Determination of baselines and additionality for the CDM

A crucial element of credibility of the climate regime

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1. Introduction

The Clean Development Mechanism (CDM) allows countries without emission targets to invest in greenhouse gas reduction projects and thus create Certified Emission Reductions (CERs). CERs are calculated by comparing emissions of the CDM project with emissions of a hypothetical "baseline scenario". The baseline shall reflect the business-as-usual scenario (Michaelowa and Fages 1999). There is a wealth of baselines literature (see reference list in Probase 2003), particularly several discussion papers of the OECD. For a good summary of those, see OECD (2001).

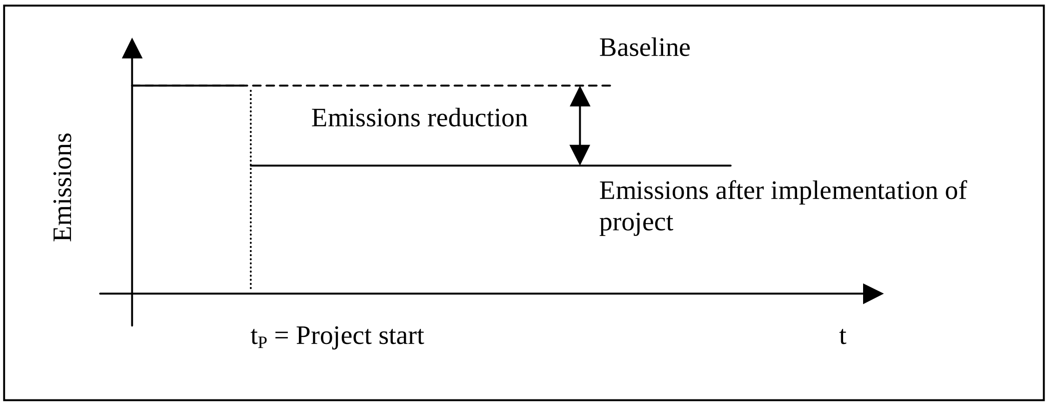

Figure 1: Principle of the baseline

Another question is now *which* projects can generate CERs. Shall any project be able to produce CERs if its emissions are below the baseline scenario defined for the project? Or shall it be tested whether the project would have happened anyway and thus is "additional" to a business-as-usual development? Host countries do not have emission budgets from which the CERs would be deducted. Therefore, both the host and the investor have an incentive to overstate the amount of emission reduction achieved by the CDM project as they can then enhance revenues (Michaelowa 1998). If CERs will be created that represent emission reductions that would have happened anyway, these "fake" reductions will undermine the integrity of the Kyoto Protocol. In the international climate negotiations, this debate has been raging over several years. Contrary to many expectations, the international community has taken the fears about the integrity seriously and developed a complex international process to

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determine baselines and have them independently checked. In 2003, the CDM Executive Board and its Methodology Panel came a long way in defining the rules for baseline setting and additionality determination but it still remains to be seen how they will be applied in practice.

2. Baseline Determination

Baselines can be project-specific or standardised, In the latter case, the same baseline is used for an entire class of projects (for a thorough discussion see Probase 2003). A mix of the two applies if partly standardised data, e.g. emissions factors, are chosen.

The Marrakech Accords (UNFCCC 2001) have set three baseline approaches but did not specify how to choose between them:
a) Existing actual or historical emissions
b) Emissions of an "economically attractive course of action, taking into account barriers to investment"
c) Emissions of the "average emissions of similar projects undertaken in the previous five years, in similar … circumstances, and whose performance is among the top 20 percent of their category".

They also specify that baselines should be project-specific.

2.1. Small scale project rules

For small-scale projects under the thresholds defined in the Marrakech Accords, baseline rules have been fixed by the Executive Board in January 2003 (UNFCCC 2003a). These rules give an indication how large-scale project rules could look like. Energy project types were differentiated strongly and for each type, a methodology was defined. In some cases, project proponents can choose between several methodologies. I will describe the methodologies and data needs for the most important project types.
For a system where all fossil fuel fired generating units use fuel oil or diesel fuel, the baseline is the annual kWh generated by the renewable unit times an emission factor (kg CO_2/kWh) defined by the Executive Board for three load factor ranges and five size classes. They range from 0.8 to 2.4. In this case thus no data have to be collected.
For grids with different fuels, the emission factor calculation is relatively complex and needs up-to-date data. There are several options: a) The average of the "approximate operating margin" and the "build margin", where: (i) The "approximate operating margin" is the weighted average emissions of all generating sources serving the system, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation; (ii) The "build margin" is the weighted average emissions of recent capacity additions to the system, defined as the lower of most recent 20% of plants built or the 5 most recent plants;
b) The weighted average emissions (in kg CO_2/kWh) of the current generation mix.

Box: How to calculate grid emission factors

You install a hydro plant of 10 MW that generates 70 GWh p.a.. The grid it serves has the following characteristics:
5000 MW hydro generating 35 TWh p.a.

10000 MW coal generating 70 TWh p.a. with an emissions factor of 1.1 kg CO_2/kWh
3000 MW gas generating 15 TWh p.a. with an emissions factor of 0.5 kg CO_2/kWh
2000 MW oil generating 6 TWh p.a. with an emissions factor of 0.8 kg CO_2/kWh
The last 4000 MW built have the following characteristics:
1000 MW hydro generating 7 TWh p.a.
2000 MW coal generating 14 TWh p.a. with an emissions factor of 0.9 kg CO_2/kWh
1000 MW gas generating 6 TWh p.a. with an emissions factor of 0.4 kg CO_2/kWh

Option a) is calculated as follows:

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

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

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

Option b) gives:

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

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

These data are often not publicly available and their collection has been difficult for many project developers. Sometimes they have resorted to some rough estimates which however so far has not been accepted by the CDM Executive Board.

2.2. International procedures to derive baseline rules

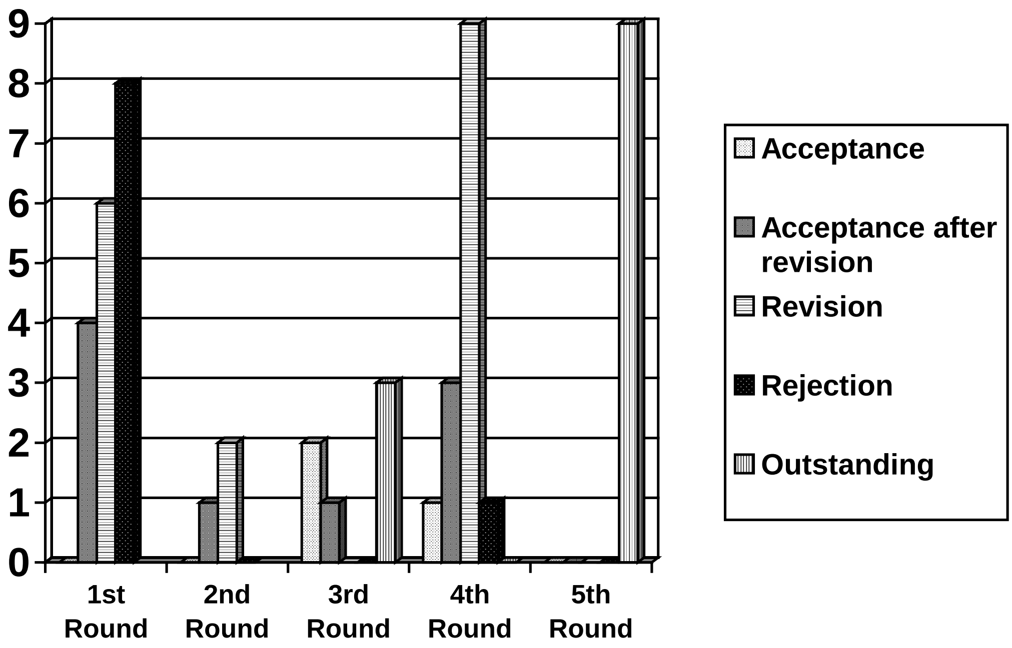
In contrast to earlier expectations, no rules for baseline setting for large projects were defined by the CDM Executive Board. It was decided to set up a “Methodology Panel” whose task is to evaluate proposed baseline methodologies. Project developers have to submit a new methodology together with their Project Design Document unless an approved methodology already exists for that project type (UNFCCC 2003c). Each methodology submission is evaluated by two independent experts. Then the Methodology Panel makes a recommendation to the Executive Board which takes the final decision.

In March 2003, the Executive Board agreed on some, fairly general, principles for baseline determination (UNFCCC 2003b). Data sources and assumptions have to be specified in detail. Baselines are to be defined in relation to production, i.e. emissions per unit of production. This avoids generation of CERs for reduction of production. Retrofit projects can only use historical emissions of the old plant if production and lifetime of the plant are not extended. If one chooses the third approach under the Marrakech Accords, the lower of two emissions factors has to be used:

1. production-weighted emissions of the best 20% of similar projects done under similar conditions in the last 5 years
2. production-weighted emissions of similar projects done under similar conditions in the last 5 years that belong to the best 20% of all curretly operating projects

Until February 2004, 38 methodologies were submitted of which 12 have been accepted. While initially, the success rate of methodology submissions was rather low, it has improved in the recent rounds (see Figure 2).

Figure 2: Status of methodology submissions



The sectoral distribution is shown in Figures 3 and 4.

Figure 3: Baseline methodology submissions according to sector

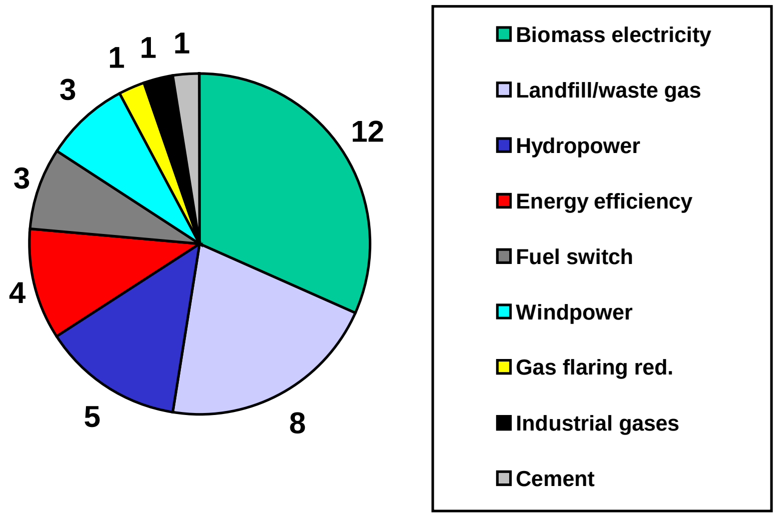
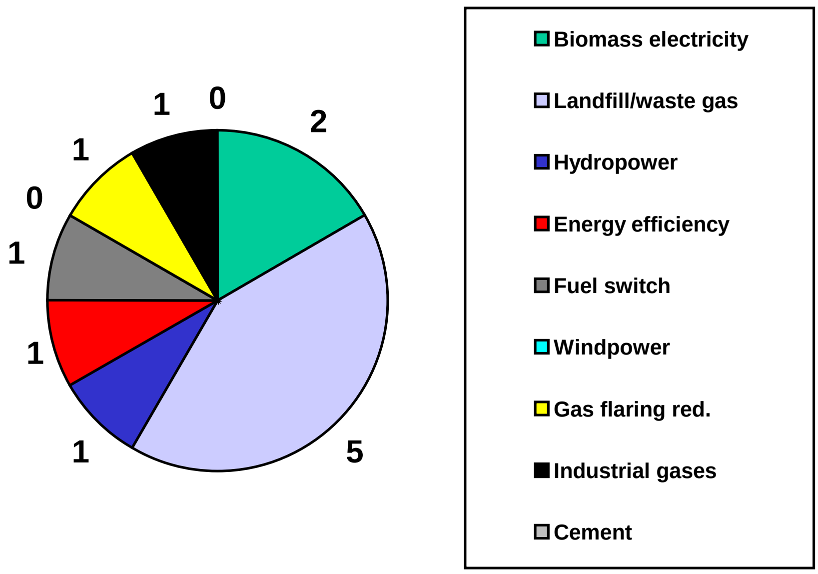


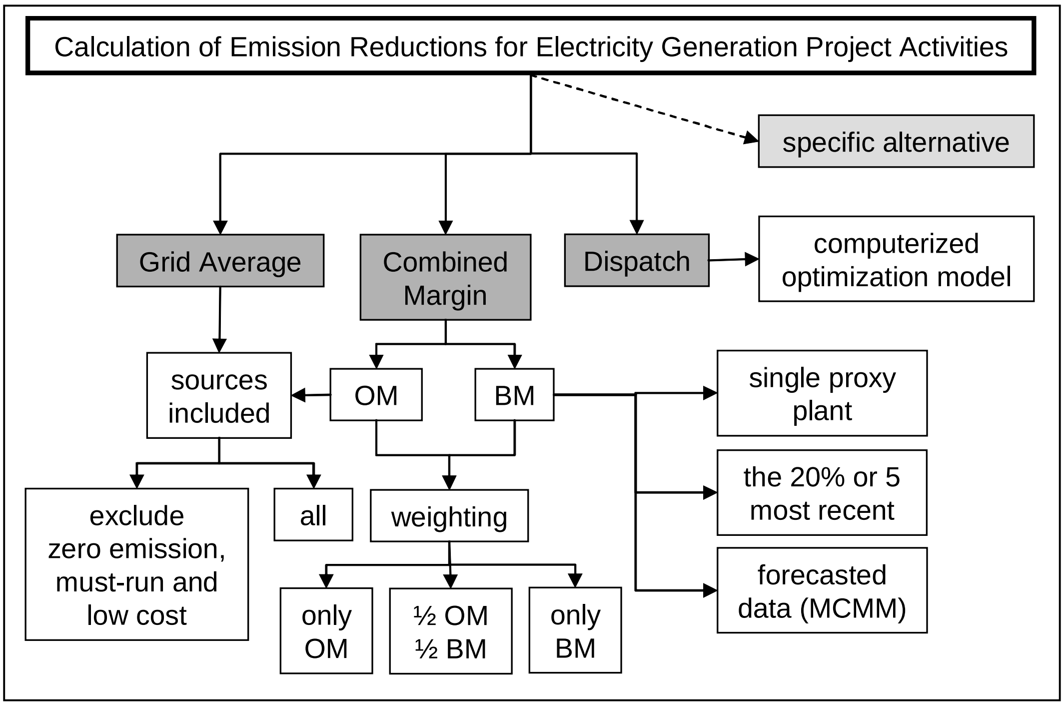
Figure 4: Accepted baseline methodologies according to sector



The results show that that different methodologies are approved for the same project types due to the fact that they are heavily circumscribed. However, the Methodology Panel is currently preparing a consolidation of methodologies to avoid "methodology proliferation" which could give rise to gaming due to methodology shopping.

How do methodologies for large electricity projects look like? While the approaches differ, they often involve the operating / build margins that have been defined for the small scale projects. Ellis (2003) provides a good overview about the different methodologies submitted. Figure 5 sketches the approaches used so far:

Figure 5: Approaches used for electricity baselines



OM: Operating margin, BM: Build margin, MCMM: Modified Combined Margin Method

Source: Müller-Pelzer (2004)

Dispatch modelling, also known as the production cost model, is the most sophisticated approach. It can be applied ex-post for verification or ex-ante if a model is used to simulate the complex operations of the interconnected grid system responding to a volatile demand. Taking into account both short term marginal costs and long term marginal costs (also called marginal capacity costs), this approach covers adjustments of the current system as well as impacts on ca-pacity addition. However, its implementation is costly and data requirements are high. Dispatch modelling was a favourite in the initial submissions to the EB but suffered serious setbacks as two methodologies using it in a "black box" fashion were rejected outright.

The AT Biopower project methodology in Thailand was the first renewable electricity methodology to be approved. It uses a simple grid average (option b from above) and forecasts the emission factor for the entire crediting period. If however, the actual emission factor proves to be lower, the latter has to be used. In this repect, the developer shot himself in the foot as he still will have to collect the actual data without a chance to enhance CER generation. He should have stuck to the ex-post approach from the outset. The methodology can only be used for plants where the biomass supply is at least twice the demand from the project.

The second electricity methodology, developed for the El Gallo hydro project in Mexico, uses a combined operating and grid margin (option a) above) on the basis of ex post activity and grid data. It can only be used for projects below 60 MW.

The Vale de Rosario bagasse cogeneration methodology is special inasmuch as it uses a combined operating and grid margin (option a) for the first crediting period and switches to a pure build margin for the remaining two 7-year crediting periods. Hydro is included in the operating margin as long as the load is fully covered by hydro. The methodology is restricted to cases where more than 80% of installed capacity are hydro.

The Methodology Panel is currently working on criteria for the choice of operating / build margin.

2.3 Data needs for baselines – an underestimated problem

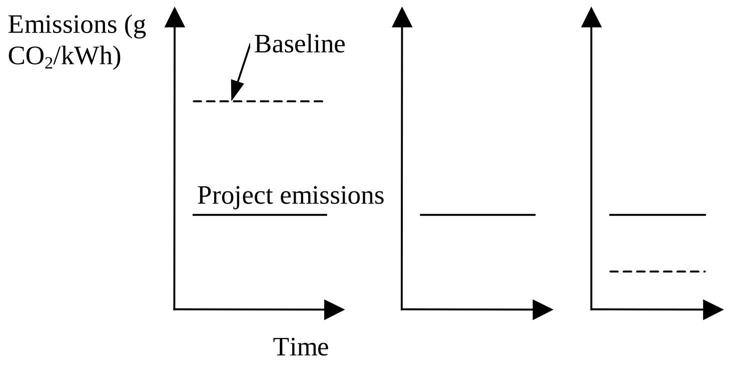
To calculate an electricity baseline, up-to-date and detailed grid data have to be available. This is only the case in a few countries like India and Chile, where the generation data for each power plant are posted on the internet. In China, on the other hand, these data are heavily guarded state secret and even a multi-man month effort could not report reliable grid emission factors. In other countries like Thailand, current grid data quality and availability is good but likely to deteriorate with liberalisation, as independent power producers do not report their generation data. A necessary condition to become an attractive CDM host is thus that the Designated National Authority published and regularly updates the operating and build margin of the relevant grids. As this will entail costs, data collection and publication should be integrated into the ongoing multilateral and bilateral CDM capacity building programmes (see chapter 9 in this volume).

3. Why baseline and additionality determination are not the same

Given the wide range of efficiencies, technologies and industrial practices found in most sectors, comparatively GHG-friendly performance will rarely be a sufficient measure of additionality for the CDM. Every sector and every industry has its more GHG-friendly facilities – the world’s hydroelectric and nuclear facilities being notable examples in the electric sector. But the purpose of the CDM is not merely to identify low-emitting activities and reward them with a monetary payment. Its purpose is to stimulate additional low-emitting activities that would not have happened otherwise, thereby expanding the range of mitigation options available to Parties striving to meet their Kyoto targets. Any CDM project that purports to create GHG reductions when those reductions don’t really reflect any extra achievement in exchange for credits has not legitimately earned those credits. If CDM decisions lose sight of this crucial point, then the CDM will be generating meaningless, unearned, tradable credits that displace real reductions in Annex 1 countries. To be effective, CDM investment must be clearly directed at new and additional effort (Kartha et al. 2003).

Many observers (e.g. Rentz 1998) argue that once a baseline is set and the project emissions are below the baseline, the project is also additional. This is a fallacious argument as Figure 6 shows:

Figure 6: Different baselines for the same CDM project



A new gas-fired power station is proposed as a CDM project. Let us assume that the baseline now is defined by the average grid emissions intensity. The high baseline on the left is due to a high share of the grid electricity is based on old coal-fired power plants. In a grid with a high share of renewables, the baseline could be lower than the project emissions and the project not earn any CERs. The baseline can also be equal to the project's emissions intensity (see middle of Figure 6). So the same project with the same economic parameters can earn highly different amounts of CERs depending on the grid it feeds.
The baseline can only determine additionality if it is defined by economic parameters. This is the case in the second baseline option of the Marrakech Accord, where the baseline is the economically most attractive alternative. Using the same figure the left baseline would be chosen if a coal-fired plant would be the most profitable option. The baseline would equal project emissions if a gas-fired power plant is most attractive and it would be lower if a gas-fired cogeneration plant is most attractive.

3.1 Need for additionality determination

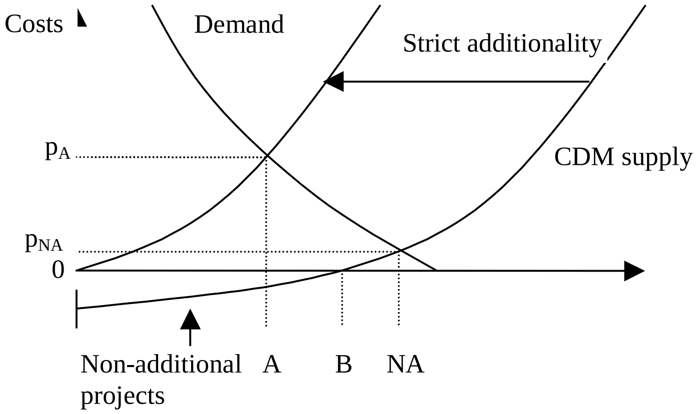
3.1.1 Environmental credibility

As the CDM is the only path to increase the overall emissions budget of Annex B, the existence of non-additional CERs blows up the budget ("tropical air"). Once non-additional emission rights have entered the system, they will remain in it due to the banking provision.

3.1.2 No crowding out of real projects

Additionality determination avoids a downward trend on the market price due to the lower supply of CERs (see Figure 7). Thus real emission reductions in the Annex B countries and through the CDM are fostered.

Figure 7: CER price increase through additionality checks



An additionality requirement shifts the CDM supply curve to the left and leads to an increase of equilibrium price from p_{NA} to p_A. The amount of additional CDM projects increases from the distance B-NA to 0-A. Obviously, due to the competition between the Kyoto Mechanisms and domestic action, the overall amount of CDM will fall from 0-NA to 0-A. However, CDM revenue rises if the demand curve is steep enough.

3.1.3 Real financial and technological flows to host countries

Non-additional projects by definition do not lead to additional financial flows to host countries. Only if the host country retains a part of the CERs, a positive revenue results. As current emission reduction purchase agreements show, generally CERs are given to the investor. In such a case, a non-additional project is a burden to the host country due to the approval transaction cost.

3.1.4 Incentives for host countries to take up policies and measures and targets

A strict additionality rule leaves profitable projects to the host countries and thus gives them an opportunity for trading if they take up an emission target. Otherwise a target and a continued CDM regime are equally attractive.

3.2 Problems related to additionality determination

3.2.1 Higher transaction costs

Additionality determination entails another check and thus increases transaction costs of CDM projects. However, project developers will anyway calculate financial parameters of their projects to get external finance. If additionality tests are standardized (e.g. by applying thresholds), costs can be kept low. For suggestions for standardisation of financial parameter calculation and country risk factors see Greiner and Michaelowa (2003).

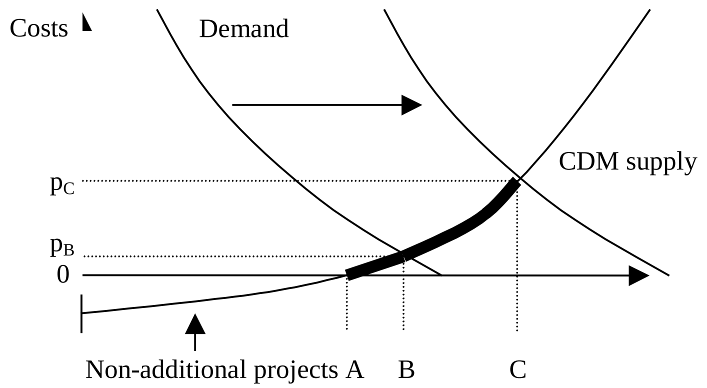
3.2.2 Gaming of numbers or exaggeration of barriers

Project proponents can deliberately understate the economic attractiveness of their project or blow up barriers. Here the vigilance of validators becomes paramount which should be bolstered by the liability rules of the Marrakech Accords. The experience with financial auditing shows that an overwhelming majority of audited companies did not “cook the books”.

3.2.3 “Grubb’s paradox” vanishes with rising CER prices

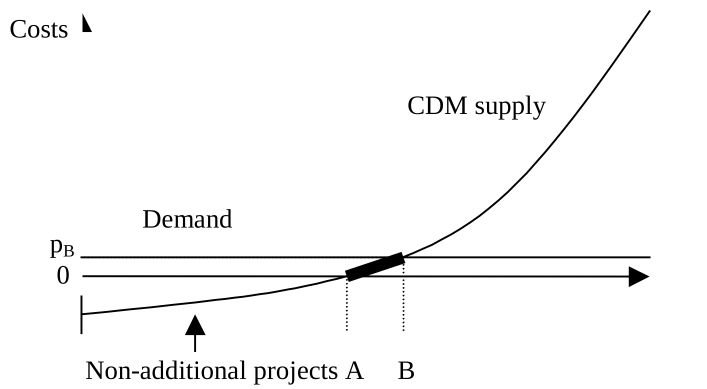
Michael Grubb (Grubb et al. 1999) succinctly stated the paradox that both overly cheap and overly expensive projects cannot make it into the CDM. This is illustrated by Figure 8.

Figure 8: Grubb’s Paradox



If non-additional projects are excluded, CDM is limited to A-B. However, an increase in demand increases CDM volume to A-C. As shown in Figure 2, an exclusion of non-additional projects leads to a CER price increase and thus increased CDM volume. Only in the case of an oversupply of hot air the paradox binds as an increase in CER prices is impossible (see Figure 9).

Figure 9: Hot Air supports Grubb’s Paradox



3.3 Additionality testing in the international CDM rules

Whereas since the Marrakech Accords many observers thought that a separate additionality test would not be required, the CDM Executive Board decided in January 2003 that additionality should be tested for small scale projects in the form of a barrier assessment (UNFCCC 2003a, p. 19). The barriers tested are:

- Investment barrier: a financially more attractive alternative would have led to higher emissions

- Technology barrier: a technologically less advanced alternative is less risky as the new technology has a lower market share and less uncertainty regarding its performance
- Common practice or political requirements would have led to higher emissions
- Other institutional, organisational of informational barrier

For large projects, the Executive Board specified in March 2003 that an additionality test should be done (UNFCCC 2003b). After the outcry of project developers due to the rejection of eight methodologies for lack of additionality testing (JIQ 2003), the Board decided in July 2003 that an "explanation shall be made of how, through the use of the methodology, it can be demonstrated that a project activity is additional and therefore not the baseline scenario" (UNFCCC 2003e). Unfortunately, the Board did was not able to agree on the clear wording proposed by the Methodology Panel (UNFCCC 2003d). The tests specified by the Board are:

- Flow-chart / series of questions that lead to a narrowing of potential project options
- Qualitative / quantitative assessment of different potential options and an indication of why the non-project option is more likely
- Qualitative /quantitative assessment of one or more barriers facing the proposed project activity
- Project type is not common practice in the proposed area of implementation, and not required by recent/pending legislation/regulations

Further tests can be proposed. The problem with the tests defined by the Board is that their stringency depends on the way of implementation. Concerning the flow-chart / series of questions, the stringency depends on the type of questions. It is only a *framework* for a test. The answer to the question "Why is the non-project option more likely?" should essentially be the outcome of all tests applied. While barrier assessment can become a robust test, the key issue is to determine how important barriers are. There will be some barrier for every project. Otherwise everybody would start projects every day. The crucial issue is when a barrier would prevent a project ("decisive" barrier) developed by a capable developer. Can we capture this objectively? What level of barrier is decisive for project decision? The common practice and legislative test is the only test which is objective, but it does only specify a necessary, not sufficient condition for additionality.

The approved methodologies have a very different treatment of additionality. Some calculate internal rates of return, others just say in one sentence that they face a barrier. So now all depends on the interpretation of the additionality tests by the validators who have to check the Project Design Documents. A positive note comes from the market leader in validation, Det Norske Veritas, which recently stated that it rejects about 50% of the projects submitted for validation. Another positive development is the wave of comments submitted on a 15 MW Indian wind power plant submitted under the small-scale rules. The comments agreed that the additionality test was insufficient. It is likely that the project will be withdrawn. Thus critical commenting by NGOs could become a major weapon in the fight to preserve environmental integrity of the CDM.

4. Conclusions

The international rules for baseline determination and additionality testing of CDM project proposals are surprisingly stringent. Additionality determination will both help the climate and host countries. It is not more difficult than financial auditing. The fear of squeezing the CDM expressed by Grubb's Paradox is unfounded as long as there is demand for CERs. Only in a situation of a huge oversupply of hot air non-additional CDM projects can create extremely low-price CERs and thus create revenues for host countries that would be otherwise foregone. Such a situation is only likely in the initial stage of the climate regime.

Rejection of several proposed methodologies due to lack of additionality testing was a clear call that simple business-as-usual projects would not be accepted. However, the day-to-day practice remains unclear and will emerge only once projects are being registered. It also remains to be seen whether baseline standardisation can be achieved; the signals coming from the Executive Board are encouraging in this regard. A hitherto neglected issue is the data procurement to calculate baselines; this will need a concerted efforts by Designated National Authorities and international donors.

5. References

Ellis, Jane (2003): Evaluating experience with electricity-generating GHG mitigation projects, OECD, Paris

Greiner, Sandra; Michaelowa, Axel (2003): Defining Investment Additionality for CDM projects - practical approaches, in: Energy Policy, 31, p. 1007-1015

Grubb, Michael; Vrolijk, Christiaan; Brack, Duncan (1999). The Kyoto Protocol: A guide and Assesment, Earthscan, London

JIQ (2003): The MethPanel evaluation, Groningen

Kartha, Sivan; Lazarus, Michael; Michaelowa, Axel; Winkler, Harald (2003): Tradable Credits for Mozart ? ...and for Milli Vanilli, too?, mimeo, Boston

Michaelowa, Axel (1998): Joint Implementation: the baseline issue. Global Environmental Change, 8, 1, p. 81-92

Michaelowa, Axel; Fages, Emmanuel (1999): Options for baselines of the Clean Development Mechanism, in: Mitigation and Adaptation Strategies for Global Change, 4, 2, p. 167-185

Müller-Pelzer, Felicia (2004): The Clean Development Mechanism. A comparative analysis of chosen methodologies for methane recovery and electricity generation, Masters thesis, University of Cologne, Cologne

OECD (2001): Emissions baselines – estimating the unknown, Paris

Probase (2002): Procedures for Accounting and Baselines for JI and CDM Projects, Final Report, Groningen

Rentz, Henning (1998): Joint Implementation and the question of additionality – a proposal for a pragmatic approach to identify possible Joint Implementation projects, in: Energy Policy 4, p. 275-279

UNFCCC (2001): Report of the Conference of the Parties on its seventh session, Addendum, Part 2: Action taken by the Conference of the Parties, Vol II, FCCC/CP/2001/13/Add.2

UNFCCC (2003a): Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories, Appendix B1 of the simplified modalities and procedures for small-scale CDM project activities, Annex 6, Report of the 7th meeting of the Executive Board, Bonn

UNFCCC (2003b): Clarifications on issues relating to baselines and monitoring methodologies, Annex 1, Report of the 8th meeting of the Executive Board, Bonn

UNFCCC (2003c): Procedures for submission and consideration of a proposed new methodology, Annex 2, Report of the 8th meeting of the Executive Board, Bonn

UNFCCC (2003d): Report of the fifth meeting of the methodologies panel, Bonn

UNFCCC (2003e): Report of the 9th meeting of the Executive Board, Bonn