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The Clean Development Mechanism

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The Clean Development Mechanism

A Comparative Analysis of Chosen Methodologies for Methane Recovery and Electricity Generation

Felicia Müller-Pelzer

This paper was prepared in the author's co-operation with the HWWA Research Programme „International Climate Policy". It draws on the author's diploma-thesis at the University of Cologne.

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Abbreviations

AIJ	Activities Implemented Jointly
AAU(s)	Assigned Amount Unit(s)
BAU	Business-As-Usual
BM	Build Margin
CDM	Clean Development Mechanism
CDM-AP	(CDM) Accreditation Panel
CEF(s)	Carbon Emission Factor(s)
CER(s)	Certified Emission Reduction(s)
CERUPT	Certified Emission Reduction Unit Procurement Tender
CM	Combined Margin
CPCB	Central Pollution Control Board
CH_4	Methane
CO_2	Carbon Dioxide
$CO_{2\ equiv.}$	CO_2 equivalent
COP	Conference Of the Parties
COP/MOP	Conference Of the Parties serving as the Meeting Of the Parties
DNA	Designated National Authority
DOE(s)	Designated Operational Entity
DSM	Demand Side Management
EAF	Effectiveness Adjustment Factor
EB	(CDM) Executive Board
EIT(s)	Economy(/ies) In Transition
ER(s)	Emission Reduction(s)
ERU(s)	Emission Reduction Unit(s)
ET	Emission Trading
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG(s)	Greenhouse Gas(es)
HFC(s)	Hydrofluorocarbon(s)
IET	International Emissions Trading
IPCC	Intergovernmental Panel on Climate Change
IRR	Internal Rate of Return
JI	Joint Implementation
LDC	Least Developed Countries
LFG	Landfill Gas
MCMM	Modified Combined Margin Method
Meth Panel	(CDM) Methodology Panel
MLF	Multilateral Fond
MOP	Meeting of the Parties
MSW	Municipal Solid Waste
N_2O	Nitrous Oxide
NGO	Non-Governmental Organization
NM	New baseline and monitoring Methodology
NPV	Net Present Value
ODA	Official Development Assistance
OM	Operational Margin
PCF	Prototype Carbon Fund

PDD	Project Design Document
PFC(s)	Perfluorocarbon(s)
PPA	Power Purchase Agreements
PPs	Project Participant(s)
RMU(s)	Removal Unit(s)
SDDP	Stochastic Duo Dynamic Programming
SF_6	Sulfur Hexafluoride
SSc Panel	(CDM) Small Scale Panel
T&D	Transmission and Distribution
UNCED	United Nations Conference on Environment and Development
UNFCCC	United Nations Framework Convention on Climate Change
WWF	World Wildlife Fund

PREFACE

This report analyses a quickly evolving policy area – the definition of baseline methodologies under the Clean Development Mechanism (CDM) of the Kyoto Protocol. The CDM allows industrialised countries to acquire emissions credits (Certified Emission Reductions, CERs) from projects that reduce greenhouse gas emissions in developing countries. To prevent issuance of fake CERs, a complex body of rules has been developed that includes several checks and balances. In this context, the situation that would have prevailed if the CDM project had not taken place is of crucial importance. If the baseline is overestimated, the amount of CERs issued will also be too high. In the Marrakech Accord of 2001 which defines the implementation rules of the Kyoto Protocol, only three principles for baseline setting are given. The detailed rules are developed in a bottom-up process that involves submission of a draft baseline methodology by the developer of the first project of a specific type. During the last 12 months, methodologies have been submitted for a wide range of projects and many submissions have been refused. Particularly the question of additionality, i.e. whether a project would have happened anyway or is only developed due to the CDM incentive, has taken prominence.

Felicia Müller-Pelzer compares the different methodologies and gives their first comprehensive analysis. She has profited from working with the UNFCCC Secretariat during preparation of this report and thus was able to get rare first-hand insights in the methodology development process. As the CDM can only become relevant if the baseline methodology setting process is objective and transparent, this research both has policy relevance and also direct importance for project developers.

Axel Michaelowa
Head of Programme International Climate Policy

ABSTRACT

This paper explores chosen CDM methodologies for methane recovery and electricity generation regarding their additionality assessment.

First, a brief outline of the historical evolution will be given and the three flexibility mechanisms (the Emission Trading, the Joint Implementation and the Clean Development Mechanism) will be defined. Against this background, the paper will illustrate the working of the CDM, discuss the additionality concept, show limitations of the additionality assessment and explain the impact of the baseline setting.

Second, chosen methodologies will be compared and explored with the aim to identify problems of implementation. In order to make the analysis understandable, a first section explains how the methodologies were chosen. This section is then followed by a brief description of the underlying project activities. Subsequently, the author will oppose and discuss the different paths taken by the methodologies. In doing so, contradictions will be identified. Some methodologies go further than others. Some are very general in their approach and others are very project specific. These findings reveal the potential for further generalization and simplification of the methodologies.

In addition, the comprehensive evaluation makes it possible to draw conclusions about the outcome of the methodologies and to identify problems with implementing the ultimate objective of the United Nations Framework Convention [UNFCCC (1992), Article 2]. The main problem lays in the information asymmetry. But inaccuracies in quantitative and qualitative assessments also affect the outcome of the methodologies. Further, a distortion of the results can be provoked by an inadequate setting of the boundaries, an inaccurate leakage assessment and related uncertainties. Finally, the emission reductions can only be estimated correctly if an appropriate method is chosen to calculate the emission reductions.

Moreover, alternative proceedings to the present UNFCCC methodology approach and their possible impact on the CDM will be briefly discussed. Based on these results, the author will make suggestions on how to proceed in the future, especially how to coordinate and consolidate the methodologies. A simplified approach will be recommended to guarantee an effective additionality assessment and an efficient structure.

1. INTRODUCTION

Climate change is a problem of global scale significantly increasing the level of uncertainty of ecological and economical conditions, undermining the forecasts for growth and development and thereby threatening global prosperity. Recent climate models and results from extensive scientific research show, that the impacts of climate change are likely to be serious. It is extremely probable that the anthropogenic greenhouse gas emissions play a significant role in this process.

Global warming is provoked by an increased concentration of greenhouse gases in the atmosphere[1], such as CO_2, CH_4 and N_2O. Emissions arise in all the sectors of an economy[2], especially industrial processes, the building sector, the traffic and transport sector as well as in the agriculture sector.

Possible impacts consist of a variety of non-linear changes:
Due to the thermal expansion of water[3] and the polar melting process, the sea level increases and threatens the most low-lying countries (e.g. Bangladesh, small island states) exposing them to the risk of becoming totally or partially submerged. The weather, too, will become more extreme: the differences in temperature will become greater; the winds will get stronger and take new routes causing storms to occur more often. Terrestrial and aquatic ecological systems are thus vulnerable and some species will not be able to adapt to the altered climate. The consequence is an increased danger to biodiversity.

But also socio-economic systems like forestry, fisheries and agriculture are threatened. Through a shifting of the temperature zones, the output of agriculture changes and the food provisions become insecure. Health risks will increase because of a tightened supply of drinking water. This induces that epidemics such as malaria and cholera will increasingly appear.

Still, it is controversial what exactly will happen in future: With which probability, how fast and in which dimension will these developments take place? The knowledge of natural variability is still fragmentary. This is why the anthropogenic contribution to climate change is not yet clearly determinable. However, the Intergovernmental Panel

1 See Forner, Claudio (2004)
2 See Michaelowa, Axel / Dutschke, Michael (2002), p. 2
3 See Forner, Claudio (2004)

on Climate Change (IPCC) states that “a discernible human influence on climate”[4] is of a high probability.

Indisputably, the biggest polluters today are the industrial countries and therefore carry the main responsibility. This is all the more the case as the traditionally disadvantaged developing countries (and above all the least developed countries (LDC) are especially exposed to the negative impacts and will carry the biggest burden. However, in the future, the developing countries are likely to become the bigger polluters, as their emissions are rising at a very high rate.[5]

This is a typical constellation of an open access regime from which nobody can be excluded, not even if social welfare is damaged. The polluter behaves as he does, because he does not directly feel the effect of his behaviour: On the one hand, the changes take place with a large time lag, and on the other hand, the negative impacts do not affect only him, but the whole society.

Against this background, the United Nations Framework Convention on Climate Change (UNFCCC) has established a global action plan to mitigate GHG emissions in order to protect and conserve the climate. The ultimate objective of the Convention[6] is to stabilize the atmospheric GHG concentration at a safe level and at the same time to enhance sustainable development. However, the Convention failed to set binding targets and therefore, the implementation has suffered difficulties.

To strengthen the work of the UNFCCC, the Kyoto Protocol was created. The industrial countries and the economies in transition (EITs) committed themselves to reducing their emissions to 5.2% below 1990 emissions level. The developing countries refused to adopt mitigation targets. In fact, the developing countries face a dilemma: On the one hand, the worldwide mitigation activities are of their special interest, because there is a high degree of probability that the developing countries will suffer most from climate

4 IPCC (1995), chapter 8

5 See Forner, Claudio (2004)

6 See UNFCCC (1992), Article 2: “The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

change.[7] But on the other hand, they fear their growth prospects will be burdened by entering into binding commitments.

But this conflict could be diminished, because of the three flexibility mechanisms that were created to facilitate the ratification of the Kyoto Protocol. These "Kyoto Mechanisms" shall allow a sustainable and efficient reduction of the GHG emissions with the least possible social cost. One of these instruments is the Clean Development Mechanism (CDM), which is of the highest interest for the developing countries. It enables them to attract foreign investments to their countries in order to enhance sustainable development and reduce GHG emissions. In return, the investors obtain certificates, the Certified Emission Reduction Units (CERs), which the industrial countries can use to meet their emission reduction commitments. The CDM project activities have to be submitted to the CDM Executive Board (EB), which decides, if they deserve to be promoted.

This paper will analyse the first step in the process of acceptance of CDM project activities, which is currently taking place: the creation of methodologies. These methodologies will be the basis for assessing project activities submitted to the EB. Therefore, it is crucial that the proceedings of the methodologies are cost-efficient and effective regarding the achievement of the two main goals: the identification of project activities leading to additional emission reductions and the enhancement of sustainable investments. Additionality here means, that the emission reductions result from the implementation of the project activity and that this project activity would not have occurred without the CDM.

As the creation of the methodologies is still in process, there are no reliable results (e.g. on the outcome of the methodologies or on related costs) from implemented project activities yet available. This is why it is not yet possible to measure the quality of the methodologies. This will only be the case, when the first project activities have been accepted and the assessment based on the methodologies has taken place. Therefore, an **explicit cost benefit analysis** cannot be presented in this paper; neither the costs nor the benefits are foreseeable. As a result, this paper will not provide an exact quantification of costs and benefits of the current "proposed new methodologies". It is rather the objective to show, where **critical issues** exist in the additionality assessment. The quality of the methodologies will be estimated analysing chosen methodologies and referring to official UNFCCC documents as well as to specialized literature. The

[7] See Michaelowa, Axel / Dutschke, Michael (2002), p. 1

proposed new methodologies and the UNFCCC documents are publicly available on the UNFCCC website. As the CDM is a fast developing subject of a high actuality, articles dealing with the CDM and the additionality issue have been continuously published. The articles that were used for this paper were published above all by scientific institutes in newspapers and/or online.

In research, two main **positions** can be identified: Some authors, e.g. Michaelowa[8], defend that the additionality assessment of a CDM project activity has to rely on a test of investment additionality in order to exclude free riders. Others, e.g. Rentz[9], believe that this approach neglects risks and barriers to investment, and further leads to a very low participation and the dominance of a phenomenon called the Grubb's paradox (refer to the section 2.2.2.3). The Grubb's paradox means that the least efficient projects are the most likely to be accepted. Instead, they propose, above all, to enhance participation to make the CDM workable.

Most of the articles used refer to economic literature, while some are based on studies on similar processes of project acceptance. For example, they analyse the admission process of the Activities Implemented Jointly (AIJ), which are the forerunner of the CDM and the JI project activities. Moreover, the admission process of the Multilateral Fond (MLF) and the one of the Global Environmental Facility (GEF) are analysed. Experience gained from Demand Side Management (DSM) programs in the United States is also used.[10] However, the similarities between these programs and the CDM, especially concerning the additionality test, are not sufficient. The cited programs were launched earlier and disposed of less practical experience, which explains why their assessment is not as far-reaching as it is now claimed for the CDM methodologies. They represent more a pre-step in the discussion.

During the past years, the additionality definition has gained clearness and the demand for accuracy of the assessment has grown steadily. Against this background, this paper approaches the subject analysing the currently submitted methodologies. Together with the experience gained from other programs, it is possible to **estimate the tendency of the methodologies' outcome**. In the future, with a clear definition of additionality, with well structured assessment procedures and with the experience from the first

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8 See Greiner, Sandra / Michaelowa, Axel (2003), p. 5ff.

9 See Rentz, Henning (1998)

10 See Sugiyama, Taishi / Michaelowa, Axel (2000), p.7

implemented project activities, the outcome of the methodology approach will be easier to measure. The methodologies can then be accordingly adjusted.

In this paper, the first look will be at the issue of the additionality under the historical development and the discussion in literature. At the beginning, there will be a brief outline of the historical evolution and a presentation of the three flexibility instruments. Then, the working of the CDM will be explained and the concept of the additionality will be discussed, comparing different interpretations of additionality, showing the limits of the additionality assessment and explaining the impact of the baseline setting.

Second, chosen methodologies will be analysed in order to draw conclusions referring to the output of the methodologies, as well as to show the difficulties and to make suggestions for improvement. In order to make the following analysis understandable, the process of how the methodologies were chosen will be explained and the underlying project activities will be briefly summarized. Next, the results of the comparative analysis will be presented. The different paths taken by the methodologies will be opposed to each other and discussed. In doing so, contradictions can be identified. Some methodologies go further than others. Some are very general in their approach and others are very project specific. As a next step, conclusions will be drawn from the analysis, and problems with implementing the ultimate objective of the Convention will be identified. It will then be briefly discussed, what alternative proceedings to the present methodology approach could have been chosen and how this would probably have influenced the outcome of the CDM. Based on these results, suggestions will be made on how to proceed in the future. A simplified approach will be recommended to guarantee an effective additionality assessment and an efficient structure.

2. THE CONCEPT OF ADDITIONALITY OF THE CDM AND THE METHODOLOGY APPROACH

2.1 The History of Negotiations

2.1.1 From the Conference in Rio until Today

The global movement for protection of the world climate began during the 1980’s. It was initiated by the first oil crisis and became public through the report “Limits to Growth” by the Club of Rome in 1972. In its statements, the Club of Rome came to the dark result that by the year 2000 all the world's energy resources would be consumed.

As a result of this declaration, populations started panicking. Continuous growth of economies was called into question, because it was supposed that the relationship between growth and energy consumption was irreversible. However since the 1960's, due to enhanced energy efficiency, an uncoupling of growth and energy needs can be observed. This is why limiting growth is no more in the focus of scientific discussion to reduce growth, but reducing GHG emissions, which are a result from productive processes of an economy.

By publishing its First Assessment Report in 1990, the Intergovernmental Panel on Climate Change (IPCC), founded one year before, placed the climate change problem firmly on the global agenda. For the year 2100 it forecasted[11], assuming no emission reduction procedures take place, an increase in temperature between 1.5 and 4.5 °C and an increase of the sea level ranging from 70 to 100 cm. The IPCC declared that immediate emission reductions by 60% were required in order to stabilize the concentration of greenhouse gases at the level of that time (1990)[12]. In 1995, however, the second IPCC report made slightly more moderate forecasts, predicting an increase in temperature between 1 and 3.5°C and an increase of the sea level ranging from 15 to 95 cm. Nevertheless, even those more moderate values were considered as threatening.

Against this backdrop, the United Nations Conference on Environment and Development (UNCED) took place in Rio de Janeiro in 1992. During this conference a world treaty, entitled the United Nations Framework Convention on Climate Change (UNFCCC) was drawn up and the Conference of the Parties (COP)[13] was established as the supreme body of the Convention. In spite of a "lack of full scientific certainty", the United Nations recognised an urgent need to face the "threats of serious or irreversible damage" to the climate system.[14] But the UNFCCC on its own, being a non-binding agreement, turned out to be insufficient in avoiding dangerous interference with the climate system. The final declaration made in 1995 at COP1, known as the Berlin Mandate, called for the strengthening of the UNFCCC by establishing specific and binding targets and timetables for developed countries.

During the third Conference on Climate Change in sequence, COP3 in Kyoto, a far-reaching decision was made: The intense political negotiations culminated in the

[11] See Dutschke, Michael / Michaelowa, Axel (1998): Der Handel mit Emissionsrechten für Treibhausgase, p. 16

[12] See UNFCCC (1992), Article 4 (2b)

[13] For a list of all the COPs see Annex 1 of this paper.

[14] UNFCCC (1992), Article 3.3

adoption of the so called “Kyoto-Protocol”. The Parties listed in Annex I of the Kyoto Protocol agreed to accept specific, binding emission targets for the period 2008-2012. The mitigation requirement is defined as the difference between Business-As-Usual (BAU) emissions in 1990 and the maximum emissions allowed (assigned amount) by the Protocol. The emission targets refer to six different greenhouse gases known as the “Kyoto gases”: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6).[15]

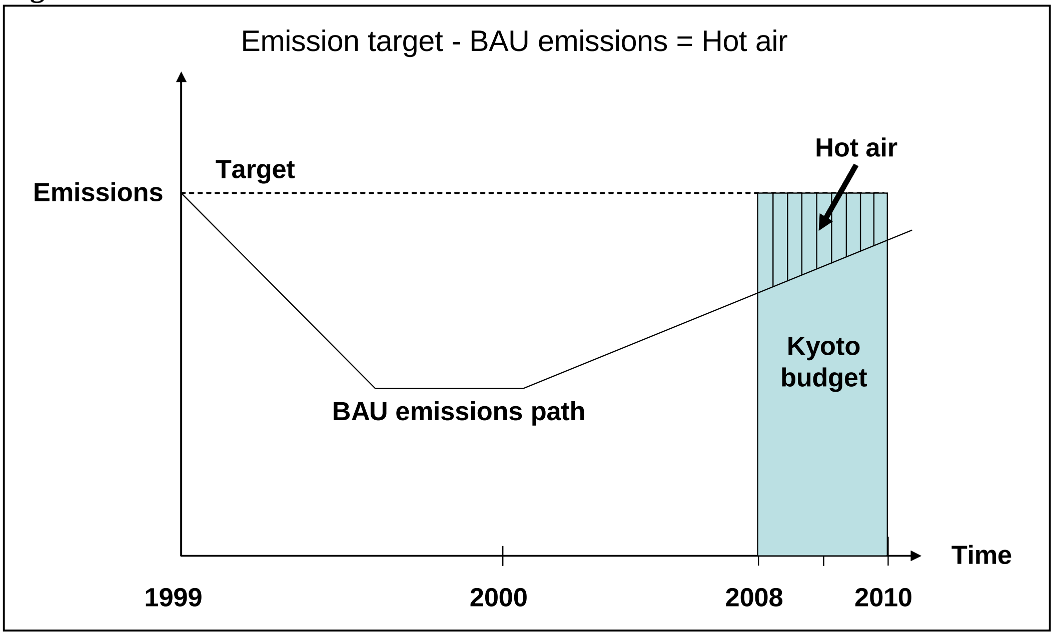
The so called Annex I countries committed themselves to reducing their emissions jointly by 5.2 % (base year 1990) until 2010; compared to what the IPCC reports claimed, this is a quite moderate target. Annex I countries are those that are mentioned in the Annex I of the UNFCCC[16] and generally recognized as industrial economies or economies in transition (EITs). Non-Annex I countries are those that are recognized as developing countries. The Non-Annex I countries refused to commit themselves to binding emission targets because of their unstable economic state and their, in many cases, so far negligible emissions.

But the Kyoto Protocol cannot be enforced until it has been ratified by at least 55 countries and covers at least 55% of the emission reduction targets. So far, 120 countries have already ratified the Protocol but still only cover 44.2% of the emission reductions.

The United States is estimated to account for roughly half to two thirds of the required ERs under the Kyoto Protocol[17] being the largest emitter of GHGs. US emissions have grown steadily since 1990 and are expected to keep growing, whereas their mitigation commitment is to reduce emissions by 7% referring to the level of 1990. On the contrary, in most EITs, such as Russia, the Ukraine and a number of Eastern European countries, emissions are predicted to stay below target levels even if no emission reduction measures are undertaken. Due to prolonged economic recession, actual emissions are much lower than the targets and are unlikely to reach the target level during the commitment period.

15 Kyoto Protocol (1997), Annex A
16 See Annex 3 of this paper.
17 See Jotzo, Frank / Tanujaya, Olivia (2001), p. 1

Figure 1: Hot Air



This difference between Business-As-Usual (BAU) emissions and Kyoto targets is called **hot air[18]**, which is illustrated in Figure 1[19].

Although estimates concerning the size hot air will reach vary widely, there is little doubt that hot air will be substantial.[20] If Russia would ratify the Kyoto Protocol, more than 55% of the emission reductions would be covered and the Protocol could enter info force. Russia's economy would profit from the ratification, as it could act as the biggest supplier of certificates on the market. As a result of its economical collapse, Russia disposes of a lot of hot air. The reduced energy consumption is a concomitant of the decline in industrial production in Russia. Therefore, Russia could profitably sell the amount of certificates based on economic data of 1990 at the market and thereby notch up a strong competitive advantage. However, without the ratification of the United States, hot air could become an important threat for the whole CDM program. In fact, it could probably crowd out the entire CDM, as the demand for credits on the global carbon market would then be inferior to the overwhelming offer consisting of a huge part of hot air from the EITs.

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18 "Hot air" is called the difference between emission allowances provided to countries and the forecasted emissions, when emissions are predicted to stay below Kyoto target levels even if no emission reduction measures are undertaken.

19 See Michaelowa, Axel (2001), p. 5

20 See Jotzo, Frank / Tanujaya Olivia (2001), p.1f.

Once the Kyoto Protocol has entered into force, the first Meeting of the Parties (MOP) will take place. The parties admitted to this meeting will be all the countries that have ratified the Kyoto Protocol. It is highly likely that not all Annex I countries will be allowed to participate, so that the Parties taking part in the MOP can differ from the Parties of the COP. Nevertheless, the COP will also serve as the MOP for cost savings. The MOP will thus take place in connection with the COP, but will exclude all Parties not having ratified the Kyoto Protocol. Therefore, reference will be made to these conferences as COP/MOP[21].

In order to speed the process up or, in the worst case, to prevent an entire failure of the agreement, Parties decided to introduce three flexibility mechanisms (the Emission Trading, the Joint Implementation and the Clean Development Mechanism) in advance without the Kyoto Protocol having entered into force. In doing this they intend to improve applicability and allow for an early start of the Protocol. At COP4 (1998), the Parties agreed on a work program ("Buenos Aires Plan of Action") to elaborate principles, modalities, rules and guidelines for the implementation of the Kyoto Protocol including the three flexibility mechanisms. However, they failed to produce results until COP6 (The Hague, November 2000), which is why the negotiating during the conference turned out to be unsuccessful and was forwarded to COP6 part II which took place in Bonn in July 2001. The result of this conference was the "Bonn Agreements", which reflected consensus on many key issues, however, many detailed decisions had to be postponed to COP7 (2001) in Marrakesh. Finally, COP7 can be described as a break through for the implementation of the Kyoto Protocol and the flexibility mechanisms. The Parties adopted a package of decisions ("Marrakesh Accords"), and made recommendations for COP/MOP1. Detailed baseline rules were left to be defined by the CDM Executive Board (EB), which supervises the CDM under the guidance of the COP/MOP.[22] The EB members were immediately elected by the COP in Marrakesh, and the EB even had its first meeting at the end of the conference. The EB is responsible for recommendations on further modalities and procedures or amendments, issues surrounding new methodologies, reviewing positions with regard to simplified methodologies and procedures, the accreditation process of Designated Operational Entities (DOE's), the public availability of information, and information databases and registries surrounding the CDM. As the EB has to comply with all these tasks, it has the right to establish panels to help to bring their work forward[23]. Three

[21] See Kyoto Protocol (1997), Article 12.4

[22] See Decision 17/CP.7, Annex, para. 5

[23] See Decision 17/CP.7, Annex, para. 18: "The Executive Board may establish committees, panels or working groups to assist it in the performance of its functions. The Executive Board shall draw on the

expert panels were created at the fifth session of the EB: the Accreditation Panel (CDM-AP), the Small Scale Panel (SSC Panel) and the Methodology Panel (Meth Panel)[24]. Regarding the CDM baseline and monitoring methodologies, the EB has approved nine of the 35 proposed new methodologies (NM0001, NM0004, NM0005, NM0007, NM0010, NM0016, NM0019, NM0021, and NM0023), but in none of the cases without making changes to the proposals.[25]

2.1.2 The Instruments of Flexibility

The three "Kyoto mechanisms"[26] were designed at COP4 to promote a prompt start of the Protocol from which an increased research and development on climate friendly techniques is expected. These three instruments shall help Annex I countries to cooperate with other countries to achieve their emission targets at the least possible cost.

The flexibility mechanisms are largely perceived as a strength of the Kyoto Protocol. They embody the concept that mitigation activities translate into instruments called carbon credits, which can be traded between countries, and/or between entities to achieve the quantified emission limitations and reduction commitments. The three flexibility mechanisms aim at reducing the mitigation costs by offering the Parties the opportunity to cut emissions more cheaply abroad than at home. Annex I countries can cut emissions where it is the cheapest to do so, as the impact on the global atmosphere remains the same. Profound differences between the countries in e.g. energy sources, energy efficiency and waste management are responsible for the differences in the marginal costs of emission reduction.

The following two figures (Figure 2 and Figure 3) illustrate how costs can be saved due to the use of the flexibility mechanisms:

Two cases can be distinguished: Figure 2 refers to the situation when both countries have committed themselves to reducing emissions (for simplification, both countries

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expertise necessary to perform its functions, including from the UNFCCC roster of experts. In this context, it shall take fully into account the consideration of regional balance."

24 See http://cdm.unfccc.int/EB/Panels, 2003-12-27: "The Executive Board at its fourth meeting 9-10 June 2002 held in Bonn, agreed to establish the panel which is to develop recommendations to the Board on guidelines for methodologies for baselines and monitoring plans (Meth Panel)…"

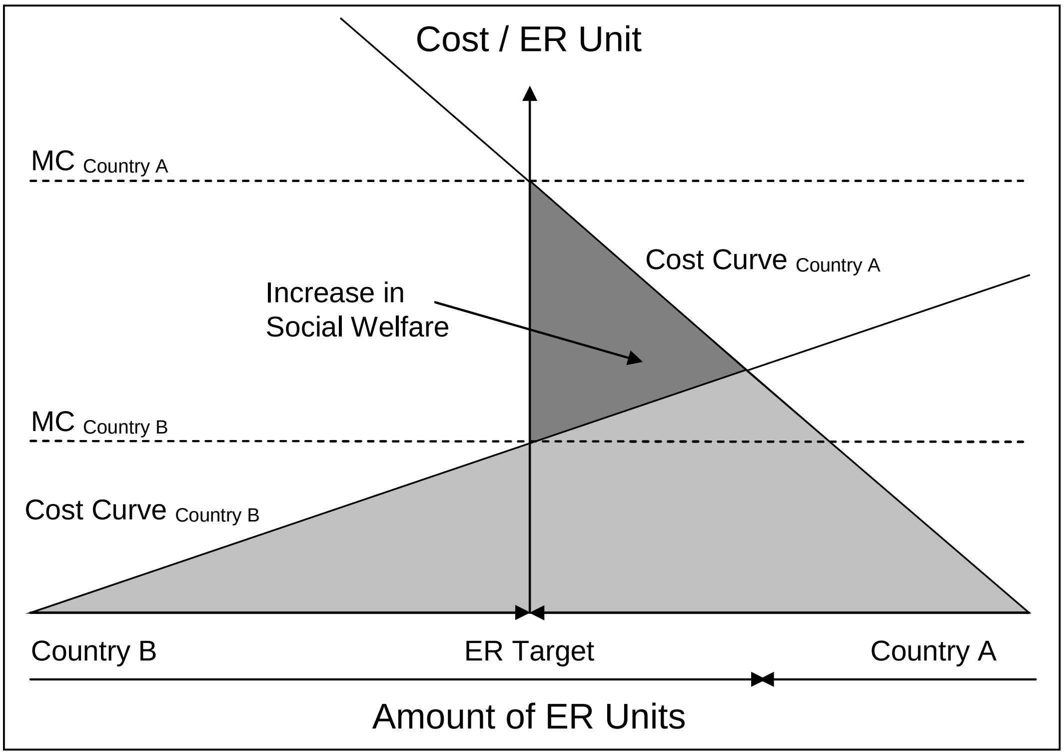
25 As at 15 November 2003

26 See Dutschke, Michael / Michaelowa, Axel (1998): Der Handel mit Emissionsrechten für Treibhausgase, p.16ff.

have the same reduction target in Figure 2)[27], while Figure 3 shows the situation when one country is committed to reducing (e.g. an Annex I country) and the other country (e.g. a Non-Annex I country) is not.

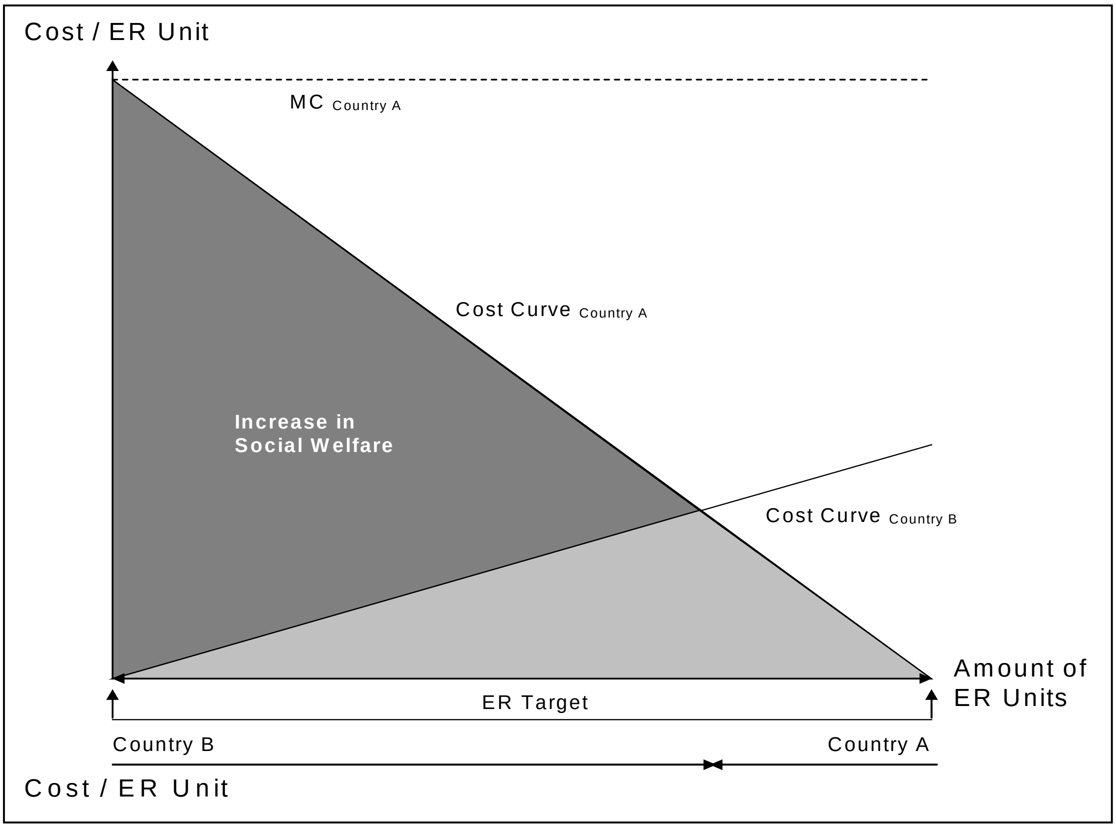
In both situations, the marginal costs of emission reduction in Country A ($MC_{Country\ A}$) are high compared to the marginal costs of Country B ($MC_{Country\ B}$). As the global emissions limit is fixed (ER Target), Emission Trading (ET) leads to a reduction of domestic mitigation in the high-cost country and to a rise in emission reductions in the low-cost country. Thus, the total amount of emission reductions is achieved with the minimal total costs (light grey area). This generates a increase in social welfare (dark grey area).

Figure 2: Total Mitigation Costs (both countries committed to reducing emissions)



[27] See Dutschke, Michael / Michaelowa, Axel (1998), p. 62

Figure 3: Total Mitigation Costs (Country A committed, Country B not committed)



In order to be eligible to participate in the flexibility mechanisms, the Parties need to ratify the Kyoto Protocol and comply with the methodological and reporting commitments. Apart from public entities, private entities are also allowed to participate under the responsibility of their governments.

The three flexibility mechanisms are:

- the Emission Trading (ET),
- the Joint Implementation (JI), and
- the Clean Development Mechanism (CDM)

All three flexibility mechanisms allow credits to be gained from action taken in other countries. The Assigned Amount Units (AAUs), the Removal Units (RMUs) the Emission Reduction Units (ERUs) and the Certified Emission Reductions (CERs) are accounting equivalents. Each unit is equal to one metric tonne of emissions (measured in CO_2 equivalents[28]). AAUs are issued on the basis of an assigned amount[29]. RMUs

[28] For a table of the global warming potential of the greenhouse gases relative to carbon dioxide, see Annex 2 of this paper

are issued on the basis of sink activities[30]. ERUs originate from JI activities and CERs from CDM activities.

Emissions Trading (Article 17, Kyoto Protocol):
"International Emissions Trading" (IET) allows countries with emission targets to trade carbon credits. Under Emissions Trading, certificates are bought and sold on the global carbon market. Offer and demand create a market price for emissions resp. emission reductions, which reveals the marginal costs of abatement throughout the economy. According to its specific cost structure for reducing emissions, a country can either buy AAUs (when its costs of emission reduction are higher than the market price of the certificate) or sell AAUs (when it is cheaper for the country to reduce emissions than to acquire AAUs at the global carbon market). In a working market, countries with lower reduction costs will reduce more emissions than countries with higher reduction costs. Thereby social costs are minimized and a social optimum can be reached. Similarly, ERUs from Joint Implementation activities, CERs from Clean Development Mechanism activities and RMUs from sink activities can be transferred and acquired. Parties must hold a minimum of certificates in their national registry for security reasons.

Joint Implementation (Article 6, Kyoto Protocol):
JI projects are undertaken by an Annex I Party and take place in the territory of another Annex I country. JI projects can either be investments in emission reduction or sequestration. They have to lead to additional emission reductions or removals for which the investing Party earns ERUs. If the PPs do not respect the compulsory annual review, or if the reviews have not been draw up on the basis of the binding guidelines, ERUs will not be generated. Nuclear projects are not eligible and sink projects have to conform to the rules on land use, land-use change and forestry sector. ERUs under JI can only be generated from 2008 onwards.

Clean Development Mechanism (Article 12, Kyoto Protocol):
The CDM is a mechanism for clean development within countries without binding emission reduction targets. It has been designed to involve developing countries into the climate change debate and to enable them to voluntarily commit themselves to reduction targets. At the same time, the CDM gives Annex I Parties the opportunity to invest in Non-Annex I countries, and to get as a return "Certified Emission Reductions" (CERs), which they are able to use to meet their emission targets. Thereby, the CDM assists

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[29] See Kyoto Protocol (1997), Article 3.7 and 3.8
[30] See Kyoto Protocol (1997), Article 3.3 and 3.4

developed countries in complying with their reduction commitments at the lowest cost. These investments have to provide benefits to the host country[31] concerning GHG mitigation plus increased potential for economic growth and sustainable development in the host country. The CDM is expected to promote project activities that involve an environment-friendly technology transfer to the host country. Independently from this, the technology and financial transfer commitments of Annex II Parties of the Kyoto Protocol are separate and remain valid.[32] As in the case of JI projects, CDM project activities have to lead to additional emission reductions or removals. The approval of all Parties is needed to launch a project activity[33] under the CDM. The approval may be gained from the Designated National Authorities (DNAs)[34]. At COP9 modalities and procedures for afforestation and reforestation activities have been specified for the first commitment period. Up to 1% of the Party's emissions in its base year may be achieved by forest management activities including potential CDM sink projects. Nuclear activities are not eligible under the CDM. To allow a prompt start to the CDM, CERs obtained through project activities from the year 2000 up to the commencement of the first commitment period can be issued as soon as the Kyoto Protocol enters into force. The EB is the supervisory body of the CDM and operates itself under the authority of the COP/MOP. It is composed of 6 representatives from Non-Annex I countries and 4 from Annex I countries. The key tasks of the EB are first to accredit operational entities, which will validate the project and verify the monitoring, second to develop simplified methodologies for small scale project activities and third to approve or reject proposed new baseline and monitoring methodologies.

Nevertheless, three main weaknesses of the Kyoto mechanisms are discussed:
First, emission reductions abroad reduce efforts made in home countries and hinder improvements of the domestic environmental situation. On a global level, this is irrelevant; however, it makes a difference for domestic policies.

Second, above all NGO's argue that certificates for emissions lead to the perception that a "right to emit" exists. The Marrakesh Accords reject this reproach by declaring that

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[31] See Kyoto Protocol (1997), Art. 12, 3a

[32] See UNFCCC (1992), Article 4 (5); see Annex 5 of this paper

[33] See UNFCCC website, the CDM PDD Glossary of terms: "A project activity is a measure, operation or an action that aims at reducing greenhouse gases (GHG) emissions. The Kyoto Protocol and the CDM modalities and procedures use the term "project activity" as opposed to "project". A project activity could, therefore, be identical with or a component or aspect of a project undertaken or planned."

[34] See UNFCCC website, Designated National Authorities

the Kyoto Protocol has not established any “right, title or entitlement”[35] to emit, on the contrary, it has introduced an obligation to reduce emissions. Tradable certificates try to integrate **external effects** by giving a price to emissions that so far are for nothing. External effects are a consequence of either unclearly defined property rights or of property rights where enforcement is accompanied by prohibitively high costs. In the case of external effects, undesirable relationships between market players appear. If there are no satisfying private agreements to internalize these externalities (e.g. because of the related high transaction costs), market allocation is negatively affected.

Finally, there is the criticism that the Kyoto mechanisms do not entirely guarantee the additionality of the emission reductions. In the Marrakesh Accords, additional emissions are defined the following:

> “Emission reductions are considered to be **additional,** if - measured against the baseline - they are <u>additional to those that would have occurred</u> in the normal course of events.”[36]

Fictitious credits (e.g. from hot air or **tropical air**[37]) are not related to emission reductions which go beyond those of the reference case. This shows that the implicit recognition of fictitious credits contradicts the concept of additionality and is thereby a definite limitation of the Kyoto mechanisms.

2.2 The Clean Development Mechanism

2.2.1 Definition

The CDM is an international instrument that consists of two components: it has been conceived to promote **cost-effective climate change mitigation**, along with **sustainable development** in Non-Annex I countries.

The fulfilment of the second component lays in the responsibility of the host country. An assessment of this aspect by an independent operational entity is considered to be

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35 Marrakesh Accords (2001), Decision -/CP.7 (Mechanisms), Principles, nature and scope of the mechanisms pursuant to Articles 6, 12 and 17 of the Kyoto Protocol, p. 51

36 Kyoto Protocol (1997), Article 12.5c

37 “Tropical air” is the term for credits generated from CDM project activities without representing additional emission reductions.

very costly. As this aspect is one of the most important reasons for a developing country to take part in a CDM project activity, the EB considered it appropriate to put the decision into the hands of the host country if the criteria for sustainable development of the project activity are fulfilled[38]. This is criticised by many NGO's. They argue that the ecological and social interdependencies are often not sufficiently controlled by host country governments. Therefore, the World Wildlife Fund (WWF) has created a label called "Golden Standard" for project developers that apply stricter modalities and procedures. The Golden Standard stands for a higher quality in sustainable development control.

Annex I countries have committed themselves to reducing emissions for the period 2008-2012. Yet, it does not matter where these emission reductions are achieved. By participating in the CDM, Annex I countries get the opportunity to transfer the anyway binding emission reductions to Non-Annex I countries. For Annex I countries, it is attractive to invest in state-of-the-art technologies in developing countries because of the bigger GHG mitigation potential. The reference technology in developing countries is typically more carbon-intensive[39] than in an industrial country. This leads to a higher cost-effectiveness of mitigation investments in developing countries. The reduction achieved through the same project in a developing country is bigger than it would be in an industrialised country. One unit in emission reductions in the developing country costs less than in the Annex I country.

Especially in poorly developed markets, financial incentives provided through CDM projects can help project participants[40] (PPs) to cover the higher costs of the new technologies or help to remove market barriers. Thereby, the CDM supports the

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38 See Decision 17/CP.7, pre-ambular part: "Affirming that it is the host Party's prerogative to confirm whether a clean development mechanism project activity assists it in achieving sustainable development"; para. 40a): "The designated operational entity shall […] (p)rior 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".

39 The Carbon intensity is the amount of carbon emissions released per unit of energy. Developing countries still rely heavily on traditional carbon intensive energy sources (coal, oil and natural gas), whereas in the industrial countries, a process of decarbonisation due to technological progress is taking place.

40 See UNFCCC website, the CDM PDD Glossary of terms: "In accordance with the use of the term project participant in the CDM modalities and procedures, a project participant is either a Party involved or, in accordance with paragraph 33 of the CDM modalities and procedures, a private and/or public entity authorized by a Party to participate, under the Party's responsibility, in CDM project activities."

developing countries in pursuing sustainable economic growth from the start[41]. Unless the developing countries do not receive part of the CERs, which they can sell at the market, the only incentives for them to engage in the CDM are the positive impacts on local development such as capital transfer, capacity building, job creation, and reduced pollution of the local environment[42].

2.2.2 The Concept of Additionality

2.2.2.1 Why Additionality Assessment?

Why is additionality such an important issue? Why does additionality not need to be tested for emission reduction activities in the same Annex I country? Why does it become decisive, when emission reductions are achieved in another country?

Only Annex I countries are obliged to prepare and report GHG inventories[43]. It is relatively easy to re-enact the real quantity of emission reductions achieved within the boundaries of the same country by comparing the annual inventories. On the contrary, developing countries did not enter into commitments. First of all, it is not possible to prove, at a country level, how much of the ERs were achieved by which project activity (it is clearly possible that different Annex I Parties invest in the same developing country). Second, as developing countries are not keeping inventories, it can only be shown at the project level that reductions have actually taken place. This embodies the additionality assessment.The concept of additionality compares two alternative scenarios that could take place in the future: the baseline and the project activity (Figure 4)[44]. The baseline[45] refers to what would happen without the support from the CDM. By opting for the project activity, emissions reductions could be achieved. However, the project activity could only take place with the additional income from the CDM.

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41 See Michaelowa, Axel / Dutschke, Michael (2002), p. 1

42 See Michaelowa, Axel / Dutschke, Michael (2002), p. 1

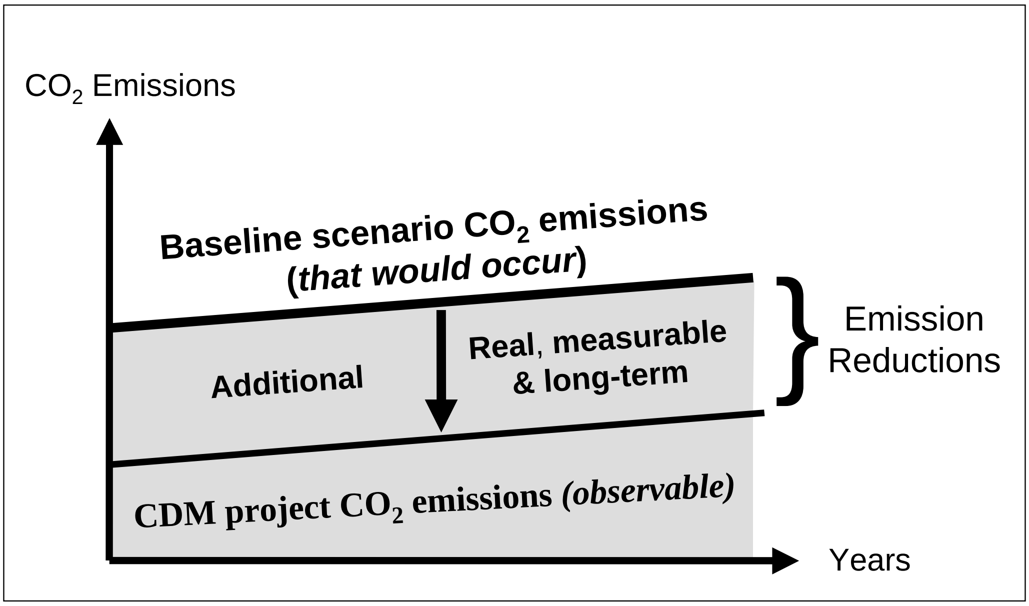
43 See Kyoto Protocol (1997), Art. 4.1a

44 See DENR Training Course (2003)

45 See UNFCCC website, the CDM PDD Glossary of terms: "The baseline for a CDM project activity is the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases (GHG) that would occur in the absence of the proposed project activity. A baseline shall cover emissions from all gases, sectors and source categories listed in Annex A (of the Kyoto Protocol) within the project boundary. A baseline shall be deemed to reasonably represent the anthropogenic emissions by sources that would occur in the absence of the proposed project activity if it is derived using a baseline methodology referred to in paragraphs 37 and 38 of the CDM modalities and procedures."

According to that, these ERs would not take place without the CDM and are therefore additional. Emission reductions have to be credible, that is to say real, measurable and long-term[46] in order to meet the sustainability criterion.

Figure 4: Additional Emission Reductions



Free riding: PPs that claim credits for a project activity that would have been undertaken anyway and is thereby not additional, are called free riders. If not identified, they get credits for their normal behaviour. These CDM credits going to free riders fail their target of creating incentives for mitigation activities. For climate change, the CDM is an **emission neutral mechanism**. As the amount in emission reductions is theoretically predetermined by the official emission targets, free rider effects in relation to the CDM lead to a deviation from the reduction targets and thus to an increase in GHG emissions. Lazarus, Kartha et al. (2000) point it out:

> "It is […] imperative that policy makers devise and adopt a CDM regime that effectively encourages legitimate projects, while rigorously screening out non-additional activities." [47]

46 See Kyoto Protocol (1997), Article 12.5b

47 Bernow, Steve / Kartha, Sivan / Lazarus, Michael / Page, Tom (2000), p. ES-3

In order to reduce this risk, Parties intend to allow the CDM crediting, only until a certain percentage of a country's emission target is reached[48].

The opposite of free riding is **free driving:** These are positive impacts of the CDM on climate change without credit generation. For example, the adoption of energy-efficient CDM technologies could change the public perception and establish a generally accepted standard for companies to select less carbon-intensive technologies instead of the conventional ones. If used more frequently in developing countries, regenerative energies will probably face fewer barriers of implementation like limited information and a lack in skilled labour. The CDM could thereby even enhance the general market adoption rate for new technologies. In addition to that, the existence of a mitigation potential in the developing countries would be demonstrated by the number of CDM project activities and possibly push the developing countries towards binding commitments. A country where a big number of CDM projects are undertaken enters into argumentative difficulties when trying to maintain that there is so far no reduction potential in the country. For scientific analysis, a drawback is that free driving is difficult to measure.

Dealing with additionality, it is crucial to clearly separate on the one hand the definition of additionality and, on the other hand, the assessment of additionality.[49] In the following, different interpretations of the additionality concept will be discussed and limitations to the additionality assessment will be shown.

2.2.2.2 Interpretations of the Additionality Concept

Additionality is defined by the Kyoto Protocol as the central criterion for the acceptance of a project activity under the CDM. The COP defined additionality as following:

> "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."[50]

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48 See Kyoto Protocol (1997), Art. 12.3b
49 See Forner, Claudio (2004)
50 Kyoto Protocol (1997), Article 12, para. 5 (3)

However, it has not been officially declared so far, which criteria are to be considered for the assessment of additionality in the concrete cases. This definition is not sufficiently specific, so different interpretations of the additionality concept exist simultaneously, which partly overlap each other and lead to very different results. The most prominent interpretations discussed in literature[51] and during UN negotiations are described below:

Activity Additionality and Intensity Additionality: The additionality concept consists of two components: The activity additionality, which represents the qualitative view and the intensity additionality, which is the quantitative view.

In the case of the activity additionality, the entire project activity has to be additional, i.e. if the project activity is different from what would happen in the baseline scenario, it is considered to be additional.

In contrast, however, the intensity additionality assumes that the activity additionality is given and only asks how much additional emission reductions are generated by the project activity. If the quantity is positive, the project activity is considered to be additional.

Investment additionality: Behind the concept of investment additionality stands the idea of a rational investor[52] who facing alternatives chooses more value over less value and prefers less risk over more risk. Based on this definition, investment additionality means that the project activity, without the support from CDM, will not be undertaken because of not being the economically most attractive course of action. However, it is closer to reality to assume that the investor makes his decisions under bounded rationality[53]. Then, it is possible that a project activity is not undertaken, due to barriers of implementation (e.g. lack of information and unavailability of credits for small investors), although it would be the economically most attractive course of action.

When investment additionality is assessed, project activities with a negative net present value (NPV) and those with a positive NPV are distinguished: If the project activity is economically unprofitable, i.e. it has positive implementation costs, it is referred to as

[51] See Langrock, Thomas / Michaelowa, Axel / Greiner, Sandra (2000), p. 7
[52] See Markowitz, Harry (1952)
[53] See Simon, Herbert A. (1957)

"economical regret"[54] and is assumed to be additional. On the contrary, if the project activity is economically feasible, it is referred to as "economical no-regret" [55] and can only be considered as additional, if there is a profound analysis of barriers showing that it will not be implemented without the support from CDM.
Deriving from this theoretical background, project activities can be classified into **four types**[56]:

1) A project activity that has a negative net present value (NPV) without the support of the CDM is considered to be additional.
2) A project activity that has a positive net present value (NPV) without the support of the CDM, but whose internal rate of return would be inferior to market interest resp. the minimal reimbursement, is considered to be additional.
3) A project activity that has a positive net present value (NPV) without the support of the CDM, whose internal rate of return is superior to market interest resp. the minimal reimbursement, but is of an unusually high market risk, which could not be reimbursed by the flow back of capital, can possibly be considered as additional.
4) A project activity that has a positive net present value (NPV) without the support of the CDM, whose internal rate of return is superior to market interest resp. the minimal reimbursement, which can be reimbursed by the flow back of capital irrespective of an unusually high market risk cannot be considered as additional.

It is a question of how strictly investment additionality has to be interpreted to decide if type 3 project activities are still additional. Type 1 project activities are clearly not profitable without the CDM, provided that there is no existing policy making the project activity obligatory and there are no other development funds available. Type 2 project activities are also almost certainly additional, as they would not be undertaken under normal market conditions. But type 3 project activities cannot be classified unambiguously by quantitative criteria, as risks cannot be measured objectively. Risks are always investor specific. Each investor has a different utility function and level of risk aversion. Type 4 project activities are indisputably non-additional, because they are profitable and can be considered as identical to the BAU scenario.

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54 See Shrestha, Ram M. / Timilsina, Govinda R. (1999), p. 74ff.

55 See Shrestha, Ram M. / Timilsina, Govinda R. (1999), p. 74ff.

56 See Shrestha, Ram M. / Timilsina, Govinda R. (1999), p. 74ff.; see Michaelowa, Axel / Fages, Emmanuel (1999), p.17ff.

Criteria for additionality assessment can be derived from parameters like the IRR, the NPV and the payback period.

Environmental additionality: Environmental additionality is a term used by PPs for describing the situation when a project activity causes emission reductions, i.e. intensity additionality. The problem was that the PPs did not address the activity additionality at all. They reduced the additionality concept only to question whether emission reductions were taking place, without asking if these emission reductions would not have taken place anyway[57]. This is why references to “environmental additionality” made by PPs in a Project Design Document (PDD) or a methodology were rejected by the EB.

Financial additionality: This aspect of additionality is still discussed very controversially. At COP 7, it was decided that a project activity has to be financially additional, i.e. it shall not divert other funds. A CDM activity should be additional to Official Development Assistance (ODA), Global Environment Facility (GEF) and other financial commitments of Annex I countries[58], because it could direct development assistance towards emission credit generating activities and away from other worthy development objectives. However, it could happen that CDM investments are only attracted towards a developing country, because of the ODA or other public financing.

Behavioural additionality: According to Meyers[59], behavioural additionality would be a better notion than investment additionality. Thereby, the author wants to make it clear that barriers can determine investment decisions. In the end, investor’s behaviour without the CDM is relevant to determine the additionality and to show that the project activity is not the baseline. The concept makes sense, but putting it into practice faces the same difficulty of assessment as the concept of investment additionality.

Technology additionality: Technology additionality means that more efficient and more modern technology is introduced only because of the CDM. Behind this conviction stands the idea that – because of market failure – there is not enough innovation taking place. This definition is close to a technocratic attitude, which considers the technology curve (what is technologically feasible) as supply curve (what

57 See e.g. NM0003

58 See Decision 15/CP.7: “Emphasizing that public funding for clean development mechanism projects from Parties in Annex I is not to result in the diversion of official development assistance and is to be separate from and not counted towards the financial obligations of Parties included in Annex I.”

59 See Meyers, Stephen (1999), p. 3

is economically feasible)[60]. A technocrat would sustain that the decision of feasibility does not refer to the whole product bundle, but to only one component, the technology. However, if the whole product bundle is attractive to consumers, it will catch on in a working market. But if the market is distorted, it is indeed possible that such attractive technologies cannot be introduced.

Sustainable additionality: The CDM has a double function: The CDM has been designed, on the one hand, to help achieve the emission targets and on the other, to contribute to a sustainable development. Sustainable additionality refers to the second component. The attitude "a ton is a ton is a ton" refers to rather short-term targets concentrating on the emission reductions. A long-term perspective requires the consistency with other dimensions of sustainability. Michaelowa and Dutschke describe this difficulty: "The CDM is explicitly serving two masters."[61] The interpretations of additionality described before do not deal explicitly with this second function of the CDM. So far, sustainability of the project activity has to be controlled by the host country. An additional assessment by an independent operational entity[62] is considered to be too costly to be carried out because of the complexity of sustainability.

Additionality at a macro-level or at a micro-level: Additionality can be measured at a macro-level or at a micro-level. At a macro-level, externalities do not have to be accounted for, as social welfare is measured. In contrast to this, at a micro-level, externalities play an important role and additionality can only be measured if the discount rate and the risk level are known, so that risk-neutral costs can be calculated.[63]. This can lead to very different results. For example, if, in a country, there is a regulation in place for landfill gas (LFG) recovery, but it is not enforced and landfill gas leaks into the atmosphere. At a macro-level, project activities capturing LFG emissions will not be additional, as there is an existent policy. On the contrary, at a micro-level, the project activity is additional, as it would not happen without the incentive from the CDM. The other way around, it could be the case that the state subsidises a carbon-intensive technology. Investments in less-carbon intensive technologies would not be undertaken, because of their competitive disadvantage and would therefore be additional at a micro- and at a macro-level. The situation would change immediately, if this subsidy was now

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60 See Schulz, Walter (2002), p. 55ff.

61 Michaelowa, Axel / Dutschke, Michael (2002), p. 7

62 Required by the Golden Standard (further explained in section 3.2.1.1 of this paper.); see Langrock, Thomas / Sterk, Wolfgang (2003), p. 8ff.

63 See Langrock, Thomas / Michaelowa, Axel / Greiner, Sandra (2000), p. 8; see Sugiyama, Taishi / Michaelowa, Axel (2000), p. 3

phased out. Arguing at a macro-level, the project activities would turn non-additional from this change on. In order to prevent such a negative outcome of the CDM project activities, a country may tend to stick to inefficient policies.

2.2.2.3 Limitations of the Additionality Assessment

On the one hand, there is a general **trade off** between the necessary accuracy of assessment, and on the other hand, the achievement of the lowest possible transaction costs as well as the stimulation of a broad participation in the CDM[64]. A strict additionality assessment is a very costly procedure, but on the other hand, a lack in assessment accuracy creates environmental costs that accrue due to climate change. **Transaction costs** (most prominently treated by Coase[65] and Williamson[66]) are called the opportunity costs in terms of time, energy and money associated with initiating and completing transactions. They occur in any market economy and can easily represent one third of the GDP of a country. In developing countries, they are thought to make up an even higher fraction. The main types of transaction costs are search and information costs, bargaining and decision costs, policing and enforcement costs. In addition to those, for the CDM project activities, special transaction costs arise[67] due to the administrative process: baseline determination costs, approval costs, validation costs, registration costs, monitoring costs, verification costs, review costs, certification costs, enforcement costs and brokerage costs. The level of transaction costs depends above all on the rules of the CDM, the degree of utilization of the methodologies and the degree of standardization of the procedures.[68] High transaction costs may discourage market participants from undertaking a transaction.

The optimal result is in the minimum of the total costs consisting of environmental costs and transaction costs. At this point, sufficiently GHG mitigation is achieved at a reasonable cost. However, where this state will be reached is difficult to determine, because the relevant costs are not yet measurable as no CDM project has been implemented so far. But some tendencies may be identified: The higher the participation in the CDM, that is to say the more transactions of the same type that are carried out, the

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64 See Friedman, Shari (1999), p. 162ff.
65 See Coase, Ronald H. (1991)
66 See Williamson, Oliver E. (1985)
67 See Michaelowa, Axel / Stronzik, Marcus (2002), p. 10f.
68 See Michaelowa, Axel / Stronzik, Marcus (2002), p. 11

smaller the transaction costs per project activity are. Through standardization of the assessment, too, transaction costs can be reduced significantly.

Grubb's Paradox: The economically most interesting and promotion worthy project activities are those at the margin. They are efficient and nearly commercially viable, but because of a market distortion not feasible without the support from the CDM. Those project activities confronted with a strict additionality assessment, which puts the threshold for additionality high, have little possibility of being accepted. Hence, a project activity with higher costs would have better chances because of being obviously economically unattractive. This means that the stricter the additionality assessment gets, the less efficient the accepted project activities are. Michael Grubb describes this: The "most 'cost-effective' projects may be the least 'additional' and strict project additionality would give perverse policy incentives."[69] The CDM would then promote only the "high-hanging fruits", meaning the investments that would almost certainly be passed over. But this is not efficient as the "low-hanging fruit", the economically more attractive projects, are not picked.

The concept of additionality has been applied before in Demand Side Management (DSM) in the US, by the Multilateral Fund (MLF) for the Montreal Protocol to control Ozone Depleting Substances, and by the Global Environmental Facility (GEF) funding for the UNFCCC. But it has never been applied as a quantitative scientific base before the CDM. To overcome this paradox, methodological development and experience are needed, which can be gained during the first stage of the CDM. For an interim period, looking at how the concept is implemented can be helpful. All information has to be made openly accessible[70] on the Internet in order to enhance transparency and public pressure. But on the other hand, even doing so transparency will remain difficult to achieve as for each project activity the situation is idiosyncratic, and thereby difficult to assess.

2.2.2.4 Baseline Setting

The most crucial component for determining additionality is the baseline setting. Additional emission reductions are defined by comparing the emissions of a reference

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69 See Sugiyama, Taishi / Michaelowa, Axel (2000), p. 4

70 See Marraskesh Accords (2001), Draft decision -/CMP.1 (Article 12) Appendix D 9, p. 94 and Draft decision -/CMP.1, Modalities for the accounting of assigned amounts under Article 7, paragraph 4, of the Kyoto Protocol, Annex II E, p. 112ff.

scenario to the emissions of the project activity scenario. Additionality determination is thereby strongly affected by the selection of the reference scenario, which is called the “baseline”. The baseline case throws up the “what-if“-question and represents what would happen without the help from the CDM. Would the same project activity be achieved even without the support from the CDM? Would there be another economically attractive project to the project developer? Would the technology in place be used further, which would correspond to the BAU case?

Again the trade off between the two main objectives of the Kyoto mechanisms, the environmental integrity and the economic efficiency, creates conflicts. In order to achieve environmental integrity, a baseline has to be transparent and conservative, whereas to be economically efficient, a baseline has to be simple, practical feasible and adjustable to changing conditions. The baseline shall be a conservative estimate of future development in order to prevent tropical air. But the more accurate the assessment is, the more cost intensive it gets. This trade off exists and cannot be overcome. The entire fulfilment of both targets, i.e. a perfect achievement of the mitigation target at minimal transaction costs, is not feasible. The challenge is to find out, how methodologies have to be designed to reach the state where the cost associated with the project activity assessment and the cost associated with a reduced accuracy of assessment are minimal.

The methods for setting a hypothetical baseline can be classified into two general approaches: **top-down and bottom-up approaches**[71]. This differentiation refers to the process of decision making. In a top-down process, the decision is taken by a panel of experts and then applied to the project activities. On the contrary, in a bottom-up process, the proposals are submitted by the PPs.

The top-down approach can create an incentive for macro cheating, e.g. to keep the baseline emissions high for the purpose of over-crediting and attracting more investment to the country, whereas the bottom-up approach can enhance micro cheating, e.g. to submit a methodology that makes free rider project activities appear CDM worthy.

71 See Baumert, Kevin (1999), p. 144ff.

The aggregation level of the baseline may vary from a **perfectly standardized** approach (benchmark-type approach) to a **completely unstandardized** approach (project-specific approach).[72]

A **benchmark**[73] is a quantitative performance standard (an emission rate or level), which is derived from official data for a country, a region, a sector, or a technology. Project activities that generate fewer emissions than the "standard activity" are considered to be additional, whereas project activities with higher emissions are excluded from the CDM. The emission reductions of a proposed project activity are then calculated deducting the emissions of the project from the established baseline emissions. Benchmarks are aggregated, because they apply a standard across a number of CDM projects. They measure only the intensity additionality using intensity or output-based indicators[74], but not activity additionality. This eliminates the need for project-specific baselines.

An aggregated baseline disposes of many **advantages** concerning the target of economic efficiency. The transaction costs for the baseline setting are distributed over a large group of projects. The bigger the scope is, the more cost-effective the top-down baseline is. The lower costs and the lower associated risk could have the secondary effect that participation in the CDM is encouraged. In addition to that, emission rates of countries and sectors are becoming more comparable and investment will be attracted to where the highest reduction potential is, that is to say to the most inefficient countries and sectors. The LDC (least developed countries) would benefit from this effect. Another strength of the benchmark approach is its ability to discover leakage[75]. If strong leakage is very likely, benchmarks are useful to prevent cheating because of their integrating scope.

But on the other hand, there are also many **disadvantages** of the benchmark approach. The up-front development costs are relatively high, because of the complex measurement requirements and the lack of data availability in many developing countries. It is true that with a greater baseline aggregation, the total transaction costs diminish, but at the same time environmental integrity can suffer because of reduced accuracy. The optimal aggregation level is difficult to determine. In general, the more

72 See Lazarus, Michael / Kartha, Sivan / Bernow, Stephen (2001), p. 8

73 See Friedman (1999), p. 162 ff.

74 See Lazarus, Michael / Kartha, Sivan / Bernow, Stephen (2001), p. 21

75 Emissions resp. emission reductions caused by the project activity, but not under the control of the project developer, are called leakage. Leakage is further treated under 2.2.2.5.

homogeneous a country, region, sector or technology is, the more accurate the benchmark approach is.

On the contrary, **project-specific baselines** are determined on a case-by-case basis. The reference case there is a specific technology or scenario. Both intensity and activity additionality are measured. The project-specific baselines do not run the risk of setting a standard wrongly and thereby discouraging participation or encouraging free-riding as it can be a problem of the benchmark approach. Project-specific baselines tend to bring out more accurate and case-specific estimations. However, varying assumptions can drastically alter the resulting emission reductions. This opens a way for micro-cheating. In addition to that, both the up-front developing costs as well as the projects proponent's costs are very high due to the low level of aggregation.

After having weighted up the pros and cons of the benchmark approach and the project-by-project approach, the UNFCCC decided to make a call for project specific baselines, which are elaborated in a bottom-up process by the PPs themselves.[76]

2.2.2.5 Key Parameters for Baseline Setting

The baseline setting depends on the following parameters[77]:

- a baseline can be historical or forward-looking,
- the lifetime of the equipment has to be determined,
- the lifetime of the baseline has to be chosen,
- a baseline can be determined ex-ante or ex-post,
- the boundaries have to be specified
- the leakage has to be accounted for, and
- the uncertainties have to be estimated

Historical or forward-looking: The official data used for the baseline can be current resp. past data (historical baseline) or forecasted data (forward-looking baselines). An historical baseline is rather static. Its general weakness of backwards oriented historical

[76] See Marrakesh Accords (2001), Draft decision -/CMP.1 (Article 12), Modalities and procedures for a clean development mechanism as defined in Article 12 of the Kyoto Protocol, Annex G, 45 (a) and (c), p. 83

[77] Deduced from the UNFCCC form for proposed new baseline and monitoring methodologies: F-CDM-PNM

approaches is, that they do not capture current marginal opportunities. The next plant built for example could be a less carbon-intensive technology. The quality of the forward-looking baseline is dependent on the reliability and credibility of the forecast data.

Lifetime of the equipment: The lifetime of the equipment determines when it has to be replaced. There are two possible views: the economic lifetime and the technical lifetime. For entrepreneurs, the economic lifetime is more relevant. As soon as another technology turns out to be more profitable (including switching costs), the rationally acting investor will shift to it, unless there are more than solely economic objectives playing a dominant role.

Lifetime of the baseline: The lifetime of the baseline depends on the project's lifetime (depending itself on the lifetime of the equipment). If no readjustment of the baseline is permitted during the **crediting period**, the lifetime of the baseline is equal to the crediting lifetime. In the Marrakesh Accords[78], it has been decided to standardise the crediting lifetime giving the PPs the choice between two possibilities: or a **fixed** crediting period of 10 years or a **renewable** (max. twice) baseline of 7 years each.

The setting of the crediting lifetime is an ambiguous issue: A long crediting period encourages engagements in long term emission reductions, as the long term impacts of the project activity are taken into account. But with a longer crediting period complexity and uncertainty also grows and thereby the costs and the risk of cheating. On the contrary, a short crediting lifetime does not further complicate the estimation and calculation of emission reductions. Above all project activities linked to a high initial investment, but with a relatively steady development afterwards, only need to overcome the initial difficulty. Here, a short crediting period would be suitable.[79] The drawback is that project activities with short-time effects get a competitive advantage under a short-time crediting period. This would be contradictory to the sustainability target of the CDM, which aims at promoting long-term emission reductions. Therefore, the EB decided to give the PPs the choice between the two mentioned, both relatively long-term, crediting periods.

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78 See Marrakesh Accords (2001), Draft decision -/CMP.1 (Article 12), Modalities and procedures for a clean development mechanism as defined in Article 12 of the Kyoto Protocol, Annex G, 49 (a) and (b), p. 84

79 See Langrock, Thomas (2004)

Ex-ante or ex-post baseline: A baseline, being a hypothetical construct, which is uncertain by definition, cannot be controlled ex-post. It is always established at a certain point in time reflecting the actual expectations for the future. Therefore a baseline is principally a static construct. An estimate is always determined in advance, and ex-post determination is no more an estimate, but a reality. However, if conditions change during the crediting period as profoundly and unpredictably, that a less carbon-intensive technology or even the project activity itself becomes economically attractive, it makes sense to **readjust the baseline**. This would enhance transparency and consistency, but is contradictory to the theoretical construct of the baseline. In addition, an ex-post adjustment would lead to a higher uncertainty for the project promoter. But on the other hand, under the new favourable conditions, the project activity benefits from a competitive advantage that compensates the PPs for the credits lost. In order to reduce uncertainty for the project developer, a compromise could be reached: monitoring of the political and economic conditions and regular (not continuous) possibilities for updates (e.g. every 5 years) can be included into the methodology.

Some methodologies tried to create an ex-post baseline based on a comparison approach using a **control group**. Yet, for some technologies, it is difficult to find an appropriate, sufficiently similar control group. Taking the example of a landfill, a control group would need exactly the same conditions (e.g. quantity of wells, depth, amount of waste, consistency of waste). Because of a lack of similarity, this approach has so far been rejected by the EB when proposed in a methodology[80].

Boundaries: Baseline boundaries refer to the baseline scenario and project boundaries to the project activity scenario.

All procedures, processes and transactions that are **under the control** of the PPs shall be included into the boundaries[81]. The wider the boundary is drawn, the more impacts and interdependencies are taken into account, but, at the same time, the less cost-effective the assessment is as the complexity is growing. Therefore, a compromise has to be reached: Boundaries should be tightly related to the processes for which CERs will be claimed. If there are indirect effects on emissions, they shall be treated separately as leakage.

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80 See proposed new methodologies NM0003 and NM0034

81 See Marrakesh Accords (2001), Decision -/CP.7 (Article 6), Guidelines for the implementation of Article 6 of the Kyoto Protocol, Appendix B, 4c, p. 66

Therefore, emissions only have to be addressed, if they significantly affect the calculation of the project activity's impact, negligible emissions should just be named. In contrast, if the emissions outside the boundary are significant, but the measurement would turn out to be too costly, they can be excluded, but have to be treated as uncertainties and not as leakage. However, a threshold has to be fixed (e.g. a percentage of the totally claimed emission reductions, which is expected with a determined probability).

Looking at several project activities simultaneously, another issue appears: the boundaries of one project activity can overlap with those of another, if off-site emissions are included into the boundary (e.g. one step up-stream and one step down-stream). It could happen that the off-site emission reductions for one project are identical to the on-site reductions of another. This could lead to double counting and thereby to over-crediting, which has to be avoided.

Emissions occurring within the project boundaries are called **direct emissions**, whereas **indirect emissions** occur outside of the project boundaries, in particular leakage or spill-overs (also called "positive leakage"). The spatial dimension of boundary setting refers to the geographic area: the emissions occur either **on-site** or **off-site**. The temporal dimension is reflected in the crediting period.

Leakage: Emissions or emission reductions that occur outside the project boundary and that are uncontrollable by the PPs, but measurable and attributable to the CDM project activity, are typically called leakage[82]. In general the term leakage refers to the negative impacts on climate change (e.g. emissions due to transport), but positive leakage also exists (e.g. reduction of barriers of implementation).

Following Michaelowa and Fages[83], there is no systematic tendency in undistorted markets for project-specific baselines to show excessive emission reductions, i.e. a negative leakage.

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82 See Decision 17/CP. 7, Draft decision -/CMP.1 (Article 12), para. 51, "Leakage is defined as the net change of anthropogenic emissions by sources of greenhouse gases which occurs outside the project boundary, and which is measurable and attributable to the CDM project activity."; see Decision 17/CP. 7, Draft decision -/CMP.1 (Article 12), para. 52, "The project boundary shall encompass all anthropogenic emissions by sources of greenhouse gases under the control of the project participants that are significant and reasonably attributable to the CDM project activity."

83 See Michaelowa, Axel / Fages, Emmanuel (1999), p. 11

Following Lazarus et al.[84], leakage can be deducted either ex-ante by adding the leakage to the project emissions resp. discounting the CERs or ex-post by keeping parts of the CERs back for deduction of the leakage measured.

A special effect, sometimes defined as a form of leakage, is the so called **rebound effect**. Above all, DSM and demand reduction programs (e.g. fuel switching) are affected by this form of leakage. When project activities reduce the energy demand (e.g. by increasing efficiency), this can lead to a price reduction. The low price, on the other hand, increases purchasing power. A fraction of the emission reductions due to energy savings is offset by increased consumption. This is called the rebound effect. However, Lazarus et al.[85] state that this is no form of leakage, as the effect occurs actually within the boundaries. In fact, the baseline has not been correctly defined because it ignores that the grid is characterised by an undersupply.

Uncertainties: Uncertainties have to be monitored during the duration of the project activity to assure that the project activity is additional. They can be built into the formula as variables. Uncertainties can be addressed qualitatively ex-ante, which may be substantiated by a quantitative estimate. Its validity can be controlled ex-post.

2.2.2.6 Conclusions

This section showed that the concept of additionality has to be clearly defined in order to be operational. The implementation of the additionality concept encounters two main difficulties: the transaction costs grow with increased assessment accuracy and the most cost-ineffective project activities have the best chances to get accepted under the CDM (Grubb's paradox). To determine in advance, which scenario would occur in the absence of the CDM, standardised, analytical mechanisms for designing forecasting models and collecting data are necessary. Eventual shortcomings in the baseline setting lead to wrong results in the additionality assessment and conflicting interests of the parties involved make the baseline setting a highly political issue.

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[84] See Lazarus, Michael / Kartha, Sivan / Bernow, Stephen (2001), p. 54
[85] See Lazarus, Michael / Kartha, Sivan / Bernow, Stephen (2001): p. 56

2.2.3 The Concept of Methodologies

The UNFCCC has chosen to apply a project-by-project assessment to test the additionality and to quantify the emission reductions. Proposals will be elaborated in a bottom-up process.[86]

Yet, this procedure can get very complex and expensive, if for each project activity, the baseline setting has to be carried out ad-hoc and if the monitoring is highly case-specific. In addition, if the analysis is not based on the same assumptions, the results from the assessment of different project activities will, in all probability, not be comparable to each other.

This shows that, in order to make the CDM workable, the transaction costs have to be reduced and the consistency has to be enhanced. Therefore, methodologies have to be elaborated. The methodologies shall be applicable to a number of project activities. The same assumptions and rules will be applied to all the project activities submitted to the EB, which helps to treat the proposals in a fair way. Methodologies approved by the EB are made publicly available on the UNFCCC website.

This is a step towards standardisation, but it does not reach as far as multi-project baselines do. The standardisation[87] of the **baseline procedures** has already been undertaken. In the Project Design Document (PDD), published on the UNFCCC website, the project developer has to provide project specific values for a number of baseline parameters. The next step, now addressed by the Methodology Panel, is the standardisation of **baseline parameters** to determine multi-project parameter values, such as the fuel technology assumed for the baseline scenario, the scope of the boundaries, and the method for the calculation of ERs. Multi-project baselines would go even further standardising **baseline emission factors** applicable to a multitude of project activities.

At COP7, the Parties decided to give more guidance to the PPs for the elaboration of methodologies. They fixed the following principles in order to ensure the quality of the methodologies[88]:

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86 See Marrakesh Accords (2001), Draft decision -/CMP.1 (Article 12), Modalities and procedures for a clean development mechanism as defined in Article 12 of the Kyoto Protocol, Annex G, 45 (a) and (c), p. 83

87 See Report of the Workshop on Baselines for JI and CDM projects (2003), Catrinus Jepma, p. 3

88 See Lazarus, Michael / Kartha, Sivan / Bosi, Martina (2002), p. 17f.

2.2.3.1 The Principle of Transparency and Conservativeness

Many aspects of evaluating a project activity are subjective, i.e. there is a range of interpretations. In order to reduce the potential of gaming, the Parties state in decision 17 that a baseline shall be “reliable, transparent and conservative”[89]. Thus, the PPs shall demonstrate through their methodology that they do not disguise any facts, but on the contrary, that they are actively building confidence by explicitly choosing the most conservative estimates and approaches. PPs can give a signal of quality to the DOEs by openly exposing these wide ranges of interpretation, providing a clear documentation, justifying their interpretation and always choosing the most conservative estimate[90]. A transparent, verifiable and credible documentation will have better chances to pass validation.

2.2.3.2 Accuracy

The GHG emission reductions shall be “real and measurable, and an accurate reflection of what has occurred within the project boundary”[91]. In testing the additionality of the project activities, a methodology shall be as accurate and rigorous as necessary in order to keep the free riders off, but without discouraging the submission of really additional project activities. A very strict assessment with little chances for the PPs to make their project activity pass the procedure is contra productive. The participation would be too low and the whole CDM would fail to kick start[92]. On the other hand, too many free riders will make the market price of the CERs decrease and destroy the confidence in the mechanism.

2.2.3.3 Cost-Effectiveness

The bottom-up creation of methodologies goes hand in hand with high costs in the initial state. Methodologies need to become standardized in order to achieve cost reductions in the later states and to become manageable. For standardization, sufficient data has to be captured first. The idea is to use the first period as a kick start for the

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89 Decision 17/CP.7, pre-ambular part

90 See Lazarus, Michael / Kartha, Sivan / Bernow, Stephen (2001): p. 9

91 Decision 17/CP.7, App. C (a) (iii)

92 See Marrakesh Accords (2001), Decision -/CP.7 (Article 12), Modalities and procedures for a clean development mechanism as defined in Article 12 of the Kyoto Protocol, p. 68

CDM. The experience of the implemented project activities will help to better define the scope and standard values for the baselines.[93] During the first commitment period, the effects of the methodologies will become visible. Adjustments to the methodologies will then be made for the second commitment period.

2.2.3.4 Adequate Incentives

A kick start clearly will not happen, if additionality assessment is too tight and participation thereby too small. This is why straightforward methodologies are needed for the majority of cases. It makes sense to create more detailed methodologies for project activities with a strong impact, e.g. which claim a large amount of credits and/or which are of a very large scale, as well as for project activities, which are of a high risk of error. In general, for all types of project activities, the assessment costs should remain relatively small in relation to project activity's implementation costs so as not to cut down the participation.[94]

2.2.3.5 Practicality and Applicability

A methodology that needs a lot of detailed data cannot be applied to a situation with strong institutional constraints, low availability and scarce reliability of the data. It is necessary first of all, to ensure that the data is regularly collected and publicly available as well as easily accessible. Further on, the PPs shall be informed, where to find the data sources needed for their calculations, as research to fill eventual data gaps requires time and money. In addition to that, default methods have to be established for situations, where data is missing and cannot be procured[95]. Apart from the practicability aspect, a methodology should be applicable to a range of project activities in different countries in order to reduce transaction costs.

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[93] See Heister, Johannes (1999), p. 3

[94] See Lazarus, Michael / Kartha, Sivan / Bernow, Stephen (2001): p. 9

[95] For an example, see NM0032 in chapter 3 of this paper

2.2.3.6 Consistency and Reproducibility

The Parties decided to promote "consistency, transparency and predictability"[96] of the results from the methodologies. Otherwise, contradictions in the rigours of assessment between the methodologies would make the methodologies appear arbitrary and question the whole approach. Only if a general frame of rules and guidance without inherent contradictions has been created, can the assessment process be recognised as valid[97]. This implies a continuous adaptation of the methodologies to changing conditions. By applying an objective and systematic procedure, reproducibility of the results shall be guaranteed.

2.2.4 Proceeding and Acceptance of a CDM Project Activity

2.2.4.1 Project Activity Cycle

All information has to be made publicly available[98] and all proceedings of the EB and the Supervisory Committee have to be open to observers[99].

The project activity cycle is illustrated in Figure 5[100].

The first step for PPs that would like to submit a project activity to the EB for validation/registration is to fill out the Project Design Document (PDD) elaborated by the EB. For further guidance they can refer to a glossary of terms, which has been developed by the EB on the basis of the decisions made concerning the modalities and procedures.[101]

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[96] Decision 17/CP.7, App. C (a) (ii)

[97] See Lazarus, Michael / Kartha, Sivan / Bernow, Stephen (2001): p. 9

[98] See Marrakesh Accords (2001), Draft decision -/CMP.1, Modalities for the accounting of assigned amounts under Article 7, paragraph 4, of the Kyoto Protocol, Annex II E, p. 112ff.

[99] See Marrakesh Accords (2001), Draft decision -/CMP.1 (Article 6) Guidelines for the implementation of Article 6 of the Kyoto Protocol, Annex C, p. 59, and Draft decision -/CMP.1 (Article 12) Modalities and procedures for a clean development mechanism as defined in Article 12 of the Kyoto Protocol, Annex C, p. 77

[100] See UNFCCC website, the CDM project activity cycle

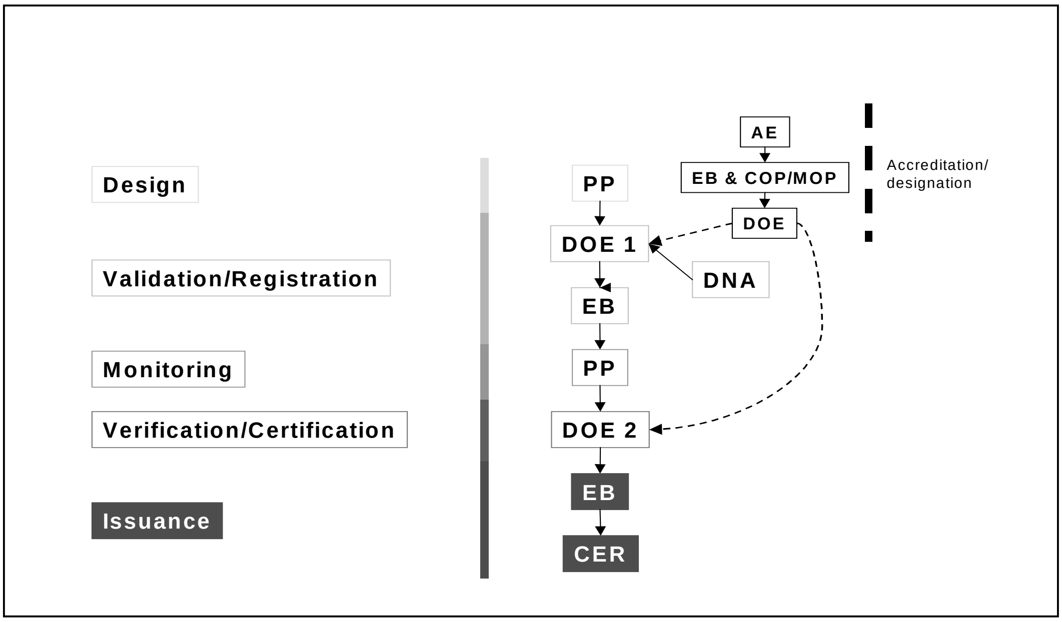
[101] See Decision 17/CP.7, Appendix B

PPs that want to propose a new methodology cannot directly address the EB. They are obliged to select one designated operational entity (DOE) from the list provided at the UNFCCC web site.

The DOEs[102] are independent auditing companies. It is their task to validate the project activity against the requirements of the CDM [103] founding their evaluation on the PDD[104] submitted by the PPs.

Through a DOE, the proposal has to be submitted to the EB for review. A new methodology has to be submitted together with the draft PDD. The project activity only can enter the validation and registration process after having the approval for the new methodology.

Figure 5: UNFCCC CDM Project Activity Cycle



Methodologies approved by the EB are publicly available at the UNFCCC website and can be used by other project developers. If the PPs use a methodology that has already been approved, they can submit their project activity directly for validation and registration.

A validated project activity then passes to the EB for official registration. This is the prerequisite for the following steps: verification, certification and issuance of CERs.

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102 See Decision 17/CP.7, Art. 12, 7.

103 See Decision 17/CP.7

104 See Decision 17/CP.7, Appendix B

During the crediting period, another DOE is responsible for a periodic independent review and for an ex-post control of the monitoring of the additional reductions in anthropogenic emissions by sources of greenhouse gases. The certification is the final document assuring that, during the crediting period, the project activity achieved additional emission reductions. This assurance is the basis for the issuance of CERs.

2.2.4.2 Guidelines for the Project Participants

This is to summarise which guidelines have been established so far and have to be taken into account in the further analysis.

The PPs are allowed to choose the most appropriate approach for the **baseline setting** out of the following three[105], providing a justification of the choice in the PDD:

a) "Existing actual or historical emissions, as applicable" (historical baseline)
b) "Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment" (forward-looking baseline)
c) "The average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 % of their category" (control group approach)

Further, the EB suggests four possibilities[106] for providing evidence of the **additionality** of the proposed project activity:

a) "A flow-chart or series of questions that lead to a narrowing of potential baseline options
and/or
b) A qualitative or quantitative assessment of different potential options and an indication of why the non-project option is more likely
and/or

[105] Decision 17/CP.7, Art. 48.
[106] EB10, Annex 1, A.2.

c) A qualitative or quantitative assessment of one or more barriers facing the proposed project activity (such as those laid out for small-scale CDM project activities)
and/or
d) An indication that the project type is not common practice (e.g. occurs in less than [<x%] of similar cases) in the proposed area of implementation, and not required by a Party's legislation/regulations."

The drawback of these suggestions is that the four additionality tests are not entirely equivalent. In order to assure that the methodologies treat the project activities equally, further guidance is needed from the EB.[107]

In the Marrakesh Accords[108] it has been set up that two alternative **crediting periods** are eligible:

a) A renewable crediting period of 7 years (maximal 21 years)
b) A fixed crediting period of 10 years

Definitions of **boundaries**[109] and **leakage**[110] have been provided in the Marrakesh Accords. So far, the EB has not yet decided, how emissions being under the control of the project developers and attributable to the project activity are related to the categories of direct and indirect emissions.

2.2.4.3 Conclusions

This section explained the concept of the methodologies and showed the theoretical background and the decisions already taken by the EB. In the following section, it will be analysed how the concepts and guidelines are put into practice and how to optimise their implementation.

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107 See Jung, Martina / Michaelowa, Axel (2003), slide 5

108 See Marrakesh Accords (2001), Draft decision -/CMP.1 (Article 12), Modalities and procedures for a clean development mechanism as defined in Article 12 of the Kyoto Protocol, Annex G, 49 (a) and (b), p. 84

109 See Marrakesh Accords (2001), Decision -/CP.7 (Article 6), Guidelines for the implementation of Article 6 of the Kyoto Protocol, Appendix B, 4c, p. 66

110 See Marrakesh Accords (2001), Draft decision -/CMP.1 (Article 12), Modalities and procedures for a clean development mechanism as defined in Article 12 of the Kyoto Protocol, Annex G, 51, p. 84

3. COMPARATIVE ANALYSIS OF CHOSEN METHODOLOGIES

3.1 Description of Methodologies for Methane Recovery and Electricity Generation

3.1.1 Introductory Remarks

It is essential for the discussion of methodologies that there is no confusion between the assessment of the methodology and the assessment of the project activity. The methodology is the means to assess the project activity. The submitted methodology may be acceptable, while the project activity may not. These two levels are sometimes difficult to separate.

To draw this line of separation is even more complicated, as the construction of methodologies stands in a direct interdependence with the related project activity regarding country specific, sector specific and technology specific information. For the current state, it is important that the approach presented in the methodology is principally correct and suitable to the conditions of the project activity. It is then the task of the DOE to control if the given information is credible.

For this paper, all proposed new methodologies where considered until 15 November 2003. Methodologies submitted afterwards were no longer able to be included into this research. All methodologies submitted by the PPs to the Secretariat of UNFCCC and cited in this paper are available on the UNFCCC website (http://cdm.unfccc.int).

The following analysis will examine the consistency across chosen methodologies as well as draw conclusions for simplification and improved proceeding of additionality assessment.

3.1.2 Selection: Building Clusters and Weighting

In order to compare the submitted methodologies, they were grouped according to the project type. The results were the following six clusters: methane recovery (from land filling), electricity generation, energy efficiency, manure management, fuel switching and fugitive emissions (not from land filling).

As a next step, those methodologies which address the additionality assessment sufficiently were identified (highlighted in Figure 6). Methodologies not dealing profoundly with this issue were considered irrelevant for this research. There are two kinds of cases in which the additionality assessment was considered to be insufficient: In the first case, methodologies only deal with the concept of "environmental additionality" (NM0003, NM0006 and NM0008). As stated in section 2.2.2.2, this interpretation of the additionality concept is too narrow. In the second case, methodologies do deal with additionality too superficially (NM0025, NM0026, NM0033 and NM0034) or not at all (NM0011, NM0012, NM0013).

The methodologies NM0002, NM0009, NM0014 and NM0015 are not listed in Figure 6, because they have been rejected by the EB. The project developers then improved and resubmitted the methodologies again to the Secretariat. NM0002 was resubmitted as NM0029 and NM0009, NM0014 and NM0015, all three together, as NM0019.

Figure 6: Overview on Clustering and Weighting of the Submitted Methodologies

<u>Methane Recovery</u> (from land filling) NM0004: Salvador Da Bahia Landfill Gas Project NM0005: Nova Gerar Landfill Gas to Energy Project NM0010: Durban Landfill-gas-to-electricity project NM0021: Cerupt methodology for landfill gas recovery NM0032: Municipal Solid Waste Treatment cum Energy Generation, Lucknow, India
<u>Electricity Generation</u> NM0001: Vale do Rosario Bagasse Cogeneration (VRBC) Project NM0006: El Canada hydroelectric project NM0008: Penas Blancas hydroelectric project NM0010: Durban Landfill-gas-to-electricity (South Africa) NM0011: 26 MW bagasse/biomass based cogeneration power project, Koppa, India NM0012: Wigton wind farm project NM0013: Felda Lepar Hill Palm Oil Mill Biogas Project in Malaysia NM0019: A.T. Biopower rice husk power project NM0020: La Vuelta y la Herradura hydroelectric project

NM0023: El Gallo Hydroelectric Project NM0024: Colombia: Jepirachi Windpower Project NM0025: 18 MW Biomass Power Project in Tamilnadu, India NM0027: CERUPT: Alternative Investment Analysis: Catanduva Sugarcane Mill, Brazil NM0030: Haidergarh Bagasse Based Co-generation Power Project NM0031: OSIL – 10 MW Waste Heat Recovery Based Captive Power Project NM0035: TA Sugars co-generation and fuel switch project – capacity augmentation component
Fugitive Emissions (not from land filling) NM0003: Construction of new methanol production plant (called: M 5000) NM0007: HFC Decomposition Project in Ulsan (Korea) NM0026: Rang Dong Oil Field Associated Gas Recovery and Utilization Project
Energy Efficiency NM0017: Steam system efficiency improvements in refineries in Fushun, China NM0018: Metrogas Package Cogeneration Project
Manure Management NM0022: Methane capture and combustion from swine manure treatment for Peralillo
Fuel switching NM0016: Graneros Plant Fuel Project (South Africa) NM0028: TA Sugars cogeneration and fuel switch project – fuel switch component

The result of the clustering and weighting was that the two categories “methane recovery” and “electricity generation” remained the only ones providing enough (more than two) cases to conduct a reasonable comparative analysis.

The category “fuel switching” appears at a first glance to be suitable for the analysis as all three cases deal quite profoundly with additionality. However, the methodology NM0029 is entirely different from the two other cases, as it refers to an immaterial project activity. **“Immaterial project activities”** are activities that are hypothetical, but are not put into practice. In the case of NM0029, the project activity is an “avoided fuel switching” from charcoal to coal. Because of a new policy, the Brazilian charcoal lost its competitive advantage regarding coal. As users of charcoal are now obliged to reforest the quantity needed to produce the charcoal they consume, charcoal turned out to be more expensive than coal. A reasonable reaction of the affected businesses would be to change from charcoal to coal. This substitution from a “cleaner” energy source to a more CO_2 intensive one could be prevented by the CDM. Additional income from credits could compensate the competitive disadvantage. However, the category “immaterial project activities” is very controversial category. An additionality assessment cannot create unequivocal and indisputable results. Some experts object to this kind of project activities that credits must not be gained for maintaining a BAU scenario, but for investments in mitigation techniques. Further, they reject this project category because of its high inherent uncertainty. Other experts are in favour of “immaterial project activities”, because, compared to the baseline, emission reductions are actually generated. They argue that the reasoning behind the concept is rational and not more hypothetical than any other baseline. To conclude, NM0029 is a special case, the other two cases do not offer enough material to conduct a separate analysis and therefore, this category has not been chosen.

The category “fugitive emissions” is separate from “methane recovery”, because it also covers other GHGs and other technologies than land filling. The category of “fugitive emissions” is very heterogenic, as the technologies differ widely. Therefore, it is unsuitable for a comparative analysis.

3.1.3 Description of Chosen Methodologies

Methodologies are submitted by the PPs. The Parties participate in a CDM project activity either directly by the government being listed as a PP in the PDD, or indirectly represented by a public body or private company. Those private companies can be e.g. suppliers, developers, engineering and consulting companies. Corresponding to the Parties involved, project activities are classified as being **unilateral**, **bilateral** or **multilateral**. Unilateral CDM project activities are undertaken by the Designated National Authorities (DNA) of a Non-Annex I country on its own. This is an interesting option if the country disposes of enough capital and know-how. The Party has the opportunity to sell directly the credits gained in the market for certificates. Bilateral CDM project activities represent the original idea of the CDM between an Annex I Party and a Non-Annex I Party. Multilateral project activities are undertaken by several Annex I Parties together, which either join forces within the scope of the project activity or which are united by an official entity e.g. a development fund like the Prototype Carbon Fund (PCF) of the World Bank.

All projects are required to meet the mitigation objective as well as the sustainability objective. But sustainability has not yet been explicitly defined by the EB. The EB understands this criterion as the enhancement of economic growth and development of the area, but does not approach ecological questions concerning interactions with other ecosystems. They only refer to the part of emission reductions.

3.1.3.1 Description of Methane Recovery Project Activities

Methane (CH_4) is the second contributor to climate change after carbon dioxide (CO_2), but its influence on the greenhouse effect is considered to be 21 times bigger than the one of CO_2 (the factor to express CH_4 in terms of $CO_{2\text{ equiv.}}$ is 21). Although it is not yet as present in the atmosphere as carbon dioxide, methane concentrations have more than doubled over the last two centuries largely due to human-related activities. In order to halt the annual rise in methane concentrations, reductions of about 10 % in emissions from these anthropogenic sources would be necessary.[111]

Landfill gas is created by anaerobic decomposition, which is the process of decomposing garbage buried in the landfills. The decay produces natural gas consisting of approximately 50 % methane. When untapped and unmanaged, this gas can leak into the atmosphere. This gas leakage not only poses a threat to the environment and surrounding properties, as fires and explosions can occur, but the bad odour also affects living conditions.

This explains why recovery and use of methane generated in municipal solid waste (MSW) landfills has strong global and local environmental and economic benefits: Apart from climate protection, the methane mitigation at landfills has positive effects on air and groundwater quality and further on health and living conditions.

In order to recover the landfill gases, a gas collection system has to be implemented consisting of a piping and well network. Pollution of groundwater can be prevented by adding a leachate drainage system. For excess landfill gas, flaring equipment is needed

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[111] See EPA, GHG Info (2003)

and in the case of power production, an electricity generation plant and generators have to be added.

The following projects are about landfill gas capture, flaring and renewable energy generation. To make it easier to understand the proceeding of the methodologies the paper further deals with, a short description of each project is provided:

NM0004: VEGA Bahia Tratamento de Residuos S.A. (Brazil); SUEZ Environnement (France); ICF Consulting

The project activity consists of installing the equipment for methane capture and flaring at the landfill Aterro Metropolitano do Centro. Subsequently, a landfill-gas-to-energy technology will be added. However, this methodology only takes into account the first step. The project activity encloses flaring with controlled burning. By optimising the waste decomposition, it will be possible to increase the waste disposal volume. The project, with a pre-determined capture and flaring percentage, was auctioned by a call for tender. The actual project developer got the contract and is even able to exceed the fixed target; yet, this would not create any additional benefits for him.

NM0005: EcoSecurities; S.A. Paulista (Brazil); World Bank Netherlands Clean Development Facility (WB NCDF)

NovaGerar is a joint venture between EcoSecurities (an environmental finance company) and S.A. Paulista (a Brazilian civil engineering and construction firm). S.A. Paulista possesses a 20 year concessionary licence to manage two landfills (Lixao de Marambaia and Aterro Sanitario de Adrianopolis). NovaGerar has been created to explore the gas collection and utilization activities related to the project. The project includes electricity generation, but the PPs do not claim CERs for electricity generation. Therefore, only the methane recovery methodology applies. 12 MW are the expected capacity for electricity generation. The mitigation activity combines combustion of the recovered gas and flaring of the excess gas.

NM0010: Durban Solid Waste (DSW) (South Africa); The Ethekwini Municipality (South Africa); The Prototype Carbon Fund (PCF); The Republic of South Africa

In contrast to the projects described so far, this project claims CERs for electricity generation. Therefore, both, a methane recovery and a electricity generation methodology, have to be applied. The objective is to enhance the collection of landfill gas at three landfill sites. The electricity generated will be introduced to the grid. There will be reduced emissions related to coal-fired power production (which is common practice in South Africa) as well as adverse impacts related to the transportation of coal and coal mining (dust and acid mine drainage). In order to improve water quality, wells need to be installed for leachate removal.

NM0021: ONYX (France); SASA (ONYX subsidiary in Brazil)

This project will take place in the City of Tremembé, Sao Paulo. The operator is SASA, the Brazilian subsidiary of Onyx. The landfill is divided into two disposals, and another new area is planned. The mitigation project will introduce the latest European waste management standards to the landfill. Some electricity will be generated but will only be used on-site. This explains why no CERs will be claimed for electricity generation. If later electricity is fed into the grid, an electricity generation methodology, as for NM0010, will have to be used.

NM0032: Infrastructure Development Finance Company Limited; Asia Bioenergy Limited (India, Austria, Singapore); Lucknow Nagar Ninam; Uttar Pradesh Power Corporation Limited; Ministry of Non-conventional Energy Sources; Prototype Carbon Fund (PCF)

This project is located in the town of Lucknow in the state of Uttar Pradesh, India. The technology to be introduced is called biomethanation of municipal solid waste treatment with power generation. Biomethanation is the term for an enhanced methane production by anaerobic digestion of biodegradable organic matter, catalyzed by enzymes secreted by micro organisms. The project consists of three separate components that result in emission reductions: biomethanation and capture of municipal solid waste and thereby reduction of methane escaping into the atmosphere, displacement of fossil fuel during power generation at the project site, and displacement of chemical fertilizer by organic fertilizer from biomethanation. The last part is not covered by the proposed methodology and will be treated in a separate methodology.

3.1.3.2 Description of Electricity Generation Project Activities

Power generation from renewable energy – e.g. wind, solar radiation, hydro power, earth energy, and biomass – provides heat and electricity from natural resources that are not depleted over time. Resources which can be used without an impact on the climate system are called **zero-emission sources**. Zero-emission technologies do either not generate emissions (e.g. water power) or generate emissions that are exactly as high as what has been absorbed before in the lifecycle (e.g. biomass). Oil, gas and coal are not considered as zero-emission fuels, because the absorbance of emissions and the re-emission do not take place in one lifecycle. However, not all uses of renewable energy are zero-emission technologies, due to the fact that they are not all sustainable and environment friendly. For example, large hydroelectric projects, which pen up water reservoirs behind dams, can have negative environmental impacts on rivers, fish, and surrounding land. All the same, producing power from trees or other biomass sources that are not exploited in a sustainable way, but are harvested too quickly without allowing enough time for regeneration, is contra-productive. GHG emissions produced, when the wood or biomass is burned, can then not be adequately offset by new growth.

As the submitted energy generation methodologies all deal with zero-emission technologies and the supply of electricity to the grid, they have a similar structure and become comparable, even though they use different renewable technologies. Electricity is produced from different combustion processes: Bagasse is the organic waste from sugar cane cultivation, and rice husk is the organic waste from rice cultivation. Further, landfill gas is used. Other technologies are wind power, energy from waste heat recovery and hydroelectric activities. Hydroelectric projects are so far considered to have more positive than negative impacts on climate change, but there is a discussion going on to exclude big hydroelectric projects from eligibility, as they are very likely to destroy nature. The combined production of heat and electricity which is known to be of high efficiency is called cogeneration.

To make it easier to follow the proceeding of the methodologies, which will be analysed, a short description of the project activities is following:

NM0001: Vale do Rosário Bagasse Cogeneration (VRBC); Vale do Rosário Sugar Mill (VR); Econergy Brasil (ECONERGY); Swedish Energy Agency

This is a bagasse cogeneration project. It consists of expanding the mill's cogeneration system in order to increase its efficiency and to add value. Therefore, a shift from low-pressure to high-pressure boilers is necessary. The mitigation project supports the economic development of the country. There will be different project phases. In an initial phase, a capacity of **4 MW** will be reached, whereas in the later project phases capacity can get as high as **35 MW**. The project was considered by the project developers prior to the electricity market deregulation in Brazil, but had been abandoned.

NM0010: refer to the description of methane recovery project activities (section 3.1.3.1)

NM0019: A.T. Biopower Co. Ltd. (ATB) (UK); Rolls-Royce Power Ventures Ltd. (RRPV) (UK); Al Tayyar Energy Ltd. (ATE) (Thailand); The Engineering Business Division of the Electricity Generating Authority of Thailand (EGAT EB)

This project plans to use rice husks that would otherwise be burned in the open air or left to decay for energy generation. It will be the task of the project developers to construct and operate a new rice husk power plant in Pichit province. The gross generating capacity will reach approximately **22 MW** (net **20 MW**). NM0019 states that, following scientific forecasts, Thailand's demand for electricity will double from 2001 to 2012. By increasing the capacity, the project will contribute to securing steady supply sources. In addition to that, the mitigation project improves the disposal of a major source of agricultural waste and delays or even displaces carbon intensive fuels in the grid, which is dominated by natural gas, lignite and imported fuel oil.

NM0020: Republic of Colombia; Empresas Públicas de Medellín E.S.P. (EEPPM); Electric Power Development Company, Ltd. (Japan)

This is a hydroelectric project consisting of two hydroelectric plants in a chain. It will have a total installed capacity of **31.5 MW**. La Vuelta is located in the upper part of the river and will have a capacity of **11.7 MW**, whereas La Herradura lays in the lower part and will reach a capacity of **19.8 MW**. In addition to representing a zero-emission technique, which will reduce GHG emissions, it will improve the electricity service in Colombia and contribute to the regional development.

NM0023: Mexico; Impulsora Nacional de Electricidad (INELEC), S.A. de C.V.; Corporación Mexicana de Hidroelectricidad, S.A. de C.V.; Scudder Latin American Power Fund (SLAP); Prototype Carbon Fund (PCF)

This is also a hydroelectric project, which makes use of an existing dam, at the Cutzamala River in the state of Guerrero. By feeding electricity to the grid, it avoids electricity generation and CO_2 emissions at fossil fuel fired power plants. The capacity will reach **30 MW**. Due to a lack of funds, clean energy generation has never been implemented, although the energy demand is increasing. For sustainable development, growth diversification in the grid is indispensable.

NM0024: Empresas Públicas de Medellín (EEPPM); the Prototype Carbon Fund (PCF); the Republic of Colombia

This project is a wind based generation facility. It will be located in Wayuu Indigenous Territory in the North-eastern region of the Atlantic Colombian coast, within the region of Uribia in the Department of Guajira. The construction will be completed in January 2004. The electricity generated will be fed to the Colombian National Interconnected

System (SIN). The facility will deliver around 68.3 GWh/year. The aeolic capacity addition of **19.5 MW** is relatively small in relation to the installed net capacity of 13.2 GW of the grid. In spite of this, it is a very useful project activity, because of the increasing energy demand. It will not displace other facilities, but eventually delay them. In Colombia, energy facilities are mostly thermal.

NM0027: Grupo Virgolino de Oliveira; Catanduva Sugarcane Mill; Ecoinvest; The Ministry of Science and Technology of the Federative Republic of Brazil; The Ministry of Housing, Spacial Planning and Environment of the Netherlands; Senter, Dutch governmental agency (CERUPT) [112]

This is a project that uses bagasse to produce energy. First, the electricity generated will be used for the production of sugar and alcohol on-site. Then, the surplus of electricity (surplus capacity equalling about **19.5 MW**) will be commercialized. The project is now in the setting-up phase with financial structuring, Power Purchase Agreements (PPA) and turnkey services under negotiation. The capacity of the electricity plant will be of **25 MW**. GVO is the parent company of Usina Catanduva Sugar Mill and plans to start operation in 2004.

NM0030: Balrampur Chini Mills Limited (India)

This is another bagasse cogeneration project with a **20 MW** nominal capacity. The facility will operate for 320 days per year, with 200 days of crushing season and 120 off-season days. The PPs ensure that there is sufficient bagasse available, so this will not create leakage. The facility will utilize available mill generated bagasse effectively for generating steam and electricity, for meeting on-site consumption and for exporting the surplus electricity to the grid. On-site consumption consists of the sugar plant requirements of steam and power, the auxiliary power as well as the steam requirements of the cogeneration unit itself. This increase in capacity is very welcome to the region, as there is already a power deficit in Uttar Pradesh.

NM0031: OSIL; Ministry of Environment & Forestry, India

This is a project that aims at recovering wasted heat in a coal based rotary kiln for sponge iron making. Energy efficiency has a high potential of being improved at this facility, as a significant amount of waste gases at 800°C are exhausted from the Direct

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[112] CERUPT (the Certified Emission Reduction Unit Procurement Tender) is the public tendering procedure of the Governmental Agency Senter. It has been argued that the Dutch approach does not fully correspond to the requirements of Article 12 of the Kyoto Protocol. Many NGO’s (like “CDM watch”) claim that the CERUPT benchmarks are not conservative and that most CERUPT projects turn out to be BAU projects, i.e. non-additional; see CDM watch (2004).

Reduction Iron (DRI) kiln and released into the atmosphere. The sensible heat contained in the waste gases will be recovered and utilized to meet the total power requirement of Orissa Sponge Iron Limited (OSIL) and Orissa Steel Works (OSW).

NM0035: Thiru Arooran Sugars Ltd, India; Prototype Carbon Fund (PCF)
In this case, a sugar cogeneration facility is already in place. The cogeneration units produce enough steam and electricity from bagasse to satisfy sugar mill demands during crushing season. By installing high efficiency boilers and additional turbines, efficiency could be enhanced, and the excess power could be fed to the grid. During off-season, coal or lignite will be used instead of bagasse in an early project phase, but gradually these energy sources will be substituted by agro-biomass. This methodology deals with the capacity augmentation component, whereas another methodology (NM0028) only treats the fuel switching component.

3.1.4 Comparison of Selected Methodologies

Based on the criteria responsible for the additionality of a project activity, which have been explained in section 2.2.2, the methane recovery methodologies and the electricity generation methodologies will now be analysed and compared.

3.1.4.1 Methane Recovery

Baseline Selection
Most methane recovery methodologies start by explaining what the baseline scenario is and how it has been identified by using a **Scenario Analysis**. Apart from NM0004, all methodologies use this approach. NM0004, however, starts with a pre-determined baseline scenario. The PPs support their approach referring to the fact that, in this special case, there has been a call for tender with a determined percentage of methane to be recovered. As the contract has been signed, the PPs declare the contract scenario as the only possible baseline scenario. Still, it should be addressed, if there is a possibility of renegotiation.

NM0005 states at the beginning, that the methodology is only applicable, if the BAU scenario is the baseline. This restriction is permissible, because this is the output of the scenario analysis in this case and this is the basis for all further calculations provided by this methodology.

In order to choose the baseline scenario, a wide set of arguments is presented. NM0010 defines them clearly by differentiating between legislation (regulatory requirements / policy), landfilling capacity, costs, environmental issues and revenue. They can be classified into qualitative (cost, revenue) and quantitative criteria (legislation, capacity, environment).

Additionality Assessment

After having determined the baseline scenario, it has to be demonstrated that the baseline scenario is not identical with the scenario of the project activity. The methodologies proceed respectively in another way, if there is a policy in place or not.

If there is **no policy in place**, e.g. NM0021 can be used. The legal requirements are tested to ensure that all relevant regulations have been dealt with. Then, NM0021 makes a quantitative analysis comparing the baseline scenario to the project activity. It has to be shown, that the project activity is not the least-cost-opportunity. As an alternative, NM0005 compares the IRR of the project activity either to the IRR of the baseline scenario or, alternatively, to bond rates or other hurdle rates. NM0005 also provides a sensitivity analysis of the calculation of the IRR.

After having tested the quantitative aspects, NM0021 continues with a qualitative assessment. This assessment consists of a barrier analysis (also applied by NM0010), a test that shows that the project activity is “not common practice” and a credibility estimate.

The barrier analysis, the methodologies apply, can be systematised in three main categories: structural criteria (investment barrier, barrier due to prevailing practice, technological barrier and limited information), institutional barriers such as policies or regulations and rather strategic, company internal criteria (e.g. managerial resources, organizational capacity, financial resources and capacity to absorb new technologies).

The test, showing if a project activity is “not common practice” in the country, deals with a barrier of implementation. If the corresponding technology is implemented in less than 5 % of the cases, NM0021 considers the project activity as being “not common practice” in the country.

Lastly, credibility is assessed by analysing if the financing perspective is realistic. The analysis checks if the PPs can count on sufficient local support, if physical obstructions like availability of fuels, skilled employees and techniques exist, and finally, if future legislation, if enforced, could influence the baseline.

Another approach is chosen in the case of an **existing policy**. Two situations are possible: the over-performance (NM0004) and the non-compliance (NM0032).

In the case of over-performance, a quantitative analysis is chosen. The baseline is characterized by the implementation of the contract or policy in place, whereas the project activity comprises an over-performance of the contract, i.e. the emission reductions are higher than the contract requires. The underlying argument of NM0004 is that the over-performance would not create additional revenues, as the quantity in emission reduction is fixed in the contract and related to fixed revenue. Therefore, a simple cost comparison is sufficient to show that the project activity would not be undertaken.

In the case of non-compliance, a qualitative analysis is applied. First of all, the reasons have to be specified by the PPs e.g. financial reasons (no support by municipal bodies), no allocation or appropriation by the state or the government. As a next step, a barrier analysis is conducted examining investment barriers, technological barriers and barriers due to prevailing practice. In NM0032, this analysis is followed by a description stating that the BAU scenario is identical with the baseline scenario, specifying the percentage of compliance and explaining how measures will be implemented under the CDM to increase compliance.

Baseline Setting

Technology specific, country (region) specific and project specific components can be identified. Technology specific and country (region) specific components can be standardized, whereas project specific components have to be assessed for each project activity submitted.

The setting of the **baseline type** is project specific. NM0004, NM0005, NM0010, NM0021 choose a forward-looking baseline, whereas NM0032 uses an historical baseline. This can be explained by the fact that NM0032 is the case of a non-complied regulation. The assumption is that in the baseline scenario “nothing would change”, i.e. the BAU scenario.

The **crediting lifetime** is project specific and coincides with the operational lifetime except for NM0004 (with an operational lifetime of 17 years) and NM0021 (with an operational lifetime of 30 years). NM0004, NM0005, and NM0010 use a renewable crediting period of 3 times 7 years, whereas for NM0021 and NM0032 a fixed crediting period[113] of 10 years is chosen.

Boundaries have to be equivalent for the baseline scenario and the project scenario. The boundaries are addressed as following:

The **geographic boundary** is generally defined as the actual and future project site(s) of the BAU activity. In most cases (NM0004, NM0005, NM0010, NM0032), only the direct on-site emissions are included into the boundary. This is a narrow definition. Only the CERUPT methodology, NM0021, includes all direct emissions. A narrow boundary turns measurements of emission reductions less complex, but, at the same time, runs the risk of excluding other decisive emissions. Therefore, an accurate leakage assessment is crucial in conjunction with a narrow boundary.

The **system boundary** is very important for project activities generating electricity with landfill gas as a fuel. If no CERs are claimed for displaced grid electricity, the system boundary consists of the power purchase options and eventual autogeneration options (NM0010). If, on the other hand, unused excess capacity is supplied to the national grid, for which CERs are claimed (NM0005), the electric system forms the system boundary. Methodologies for project activities not generating electricity only take the urban waste management system as a system boundary (NM0032)

All emissions not comprised in the boundaries are considered as **leakage**, i.e. all indirect on- and off-site & direct off-site emissions (NM0004, NM0005, NM0010, and NM0032), except in the CERUPT case, where leakage covers only the indirect emissions (NM0021).

Direct on-site emissions in the baseline come from the uncontrolled release of landfill gas (NM0005). Emissions from transportation of leachate are excluded for simplicity and conservativeness (NM0021). In the project scenario, the main emissions are the fugitive landfill gas emissions (NM0005, NM0021). The following are emissions considered to be negligible: First, CO_2 emissions generated from CH_4 produced by plastics decomposition (NM0004, NM0032) are not included for simplicity, i.e. because of their small amount. For the same reason, emissions from the use of auxiliary and back-up power either from the grid or from a generator using landfill gas or diesel are

[113] Required by CERUPT and the PCF

excluded (NM0021). The energy used for preparing the gas for final use is also considered to be negligible (NM0021).

Direct off-site emissions in the baseline case are emissions from the use of grid electricity (NM0004, NM0005) and in the project scenario, the transportation of equipment to the project site and the use of electricity generated from landfill gas (NM0004, NM0005, and NM0021). The electricity from landfill gas is a positive leakage for NM0004 and NM0005, but not for the CERUPT methodology, for which it belongs into the boundaries. All direct off-site emissions are excluded for conservativeness.

Indirect on-site emissions in the baseline scenario are not identified. In the project scenario, emissions from electricity used for operation of lights and fans on-site are excluded by NM0005 and NM0010, because electricity from the landfill gas is carbon neutral. Emissions from the construction of the project are excluded as well by NM0005 and NM0010, since those emissions would occur with an alternative project in the baseline, too.

Indirect off-site emissions can be generated from transport of waste to the landfill in the baseline scenario as well as in the project scenario and are therefore excluded (NM0005, NM0021). Emissions from the grid electricity for pumping during the year are also excluded, because they are considered to be negligible (NM0004, NM0032).

In the proposed methodologies, leakage seems to be negligible. This warrants the narrow boundary. Although in principle, the boundary setting is project specific, a technology specific standardization of the boundary including only the direct on-site emissions makes sense, because, generally, the leakage occurring seems to be negligible.

The **uncertainties** addressed generally refer to the conditions under which the methodology is applicable and to the risk that the key assumptions could not be met (NM00010), e.g. the tariffs for electricity (NM0005, NM0010) and the performance of the plant are uncertain. It cannot be proved definitely that the setting of plausible alternatives in the scenario analysis has been done correctly. Further, the financial analysis could be not conservative enough and the financial assessment applied to a borderline case might lead to wrong results (NM0005). Especially for the technology of landfill gas recovery, the quantity of CH_4 released to atmosphere in the baseline remains uncertain, because there are commonly no CH_4 release monitoring systems in landfills of developing countries and for this reason the baseline has to be constructed without historical data supporting the trends[114].

Concerning the baseline setting, the **general conditions** are country specific:
NM0004 states for **Brazil** that, the typical recovery of methane or biogas is minimal and that there is no regulation in place. 20% recovery is therefore a very conservative estimate. NM0005 proved by a control group approach that uncontrolled release of landfill gas (LFG) to the atmosphere is the prevailing practice. The minimal standard for landfill gas collection systems is fixed by regulation requiring 40 passive drainage wells at approximately 50 m intervals reaching 2 m in depth. NM0021 points out, that the landfill gas is only required to be vented in order to avoid the risk of explosion, because the current priority of national policy is to prevent the illegal dumping and to improve the conditions at official landfill sites.

In **South Africa** (NM0010), monitoring of CO_2 and CH_4 concentrations at all hazardous and large landfill sites is required. The concentration of the flammable gas in the air must not exceed 1% and the concentration of CO_2 must not exceed 0.5% by volume. If the methane concentration exceeds 5% in the air, permanent venting systems become obligatory. Hence, the cost for gas capture and flaring are still so high that it is not probable to be prescribed in the near future. Therefore, the currently existing wells, which would continue to operate with a declining efficiency, would not be replaced and no further wells would be installed. On the other hand, in the case of NM0010, the fact, that there are existing wells, is project specific, because they were originally only put in place to control for odour, to guarantee local safety as well as to investigate the potential for electricity generation. But these plans had been abandoned for cost reasons.

On the contrary, in **India**, there is a policy in place (MSW Management Rules, 2000), but NM0032 underlines, that it is not enforced. The percentage of compliance is reflected in the yearly compliance report (published by Central Pollution Control Board, CPCB). NM0032 proposes to set the baseline assuming an increasing percentage of compliance starting in 2003 with a compliance of 0% in order to achieve compliance of 50% in 2015.

Calculation of ERs

All methodologies monitor the landfill gas that is captured. This differential is taken to represent the ERs. This proceeding does not entirely follow the additionality concept: it

[114] See Hanna, Javier (2004)

is not possible to say, that a ton of methane collected is equal to one ton of methane not released into the atmosphere, because the new gas collection system itself has an influence on the generation of GHGs. Therefore, the emissions captured are not entirely equal to the emission reductions achieved. Still, it would be less accurate to use estimations for modelling the baseline emissions to compare them directly to the emissions of the project activity. A monitoring of the baseline emissions (being hypothetical) is not possible, if the project activity has once been put into practice. In order to satisfy the additionality criteria, a correction factor has to be applied. The solution might be a default factor, which is deducted from the emissions captured. The remaining emissions recovered are then considered to represent the emission reductions. In order to determine the baseline emissions equally for each landfill gas recovery project activity, a technology specific standardized calculation method has to be employed.

NM0005 uses the **Effectiveness Adjustment Factor** (EAF) to compare the gas collection system of the baseline to the one of the project scenario. The EAF is determined by the frequency and the depth of the gas wells, the suction applied to the wells, and the efficiency of flares (the results are highly site specific). NM0005 for example reduces the estimated baseline emissions by 25%. In the case of NM0004, the effectiveness of the gas collection system is not estimated, because of the project specific circumstances: there exists the tender contract, which is taken as the baseline scenario, and it is believable that the project developer will be able to comply to it, because its performance has been among the top 20% in the previous five years.

The model for calculating the emission reductions is very technology specific: All methodologies except NM0032 apply the **First Order Decay Model** to measure the emission reductions. This model is generally applicable to landfill gas recovery project activities, which dispose of the data needed. The results are project specific, as the methane generation rate (depending on the waste composition (organic fraction) and the overall waste disposal practice) is highly site specific. The decay rate instead, which is another parameter of the model, is country/region specific as it depends on the temperature and humidity of the landfill.

In the case of a lack of data availability, like in India (NM0032), the **IPCC default method**, which is a mass balance approach that involves estimating the degradable organic carbon content in the solid waste to calculate the CH_4 that can be generated by the waste[115], may be used instead. The monitoring of the quantity of waste received at the landfill and of the quantity of methane flared has to be continuous, as it can vary by more than 20% during a day (amount of LFG collected, percentage of LFG that is CH_4, flare working hours), the flare emissions have to be quarterly analysed. This is also technology specific.

3.1.4.2 Electricity Generation

Baseline Selection

Similar to methane recovery methodologies, most electricity generation methodologies start with the identification of the baseline scenario. Therefore, the PPs use either a **Scenario Analysis** or **Series of Questions**. However, NM0023 and NM0019 compare a pre-determined baseline scenario to the project activity without discussing other options.

The Series of Questions are applied by NM0001 in a well structured way, but remain unclear and confusing in the case of NM0020.
NM0001 asks four questions concerning the hypothetical behaviour of:

1) The public sector (eventual policies and plans),
2) The private sector (referring to historical similar plants and other possible investors and their access to resources),
3) The present promoter (this has to be done by a barrier analysis, but in special cases, e.g. for a small-scale project, it is sufficient to add a convincing paper trail demonstrating that the project activity has been conceived and implemented only because the project activity was in the running for the CDM),
4) Public sector's policies and programs

Instead of this clearly structured approach, NM0020 poses a confusing set of questions e.g. referring to policies (regulatory and institutional conditions), to market barriers (risks, economically attractive course of action) and other barriers. Finally, it addresses the question of how the CDM would help to overcome the named barriers, but without supplying clear criteria. It only states that the project activity has been considered for a

[115] See Hanna, Javier (2004)

long time, but was never undertaken. It then states that the CDM changed the attitude of the PPs now perceiving the project activity under the CDM as an opportunity.

The other possible approach is the Scenario Analysis. Similarly to the methane recovery methodologies, it starts by identifying possible future scenarios which will then be put through a quantitative (NM0010, NM0020, and NM0035) and/or a qualitative assessment (NM0024, NM0027, and NM0035). NM0030 does not conduct a profound assessment. It only discusses the different options under plausibility aspects. The methodologies NM0010, NM0019 and NM0023 state that they are only applicable, if the BAU scenario is the baseline scenario.

For the qualitative assessment, the following criteria can be identified: NM0010 and NM0035 assess legislations and national policies, NM0010 and NM0020 explain cost reasons (NM0020 restricting the analysis to developer's projects), NM0010 treats a technology barrier and NM0035 looks at the power requirements in the grid.

The quantitative assessment offers two variations to proceed:
NM0024 and NM0035 use the least cost planning. First, all alternatives within the boundaries of the baseline scenario are identified. Then, investment costs are estimated, and the least cost option is considered to be the baseline scenario (NM0035). Finally, the investment costs are estimated for the project activity (NM0035). As NM0035 is related to a capacity augmentation, it also estimates the increased electricity generation. NM0024 points out that, for this analysis, key parameters like the project lifetime and the discount rate have to be specified in the PDD.

Another criterion, the internal rate of return (IRR), is used by NM0027. This is a suitable criterion if the projects, apart from provoking costs, create benefits. NM0027 compares the IRR of several scenarios to each other and chooses the activity with the highest IRR as the baseline scenario. However, investment theory teaches that the selection between projects cannot be based on a direct comparison of the IRRs. The IRR may only be used in reference to the market interest. Therefore, the proceeding of NM0027 at this point of the analysis is not valid.

Additionality Assessment

The assessment, whether the project activity is not the baseline, can be done quantitatively or qualitatively.

NM0010, NM0027 and NM0031 choose a quantitative approach using a comparative cost analysis. This is applicable if income from the project activity is not substantial.

NM0010 compares the cost for purchasing power (baseline scenario) to those of autogeneration (project activity). For this analysis, reliable market data is needed. If the data is not available, a continuous monitoring could be an alternative. The difficulty is that a baseline cannot be determined ex-post, as the point of reference is the decision today which relays on an ex-ante estimation for what will happen in future. However, an ex-post reassessment of the baseline is indispensable, if conditions have changed and the PPs would, at a certain point in time, have adopted the project activity even without the CDM. From this point on, the project activity would no longer produce credits.

NM0031, on the other hand, compares the project activity not to the market prices, but to the costs of its own fuel based power plant, as this would be the baseline scenario for the OSIL activity.

A qualitative approach is chosen by NM0001, NM0019, NM0020, NM0023, NM0024, NM0027 and NM0031. As well as in the case of the methane recovery methodologies, the electricity generation methodologies look at different barriers, which can be put into five groups: institutional barriers, structural barriers, strategic barriers[116], the rubric "how to overcome" these barriers and the analysis of similar activities.

Regulatory barriers (NM0023, NM0027, and NM0031) and national policies (NM0019) belong to the rubric of **institutional barriers**.

Six **structural barriers** can be identified. NM0027 deals with a barrier due to limited information. A barrier to investment is largely cited (NM0001, NM0019, NM0020, NM0023, NM0024 and NM0027), referring for example to the access to capital, a lack of funding, the perceived market risk, a low return of investment and cost/profit limitations. Another barrier, only named by NM0019, is the political gaming. Two other market barriers described are the technological barrier (NM0019, NM0024, NM0027 and NM0031) and the barrier due to prevailing practice (NM0019, NM0020 and NM0030). The last barrier, which is very similar to the barrier due to prevailing practice, occurs if a project activity is "not common practice"[117] (NM0023, NM0024, NM0027, NM0030, NM0031 and NM35): NM0024 states that technologies applied in

[116] See Wied-Nebbeling, Susanne (2004), pp. 8-12
[117] See EB10, Annex 1, A.2.

less than 5 % of the cases in the country or in less than 5 locations are to be considered as "not common practice". NM0030 stands for another percentage referring to the Pareto 80/20 Rule: the methodology pretends that the Pareto Rule claims that 20% of the technologies implemented are "not common practice". This interpretation is wrong, as the 80/20 Rule refers to the efficiency in production processes and means that 80% of the benefits come from only 20% of the effort[118]. All the same, NM0031 considers technologies with a market share smaller than 20% to be "not common practice". But it does not state why exactly this percentage has been chosen.

Comparable to the cases of methane recovery, PPs enumerate **strategic barriers**, i.e. company related barriers like corporate culture (NM0001), corporate decision-making criteria and opportunity costs (NM0001), managerial resources (NM0019, NM0027), financial resources (NM0027), capacity e.g. organisational capacity and capacity to absorb new technologies (NM0023, NM0027).

The rubric **"how to overcome"** shows how the CDM helps the PPs to overcome the barriers named before (NM0023).

NM0023 chooses an additional barrier test to examine if **similar activities** have been successful. The activities have to be similar, in the sense of a control group approach, which refers to several criteria, like the country, the technology, the scale, and the environment. If the other activities have not been successful, this is interpreted as a signal for a barrier. If they have been successful, further analysis is needed to prove why the proposed project activity would instead be unlikely to take place. However, it can be difficult to find a control group of activities that are similar enough to allow conclusions to be drawn.

Baseline setting

Again, as for methane recovery methodologies, technology specific, country (region) specific and project specific components may be identified.

The setting of the **baseline type** is project specific. NM0010, NM0019, NM0023, NM0024, NM0027, and NM0035 choose a forward-looking baseline, whereas NM0001, NM0020, NM0030, and NM0031 use a historical baseline.

118 See Meth Panel Recommendation for NM0030 (2003)

Here, the **crediting lifetime** often differs from the operational lifetime of the project activity (mentioned in brackets, if different). NM0010, NM0019 (minimum of 25 years), NM0020 (50 years), NM0023 (25 years) and NM0024 use a renewable crediting period of 3 times 7 years, whereas for NM0027 (25 years)[119], NM0030 (20 years), NM0031 (20 years) and NM0035[120] (15 years) a fixed crediting period of 10 years is chosen.

Boundaries

The baseline boundary and the project boundary should have the same scope and be constructed following the same rules. The scope of the boundary is project specific. Nevertheless, there is a **common basis** where all methodologies start from:

In all cases, **geographic boundary** comprises the project site including all the equipment (e.g. NM0001: cogeneration equipment and bagasse storage). It then has to be examined to see if other facilities (e.g. NM0001, NM0030: nearby facilities) could be affected by the project activity (e.g. NM0001, NM0030: change in fuel consumption).

The **system boundary** is generally the interconnected system. For NM0010, not only the power purchase option, but also the autogeneration option is part of the system boundary. NM0027 and NM0030 do not include the interconnected grid into the boundary, stating that the impacts are not under the control of the project developers. Significant imports or exports have to be considered. For example, NM0023 and NM0024 make the conservative assumption that the import comes from zero-emission fuels. This means that they do not claim CERs for reducing carbon-intensive electricity imports. The export of electricity is taken into account using national data.

The emissions should be classified as direct on-site, direct off-site, indirect on-site or indirect off-site. Emissions outside of the boundary are automatically leakage. It has not been clearly defined, if the boundary should always include all direct emissions and mitigation like the CERUPT methodologies do (NM0027 in the case of electricity generation and NM0021 in the case of methane recovery). Most methodologies include only the direct on-site emissions and some of the off-site emissions in their boundary.

How far **related activities** have to be included into the boundary, is a very project specific decision, which has to be controlled by the DOE. It is a conservative approach

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[119] Required by CERUPT

[120] Required by the PCF

if some **baseline emissions** are not included into the calculation (e.g. NM0019). This can, at the same time, reduce complexity. Emissions only necessitate being included, if they are bigger in the project scenario than in the baseline scenario.

Significant emissions from **transport and construction** (excluded by NM0031 because the amounts are negligible and the emissions occur only during the first project phase) of e.g. a new plant or transmission lines (NM0030) should be considered (e.g. NM0019 and NM0020). If a fuel has to be supplied, emissions from the **fuel handling**, including extraction, processing (NM0023) as well as transportation of fuel, material or perhaps even manpower (e.g. NM0019, NM0030) to project site and on-site, have to be considered. Impacts of a **start-up / auxiliary / back-up fuel**, if needed (e.g. NM0019, NM0027), have to be estimated.

Transmission and distribution (**T&D)** losses should be included, if they are significant and higher in the project scenario than in the baseline scenario like NM0030 suggests, but they may be excluded like in NM0001, if they are estimated to be equally high in the baseline and in the project scenario.

The emission reductions through **replaced heat or electricity production** at the project site that are an indirect effect of the project activity (NM0027) may be included into the calculation.

The most important part of the baseline emissions consists of the direct emissions from the **power produced in the gri**d without the project activity implemented (NM0027). The related emissions are rather <u>country specific</u>.

It is generally stated by the methodologies that only **significant** emissions necessitate being included into the calculation. However, only NM0027 makes the effort to formulate a concrete **threshold**: significant means that the respective emissions are bigger than 1 % of the total emissions. This threshold applies to emissions inside the boundaries as well as to leakage. Concerning the estimation of **leakage**, which, even if principally measurable, remains of very high subjectivity, it would not be a conservative approach to claim credits for positive leakage, nor to claim the whole quantity of calculated CERs in the case of significant leakage. However, it would be artificially and cost intensive to force PPs to include negligible leakage that is difficult to estimate into the calculations. In order to make the issue of leakage measurement more "user-friendly", it makes sense that leakage just has to be named, until it is significant. Nevertheless, the negligibility should be demonstrated by applying mathematical rules e.g. a specific percentage of the ERs created by the project activity or of the total emissions like in NM0027 (<1%). The way leakage is calculated has to be provided for verification. If leakage is, on the contrary, significant, a default percentage has to be deducted from the CERs. The height of this percentage is very case specific and has to be validated by the DOE. A default portion would simplify the proceeding. If leakage exists but cannot be measured, it can only be addressed under the rubric of **uncertainty**.

Some technology specific components can be identified:
Bagasse is considered to be a zero-emission fuel. This means that **CO_2** from **bagasse combustion** is carbon neutral and can be ignored (e.g. NM0019). All the same, it is conservative to ignore **N_2O** emissions from bagasse combustion for the baseline scenario and for the project scenario, as by the rotting of bagasse, there is much more N_2O generated. The baseline scenario should be determined conservatively. For example, if the bagasse, like explained in NM0019, would be left to rot on the field, it is a simplifying and conservative **assumption** to say that all surplus bagasse would be **burned** open air. As CO_2 and N_2O are not relevant, only CH_4 would be accounted for. Energy-from-bagasse project activities typically mention CH_4 and CO_2 emissions in the baseline case from **bagasse storage**. But these emissions may be excluded, because cogeneration projects neither increase the bagasse production nor extend the term of the BAU bagasse storage. The process of decomposition advances quite slowly. NM0001, NM0019 and NM0027 state that their bagasse, which is well exposed to oxygen, produces less anaerobic methane (approximately 80% of CO_2 and only 20% of CH_4) as in the baseline case, where it would be left to rot. In addition to that, the amount of stored bagasse is limited to a time smaller than one year and the remaining bagasse is burned before the next harvest season. Further, the quantity of energy used for **preparing the gas** for final use should be estimated. In the case of **restricted bagasse**, the project may lead at other facilities to a diversion from biomass to a more carbon-intensive fuel (NM0001, NM0019). If the impacts of the tight supply are significant, they may be taken into account using a discount factor (NM0019).

During **hydroelectric projects**, CH_4 may leak into the atmosphere from the reservoir because of organic matter decomposition in the flooded areas (NM0023). Another source of emissions is the CO_2 from the **cement plant**, which produces the concrete used for construction of the project (NM0020). CH_4 emissions from displaced hydro energy in other plants are considered by NM0020 to be in most cases negligible.

Uncertainties: The uncertainties refer to the **accuracy of projections** e.g. the baseline scenarios, the models, algorithms and parameters for baseline emission calculations, the assumptions concerning the marginal costs, the development of generation mix, the output of the plants and the development of emission factors during the crediting period.

Uncertainty may be reduced by conservative assumptions or by monitoring the activity related data ex-post and using it in the actual computation of CERs: the ex-post CEF should replace the ex-ante CEF if it represents a lower value. But uncertainties are only reduced from the point of view of the credit issuing body. Taking the ex-post values, the uncertainty for the project developers increases as their calculations are based on the ex-ante estimations.

Concerning the baseline setting, several issues are country specific: the availability of official grid data, official projections for the annual grid and assumptions concerning the mode of disposal for unwanted agricultural residue (NM0019).

The methodologies all have something in common, which is that the baseline scenario is not one specific alternative project. On the contrary, the impact of the project activity is dispersed throughout the electric sector's operation and expansion, as the most likely non-project option is to use power from the grid. Therefore, the project activity will displace or delay an equivalent amount of grid electricity, which can be generated by fossil fuel, but also by renewable energy sources.

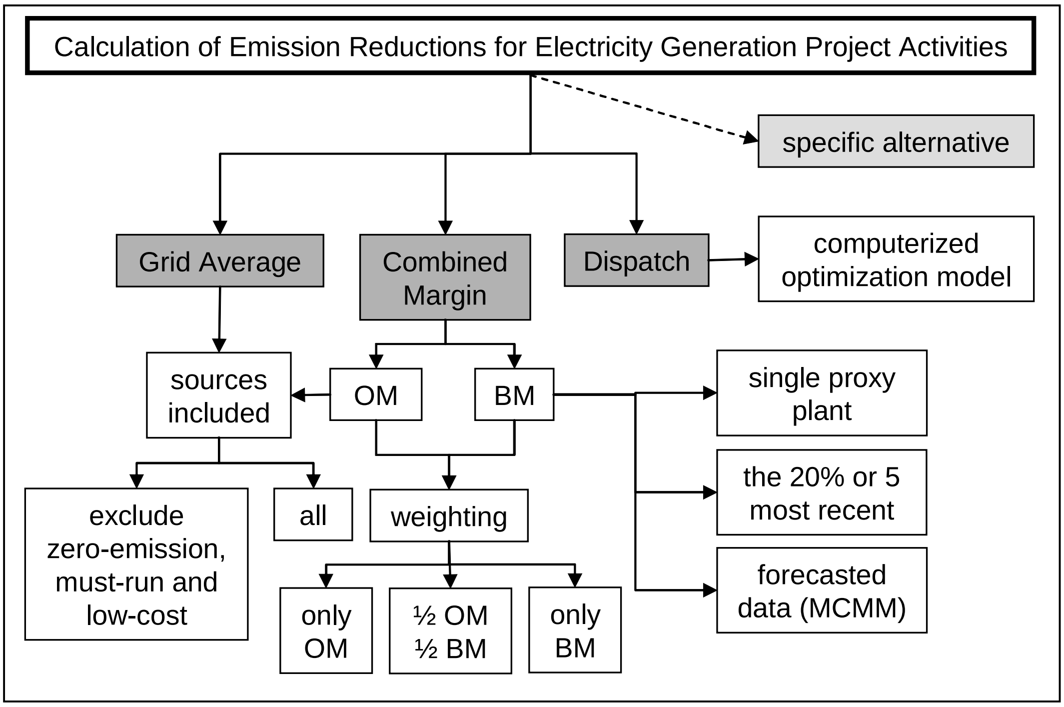
Calculation of the Emission Reductions:

The annual grid average carbon emission factor (CEF) is calculated using official data of and projections for the national, regional or local electricity grid. The CEFs refer to the different kinds of electricity generation. For the sake of conservatism, the CEF for each electricity generation type should be based on the best technology available in the particular grid and include future technological improvements. The CEFs should result in an average weighted CEF for the whole baseline scenario.

The PPs have chosen various options belonging to three main groups of methods: the Dispatch Approach, a very accurate but complex method, the System Average Approach, a simpler but more transparent method, and marginal approaches.

These methods are illustrated in Figure 7 and explained in the following.

Figure 7: Methods for the Calculation of the Emission Reductions



The Dispatch Model:

The Dispatch Model, 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 capacity addition. However, its implementation is costly and data requirements are high. NM0020 fixes ex-ante baseline parameters, but admits that there is still an ex-post component, because the calculation uses values of the situation where the project activity has been implemented. NM0024 clearly defines its approach as an ex-post dispatch analysis, pointing out the increased accuracy and reliability of data. However strictly spoken, as discussed in section 2.2.2.5, an ex-post baseline setting contradicts the concept of a baseline, which is an ex-ante estimation.

The System Average Approach:

On the contrary, this is the easiest method to calculate the emission reductions achieved by supplying the less carbon intensive energy to the grid. It is calculated by taking the **weighted average emissions rate of all current operating electricity plants** in the country resp. region. In the case of NM0010, the grid emission rate is calculated from the grid operator reported data for annual CO_2 emissions and power output. It averages coal-fired power plants and other less carbon-intensive power sources. The methodology argues that this is conservative, because the project is a must-run-capacity and will affect the whole supply mix. The project activity's impact on the current capacity is decisive. On the contrary, NM0010 states that the impact on green field projects can be neglected as the South African grid is characterized by its overcapacity and the project activity's contribution to the grid is very small.

This example shows that it depends on the one hand on the type of electric grid and on the other hand on the project activity itself, why an approach is conservative or not. In section 3.2.1.2, this finding will be used for suggestions of improvement.

The Operational Margin (OM) Method:
The OM refers to adjustments in the existing grid mix due to the project activity. The planning horizon is rather short-term. Therefore, the short term marginal costs (= the operating costs for the last unit produced by a plant to meet the demand) are relevant. The emissions produced by the plants, which are on the margin, are taken to calculate the carbon emission factors (CEF).

As explained in NM0030, four main approaches may be distinguished to calculate an OM: The calculation of the OM can follow a **dispatch analysis**, which would be a similar calculation like it has been explained for the Dispatch Model, but only referring to the short term marginal costs. A **dispatch decrement analysis** is a less costly and less complex alternative, which continuously analyses dispatch data in order to achieve empirical evidence on how the load is covered. The simplest method would be a **generation weighted-average** of all resources, assuming that the project avoids a proportional fraction of all generating units in the system, but which can create large inaccuracies not providing realistic baselines in some cases. A modified method is the **weighted average of all resources except zero-emission, low-cost and must-run facilities.** This approach is more accurate for projects that displace peak-load facilities in grids, where zero-emission, low-cost and must-run facilities cover only the base load. But if there is a possibility that the project activity displaces also zero-emission, low-cost and must-run facilities like in hydro-dominated grids, only a certain portion (e.g. a country specific percentage) may be excluded from the OM. Otherwise, this approach would no longer be conservative. There are different options to calculate the portion to be excluded: the most sophisticated option is to determine the hours per year in which zero-emission, low-cost and must-run facilities also cover middle- and peak-load. The drawback: the data is often difficult to obtain in developing countries. Another option is to simply exclude the base load zero-emission, low-cost and must-run facilities based on measured historical data. Any generation above the base load is assumed to be part of the OM.

The Build Margin (BM) Method:

The BM stands for the investment alternatives in other sources of electricity, i.e. it represents adjustments of green field projects due to the project activity. The planning horizon is rather long-term. Planned projects may be entirely displaced or only delayed by the project. Since the project activity may affect all prospective new capacity, the BM baseline should generally reflect all power plant types to be added to a system. NM0030 characterises two options for calculating the BM: if sufficient data is available the **average of recent capacity additions** is taken, estimated by choosing either the generation-weighted average emissions rate of the most recent 20% of plants built (on a generation basis), or the most recent 5 plants, whichever is greater. Alternatively, a **single proxy plant type** may be defined as the lowest cost resource (region specific). Also national policies for the expansion have to be taken into account.

If it is rather unlikely that certain sources will be displaced or delayed by the project activity, they may be excluded from the calculation of the BM. For example, NM0030 excludes large-scale projects bigger than 250 MW and public-sector long term energy system planning. This avoids the exclusion of the next most recent projects from the BM, which are probably affected by the project activity.

Nevertheless, BM predictions are very vague, especially in developing countries and markets where new technologies are emerging, because it is just an assumption that historic and current expansion data is indicative for future capacity increase.

The Combined Margin (CM) Method:

The combined margin is composed of both the operating margin and the build margin, because most project activities have short as well as long term impacts. The weighting is dependent from a variety of factors. The default weighting chosen in the methodologies NM0001, NM00023 and NM0031 is ½ OM and ½ BM, at least for the first crediting period. NM0001 sets the combined margin for the second and third eventual crediting period equal to the BM, reasoning that in later stages, only the long term impact remains relevant. The Modified Combined Margin Method (MCMM) is a modification of the Combined Margin Method. In the MCMM, the baseline emission factor is sensitive to sector wise capacity additions.

Figures 8a and b provide an overview of the proposals made by the chosen electricity generation methodologies.

Figure 8a: Proposals Made by the Chosen Methodologies

NM0010: **grid average** emission rate (coal-fired power plants and other less carbon-intensive power sources).
NM0031: **CM= ½ OM + ½ BM.** OM: weighted average emissions (in kg $CO_{2\ equiv.}$ / kWh) of current generation mix (in case of a hydro-dominated grid low-cost must-run hydro power may be excluded), BM: generation weighted average of the 20% recently built or 5 most recent, (if project size less than 1% of the grid size, ex-ante calculations with future capacity additions not necessary), ex-ante calculation with future capacity additions to be performed at an interval of 5 years.
NM0023: **CM= ½ OM + ½ BM** (default weighting may be varied). OM: generation weighted average excluding sources with zero- and low-operation cost (hydro, geothermal, wind, solar, nuclear, low-cost biomass), BM: generation weighted average of the 20% recently built or 5 most recent (even small projects may at least delay the commissioning of new generation sources).
NM0001: **CM= ½ OM + ½ BM** for the first 7 or 10 year crediting period. **Only BM** for the remaining two 7-year crediting periods, with its re-calculation in years 8 and 15 to reflect the evolution of the power market. OM: generation weighted average excluding sources with zero- and low-operation cost (wind, sun, biomass, hydro (only base load hydro excluded) and nuclear.), BM: generation weighted average of the 20% recently built or 5 most recent plants excluding new installations of electric supply capacity (and similar capacity under construction) in individual plants that are larger than 250 MW.

Figure 8b: Proposals (continuation)

NM0019: **only OM** because of the size ("small" size, "little" impact) of the project relative to the total capacity growth planned for the grid and the host country's energy policies (unlikely to cause the cancellation of planned construction). The grid average (hydro included) including the project will be used as a very close approximation of the grid average without the project, which is conceptually more accurate as the baseline. For biomass generation, the inclusion of the project in the grid average will in fact lead to conservatism.
NM0027: **only BM** because other power plant(s) would have been added to the grid instead or with a lower capacity (prove the mix of power plants that would normally have been added).
NM0030: **MCMM** (Modified Combined Margin Method) the baseline emission factor is sensitive to sector wise capacity additions. Thus, the baseline for the credit period will be the average of annual operating margin and build margin obtained using projected capacity additions (**ex-ante calculations** and not including ex-post data).
NM0020: simulates **ex-ante system dispatch** using the Stochastic Duo Dynamic Programming (SDDP).
NM0024: **ex-post system dispatch** using a least cost expansion-planning model, the Super-OLADE model will be improved during operation by using monitored data.

3.1.4.3 Conclusion

This analysis showed that there is a potential for further generalization and simplification of the methodologies. Above all, the methodologies have to be coordinated and consolidated, which may be done by a panel of experts.

From these bottom-up methodologies, which will be fine-tuned by experts, the UNFCCC expects more accurate baselines and monitoring procedures than from top-down benchmarks.

3.2. Implementation of the Concept of Additionality

3.2.1 Problems of Implementation

3.2.1.1 Principal Agent Problem

The main problem lays in the information asymmetry[121] between the PPs and UNFCCC. The relationship between these actors can be described using the principal agent model: The principal hires the agent to perform tasks on his behalf, but he cannot control if the agent performs them in the principal's interest, as the incentives of the agent may differ from those of the principal.[122]

In this case, the PPs are the agents and the UNFCCC (represented by DOEs and the EB) is the principal. They can propose project activities and get a kind of "contract" for CER's, when their project activity is accepted. The DOEs, who assess the project activity, can simply give a judgement basing their analysis on the plausibility of the documentation, but the DOEs do not dispose of all the information the PPs have. It is either impossible or too expensive for the DOEs to monitor the agent's decisions and performance. The PPs pursue their special interest, which is to get their project activity accepted by the EB. If the PPs are not free-riders, there is no direct conflict of interest in assessing additionality. However, if they are free-riders, the interests differ substantially and the PPs will try to present the project activity in a way that makes it acceptable for the CDM. They will submit financial data that artificially raises costs, and try to make the project activity appear as environmentally friendly as possible and the baseline as carbon-intensive as possible.

Special transaction costs arise, when the principal tries to ensure that the agent acts in precisely the way the principal would like. These transactions costs from investigation and selection processes, information gaining and monitoring activities as well as residual losses are called **agency costs**. To resolve the conflict of interest, the principal can create special incentives for the agent to behave in a conform manner.

The problems between the principal and the agent can be differentiated into adverse selection and moral hazard:

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121 See Varian, Hal R. (2004), p. 686ff.

122 See Fritsch, Michael / Wein, Thomas / Ewers, Hans-Jürgen (2003), p. 290ff.

Adverse selection[123] is a problem that occurs before the project activity has been accepted. PPs can give wrong information to the DOEs in order to appear CDM worthy. This is because of Grubb's paradox, which states that less financially viable project activities have greater chances of being accepted. Those project activities that really need support from the CDM may not even have the resources for procuring as much expertise as the competing firms.

By a bottom-up approach, the PPs are free to propose a methodology. Due to the conflict of interest, they will propose exactly those assessments, which are favourable for them. On the contrary, the CDM program has to find out, which proceedings and control mechanisms sort out the highest number of free-riders. Bottom-up approaches are a good tool to get ideas that are elaborated by practical people. This has a positive impact on the acceptance of the control mechanisms, plus is close to the market and ensures that implementation is feasible for the PPs. However, the proposals tend to be rather lax, and the approach chosen is the most favourable that exists for the submitted project activity, as PPs would like to get their projects accepted. Therefore, the bottom-up proposals are a good starting point to prevent negative effects of top-down criteria. But if the additionality assessment is ever expected to really put off a high percentage of the free-riders, adjustments have to be made by a panel of experts in order to make the analysis stricter.

On the contrary, **moral hazard**[124] occurs after the acceptance and during the implementation of the project activity. Emission reductions are to be monitored during the crediting period. The results can be modified / manipulated by the PPs without the DOE noticing.

In order to overcome these problems, either the principal or the agent has to become active.

The principal can choose strategies creating incentives for the agent, e.g. by controlling the agent's performance and introducing performance-related components or by offering long-term contracts. The control of the agent's performance is called **screening**[125] and is carried out by the DOEs: The agent's performance cannot be explicitly measured, but the DOEs are able to analyse if the methodology is suitable for

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123 See Akerlof, George (1970), see Varian, Hal R. (2004), p. 690ff.

124 See Varian, Hal R. (2004), p. 692

125 See Fritsch, Michael / Wein, Thomas / Ewers, Hans-Jürgen (2003), p. 297ff.

the project activity. The first DOE assesses the additionality. This part of the screening belongs to the phase before project has been accepted. If the project activity passes this before-the-fact screening, it gets accepted by the EB. During the crediting period, emission reductions are controlled by a second DOE, which assesses if the documentation is plausible plus if the facilities and assets are existent. As long as consequences can easily be monitored, the after-the-fact control is more effective.

For the agents, i.e. the PPs, it is uncertain, if the project activity will pass the control. Michaelowa et al. describes this as "the knack of a good CDM project developer (…) to 'smell' at which combination of financial indicators and barriers the project is still accepted…"[126] It is difficult to measure uncertainty in advance and therefore it is also difficult to determine, what assessments – quantitative or qualitative – lead to better results. By **signaling**[127] their CDM worthiness, the PPs can try to actively influence the decision taking of the EB. This can be achieved by clear documentation as well as by conservative estimations. Another possibility to signal the quality of the proposed project activity even to outsiders is represented the label "Golden Standard" created by the WWF. These project activities go further than the UNFCCC PDD requires. Above all, this label stands for ecological integrity applying a stricter assessment of the project activity's effects on sustainability. Proceeding like this, they pretend to exclude nearly all of the free riders. Yet, deeper assessment goes hand in hand with a cumbersome process with very high transaction costs.

It is obvious that the PPs have plenty of possibilities for cheating, above all in the beginning, when DOEs are not yet as familiar with the technologies and industry standards in different countries.

Another difficulty in the control process is that the agent's costs can rise so high that participation decreases. This is not at all intended by the control procedures, as the CDM will only "survive", if it is popular.

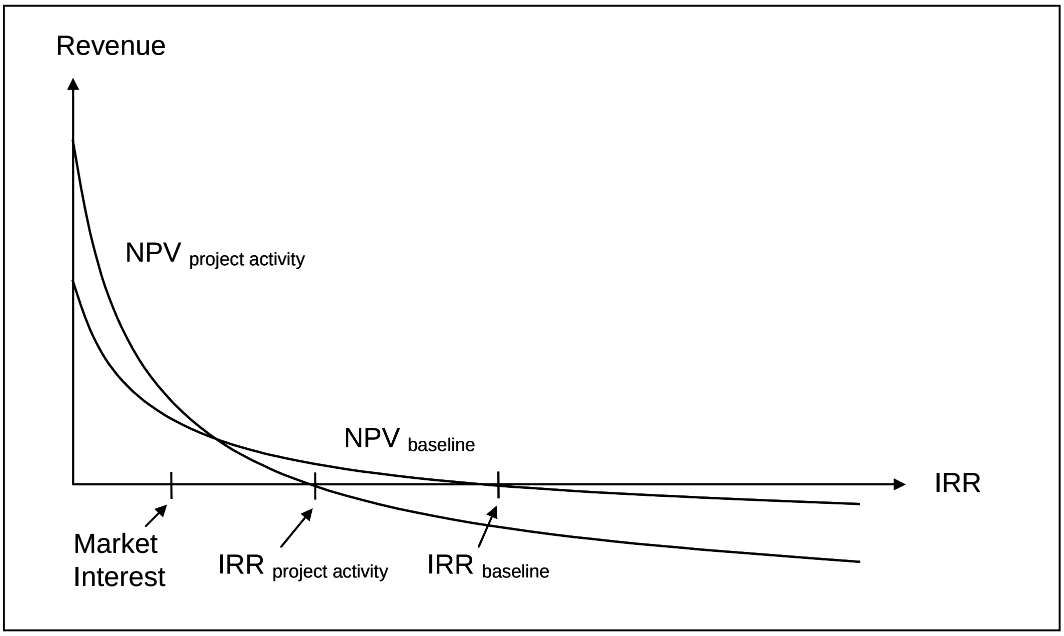
[126] Kaupp, Albrecht / Liptow, Holger / Michaelowa, Axel (2002), p. 3

[127] See Varian, Hal R. (2004), p. 694, See Fritsch, Michael / Wein, Thomas / Ewers, Hans-Jürgen (2003), p. 298ff.

3.2.1.2 Quantitative Assessment

A pure cost analysis may be carried out, if the project activity does not generate substantial benefits. If, on the contrary, benefits are made, either a net present value (NPV) or an internal rate of return (IRR) analysis are applicable. However the **IRR analysis**, as implemented in the submitted methodologies, is invalid. This is because a selection based on an IRR comparison must refer to the market interest and can never directly compare one IRR to another. Of course, the results may be the same, but there are situations, like in Figure 9, in which the IRRs are higher than market interest. In this case, the smaller IRR is preferable. The outcome is that the project activity actually represents the baseline scenario. The $IRR_{baseline}$ belongs to the scenario that initially was assumed to be the baseline, but actually is only a sub-optimal scenario.[128]

Figure 9: IRR: Comparison of Projects



The manipulability of financial indicators: PPs may easily "doctor the accounts" by varying the overheads allocation rates, the discount rate or the project's lifetime. It cannot be said in advance, how well the DOEs will be able to discover the cheating. It is already a problem in industrial countries to decide, if the documentation is credible. Therefore, the only way to enhance the impression that the information given to the DOEs is true is by presenting an exact and accurate documentation as well as by including a sensitivity analysis if the IRR or the NPV are used as indicators. Incomplete

[128] See Breuer, Wolfgang (2002), p. 136ff.

and unclear documentation should be assumed to be wrong and be rejected by the DOEs.

3.2.1.3 Qualitative Assessment

A straightforward investment analysis is not the most suitable assessment, when financial motives do not (fully) determine the baseline scenario. This is the case in most developing countries suffering from market distortions. The predominant factors are constraints that result in **barriers of implementation**.
Baumol et al. defines a barrier as the following:

> "… (A) barrier is an undefined object whose presence is to be judged only in terms of its undesirable consequences for social welfare."[129]

Barriers are a natural phenomenon of any market. But there are some barriers, which can cause **market failure**. These barriers indicate that the market does not allocate resources efficiently. However, market regulation is principally considered as the most successful way to guarantee high social welfare. That is why interventions have to be justified, i.e. they have to show that there is a market failure leading to undesirable results. Furthermore, the effects that intervention itself has on social welfare have to be studied.

The most prominent possible reasons for a market failure **in the model of perfect competition** are external effects, indivisibilities, lack in information and lack of adaptability.[130]

External effects lead to a mis-pricing of the relevant good or service resulting in over- or under-consumption.[131] There can be negative externalities such as air pollution and positive externalities such as experience, a public good, gained through research and development activities. **Indivisibilities** can create a barrier to entry for small investors, which cannot reach the optimal business size. A **lack in information** and a **lack of adaptability** are, in the model of perfect competition, no reason for market failure. Asymmetric information can be overcome by screening and signalling activities.

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[129] Baumol, William J. / Panzar, John C. / Willig, Robert D. (1988), p. 5
[130] See Fritsch, Michael (1993), p. 1
[131] See Golove, William H. / Eto, Joseph H. (1996), p. 18

Innovations are generally fraught with a high risk of failure. The risk aversion is reflected in the investor's discount rate. Still, a high discount rate does not automatically indicate a market failure.[132] It is not possible to determine that an investor's attitude is "too risk averse", as neither an "optimal risk aversion" nor an "optimal rate of innovation" can be defined objectively. This judgement would be a pretension of knowledge.

However, in a market with **imperfect competition**, the bargaining power of the players is not equally distributed[133]. Players with strong bargaining power are likely to behave in their self-interest and to exploit the advantages.

The **nirvana fallacy**[134] argues that the conditions of the model of perfect competition do not apply to real markets, because perfect competition is an unobtainable ideal. Nevertheless, they give a good orientation for further analysis of situations under imperfect competition.

Arrow[135] recommends relaying further on the concept of transaction costs. Prohibitive transaction costs can impede a market to work properly. For example, in developing countries, especially in least developed countries[136], factor immobility poses big problems. Geographical and occupational immobility of labour causes unemployment and productive inefficiency. In addition, the access to financial resources is often limited, which inhibits investments. Those market barriers can result in an exclusion of people on low income from financial resources, but also from essential goods and opportunities (food, clothing, housing, and education).

The consequence is to examine, if the proposed interventions actually represent the second-best-strategy to overcome the market imperfection and if they can compromise other public or social values.
It has to be tested, whether the intervention

- is based on a pretension of knowledge,
- is efficient,
- is close to the market,

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132 See Golove, William H. / Eto, Joseph H. (1996), p. 8

133 See Golove, William H. / Eto, Joseph H. (1996), p. 19

134 See Demsetz, Harold (1969); see Fritsch, Michael / Wein, Thomas / Ewers, Hans-Jürgen (2003), p. 64ff.

135 See Arrow, Kenneth J. (1969), pp. 59-73

136 See Greiner, Sandra / Michaelowa, Axel (2003)

- helps enhancing competition and
- is sustainable.

The CDM is no typical governmental intervention, but has a similar effect like a subsidy. Project activities which generate additional emission reductions get a supplemental income from the issuance of the CERs. The detailed additionality assessment of the CDM tries to prevent a pretension of knowledge. Nevertheless, it is not possible to analyse all eventual direct and indirect discrimination effects on other activities (e.g. the assessment of sustainability). The efficiency of the CDM depends on its scope and the cost of its structure. By using the project-by-project approach, the CDM is very close to the market, the PPs being fully responsible of their project. In the rubric "how to overcome" the barriers, it is demonstrated how the CDM enhances competition and reduces market imperfection. The sustainability of the project activity has to be guaranteed by the host country and is not explicitly controlled.

In the following, the barriers for a qualitative additionality assessment used in the chosen methodologies will be discussed. Yet, it is not possible to measure the effect a barrier will have on the additionality of the concrete project activity. Therefore, this aspect has to be addressed argumentatively by the PPs in the PDD. This is why the rubric of **"how to overcome"** the mentioned barriers is indispensable for a good methodology. The PPs have to show ex-post, how exactly the additional income from the CERs helped them to overcome the assumed barriers.[137] Although, this is not a guarantee for a correct barrier analysis, the more concrete the analysis becomes, the more difficult it is for the PPs to cheat.

Barriers can be put into three main groups: **structural barriers, institutional barriers** and **strategic barriers**.[138]

Six barriers could be defined as **structural barriers**.
Three of the market barriers, which are identified by the methodologies, can be suspected to cause market failure: the barrier to investment (i.e. a lack of financial resources because of indivisibilities), the barrier due to limited information and the barrier due to political gaming.

[137] See Langrock, Thomas (2004); see Greiner, Sandra / Michaelowa, Axel (2003), p. 21
[138] See Wied-Nebbeling, Susanne (2004), p. 8-12

1. Barrier to investment: If financial resources are badly accessible to small investors, the necessary resources can quickly exceed the investor's potential. Such a barrier to investment would not be accepted if the additionality assessment would refer to a macro-level. Other investors disposing of more resources would employ the project, if it was attractive.

2. Barrier due to limited information: This barrier, under perfect competition, is rejected for not being sound and strong enough. However, empirically, imperfect information[139] is a prominent barrier under imperfect competition, above all in developing countries, because information is a very costly good. This is consistent with the concept of bounded rationality.[140]

3. Barrier due to political gaming: The implementation of a project activity can be prevented because of a lack of political feasibility or because of unequally distributed political bargaining power.

Further on, the methodologies use three other criteria, which refer to very similar concepts:

4. Technology barrier

5. Barrier due to prevailing practice

6. Not common practice

The technology barrier states that a certain clean technology has no chance to be introduced to the market. The reason is that the technology has never or seldom been applied in the country before. That is to say, it has a very small market share. There, the technology barrier touches the barrier due to prevailing practice, which states that a new technology has no chance on the market because the technology in place is dominant. The new technology that is "not common practice" involves a higher risk. To be more specific, a lack in qualified labour, in experience and capacity may be the underlying reasons. Altogether, this makes the project economically unattractive.

On a working market, these barriers can be overcome, if the project itself is worthwhile, as it will attract the necessary resources to the country. But in many developing countries this is not the case. For example, for reasons like the low standard of living or political disturbances, qualified labour is not willing to move there. Not all developing

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[139] See Golove, William H. / Eto, Joseph H. (1996), p. 5

[140] See Simon, Herbert A. (1957)

countries are affected equally by these difficulties. There are e.g. Latin-American countries, which still attract qualified labour, capital and companies, whereas many African countries face far more severe problems.

However, using terms like “technology barrier”, “barrier due to prevailing practice” and “not common practice”, another interpretation comes up. The fact that technologically feasible innovations are not directly implemented could be interpreted as being a signal for a barrier. But this would be a technocratic interpretation.[141] An innovation can establish itself in a working market, if the whole product bundle is convincing. It is not enough to only look at the technical component and at what is environmentally feasible.[142] Innovations that do not satisfy the consumer under all aspects of the whole product bundle are, in the end, not competitive enough and therefore, are not worth being promoted by the CDM.

In order to create a transparent methodology and to prevent wrong interpretations of ambiguous terms, it would be better to subsume the real underlying disadvantages, such as the lack of qualified labour, the lack of experience and capacity, directly under the structural barriers. Then, there will be no misunderstandings and above all the least developed countries (LDC) will be credible in putting forward these barriers. Above all, it cannot be in the interest of a clear additionality assessment to inflate one and the same disadvantage by listing it under three different categories. Additionality assessment procedures need to be as clear and unambiguous as possible.

If the PPs would instead use the criterion “common practice” in a different context, i.e. in order to determine the baseline, it could be useful: Taking as an example a village, that is only equipped to generate electricity by using diesel for 3 hours per day, whereas all neighbour villages already have electricity 24 hours a day. To determine the baseline correctly, the question is, if the 3 hours a day of diesel technology should be considered as the baseline scenario or, if the 24 hours a day should be viewed as “common practice”. In this case – just for baseline determination – the concept of “common practice” is justified.[143]

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[141] See Schulz, Walter (2002), p. 55ff.
[142] See Golove, William H. / Eto, Joseph H. (1996), p. 18
[143] See Netto, Maria (2003)

Institutional barriers:

The only institutional barriers addressed are the **policies and regulations**. They can influence market transactions in diverse directions. Some policies create political market distortions, whereas others remove them. Regulations can reduce negative environmental externalities and/or enhance energy conservation. They can also help less emission intensive technologies to get a competitive advantage over more emission intensive technologies, like the CDM does.

So far, it is not yet possible to say, if the CDM will get a high participation and an important role for reaching mitigation commitments. But if it will, even the existence of the CDM itself could have an impact on the baseline[144]. For example, it could slow down policies in favour of low-carbon technologies in developing countries. By putting an environmentally friendly policy into practice, a government would diminish its chances for getting CDM project activities accepted. Depending on the scope the CDM will get, it could have negative drawbacks on national policies.

However this will only become a problem, if the CDM reaches a high importance in the market. Then, a special regulation would become necessary. In order not to destroy the incentive for the implementation of a national policy, three possible solutions are available:

The first possibility is that the project developer only gets the credits from the CDM (if the national subsidy is higher than the income from the CDM credits, the project developer could get paid out the remaining part of the subsidy). The second possibility is that the project activity is not accepted under the CDM because of an existing policy, but this could destroy the incentive to put the new policy into practice. The third possibility is that the project developer gets a portion of the CDM credits and a portion of the national subsidy, but this is difficult to put it into practice.

In any case, an over-promotion has to be prevented, as this would be likely to create wrong incentives. But until the CDM manages to get such a strong influence, the effects on local policies will be negligible.

Strategic barriers

The only strategic barriers, the methodologies deal with, are company related barriers such as corporate decision-making criteria and opportunity costs, managerial resources,

[144] See Discussion during Meth Panel 8 (2003)

financial resources and capacity e.g. organisational capacity and capacity to absorb new technologies. However, these barriers mentioned in the methodologies will always exist and as they belong to any market, they cannot be accepted as barriers that indicate a market failure.

On the contrary, the underlying barriers like investment barriers and information barriers have to be named openly. If these constraints are already exposed under the structural barriers, they should not be quoted again under a different name. This would lead to an inflation of the additionality assessment, while it is the objective to keep the methodology slim and clearly arranged.

In addition to this general evaluation, further research on how important which barriers are is indispensable.

3.2.1.4 Quantitative versus Qualitative Criteria

At a first glance, one could think that quantitative criteria are more objective. But they are not by definition more reliable than qualitative criteria. While some data can be checked using market information, company-specific information is difficult to evaluate. Financial data can be manipulated so that even the DOEs cannot make it out. There will always be some risk of tropical air and there will be no way to achieve 100% accuracy.

3.2.1.5 Boundaries, Leakage and Uncertainties

Boundaries

More guidance is needed for the setting of the boundaries and the inclusion or exclusion of emissions or emission reductions. Some methodologies (e.g. NM0001) directly state that some emissions are negligible and therefore not included; whereas others (e.g. NM0030) leave the decision open to the project developer. It would be better to proceed like it has been done in NM0027, fixing the concrete threshold and then explaining, why which emission has been included or excluded. Thereby the methodology is becoming clearer and easier to apply under different project conditions.

In general, an approach explaining under which conditions what decision has to be taken is more useful than project specific pre-determined decisions. For example, NM0035 is a bit more open to other project types including considerations for hydroelectric projects (land inundation), which is a good step into the direction of comprehensive methodologies.

Leakage

Resulting from the definition of the boundaries, leakage, too, is very project specific. It may cover a variety of effects, e.g. electricity used from the grid, competitive effects (supply of biomass), emissions due to transportation or industry shifting from one country to another. Some types of leakage, e.g. the tight supply of biomass, can be standardized for biomass project activities. As it will always remain a problem to quantify the portion, which should be deducted from the calculated emission reductions, a standard percentage should be fixed. This will eventually reduce accuracy, but a case by case determination of the percentage may cause high transaction costs. In time, accuracy can increase through advances in knowledge and more experience. Subsequently, for the second crediting period, the proposal made by Geres and Michaelowa[145] to create a **leakage matrix** opposing possible kinds of leakage to different project types, could be put into practice. The correction factors would then be determined by independent experts and adopted by the EB. Geres and Michaelowa point out that it is not the aim of this method to lead to a perfect theoretical evaluation of the leakage, but to create an incentive for the project developer to keep negative leakage effects small.

Uncertainties

No single baseline can be considered as being perfect because of the inherent uncertainty. The following types of baseline uncertainty can be distinguished[146]:

- project performance uncertainty, which relates to uncertainty about the activity level of the project over the crediting lifetime,
- measurement uncertainty, which relates to uncertainty about the quality of the data (e.g. how well is output measured?),
- counterfactual uncertainty, which deals with the fact that the baseline is hypothetical and thus by definition unknown; and
- background uncertainty, which relates to a range of possible external factors such as economic growth, international prices of oil and gas, national policies, legislation and international political developments.

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145 See Geres, Roland / Michaelowa, Axel (2002), p. 8

146 See Report of the Workshop on Baselines for JI and CDM projects (2003), Katherine Begg, p. 9

3.2.1.6 Emission Reductions: which approach to choose?

The strength of the CM methodology is its simplicity, robustness and comprehensiveness. There is only a limited quantity of data necessary, which may be procured without difficulties in most cases[147]. It is **applicable to most electricity-to-the-grid project activities**, as the proceeding is very standardized (there is a potential for multi-project baselines), and at the same time, the results are very project specific. Basing the calculations on the default CM, it is possible that future standardized emission factors can be developed for different regions in order to create multi-project baselines. It is appropriate to take the CM as a default method[148] consisting of:

- the **OM**, which would be the generation weighted average without zero-emission, low-cost and must-run resources, and the **BM**, which would be, for the first crediting period (7 or 10 years), the outcome of a generation weighted average of the 20% recently built or 5 most recent projects.
- For eventually following crediting periods, only the BM, calculated using new construction data, would be taken as the baseline.

During the first years after implementation of the project activity, the OM is more important for the calculation of the emission factors, because the system only rebounds with a delay. Later, the BM becomes more relevant. Therefore, at the beginning, emphasis should be placed on the OM and at the end emphasis should be placed on the BM. This scheme is applied by the default CM method in the case of a renewable crediting period.

However, the appropriateness of a method applied is depended on two components:

- the type of project activity and
- the kind of interconnected grid system.

For a technology that replaces peak load, another calculation method should be applied, than for must-run (e.g. hydro) or volatile (e.g. solar and wind) technologies. Concerning the type of grid, project activities may encounter very different conditions: for example

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147 See Lazarus, Michael / Kartha, Sivan / Bosi, Martina (2002): p. 44: “As demonstrated by the CERUPT methodology in use for small-scale projects, the data for an approach like this are readily available and the calculations are straightforward (CERUPT, 2001, volume 2c).”

148 See Lazarus, Michael / Kartha, Sivan / Bosi, Martina (2002): p. 44; see Bosi, Martina / Laurence, Amy (2002), p. 37

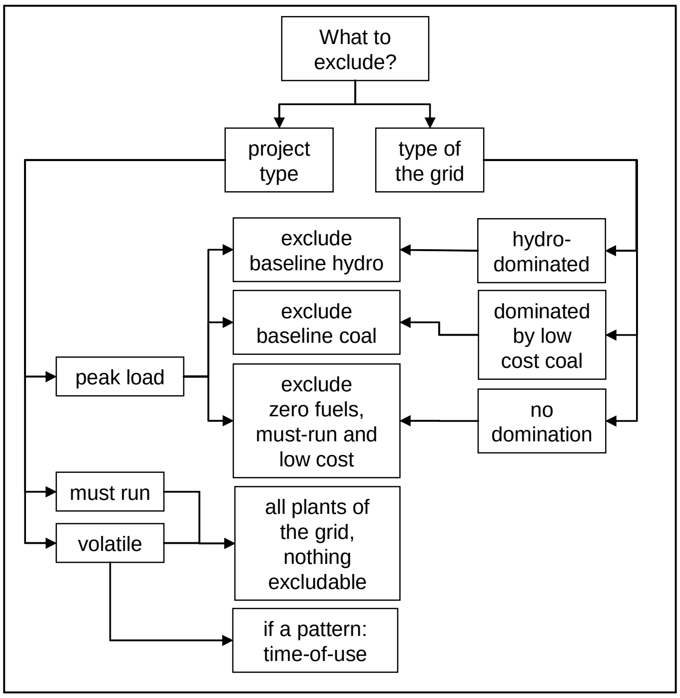
Brazil has a hydro-dominated grid, whereas South-Africa has a coal dominated grid and even has an excess supply.

For a technology displacing peak load, the emission factor does not need to include the base load sources, however, including those sources does make the estimate more conservative. Nevertheless, if the grid is dominated by a special technology, it has to be proved, which part of it belongs to the base load and which part covers the shoulders of the load curve.

On the contrary, if a must-run or volatile technology is implemented, it cannot be assumed that only peak load is displaced. It is not conservative to exclude must-run, low-cost and zero-emission fuels. If, in the case of the volatile technology, there is a distinguishable pattern, eventually some sources can be excluded during certain seasons. This pattern can be revealed by a time-of-use analysis. However, this analysis is costly and labour intensive.

The relationships between the type of project activity and the type of grid are illustrated in Figure 10.

Figure 10: Exclusion of Sources from the Calculation of Emission Reductions



By using the proposed default CM method, **hydro-dominated grids** would tend to over-estimate baseline emissions. First, a **threshold** has to be defined, which percentage of

hydro-electric generation has to be reached in the grid mix (e.g. > 50%) to consider a grid being hydro-dominated. In a hydro-dominated grid, **only base load** hydro-electric sources may be excluded for conservatism.
On the contrary, in a grid that is **dominated by a cheap fossil fuel** (e.g. South Africa), it might be necessary to exclude the fossil fuel used as a must-run to cover the base load, if it is not displaced e.g. by the project activity itself being a must-run.

The **Dispatch Model** can only be used, when the large amount of data is available at affordable costs, e.g. for a grid owner, who, in any case, has to monitor the grid mix.

The **System Average Approach** is suitable for special project activities. The smaller the differences between the carbon intensities of the fuels used in the grid, the smaller the differences between the marginal approach and the average approach are.

The South African case (NM0010) is an ideal example where the grid average over all plants is conservative. In addition to the criterion of the carbon intensities, NM0010 lists the following three criteria:

- the project activity is a **must-run capacity** affecting the whole supply mix (therefore average over all plants),
- the project activity's **contribution** to the grid is **very small** (would only delay and not displace eventual projects, therefore has only small impact on BM), and
- there is **overcapacity** in the grid (no significant impact on BM).

The BM is difficult to calculate in the case of overcapacity. The question has to be addressed, if the last 5 constructed plants or the last 20% of installed capacity are a plausible approach for future investments, or if forecasted data would be more reliable. There is also another question in reference to the weighting, because a 50/50 weighting of the OM and the BM could be inadequate for a system with overcapacity. The System Average Approach avoids these difficulties.

Referring to the other proposals made, the following conclusions can be drawn:
Lazarus, Kartha and Bosi state[149] that any project activity, even if it is very small, has an impact on the BM. Yet, for the sake of simplicity, a project activity may only use **the OM**, if there is overcapacity in the grid and the project activity's impact on the grid is

[149] See Lazarus, Michael / Kartha, Sivan / Bosi, Martina (2002): p. 33 and p. 38

minimal (e.g. < 1%). On the contrary, the proposal to only use **the BM**, because other power plants would have been added to the grid, is not logical, because any project has an impact on the current grid mix. The OM cannot be neglected just because the project activity displaces new green field projects instead of only delaying them.

MCMM: This method tries to overcome the inaccuracies in BM determination due to the historical and current data used in the default CM. The MCMM establishes the BM on forecasted data. Depending on the kind of grid, this can be a reasonable solution. However, it has to be examined, if calculations should exclusively be based on ex-ante forecasted data, or if, in addition, ex-post data should be monitored.

In general, should the methodologies use **ex-ante or ex-post** data? It is correct that the ex-post baseline calculation is contradictory to the definition of the baseline. But the overwhelming Principal Agent Problem suggests, for the sake of conservatism, to monitor ex-post data and then, to choose between the ex-ante and the ex-post value the lower one.

3.2.2 Alternatives to the Present Proceeding

3.2.2.1 Auction

Alternatively to the bottom-up process chosen by the UNFCCC, governments could decide to invite tenders for the implementation of GHG mitigation projects. The contract would be awarded to the most cost-efficient offer.

However, two difficulties may occur: Governments, the same as individuals, do not act under perfect and complete information, and can err in their interpretation of situations. Under this conditions, it cannot be guaranteed, that governments choose the most cost-effective offer. In addition to sub-optimal decisions due to limited information, governments do not necessarily behave like a “benevolent dictator”. On the contrary, they can be corrupt. The integrity of governments is not always a foregone conclusion, neither in industrial countries with democratic systems nor in developing countries, where the educational level is low and where political disturbances are frequent.

This leads to the conclusion that an auction does not principally lead to better solutions than the approach chosen by the UNFCCC.

3.2.2.2 Benchmark

As discussed before in section 2.2.2.4, an aggregated approach opens a way to cost reduction. However, a benchmark’s outcome is relatively uncertain referring to the level of accuracy. A benchmark reduces the additionality assessment to its intensity dimension. Therefore, it has been rejected by the UNFCCC, which instead decided to apply the project-by-project approach providing a higher accuracy.

3.2.2.3 Lax Additionality Testing

The costs that accrue to the PPs may be reduced by softening the additionality assessment. The outcome of such an assessment would be that nearly all proposed new project activities would be considered additional. Yet, this would most probably lead to an under-achievement of the Kyoto targets because of wide-ranging free riding. As Non-Annex I countries are not obliged to establish inventories, the real quantity in GHG mitigation would become a matter of faith. The Annex I countries would transfer most of their emission reduction activities to Non-Annex I countries, because of the low costs for emission reductions there. A lax additionality assessment could lead to a race to the bottom of the certificate’s price and thereby threaten the survival of the CDM.

3.2.2.4 Heavy Bureaucratic Additionality Testing

At a first glance, a very strict additionality testing appears to be the best choice to eliminate free riders. Yet, as explained in section 2.2.2.3, Grubb’s paradox shows that, under such an assessment, the least cost-effective projects are likely to be promoted and not those at the margin. However, if the market was working, the projects at the margin, which are more efficient, would be the next to be implemented. These projects are worth being promoted, whereas inefficient and ineffective projects should not be further subsidized.

Apart from that, a very complex and expensive assessment keeps the number of submitted projects low. The high transaction costs of the bottom-up process can then only be distributed on a small number of projects, which results in high costs per project activity. This shows that, due to the low participation, the entire CDM could fail under this very strict and costly assessment.

It is difficult to determine exactly the point at which the assessment is getting too strict. Therefore, during the first implementation phase, it will probably become necessary to adapt the severity of the assessment according to actual participation and transaction costs.

3.2.2.5 Recommendations

It cannot definitively be said if an auction or a benchmark would deliver better results than the chosen bottom-up project-by-project approach. However, it has been shown that neither the lax additionality testing nor the heavy bureaucracy is a positive alternative. Therefore, a simplified additionality assessment is recommendable, which gives guidance to the PPs in order to assure the quality of assessment and, at the same time, reduces costs through standardization.

3.2.3 Simplified Proceeding

A good methodology should be drafted to lead to the optimum in the trade off between the elimination of free rider effects, low transaction costs and a high participation in the CDM.

A small quantity of free riders may be tolerable, as free rider effects can be offset by free driver effects. Yet, free driver effects are not measurable. The consequence is that it can only be estimated, how much free riding is acceptable without threatening the implementation of the Kyoto targets.

In order to achieve high participation and low transaction costs, it is necessary to establish clear, simple and well accepted criteria for additionality assessment and to cut the structural costs rigorously by standardising the proceeding.

The methodology should demand a certain effort from the PPs. Free riders, who are not willing to make this effort, will be directly turned off. In addition, most of the impudent free riders will not pass the assessment, as all information will be made publicly available, plus the DOEs control the credibility of all data and statements. Nevertheless, some free riders will always be unrecognized. If the negative effect of those free riders is more than compensated by the free driver effects, it is not detrimental to the achievement of the Kyoto targets. The occurrence of free driving, due to a change in public perception, becomes more probable, when there is a higher level of participation in the CDM.

Resuming the results of the comparison of the chosen methodologies, simplified decision trees for methane recovery and electricity generation have been created. The outcome of the analysis is presented in the following synopsis:

The baseline determination, the first part of the analysis, is shown in Figure 11. The two possible ways of approaching the question (scenario analysis or series of questions) are indicated. Whereas a scenario analysis can be undertaken by applying quantitative and/or qualitative criteria, the series of questions imply a behavioural model. Both proceedings lead to the most probable baseline scenario. The output of this first step of the analysis is that there are only two plausible scenarios left: the baseline and the project activity under the CDM.

Figure 11: Baseline Selection Procedure

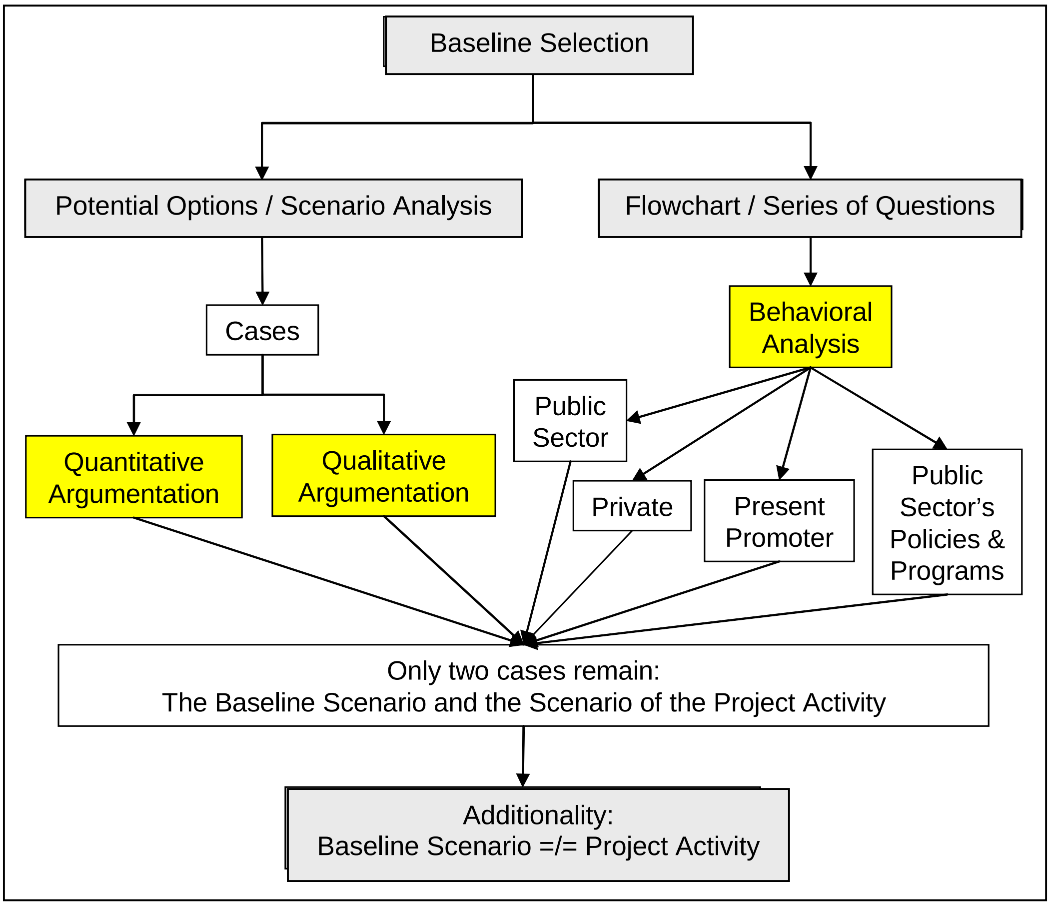
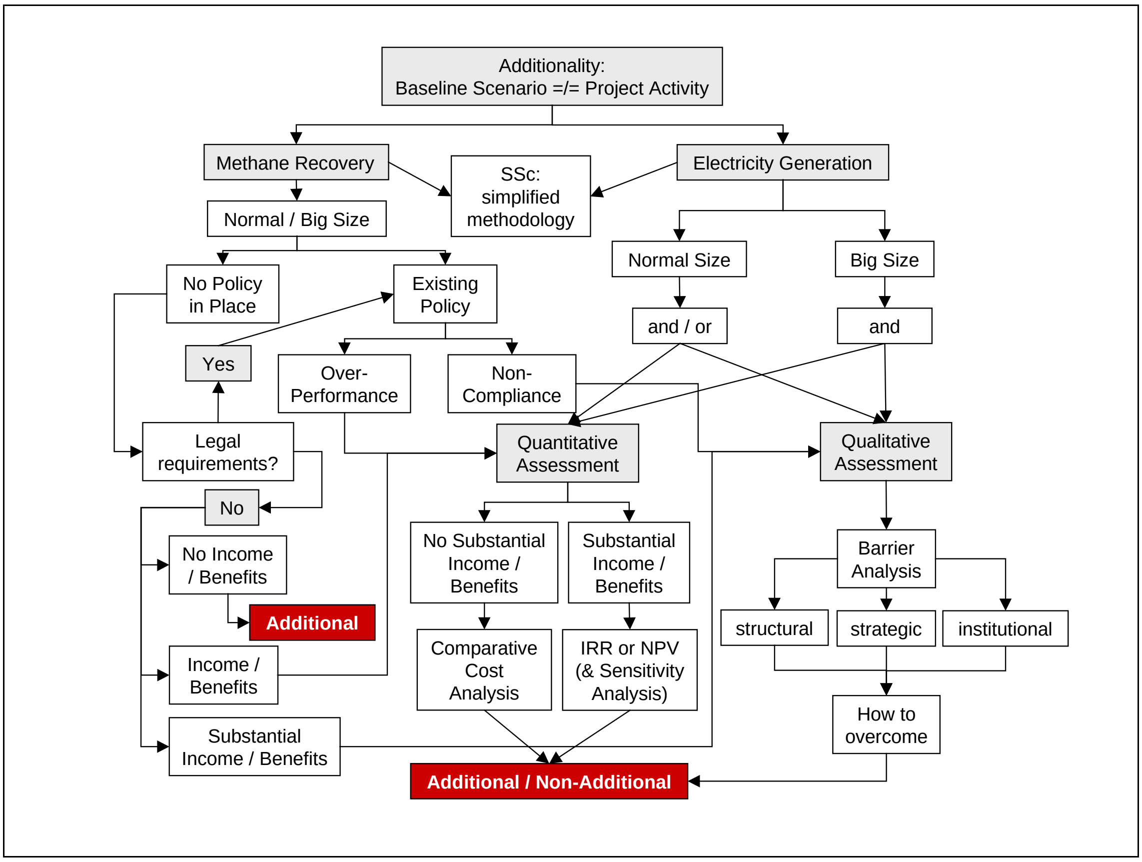


Figure 12 then deals with the additionality assessment. The procedures for "methane recovery" and "electricity generation" show some similarities, but differ in other points.

Figure 12: Additionality Assessment Procedures



In both cases, the first step refers to the project activity's size. For small scale project activities, there are simplified methodologies available in order to cut transaction costs, which are prohibitive for projects with little financial capacity.

In the case of "electricity generation", project activities of a normal size (to be defined by the EB in relation to the national grid) can apply as thought appropriate

- a quantitative assessment, applying a comparative cost analysis or, in the case of substantial income or other benefits, an IRR or NPV analysis and/or
- a qualitative assessment of the barriers of implementation and how to overcome them.

However, big project activities (the concrete size to be defined) are obliged to rigorously address both the quantitative and the qualitative assessment because of the important impact of the project activity on the grid.

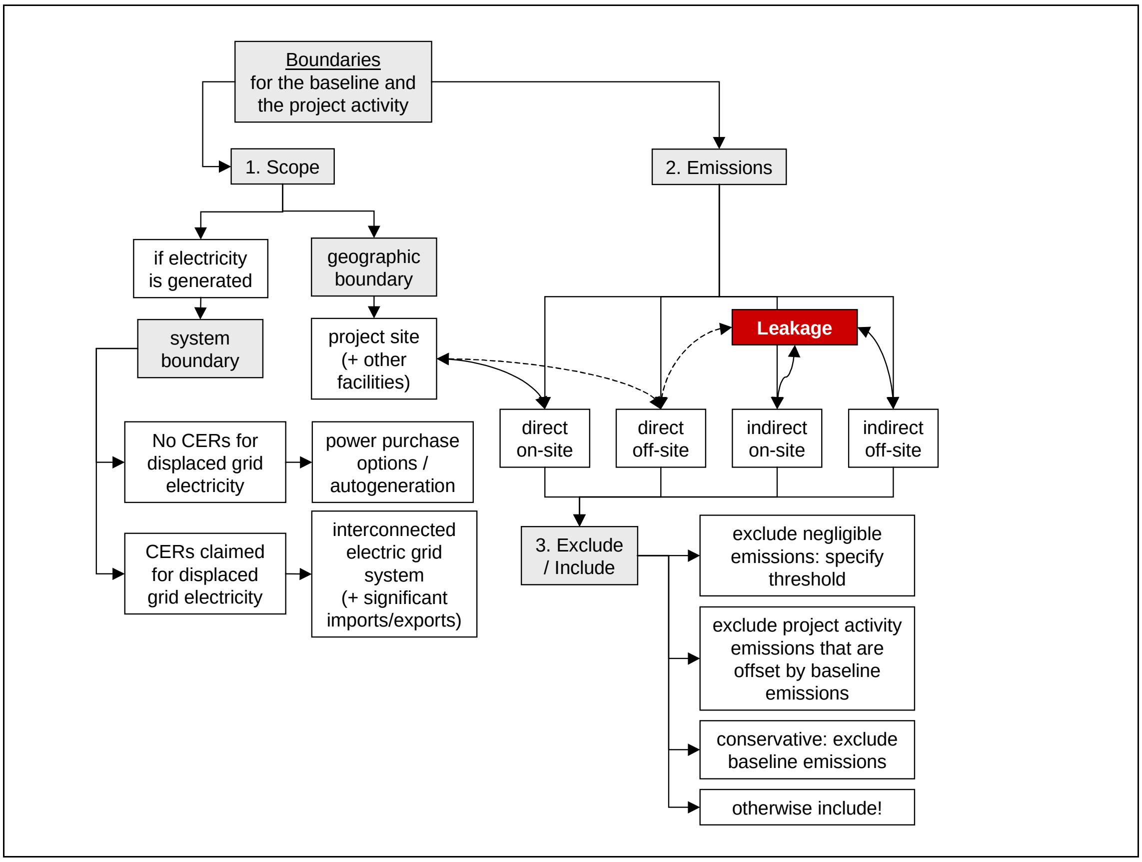
In the case of “methane recovery”, the next step is the differentiation between project activities with policies in place and without.

If the PPs state that there is no policy in place, there is still a rebound mechanism, where they have to expose all relevant legal requirements. If no legal requirements can be identified through this test, additionality will be determined following the income or other benefits created through the project activity. If there is no income or other benefits generated, the project is assumed to be additional. On the contrary, if the project activity yields income or other benefits, a quantitative assessment (IRR or NPV) has to be undertaken. If the project activity is not the economically most attractive course of action, it is assumed to be additional. However, if the income or benefits created are substantial, a qualitative assessment has to be carried out in addition to the quantitative assessment.

In the case of a policy in place, it has to be differentiated between over-performance by the project developer or non-compliance in the country. In the first case, a quantitative analysis has to follow, whereas in the second case, a qualitative analysis is appropriate.

In Figure 13, the setting of the boundaries is illustrated. First, the scope of the boundary has to be determined. The boundary consists of a geographic boundary and, if electricity is generated, a system boundary. The geographic boundary includes the project site and eventually other affected facilities. The system boundary includes the different power purchase options and eventual autogeneration options if no CERs are claimed for displaced grid electricity. In contrast, if CERs are claimed for displaced grid electricity, the system boundary covers the interconnected electricity grid system including only significant imports and exports. As a second step, the emissions occurring have to be specified and put into the categories direct on-site or off-site emissions and indirect on-site or off-site emissions. Direct on-site emissions are always considered as being inside the boundary. Indirect emissions are considered as leakage. Direct off-site emissions can either be included into the boundary or have to be considered as leakage. Here, further guidance is needed from the EB. As a last step, it has to be decided, which emissions are finally included into the calculation of emission reductions. Negligible emissions can be excluded for the sake of simplicity. Project emissions can be excluded if they are offset by baseline emissions. Baseline emissions can always be excluded, as this makes the estimate more conservative. In all other cases, the emissions have to be included.

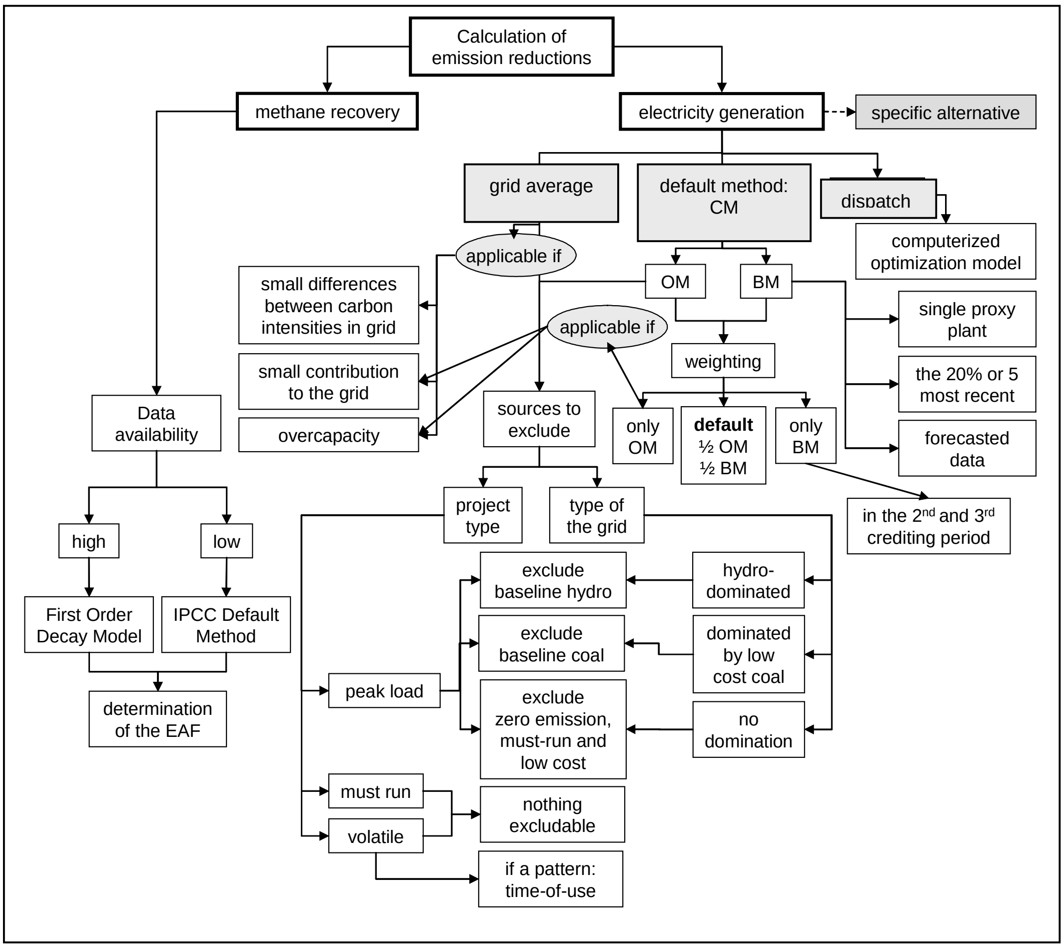
Figure 13: Boundaries for the Baseline and the Project Acivity



Finally, Figure 14 gives a synoptic overview on the methods to calculate the emission reductions achieved by the project activity. In the case of methane reduction, the choice of the appropriate model is very clear, only depending on the data availability: with sufficient data available, the First Order Decay Model is chosen, and under limited data availability, the IPCC Default Method has to be chosen. Lastly, the correction factor for the estimate of baseline efficiency, the Efficiency Adjustment Factor, has to be determined. Then, the CERs are able to be calculated.

In the case of electricity generation, the procedure for selecting an appropriate method is more complex. Principally, the Combined Margin (CM) is taken as the default method, if there is not one specific alternative to be displaced by the project activity. If the project developer disposes of the data needed to conduct a dispatch analysis, he is very welcome to use this accurate method. Instead of the CM, the grid average may only be chosen under specific conditions: In order to make the result of the average method come close to the results of a marginal method, the differences of the carbon intensities in the grid have to be relatively small. Further, the contribution of the project activity to the grid should be small and the grid should be characterised by overcapacity. This is to ensure that the impact on green field projects is, for the sake of simplicity, negligible.

Figure 14: Methods for the Calculation of Emission Reductions



The Combined Margin consists of the Operational Margin (OM) and the Build Margin (BM) weighted equally. For the sake of simplicity, exclusively the OM may be taken in the case of a small contribution of the project activity to a grid with overcapacity. For a second or third crediting period, exclusively the BM may be used.

From the calculation of the OM resp. the grid average, sources may be excluded following the project type and the type of grid, as illustrated in the decision tree and for the reasons explained in section 3.2.1.2. The calculation of the BM can either be based on a single proxy plant, on recent capacity additions (the 20% or 5 most recent) or on forecasted data.

4. CONCLUSION AND OUTLOOK

The objective of this paper was to identify critical issues of the additionality assessment of CDM methodologies. Therefore, a comparative analysis of chosen methodologies was carried out, which led to the following conclusions:

There is a standardisation potential of some baseline parameters: The reference technology (i.e. the technology currently implemented in the country) as well as the national policies and regulations are country specific and can get standardised. The calculation of the emission reductions has both technology and country specific elements, which can be represented as variables in a general calculation model.

The additionality assessment may be further simplified: More guidance is needed concerning the quantitative and qualitative tools. It has to be specified under what conditions which quantitative indicator is applicable. The qualitative analysis needs more simplicity and clarity which can be achieved by reducing the test to the decisive barriers.

Furthermore, it has been shown that the cheating of the PPs is not entirely avoidable: Quantitative indicators may be manipulated by varying the lifetime, the discount rate or the overheads allocation rates in the calculation. Quantitative indicators do no better. The existence of market barriers and their influence on the project activity is difficult to measure, since the estimation is very subjective and difficult to prove. The PPs' argumentation can become more reliable, if they concretely and in detail show exactly how the CDM helps them to overcome the barriers, e.g. by listing the costs a barrier creates to them, and how these are covered by the credits from the CDM.

In effect, a methodology only can establish, how the PPs have to proceed, i.e. which steps they have to complete. But the real control lies in the hands of the DOEs getting insight into detailed documentation during the validation and verification activities.

Most of the analysed methodologies already meet high demands regarding their additionality assessment. Therefore, the priority now should be to consolidate the methodologies, to enhance the participation and to reduce the structural costs of the CDM.

Participation can be enhanced through clear and simple guidelines giving more guidance to the PPs. By disposing of simplified and cost-effective methodologies, the PPs will encounter fewer difficulties in submitting their project activity.

Especially the first stage of the CDM will be essential for gathering experience on the concrete project activities. In the longer run, costs may be reduced through further standardization based on the experience gained from the first project activities implemented.

It would be a great achievement to create conservative multi-project baselines, for example by constructing a project type matrix with standardised emission factors as proposed by Michaelowa[150], differentiating between the host countries. At this point, the stage of multi-project baselines would be reached. The up-front costs of developing this matrix and the costs arising during the project activity cycle to the PPs are relatively low.

The destiny of the CDM is still vague, not only because of its shortcomings, but also because of the uncertain future of the entire Kyoto Protocol. Scenarios range from a collapsing CDM to a working mechanism that helps to reduce the mitigation costs, reach the emission targets of the Kyoto Protocol and enhance sustainable development in developing countries.[151] The recommendations made in this paper aim at creating methodologies which are cost-efficient and accurate enough to make the CDM workable.

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150 See Michaelowa (1999), p. 14

151 See Grubb, Michael et al. (2003), p. 1

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ANNEX

Annex 1: List of the COPs

COP1	Berlin, 1995
COP2	Geneva, 1996
COP3	Kyoto, 1997
COP4	Buenos Aires, 1998
COP5	Bonn, 1999
COP6	The Hague, 2000
COP6II	Bonn, 2000
COP7	Marrakesh, 2001
COP8	New Delhi, 2002
COP9	Milan, 2003

Annex 2: Table showing the global warming potential of the greenhouse gases relative to carbon dioxide

Comparison of 100-Year GWP Estimates from the IPCC's Second (1996) and Third (2001) Assessment Reports		
Gas	**1996 IPCC GWP**	**2001 IPCC GWP**
Carbon Dioxide	1	1
Methane	21	23
Nitrous Oxide	310	296
HFC-23	11,700	12,000
HFC-125	2,800	3,400
HFC-134a	1,300	1,300
HFC-143a	3,800	4,300
HFC-152a	140	120
HFC-227ea	2,900	3,500
HFC-236fa	6,300	9,400
Perfluoromethane (CF_4)	6,500	5,700
Perfluoroethane (C_2F_6)	9,200	11,900
Sulfur Hexafluoride (SF_6)	23,900	22,200

Sources: Intergovernmental Panel on Climate Change (IPCC), “Climate Change 1995: The Science of Climate Change”, Cambridge University Press, Cambridge, UK, 1996, http://www.ipcc.ch/pub/reports.htm (2003-12-20).

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Annex 3: Annex I to the United Nations Framework Convention on Climate Change (UNFCCC)

(Differences to Annex B of the Kyoto Protocol printed in bold)

Australia
Austria
Belarus [a]
Belgium
Bulgaria [a]
Canada
Croatia [a]*
Czech Republic [a]*
Denmark
European Economic Community
Estonia [a]
Finland
France
Germany
Greece
Hungary [a]
Iceland
Italy
Japan
Latvia [a]
Liechtenstein *
Lithuania [a]
Luxembourg
Monaco *
Netherlands
New Zealand
Norway
Poland [a]
Portugal
Romania [a]
Russian Federation [a]
Slovakia [a]*
Slovenia [a]*
Spain
Sweden
Switzerland
Turkey
Ukraine [a]
United Kingdom of Great Britain and Northern Ireland
United States of America

a/ Countries that are undergoing the process of transition to a market economy.
* Countries added to Annex I by an amendment that entered into force on 13 August 1998, pursuant to decision 4/CP.3 adopted at COP3.

Annex 4: Annex B to the Kyoto Protocol

(Differences to Annex I to the UNFCCC printed in bold)

Australia
Austria
Belgium
Bulgaria [a/]
Canada
Croatia [a/]
Czech Republic [a/]
Denmark
Estonia [a/]
European Community
Finland
France
Germany
Greece
Hungary [a/]
Iceland
Ireland
Italy
Japan
Latvia [a/]
Liechtenstein
Lithuania [a/]
Luxembourg
Monaco
Netherlands
New Zealand
Norway
Poland [a/]
Portugal
Romania [a/]
Russian Federation [a/]
Slovakia [a/]
Slovenia [a/]
Spain
Sweden
Switzerland
Ukraine [a/]
United Kingdom of Great Britain and Northern Ireland
United States of America

[a/] Countries that are undergoing the process of transition to a market economy.

"The Parties included in Annex B may participate in emissions trading for the purposes of fulfilling their commitments under Article 3. Any such trading shall be supplemental

to domestic actions for the purpose of meeting quantified emission limitation and reduction commitments under that Article."
(Kyoto Protocol, Article 17)

Annex 5: Annex II to the United Nations Framework Convention on Climate Change (UNFCCC)

Australia
Austria
Belgium
Canada
Denmark
European Economic Community
Finland
France
Germany
Greece
Iceland
Ireland
Italy
Japan
Luxembourg
Netherlands
New Zealand
Norway
Portugal
Spain
Sweden
Switzerland
Turkey
United Kingdom of Great Britain and Northern Ireland
United States of America

"The developed country Parties and other developed Parties included in Annex II shall provide new and additional financial resources to meet the agreed full costs incurred by 14 developing country Parties in complying with their obligations under Article 12, paragraph 1. They shall also provide such financial resources, including for the transfer of technology, needed by the developing country Parties to meet the agreed full incremental costs of implementing measures that are covered by paragraph 1 of this Article and that are agreed between a developing country Party and the international entity or entities referred to in Article 11, in accordance with that Article. The implementation of these commitments shall take into account the need for adequacy and predictability in the flow of funds and the importance of appropriate burden sharing among the developed country Parties."
(UNFCCC, Article 4.3)