate Geothermal Project, Nicaragua

SKM, through the involvement of SKM staff in the client organisation (Polaris Energy Nicaragua S.A.) has been involved in the CDM process as it has been applied to the San Jacinto-Tizate Geothermal Project. This has covered management activities related to Project Design Document, DNA Approval, DOE Validation and Application for Registration, Monitoring Protocol, Monitoring Procedure, development of data processing procedures and a CER Verification audit[7]. The Nicaraguan grid is quite small - only 700 MW with only a few plants[8]. The Simple OM method was applied. Additionality was demonstrated through a benchmark financial analysis.

Carbon credits were considered in early feasibility studies for the San Jacinto-Tizate project and the realization of income from CERs is expected to have a significant positive impact on the project's economics.

Some minor revisions were required to the initial Monitoring Report and the Verification Report to deduct electricity supplied from the grid to the project from electricity supplied to the grid from the project. The electricity supplied by the grid is considered leakage as it increases baseline emissions due to the project activity. The EB has instructed the CDM Registry Administrator to issue the CERs when this matter has been addressed in revised reports.

The lesson learned is that careful attention must be paid to implementation of the Monitoring Plan and reporting of emissions reductions. Undertaking an Initial Verification and a First Periodic Verification within a short time of project start-up (3-6 months) could be advantageous. It may allow early identification of any issues related to data gathering, data quality, data reporting, adherence to the Monitoring Plan,

unidentified leakage etc. It may also reduce the risk that potential CERs could be lost through inadequacies in any of these areas.

10. WHAT DOES THE FUTURE HOLD?

The window for CDM projects to become registered in time to generate CERs during the First Crediting Period is rapidly becoming smaller. Projects that are not already well under way are unlikely to be registered in time to realise a significant income stream. Of course, if the Kyoto Protocol (or something similar or equivalent) is extended beyond the First Crediting Period (which expires on 31 December 2012), then it will be a different ball game. Signs are emerging which seem to point towards CDM continuing in one shape or another. Other similar mechanisms are also being discussed. Current initiatives in the United States (at an inter-state level, eg. California linking with the north-eastern states under the cap-and-trade Regional Greenhouse Gas Initiative (RGGI)), and in Australia are promising. These may lead towards a truly global carbon emissions trading marketplace that incorporates CDM and similar mechanisms and which covers more of the total global greenhouse gas emissions than at present.

Geosequestration (storing CO_2 in geological strata) is also an interesting possibility and is receiving more and more attention both inside and outside CDM. The direction taken with geosequestration of anthropogenic carbon emissions from fossil power could also have a potential direct impact on some geothermal projects, especially those with elevated NCG levels (NCGs are usually around 90% CO_2). Geothermal projects with 2% NCG in the steam flow could conceivably reinject the NCG into the geothermal resource and seek up to an additional 20% CERs (or existing non-CDM geothermal projects could consider CERs for sequestering their existing emissions). Leakage would have to be addressed (both of fugitive CO_2 back into the atmosphere, and of its re-circulatory impact on reducing output from non-CDM projects operating on the same geothermal resource, itself potentially offset somewhat by reservoir pressure maintenance considerations).

As indicated in Section 5, the potential financial impact of CDM CERs on sustainably developed geothermal projects may be quite significant and this is already being seen as renewed interest in geothermal among potential developers.

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End-notes

[1] The group include renewable energy, forestation, destruction of Greenhouse Gases. Moves are underway to include geosequestration and biodiesel

[2] Refer: http://cdm.unfccc.int/CommonImages/ProjectCycleSlide

[3] Refer:http://cdm.unfccc.int/methodologies/Pamethodologies/AdditionalityTools/Additionality_tool.pdf

[4] Refer:http://cdm.unfccc.int/methodologies/view?ref=AMS-I.D.

[5] Refer: http://cdm.unfccc.int/methodologies/SSCmethodologies/AppB_SSC_AttachmentA.pdf

[6] Refer http://cdm.unfccc.int/Projects/DB/KPMG1159285050.32 /view.html

[7] Refer http://cdm.unfccc.int/Projects/DB/DNV-CUK1135673240.22 /view.html

[8] Refer http://cdm.unfccc.int/UserManagement/FileStorage/DVPF9FQ766NH7G6XKBEDNLY4R9X1TQ

Appendix 1. The CDM Process

Pre-Design Phase

In addition to the phases in Figure 1 there is also a pre-design phase not mentioned in the CDM flowchart. This phase is where the project proponents define the investment opportunity with sufficient detail that they believe the project will be feasible if it can be registered as a CDM project. They will then proceed with a formal Stakeholder Consultation and they will prepare any Environmental Assessments and obtain any pre-project Environmental Approvals required by competent authorities in the Host country. During this phase a Project Idea Note may be prepared and circulated to interested investors.

Design Phase

The start of the UNFCCC CDM process is the design phase. This is where the project is presented in a formal manner using an approved documentation template. This template is called the Project Design Document (PDD). The current edition is version 3, effective 28 July 2006.

The table of contents for every PDD, based on the current (Oct, '06) template, is:

A. General description of project activity
B. Application of a baseline and monitoring methodology
C. Duration of the project activity / Crediting period
D. Environmental impacts
E. Stakeholders' comments

Annex 1: Contact information on participants in the project activity
Annex 2: Information regarding public funding
Annex 3: Baseline Information
Annex 4: Monitoring plan

General description of project activity
This is relatively straightforward. It looks at where the project is located, who the participants are, a technical description of the project activity, an estimate of the emissions reductions and whether any public funding is involved.

Application of a baseline and monitoring methodology
This section describes why the particular baseline and monitoring methodology and additionality approach selected by the project proponents is relevant to this project activity and how the selected baseline and monitoring methodology has been applied. It presents the baseline scenario and proceeds with an "explanation of how and why this project activity is additional and therefore not the baseline scenario in accordance with the selected baseline methodology".

Duration of the project activity / Crediting period
The life of the project must be defined. Emissions reductions may be sought for a single crediting period up to a maximum of 10 years with no option for renewal, or a renewable period of up to 7 years which may be extended up to 2 times (total 21 years). In no case shall the crediting period in total be more than the project life.

Environmental impacts
As indicated above, environmental impacts, if considered significant by the project participant or the host Party, must be considered in an environmental assessment.

Stakeholders' comments
The guide to completing the PDD requires the project participants to "describe the process by which comments by local stakeholders have been invited and compiled. An invitation for comments by local stakeholders shall be made in an open and transparent manner, in a way that facilities comments to be received from local stakeholders and allows for a reasonable time for comments to be submitted. In this regard, project participants shall describe a project activity in a manner which allows the local stakeholders to understand the project activity, taking into account confidentiality provisions of the CDM modalities and procedures. The local stakeholder process shall be completed before submitting the proposed project activity to a DOE for validation." Commentary on whether CDM consultation can be included with consultation on other aspects of the project, eg environmental assessment

In the past this phase could take several years depending on the diligence of the Project Participants regarding socialization, the status of an approved methodology and the status of baseline data. Costs can range from 00,000's to 000,000's. This duration and cost is reducing quickly as these barriers are removed. Large corporate players can also positively influence the final outcome - for example, on the Java-Madura-Bali interconnected grid, Chevron Corporation lead point on the baseline emission factor per ACM0002 and strongly supported the CDM establishment activities in Indonesia over several years. These corporate citizenship activities will reduce the time and cost for other potential CDM project participants in Indonesia.

Validation / Registration Phase

An independent validation of the proposed CDM project by an UNFCCC registered Designated Operational Entity (DOE) is required. The role of the DOE is to:

- Ensure comments by local stakeholders have been invited, a summary of the comments received has been provided, and a report to the designated operational entity on how due account was taken of any comments has been received;
- Confirm that project participants have submitted to the DOE documentation on the analysis of the environmental impacts of the project activity, including transboundary impacts and, if those impacts are considered significant by the project participants or the host Party, have undertaken an environmental impact assessment in accordance with procedures as required by the host Party;
- Confirm that the activity is expected to result in a reduction in anthropogenic emissions by sources of greenhouse gases that are additional to any that would occur in the absence of the proposed project activity;
- Confirm that the baseline and monitoring methodologies comply with requirements pertaining to Methodologies previously approved by the Executive Board and have applied correctly and conservatively,
- Confirm that adequate provisions for monitoring, verification and reporting are included,
- Prior to the submission of the validation report to the Executive Board, have received from the project participants written approval of voluntary participation from the designated national authority of each Party involved, including confirmation by the host Party that the project activity assists it in achieving sustainable development;
- Make publicly available the project design document;
- Receive, within 30 days, comments on the validation requirements from Parties, stakeholders and UNFCCC accredited non-governmental organizations and make them publicly available;
- After the deadline for receipt of comments, make a determination as to whether, on the basis of the information provided and taking into account the comments received, the project activity should be validated;
- Submit to the Executive Board, if it determines the proposed project activity to be valid, a request for registration in the form of a Validation Report and Validation Statement including the project design document, the written approval of the host Party as referred to in subparagraph (a) above, and an explanation of how it has taken due account of comments received;
- Make this Validation Report publicly available upon transmission to the Executive Board.

At that time of the submission for registration, the Registration Fee must be paid. This currently equivalent to $US0.20 per anticipated CER for the first year of operation. It is actually a prepayment of fees for the issuance of CERs.

The EB will check that all the application for Registration is complete. Registration is considered final 8 weeks after the date of receipt of payment of the Registration Fee, unless a Party involved in the project activity or at least three members of the EB request a review of the proposed CDM project activity. EB reviews are limited to issues associated with the validation requirements.

The duration of this phase will depend on the diligence of the Project Participants regarding socialization, environmental approval, DNA approval and the application an approved methodology. Where these are all correctly addressed and appropriate approvals are in place, Validation and Registration can take around six months (three of which are compulsory - 30 day web-based international socialization and 8 week EB review). Costs are in the 00,000's range (for the DOE Validation, excluding Project Participant's costs and the Registration Fee (which is actually a pre-payment)).

Monitoring Phase

The elements of a Monitoring Plan must be presented in the PDD. The manner of gathering data, storing data, archiving data, verifying the accuracy of data gathered (through a Quality Assurance and Quality Management process), and of identifying who is responsible for all these aspects must be included in the Monitoring Plan. Once the Project starts, the data necessary to calculate CERs must be gathered. This must be done strictly according to the Monitoring Plan, or the verification may fail.

The Monitoring Plan should cover:

- The collection and archiving of all relevant data necessary for estimating or measuring anthropogenic emissions by sources of greenhouse gases occurring within the project boundary during the crediting period;
- The collection and archiving of all relevant data necessary for determining the baseline of anthropogenic emissions by sources of greenhouse gases within the project boundary during the crediting period (in the case of ex-post determination of the CM);
- The identification of all potential sources of, and the collection and archiving of data on, increased anthropogenic emissions by sources of greenhouse gases outside the project boundary that are significant and reasonably attributable to the project activity during the crediting period;
- The collection and archiving of information;

- Quality assurance and control procedures for the monitoring process;
- Procedures for the periodic calculation of the reductions of anthropogenic emissions by sources by the proposed CDM project activity, and for leakage effects;
- Documentation of all the steps involved in the calculations.

The duration of this phase is ongoing. Costs are essentially all Project Participant's costs.

Certification/Verification Phase

"Verification is the periodic independent review and ex post determination by the designated operational entity of the monitored reductions in anthropogenic emissions by sources of greenhouse gases that have occurred as a result of a registered CDM project activity during the verification period. Certification is the written assurance by the designated operational entity that, during a specified time period, a project activity achieved the reductions in anthropogenic emissions by sources of greenhouse gases as verified".

A DOE is required to verify(audit) the results (CERs) obtained through the Monitoring Plan. This DOE may be the same one as the Validator in the case of a small-scale activity, but it must be a different DOE in the case of a large-scale activity.

Once it has completed its verification activities the DOE will issue a Verification Report. It shall then "certify in writing that, during the specified time period, the project activity achieved the verified amount of reductions in anthropogenic emissions by sources of greenhouse gases that would not have occurred in the absence of the CDM project activity. It shall inform the project participants, Parties involved and the Executive Board of its certification decision in writing immediately upon completion of the certification process and make the Certification Report publicly available".

The frequency of this phase is intermittent. Costs should be in the 00,000's range (for the intermittent DOE Verification/Certification, excluding Project Participant's costs).

Issuance of CERs

The DOE's Certification Report serves as a request for issuance to the EB of CERs equal to the verified amount of reductions of anthropogenic emissions by sources of greenhouse gases. The issuance is considered final 15 days after the date of receipt of the request for issuance, unless a Party involved in the project activity or at least three members of the EB request a review of the proposed issuance of CERs. Such reviews are limited to issues of fraud, malfeasance or incompetence of the DOE.

Upon being instructed by the EB to issue CERs for a CDM project activity, the CDM registry administrator, working under the authority of the EB, issues the specified quantity of CERs into the pending account of the EB in the CDM registry. Upon such issuance, the CDM registry administrator forwards the quantity of CERs corresponding to the share of proceeds to cover administrative expenses (currently a charge of 0.20USD rather than a share of CERs (except for the first 10,000 CERs at 0.15USD/CER)) and to assist in meeting costs of adaptation (currently 2% of CERs), to the appropriate accounts in the CDM registry for the management of the share of proceeds and forwards the remaining CERs to the registry accounts of Parties and project participants involved, in accordance with their instructions. At this point in time the UNFCCC Secretariat is acting as the CDM Registry on behalf of the EB.

Each CER is uniquely identified so that the project against which it was issued is known, as well as other information relating to date of issue, date of retirement etc.

Accounts with the CDM Registry for the holding of CERs need to be set up by Project Participants. The host Party also needs to set up an account.

The frequency of this phase is also intermittent and is tied to the Verification/Certification Phase. Costs are essentially Project Participant's costs plus the CDM Fees for Adaptation and Expenses as described above.

Appendix 2. The CDM Process applied to Renewable Energy Projects

In both ACM0002 and AMS-1.D the baseline scenario is represented by "CO_2 emissions from electricity generation in fossil fuel fired power that is displaced due to the project activity" where "electricity delivered to the grid by the project would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations" (except for a small-scale project despatching onto a grid where all generation is exclusively by fuel oil of diesel, in which case the displaced emissions represent those of a modern diesel generating unit at the appropriate load factor).

The Project Boundary "includes the project site and all power plants connected physically to the electricity system that the CDM project power plant is connected to". This is impacted by the size of the grid (which could lead to use of a (regional) project electricity system) and imports and exports.

If the grid is initially balanced (supply = demand), and demand is growing, then during the balanced part of the Crediting Period some existing generation capacity is not operated (it is displaced by the CDM generation). At some point during the Crediting Period, the construction of new generation capacity will be required, but this will be delayed because of the recently added CDM project capacity.

The impact of a CDM Project on operating plant during the balanced period is captured through an Operating Margin (EF_{OM}) whereas the impact on the delay in new plant construction is captured through a Build Margin (EF_{BM}). The total impact of the CDM Project is captured by a Combined Margin (EF), also known as a Baseline Emission Factor. It is intended to reflect what happens on a grid when electricity from a new generator is added. Like it

The EF is expressed mathematically as:

$EF = w_{OM} \times EF_{OM} + w_{BM} \times EF_{BM}$

where w refers to weighting and $w_{OM} + w_{BM} = 1$

By default, both w_{OM} and w_{BM} are set at 0.5 in ACM0002. Other values may be selected where it can be demonstrated that the weighting should not be 50/50, such as on a grid with suppressed demand (w_{BM} could rise), or intermittent resources such as wind or solar (w_{OM} could rise). After the first crediting period, w_{BM} is expected to be 1 in most cases since, by that time, all CDM projects will be displacing new plant construction (Biewald, 2006).

Calculation of EF_{OM} and EF_{BM} requires data, "from an official source (where available) and made publicly available", on the CO_2 emissions and electricity despatched from all non-CDM projects despatching onto the interconnected electricity grid within the project boundary. This data (in the form of plant emission factors with units of "tonnes CO_2 equivalent/MWh despatched") should be provided in the following order of precedence:

- Directly, from the dispatch center or power producers, or
- Calculated, if data on fuel type, fuel emission factor, fuel input and power output can be obtained for each plant, or
- Calculated, using estimates of carbon content and oxidation from IPCC Guidelines, and name plate efficiencies (is available), or official anticipated energy efficiency, or conservative estimates of power plant efficiencies based on expert judgement, or
- Calculated, based on aggregated generation and fuel consumption data, if more disaggregated data is not available.

Gathering this data, in a grid with a large number of generators, and where it is not currently published in the manner described above, is not a simple task.

The Operating Margin is calculated in the following order of preference, with the most preferred methodological choice being presented first:

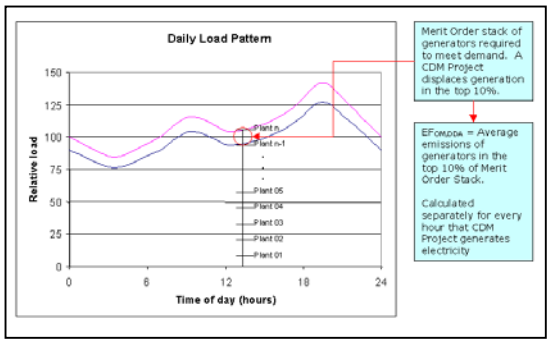
1) Despatch Data Analysis,
2) Simple Adjusted,
3) Simple, or
4) Average.

Despatch data analysis calculates, on an hourly basis, the actual average generation-weighted CO_2 emissions of generators comprising the top 10% of generators on the grid merit order despatch stack for that hour (i.e. for each hour, tabulate the energy generated and CO_2 emitted per plant according to this merit order, and calculate the weighted average emissions per MWh of the 10% of plants which were at the top of this table (being those generators which the grid operator brings onto the grid last, or takes off first, to meet changing grid demand)). This stack may vary through the day and through the year, depending on diurnal load patterns, seasonal availability of generators and maintenance impacts on available generators.

The theory is that this is the real generation which the CDM project is displacing. For each hour that the CDM project is operating, the emissions

reductions of the CDM project will match the emissions based on the despatch data analysis for the same hour. If this data is not already gathered by the despatch center, it is a very significant undertaking to obtain this. It is an ex-post calculation, meaning it must be based on actual future data and this can also mean that there is a delay in calculating the CDM project's emissions reductions until this information is published officially.

Figure A2.1. Despatch Data Analysis Operating Margin Method

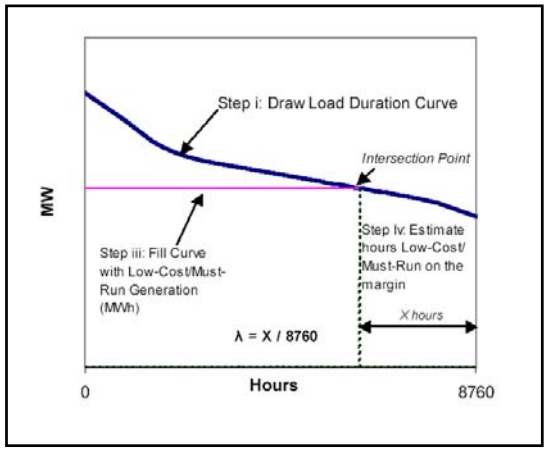


The simple analysis calculates the generation-weighted CO_2 emissions of all generators which are not "least cost/must run". Annual generation and CO_2 emissions of all plants on the grid for the five most recent years must be obtained as this method can only be used if "least cost/must run resources constitute less than 50% of total grid generation in the average of the five most recent years". This data set requires information on which plants are "least cost/must run". A clear definition of "least cost/must run" is not available in ACM0002 and this can lead to confusion. The simple OM can be calculated ex-ante based on the most recent 3 years for which data is available, or ex-post for the year in which project generation occurs.

The simple adjusted analysis is a variation of the simple analysis. It splits the generators into "least cost/must run" and "others". It then calculates the average generation-weighted emissions of "least cost/must run" plants for the period of the year that they are on the margin (refer Figure 3), and the average generation-weighted emissions of the "other" plants for the balance of the year, and adds these together. This determination requires data on the hourly load on the grid for the three most recent years if an ex-ante calculation is chosen, or for the year in which project generation occurs if an ex-post calculation is chosen.

The average analysis is the lowest ranked methodological choice, and the easiest to calculate since it requires the least amount of data. It is frequently the only option available for large grids and/or where limited officially-published data is available. It can only be used if "least cost/must run resources constitute more than 50% of total grid generation in the average of the five most recent years" and data to calculate the simple adjusted or despatch data analysis is unavailable. The analysis calculates the generation-weighted average CO_2 emissions of all generators on the grid. An ex-ante or ex-post calculation basis may be used.

Figure A2.2. Simple Adjusted Operating Margin Method



The Build Margin is calculated in a similar manner. It is the generation-weighted average "of either the five power plants that have been built most recently, or the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently", whichever "comprises the larger annual generation". This requires obtaining the dates when generation officially commenced for the set of plants which meets this criteria.

It is worth noting that, at the time of registration, project participants must choose whether they will apply ex-ante or ex-post calculations of the operating and build margin. Once chosen this cannot be changed for the first crediting period.