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**Research Report**

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# **The Clean Development Mechanism, Sustainable Development and its Assessment**

**Martin Burian**

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# **The Clean Development Mechanism, Sustainable Development and its Assessment**

**Martin Burian**

This report has been written during the author's stay at the Programme International Climate Policy of Hamburg Institute of International Economics in 2005.

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## **Executive Summary**

The Clean Development Mechanism (CDM), as established in the Kyoto Protocol needs to fulfill two objectives: First, it needs to contribute to the sustainable development of host countries to emission reduction activities. Second, it is designed to support countries facing emission targets in order to achieve their objectives in a cost efficient way. The question if the CDM succeeds in fulfilling both aims is inevitably bond to the establishment of a consistent framework ensuring sustainable development.

As established in the Marrakesh Accords, the CDM sustainable development framework consists of a local and a global stakeholder process as well as of the Letter of Approval (LoA). This thesis shows that the LoA does not ensure the achievement of sustainable development in all countries. This dilemma is created by a situation which forces host countries to compete for Foreign Direct Investments. In addition the stakeholder process is not always functioning properly. The local stakeholder process is not necessarily taking all preferences into account, either because not all locals are well informed or because local languages are not considered in the official process. On the other hand, Non Governmental Organizations (NGOs) often do not take advantage of the global stakeholder process. It must be concluded that the CDM's existing framework is not sufficient to guarantee the project's contribution to the host countries development.

A CDM market analysis demonstrates the dominance of non-renewable energy projects (85.3% of emission reductions generated), activities often not showing any other significant development impact than emission reductions, over renewable energy projects (14.7%). This puts the CDM, whose aim is to promote sustainable development, in a market situation marginalizing its development impacts.

Several reasons for generating such a development can be identified: First, gas capture and destruction projects, accounting for the overwhelming share of non-renewable energy projects, are financially attractive. Abatement costs per emission reduction certificate for e.g. hydrofluorcarbon projects, generating 22.5% of all certificates until 2012 are estimated to be as low as € 0.25, whereas prices for emission reduction certificates actually range from € 5 to € 10. But renewable energy projects not only suffer significant financial disadvantages, they also encounter difficulties in proving

additionality. Gas capture and destruction projects involve investment whose *only* return are emission reduction certificates whereas renewable energy projects, occurring with and without the CDM, have to differ from business as usual- renewable energy projects. Since gas capture and destruction projects depress prices for certificates, they diminish the renewable energy projects' potential to prove their additionality.

In the following, existing sustainable development assessments and one best practice approach with regard to their potential to assess CDM projects' contribution to sustainable development are analyzed. Among those, the Gold Standard has to be identified as a complete framework to ensure good development impacts.

An empirical analysis of selected hydro power CDM projects and a visit of the small scale Rio Blanco project activity demonstrate good development impacts of considered projects in general. Moreover 58% of all projects examined feature some kind of community development program.

In order to give a positive example, Honduras good development under the CDM has been analyzed; several reasons were identified: First there exists good data availability concerning greenhouse gas intensity of the national electricity grid facilitating the elaboration of baselines. Moreover a local NGO plays a major role by promoting renewable energy projects. Finally, Finland contributed significantly to the success of the Honduran CDM projects by forming a development partnership with local stakeholders whose outcome was a study pointing out opportunities for renewable CDM project activities.

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## **Abbreviations**

<b>€</b>	Euro
<b>US\$</b>	US Dollar
<b>AAU</b>	Assigned Amount Units
<b>AIJ</b>	Activities Implemented Jointly
<b>Annex I</b>	Member countries of the OECD in 1992, plus countries in transition
<b>Annex B</b>	Countries with binding emission reduction targets
<b>CDCF</b>	Clean Development Community Fund
<b>CDM</b>	Clean Development Mechanism
<b>CER</b>	Certified Emission Reduction
<b>CERUPT</b>	Certified Emission Reduction Unit Purchase Tender
<b>CIS</b>	Commonwealth of Independent States
<b>CO<sub>2</sub>e</b>	Carbon Dioxide and Equivalences measured in Carbon Dioxide
<b>CoP</b>	Conference of the Parties
<b>DNA</b>	Designated National Authority
<b>DOE</b>	Designated Operational Entity
<b>EIA</b>	Environmental Impact Assessment
<b>EMP</b>	Environmental Management Plan
<b>ERU</b>	Emission Reduction Units
<b>ERPA</b>	Emission Reduction Purchase Agreement
<b>FDI</b>	Foreign Direct Investment
<b>GDP</b>	Gross Domestic Product
<b>GHG</b>	Greenhouse Gas
<b>GS</b>	The Gold Standard

<b>GS-PDD</b>	Gold Standard Project Design Document
<b>GWh</b>	Giga Watt hours
<b>GWP</b>	Global Warming Potential
<b>ha</b>	hectare
<b>HFCs</b>	Hydrofluorcarbons
<b>IET</b>	International Emission Trading
<b>IETA</b>	International Emission Trading Association
<b>JI</b>	Joint Implementation
<b>LDC</b>	Least Developed Countries
<b>LFG</b>	Land Fill Gas
<b>LoA</b>	Letter of Approval
<b>MW</b>	Mega Watt
<b>N<sub>2</sub>O</b>	Nitrous Oxide
<b>NGO</b>	Non Governmental Organization
<b>NSC</b>	Normal Scale CDM Projects
<b>ODA</b>	Official Development Assistance
<b>OECD</b>	Organization for Economic Co-operation and Development
<b>PDD</b>	Project Design Document
<b>PRSP</b>	Poverty Reduction Strategy Paper
<b>ppm</b>	Parts per million
<b>RoR</b>	Run of the River hydro power projects
<b>SSC</b>	Small Scale CDM projects
<b>SSN</b>	South South North is a non-profit NGO engaging in capacity building
<b>UNFCCC</b>	United Nation Framework Convention on Climate Change

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### **A Note on this Work's Conception**

This work is part of a co-research project being planned, organized and conducted in cooperation with Dominik Schmitz. As this thesis and Schmitz' master thesis *Assessing the Sustainability of Hydro Power CDM Projects – Towards sustainable small scale Hydro Power* focus at related topics, both works refer to each other and employ each other's findings.

# 1. Introduction

As the Earth's atmosphere is one of most elementary factors of living, climate change is arguably among today's most prevalent problems.

Many of man's actions impact the Earth's climate: Fuel combustion, cement production and deforestation, but also the emission of nitrous oxide, hydrofluorcarbons and sulfurhexafluoride, exhibiting huge global warming potentials, have increased the prevalent concentration of greenhouse gases<sup>1</sup>. Most unfortunately, the increment of these components alters the physical and chemical functioning of the atmosphere leading to a negative feedback which increased global temperature by 0,6°C since late19<sup>th</sup> century (Hadley Center, 2005, see Figure 2).

Emerging from the growing awareness of global environmental problems and also taking into account that climate change needs to be tackled on a global scale, there has been a general recognition of the problem. This fact led to the founding of the United Nations Framework of Climate Change and its Kyoto Protocol. The Protocol, a multinational, binding framework to cap greenhouse gas emissions for industrialized countries also offers several instruments for cost efficient emission reductions.

One of those so called flexible mechanisms is the Clean Development Mechanism (CDM). The CDM creates emission reduction projects in developing countries, (co-) financed by industrialized countries, in order to help them to meet their emission target, as established by the Kyoto Protocol. As such, it turned out to be a powerful instrument for the achievement of industrialized countries' emission cap, attracting considerable amounts of investment. CDM projects currently under development will generate over 320 million of emission reduction certificates up to 2012 (see calculations in section 5.1.1) which satisfies about 29% of the overall need for emission reduction certificates estimated by Jotzo and Michaelowa (2005, 9).

Besides the topic of *Creating Real Emission Reductions*, there have been concerns about the CDM. One argument, stressed by developing countries, is that the CDM may exploit the financial attractive emission reduction potential of developing countries and

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<sup>1</sup>The concentration of carbon dioxide, the most abundant among all greenhouse gases, increased from 280 ppm in 1800 to over 370 ppm today (see Figure 3).

when those countries have to face emission targets on their own, as currently discussed, they would have to bear higher costs (Michaelowa, Dutschke, 2002, 5).

In order to react to these concerns, the CDM's first aim was defined as "to assist ... in achieving sustainable development" (UNFCCC, 1997, Art. 12.2). As section 3.3.4 shows, sustainable development in this context needs to be understood as a development impact – additional to greenhouse gases emissions.

The CDM was designed as a market mechanism and as it turned out in the last months, it is working as such. As an instrument, the CDM bears the potential to harness market forces to direct carbon intensive economies in so called developing countries towards sustainability.

From the very start of emission reduction activities under the United Nations Framework Convention on Climate Change there have always been reservations, whether the CDM will achieve its first goal. Several Non Governmental Organizations (The Gold Standard, 2002, 5f) stated that „the contribution to sustainable development (..) is often treated as an optional extra rather than a central feature of projects“. Also experiences gained so far raise the question whether the CDM actually creates carbon dioxide equivalents emission reductions *and* contributes to sustainable development.

But is that true? Do all CDM projects lack positive sustainable development impacts, or does this weakness just hamper a view of them? This leads to the question: Does the existing CDM framework guarantee sustainable development or does a structural dysfunction persist? To deal with these questions properly, in the present study following procedure has been chosen:

Chapter two operationalizes the concept of sustainable development and its assessment in the context of emission reduction projects. These subjects are discussed up to the identification of specific indicators in order to assess a project's development impact.

Chapter three deals shortly with anthropogenic climate change, the United Nations Framework Convention on Climate Change and its Kyoto Protocol in the light of market failure before turning to the Clean Development Mechanism. This section interprets the signification of sustainable development by employing two arguments; First, the origin of

the CDM in the context of climate policy is analyzed. Second, a scenario where the CDM does not show any sustainable development impacts is compared to a scenario where countries facing an emission cap deal with their target achievement on their own. Both arguments demonstrate that sustainable development needs to be understood as a positive development impact which is additional to greenhouse gas emission reduction.

Chapter four analyzes the CDM's framework with regard to the question if it *ensures* that projects contribute to sustainable development. Instruments that potentially could guarantee such an impact are the host country's approval, the stakeholder process and the monitoring framework. Must it be concluded that there does not exist a consistent requirement to ensure such a development?

Chapter five deals with sustainable development at the general level of project classes. All projects which are based on methodologies reducing greenhouse gas emissions through renewable energy sources will get aggregated. This CDM class renewable energy projects is supposed to have a high potential to create good development impacts. Those projects will get compared with other project classes hardly showing any development impact in order to demonstrate that potential high sustainable development projects are crowded out of the carbon market. Moreover chapter 5.2 shortly outlines the need for assessment on a project level.

Chapter six focuses on sustainable development at a project level. It provides an overview on existing CDM sustainable development assessments and one best practice approach. Those practices are analyzed concerning their ability to solve the race to the bottom inherent to the CDM.

After analytically examining the CDM sustainable development framework and CDM sustainable development approaches, chapter seven constitutes the empirical part of this thesis; it analyzes CDM hydro projects for their development impacts. It features an analysis of different project designs and a field study in Honduras.

## **2. Operationalizing the Concept of Sustainable Development**

Sustainable development seems to be a difficult subject. The reason lies probably in the fact that it is based on values (leastwise in the comparative way it is used in the Kyoto Protocol), and there consequently exist a lot of different approaches to deal with sustainable development<sup>2</sup> resulting in a vague general understanding. Furthermore it is a topic which got a real boost of public attention since the seventies, sometimes leading to its reduction to an empty shell.

Nevertheless, in order to end up with fruitful results, it is essential for this thesis to clarify the meaning of “assist ... in achieving sustainable development” (UNFCCC, 1997, Art. 12.2). This chapter aims therefore at the scoping of an operationalizable definition of sustainable development in order to prepare the ground for several integral subjects of this thesis:

- The analysis of sustainable development impacts of Clean Development Mechanism projects in chapter five
- The applicability of different Environmental Impact and Sustainable Development Assessments in the context of Clean Development Mechanism in chapter six
- The analysis of sustainable development impacts of hydro Clean Development Mechanism projects in chapter seven

To deal with this topic, the issues poverty and environment, having had a great impact on the concept of sustainable development, will get screened. This will provide the reader with an informative background and it will also allow to introduce microeconomic concepts of market failure, which will help to understand the significance of the Kyoto Protocol in further chapters. Against this background, operationalizing the concept of sustainable development will need three steps: First, concepts of sustainable development are analyzed before the background of the needs of sustainable development assessment. In a second step categories are identified allowing to evaluate project impacts. Finally, in a last step, indicators for measuring adverse and positive project impacts need to be found.

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<sup>2</sup>For a survey of different concepts of sustainable development see Perman et al. (1999, chapter 3).

## 2.1. Genesis of Sustainable Development – Environment and Poverty

### 2.1.1 Problem Poverty

Since Second World War, global wealth constantly increased<sup>3</sup> (Fischer Weltalmanach, 2004, 590). Nevertheless there are still people facing living conditions that do not meet reasonable standards. This is a common situation in very poor countries, generally being so called Least Developed Countries (LDC) but to some extent this is also true for industrialized countries<sup>4</sup>.

The World Bank defines *extreme poverty* as the living conditions of people who have to do their living with less than one US\$ per day and *poverty* with less than two US\$ per day. In 2004 21% of the world population lived in extreme poverty, 53% in poverty (World Bank, 2004), according to these definitions. After World War II the elimination of poverty in developing countries was thought to require well designed poverty alleviation programs<sup>5</sup>, which usually did not consider any environmental aspects (Perman et al., 1999, 13). As a matter of fact this approach failed for mainly two reasons:

First, development projects did not always address the needs of people in developing countries. Rather they addressed what development agencies in advanced countries thought to be the needs of people in developing countries. In literature these problems have been often discussed e.g. in the work of Martha Chens (Chen, 1984). As a consequence, reflecting a major change in paradigm, development aid was renamed to development cooperation.

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<sup>3</sup>In 2003 global added value increased by 3.9%; the Gross Domestic Product (GDP) of so called advanced countries (terminology of IMF) grew by 2.1%, developing countries by 5.0%, Commonwealth of Independent States (CIS) by 7.6%, other countries in transition by 4.5% (Fischer Weltalmanach, 2004, 590f).

<sup>4</sup>Since the mid-eighties many countries experienced substantial changes: Along with economic integration Neoliberalism became the prevailing paradigm which lead to a more and more unequal distribution of wealth. This (non-)development can be shown by analyzing the change of Gini-coefficients over time. This is one of several reasons why development measured as wealth in terms of GDP per capita is definitely not sufficient. Concepts such as Sen's Capability Approach, practically applied in the Human Development Index (HDI) or Sustainable Development feature a contextualized view of development.

<sup>5</sup>The development thesis, named after the former Prime Minister of Singapore, Mr. Lee is based on a separated view of social and economic aspects; it primarily states that it is necessary to focus on economic development. Only after having attained a certain level of national wealth the government should focus on social aspects too. This approach has been proved empirically wrong by the work of Sen (2004). It demonstrates the fact that social and economic development goals should be treated together in order to achieve a *first best solution* of development. To get to a suitable definition of Sustainable

Second, an approach which focuses mainly on economic development does not consider adequately social and ecological aspects. Although these aspects are not always measurable in a monetary way, they nevertheless can be of great significance. If an approach does not consider these aspects, it is unlikely to achieve lasting progress in development.

Hence, to secure sustainable development an holistic approach which also reflects social and ecological aspects, can be seen as an answer to prevailing problems.

### **2.1.2 Environment as a Scarce Resource**

Since Meadows publication of *The Limits of Growth* in 1972 awareness about the impact of economic actions within the system earth<sup>6</sup> grew. This awareness was further nurtured by environmental disasters caused by industrial mass production. The natural environment as a system, is roughly considered to be thermodynamically closed referred to material and open referred to energy. Moreover it is characterized by a given stock of renewable and non-renewable resources.

These natural resources are used to meet several needs (see Perman et al., 1999, 19ff), namely:

- **basic life support functions**  
e.g. water supply, air to breathe, etc.
- **resources for production**  
e.g. energy production through hydro power projects
- **sinks for byproducts**  
e.g. effluent, CO<sub>2</sub> emissions, etc.
- **recreational facilities for humans**  
e.g. swimming, fishing etc.

In the past natural resources were abundant to serve the above mentioned needs. Consequently there was no need to limit or exclude anyone from consumption of these resources. For these reasons environment was considered to be a free good<sup>7</sup>, to claim

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Development (social, economic, environmental) it still remains to deal with environmental aspects.

<sup>6</sup>See for example Boulding, 1966, *The Economics of Corning Spaceship Earth*.

<sup>7</sup>Definition of a free good: A good is a free good, if in market equilibrium excess demand for the good is zero for all positive prices, or excess demand for the good is nonnegative for a price which is zero.

these services was without charge; the only costs incurred were costs generated by the use of those resources. E.g. realizing a hydro power project creates construction costs, but since the use of water is free, water can be seen as a free good. This attitude lead to an increasingly careless use of environmental resources.

On one hand many relations between production processes and the environment were not well known. Due to the complexity of environmental interrelations, consequences of human actions can not be fully predicted. Even today many things are unknown; e.g. up to now, even after decades of intense research it is still not possible to predict precisely the impact of human actions on climate.

On the other hand, in a free market it often proved to be difficult to exclude someone from consuming natural resources, if resources are public goods<sup>8</sup>. Consequently full environmental costs (opportunity costs arising from the reduction of natural resources) are not reflected in individual decisions. Therefore those external effects<sup>9</sup> lead to market distortion: There is an incentive to adopt the position of a *free rider* for all parties (Nicholson, 1998, 519). As a result, public goods will tend to be insufficiently provided, leading to market failure (Perman et al., 1999, 136).

During the last years it became obvious, that utility which can be drawn from the environment is limited. In a world striving for unlimited growth<sup>10</sup>, nature could not provide all four above mentioned functions without limits. In addition the deterioration of one of these functions reduces simultaneously nature's capability to fulfill other functions, for example fishing and effluent are negative trade offs. Those findings caused a change in mind; by now the natural environment is regarded to be a scarce resource.

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(Nicholson, 1998, 486).

<sup>8</sup> Definition of a public good: "A good is a public good if, once produced, no one can be excluded from benefiting from its availability." (Nicholson, 1998, 743). Public goods will usually also be non rival, which means that consumption of an additional unit of the good creates zero marginal costs of production (Nicholson, 1998, 742f).

<sup>9</sup>Definition of an external effect: An external effect occurs if production/consumption decision of one agent affects the utility/production possibilities of another agent and when no compensation is made. (Perman et al., 1999, 129).

<sup>10</sup>In this context, economists often refer to principle of positive, diminishing marginal utility which is based on Gossen's Laws. See for example Krelle, Recktenwald, 1991, *Gossen und seine »Gesetze« in unserer Zeit*.

## 2.2. The Brundtland Definition of Sustainable Development

For a long time the common belief was that social and environmental problems on the one hand and economic development on the other are not connected to each other. But experience showed that poverty, destruction of environment and economic development are strongly interdependent (see Perman et al., 1999, 12). Poverty alleviation and future development can only be ensured if natural resources are not irreversibly harmed<sup>11</sup> (Meadows, 1972).

In 1987 the World Commission on Environment and Development published the report *Our Common Future*, often referred to as the Brundtland Report after the Commission's chairwoman Gro Harlem Brundtland. It turned out to be a milestone in the discussion of sustainable development and tries to point towards a global path of sustainable development. The Commission defined sustainable development as

*“... development that meets the needs of the present without compromising  
the ability of future generations to meet their own needs.”*

World Commission on Environment and Development, 1987, 43;

By now, this definition is broadly accepted and can be found on political agendas around the world, at least as a lip service. The very reason of its success lies in the fact that it is a very wide concept.

But what is the real message of the Brundtland definition of sustainable development? It states that future generations have the same rights to meet their needs as present generations. Basically it is a statement of intergenerational equity (van den Bergh, Hofkes, no indication of time, 5). This value roots in the *Age of Enlightenment* and is deeply inherited in western societies (which is one of the reasons for its success). Moreover, according to Imanuel Kant's categoric<sup>12</sup> imperative, every rational being will

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<sup>11</sup>See Meadows, 1972 *Limits to Growth*; in Meadows' world model it is assumed that natural resources are very limited substitutable though technological progress, which lead, as time showed to wrong results. The Club of Rome was heavily criticized for false projections of disposability of non-renewable resources such as oil. This publication boosted nevertheless the awareness of limited natural resources and of intergenerational equity. The Club of Rome published several new projections, recently *Limits to Growth – 30 Year Update* has been released.

<sup>12</sup>See Kant, 1986, *Kritik der praktischen Vernunft*; *The Critique of Practical Reason*.

agree to this definition.

The Brundtland definition is not sufficient to decide whether a project activity contributes to sustainable development, since two questions are left to be answered:

What does *without compromising* actually mean?

There is an ongoing debate about this topic in which several different approaches are discussed. One of the main controversial subjects is whether a substitution between non-renewable resources by technological progress<sup>13</sup> is eligible. Is it just to reduce resources and as a compensation, to leave future generations with technologies allowing a more efficient use of the remaining resources? The diversity of definitions<sup>14</sup> of sustainable development show that there is a large dissent among scientists.

Finally, several aspects need to be clarified. To judge the substitution process following information would be needed: What will be the outcome of technological progress, what will future technologies look like? And further more: How much utility will future generations derive from non-renewable resources and how much utility from applying technologies (achieved through use of non-renewable resources)?

Since we can not predict future, it is virtually impossible to answer these questions and it is not valid to judge the substitution process. Consequently, based on the commonly agreed equity principle of the Brundland Report, it is not eligible to substitute non-renewable resources through technological progress.

Unfortunately the everyday life gives a different impression. Fossil fuels are omnipresent and we show little willingness to alter our consumption behavior towards the

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<sup>13</sup>In literature this topic is often discussed in the context of *strong* versus *weak sustainability* (Perman et al. 2003, 90ff), consider also Daly, 1974, *The Economics of Steady State*, as a representative of strong sustainability. Strong as well as weak sustainability aim at constant consumption over time. Both, weak as well as strong sustainabilists focus at constant consumption but they differ over what is necessary for it's realization. Mathematically this can be considered as a dispute about the form of production functions. In a Cobb Douglas function,  $Q = K^\alpha R^\beta$ ,  $K$  = capital,  $R$  = Non-renewable resources with  $\alpha + \beta = 1$ , strong sustainabilists argue that  $\alpha > \beta$  which means that capital accumulation overcompensates the diminution of non-renewable resources whereas weak sustainabilists argue that this is not the case. Here it needs to be stressed that the sustainable development approach, employed in the Clean Development Mechanism, is a different concept: Clean Development Mechanism projects are not sustainable or unsustainable. They contribute to sustainable development, if those projects, compared to a certain baseline, are more sustainable than business as usual projects.

<sup>14</sup>For a comprehensive overview of sustainable development definitions see Perman et al., (2003, chapter 3).

use of renewable energy sources at a large scale. Almost every production process, at least at the level of intermediate inputs, uses non-renewable resources. The aim of sustainable development is a noble ideal though it proves difficult to be realized.

As a consequence the ongoing debate often focuses at what could be called a relative concept of sustainable development, which does not ask, if a project activity is truly sustainable, but rather if it contributes to sustainable development compared to a predefined baseline. This very concept is applied by the Kyoto Protocol defining the Clean Development Mechanism's aim to contribute to sustainable development. This approach implies the reference to a baseline scenario. When asked, if a project contributes to sustainable development, the question posed is, if project activities are sustainable compared to a baseline, e.g. certain level of pollution. Such a relative approach to sustainable development can lead to perverse conclusions when comparing unsustainable projects with project activities which are even worse. It is often argued that nuclear power stations, a clearly unsustainable source of energy, contribute to sustainable development compared to coal fired power stations (e.g. Delaporte, Follenfant, 2002, 124ff) by reducing greenhouse gas emissions<sup>15</sup>.

Applying this relative approach of sustainable development leads immediately to the second unanswered question which is posed by the Brundtland report, namely: What does *development* actually mean?

This approach to sustainable development seems to be much more promising. Development is generally understood as a change for the positive, but what is the subject of change?

It has already been discussed that a purely monetary evaluation of development is very unlikely to reflect all project impacts. Consequently a broader approach is needed in order to reflect all effects; development needs to be contextualized. A widely accepted and used approach to specify and operationalize the concept of sustainable development is to group Foci of Impact to three categories:

- Ecological aspects

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<sup>15</sup>Nuclear power is the only technology excluded from the Clean Development Mechanism (UNFCCC, 2002, Dec. 17, 20).

e.g. improvement or maintenance of life supporting systems

- Social aspects

e.g. improvement or maintenance of social living conditions

- Economic aspects

e.g. improvement or maintenance of economic capital. This definition falls back on the Hicksian definition of income (van den Berg, Hofkes, no indication of time, 5) which is the maximum amount of income that can be spent on consumption today without restricting one's future consumption.

These are ascertainment<sup>16</sup> widely accepted (see for example Austin et al., 1998; Sutter, 2003, 80f). The differentiation of sustainable development in those three categories finally allows the classification of project impacts on social, ecological and economic systems.

### **2.3. An Approach to an Operationalizable Definition of Sustainable Development**

As development is understood as positive change and since its impacts are differentiated in the three categories, we now have all necessary elements for an approach to sustainable development allowing a sustainable development assessment:

*Sustainable development can be seen as an improvement of at least one of the categories economic, social and environmental, without having negative impacts on any of the others.*

This definition clearly fulfills the Pareto criteria<sup>17</sup> and is in accordance with many authors, e.g. the *Sustainable Development Measurement* of Atkinson and Pearce (Atkinson, Pearce, 1993). It is also applied by Clean Development Mechanism related

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<sup>16</sup>This threefold is sometimes referred to as magic triangle (e.g. in Sutter, 2003, 26) in order to indicate, that realization of one category partly excludes the other ones. But this is not necessarily true, as a market, given the right conditions, may lead to ecological/sustainable outcomes (i.e. UNDP, WRI, WBCSD, 2002). As the flexible mechanisms of the Kyoto Protocol employ market forces in order to achieve CO<sub>2</sub> emissions and sustainable development, they can be seen as the primary example.

<sup>17</sup>The concept of Pareto improvement and Pareto efficiency was developed by the Italian economist Vilfredo Pareto. A Pareto improvement is a change where some agents are better off without making

approaches such as South South North Matrix or the Gold Standard<sup>18</sup>. Consequently, in the further course of this thesis, this definition will be used for all sustainable development related issues.

It is not the aim to discuss at this place the allocation of positive project impacts in detail but it shall be mentioned that the concept of sustainable development matches not only with the Pareto criteria but fits also well with Rawls<sup>19</sup> Max-Min Rule. According to this concept especially the poorest should benefit from development.

## **2.4. Towards Sustainable Development Assessment**

As discussed above, a differentiation of sustainable development allows a classification of project impacts on social, ecological and economic categories. In the next step specific criteria for each of these categories should be identified subsequently. Indicators will be assigned to these criteria. Finally, the measurement of those indicators allows for the assessment of sustainable development of projects (Sutter, 2003, 26).

As needs vary greatly between different countries and between different project categories, there should be no fixed list of criteria for all assessments (Sutter, 2003, 80). Those criteria are to reflect both, the interests of the Clean Development Mechanism's host country and the preferences of all involved decision makers. In order to guarantee the assessment to be practically feasible, the number of indicators should be limited (Sutter, 2003, 80) (being necessarily a compromise between completeness and applicability).

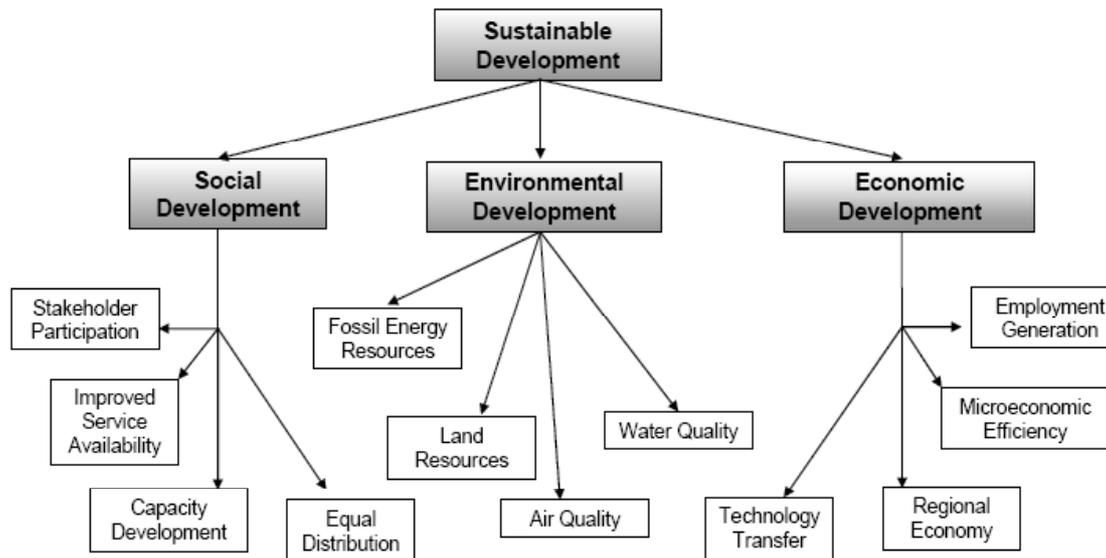
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someone else worse off (Nicholson, 1998, 502).

<sup>18</sup>For a discussion of Clean Development Mechanism related sustainable development assessments see chapter six.

<sup>19</sup>See Rawls, (1972), *A General Theory of Justice*; consider also Amratya Kumar Sen's analysis of Rawl's approach in (2004), *Development as Freedom*.

Figure 1: Hierarchical Tree of Sustainability Criteria



Source: Sutter, 2003, 81

The criteria shown in Figure 1 are based on the outcome of an e-conference<sup>20</sup> of environmental experts (Sutter, 2003, 80). They are conceptualized in a general manner and resemble the criteria proposed in a study of the UNEP (UNEP, 2004, 20f) in which sustainable development was appraised. These criteria should provide a rough idea about what a criterion possibly could be and how the whole set can be used. They may serve as an example which can be modified according to specific needs.

Those sustainable development criteria are not specific enough to assess project impacts. It is necessary to assign at least one indicator to each criterion (Sutter, 2003, 82). An exemplification can be found in Appendix II. By now, if the indicators are chosen, the concept of sustainable development is ready for application.

Finally the evaluation of indicators allows to aggregate the project's impacts, comparing it with a target figure to rank projects according to social, economic and ecological categories. This is a difficult task and different sustainable development assessments choose different accounting procedures of indicators. Specific methodologies are discussed in chapter 6.

<sup>20</sup>The conference was organized by the World Council of Sustainable Development, Sutter and the International Emission Trading Association (IETA) and held in July and August 2002.

In general two subjects need to be stressed:

First, sustainable development assessment should reflect negative and positive project impacts. Therefore sustainable development can be seen in two ways: When thinking about sustainable development, the first thing on mind is that there should be a reduction of negative impacts on environment caused by economic development<sup>21</sup>; though sustainable development is supposed to be more: maximizing positive external effects<sup>22</sup> of development (see Michaelowa, Dutschke, 2002, 12f). Screening this result with Clean Development Mechanism projects aim to contribute to sustainable development means mitigating negative effects (such as population displacement or loss of agricultural land) *and* maximizing positive externalities (such as job creation, environmental education, reduction of local pollution, infrastructure development, etc).

Second, it shall be clearly stated that at this step normative values are necessary for the further proceeding at least at two levels:

Each action has infinite consequences. For example, if a dog gets hit by a car and it dies, it will not have any (further) offspring which definitely changes future. Therefore choosing indicators among infinite consequences in order to evaluate project impacts is a question of taste. It is the assessor who decides, which effects are of relevance and which can be left aside. Consequently choosing indicators is a matter of values since it is based on personal decisions about which subjects are important and which can be ignored.

In analogy the evaluation of project impacts can only be made on the basis of one's point of view. For example some bacteria will greatly appreciate sewage water, whereas human beings benefiting from fishing and swimming will probably not appreciate waste water. Therefore accounting project impacts is also related to individual values and as such inherently arbitrary.

In order to deal with these unavoidable conditions, it is recommended that:

- Accounting procedures, which allow aggregation of indicators, should be transparent,

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<sup>21</sup>Environmental Impact Assessments (EIA) focus on estimating adverse impacts of project activities. For a comprehensive overview on EIAs see The Gold Standard, 2004. For EIA and sustainable development in the context of emission reduction projects please refer to section 2.2.

<sup>22</sup>Positive/adverse externalities occur whenever activities of an economic agent affect capabilities of other agents in ways that are not reflected in market transactions (Nicholson, 1998, 730).

in order to achieve a minimum level of scientific standard.

- As choosing indicators is a decision based on values, all stakeholders should participate in this process in order to guarantee that their preferences are reflected. Furthermore all stakeholders should be involved in the decision making process. Only under these circumstances it is ensured that the project outcome will be a Pareto<sup>23</sup> improvement.

These indicators should be appraisable in qualitative or preferably, for reasons of transparency in quantitative manners.

So far the basic needs for sustainable development assessment have been identified, this concept will be adapted in chapter six in the context of Clean Development Mechanism project assessments.

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<sup>23</sup>An Pareto Improvement is considered as an improvement which makes someone better off without

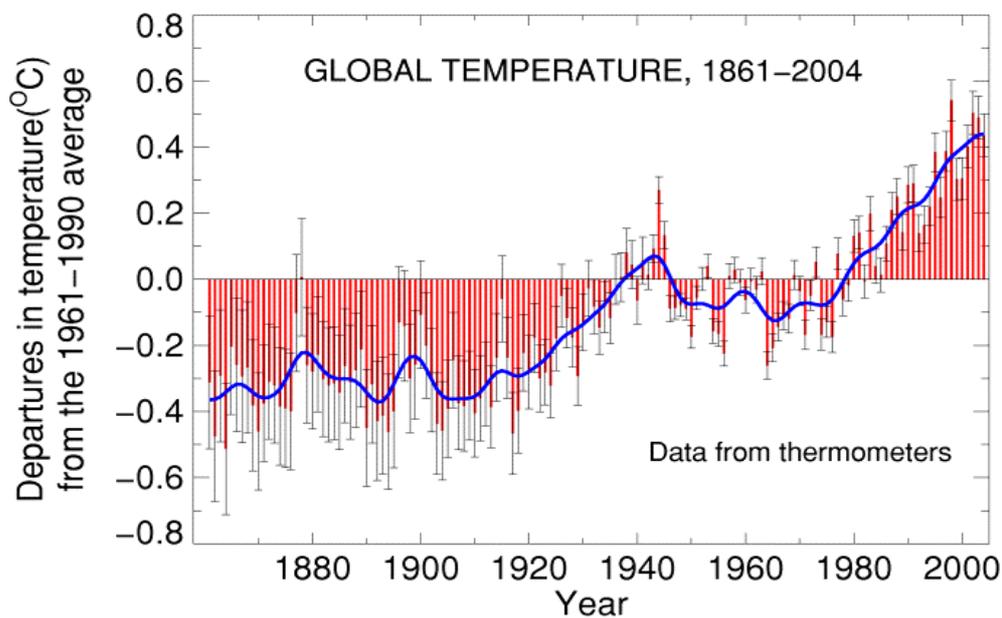
### 3. Climate Change, Kyoto Protocol and the Clean Development Mechanism

#### 3.1. Anthropogenic Climate Change

##### 3.1.1 Climate Change

The term climate change is, as the name indicates itself, used to denominate changes in earth's climate, which always experienced significant variations leading to the advancing and retreating of ice sheets caused by natural factors. For example CO<sub>2</sub> concentration<sup>24</sup>, a major variable influencing climate, varied between 180 and 300 ppm during the last 400,000 years (Kromp-Kolb, Formayer, 2005). Changes in gas concentrations and as a consequence thereof changes of climate is something inherent in nature.

Figure 2: Change in Global Average Temperature



Source: Hadley Center, Annual Global Temperatures, 2005

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making someone worse off.

<sup>24</sup>Measured in parts per million (ppm). Ppm is a measure of concentration where low levels of

Figure 2 shows the global change in average temperature since 1880. Global temperature, indicated by the 0.0°C change line, averages 15.1°C. Hence, global average temperature increased by +0.6°C since late 19<sup>th</sup> century. The graph shows a significant change in the earth's climate and raises the question whether this change is man made or if it is caused by natural factors.

### 3.1.2 Anthropogenic Climate Change

As interrelations between variables influencing the earth's climate are highly complex it is difficult to differentiate precisely between anthropogenic and natural climate change. Distinguishing between natural and human effects is problematic, since, due to natural buffer processes, large time lags between the actual emissions of greenhouse gases and their impacts on the climate exist (IPCC, 2001c, 11). Thus, it proved to be very difficult<sup>25</sup> to predict climate change but, as this section will show, there are solid reasons to assume that there exists a significant anthropogenic influence on climate:

The major anthropogenic impact on the climate is caused by the emission of greenhouse gases (GHG)<sup>26</sup>. Among all GHGs, carbon dioxide (CO<sub>2</sub>)<sup>27</sup> is considered to be the most relevant one because of the huge amounts being emitted.

Figure 3 shows an increase of carbon dioxide concentration; in the second half of the twentieth century growth of CO<sub>2</sub> emissions increased dramatically which lead to a substantially higher CO<sub>2</sub> concentration than during the last hundred thousands of years.

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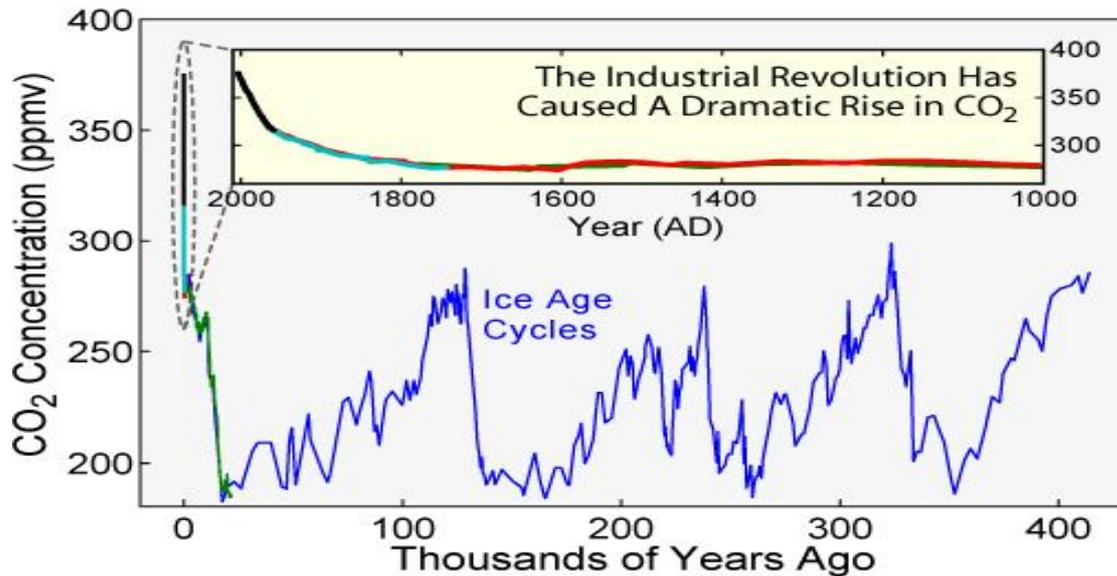
concentration are significant, as for example by indicating gas concentrations.

<sup>25</sup>Climate change prognoses were recently revised: See Moberg et al., 2005, *Highly variable Northern Hemisphere temperatures reconstructed from low- and high-resolution proxy data*.

<sup>26</sup>For a list of the GHGs which are of relevance under the Kyoto Protocol, see: <http://ghg.unfccc.int/index.html> For discussion of GHGs contribution to climate change see: IPCC, 2001, chapter 4.

<sup>27</sup>Carbon dioxide emissions contribute with about 60% to global warming (80% in the EU) followed by methane (Kromp-Kolb, Formayer, 2005, 149).

Figure 3: **Carbon Dioxide Emissions over Time**



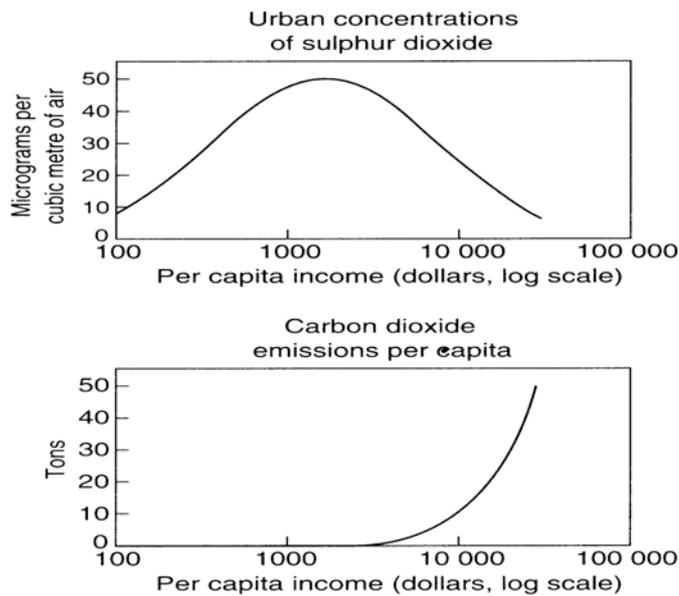
Source: Data sources see Appendix 3

The major source of CO<sub>2</sub> is caused by man made burning of fossil energy sources such as oil, natural gas and coal<sup>28</sup> (Kromp-Kolb, Formayer, 2005, 148). As the higher CO<sub>2</sub> level correlates with temperature change in Figure 2 an anthropogenic impact on climate is highly probable. Consequently the Intergovernmental Panel on Climate Change identified clearly “a discernible human influence on climate” (IPCC, 1996, 22).

The relation between environmental intensity and economic development varies underlining the need of a regime to deal with CO<sub>2</sub> emissions: Graphs showing income on the horizontal- and environmental intensity on the vertical axis are called Environmental Kuznets Curves, as depicted in Figure 4. The first graph shows a stylized relation between SO<sub>2</sub> and per capita income. With an increase in income, it is characterized by exponential growth, regression, a maximum and finally stagnation. This is the typical shape of a Kuznets Curve and the development that industrialized countries experienced in the eighties (Perman et al. 1999, 35f) for their SO<sub>2</sub> intensities.

<sup>28</sup>For figures showing global emissions from carbon fuels by types see:  
[www.en.wikipedia.org/wiki/Image:Global\\_Carbon\\_Emission\\_by\\_Type.png](http://www.en.wikipedia.org/wiki/Image:Global_Carbon_Emission_by_Type.png)

Figure 4: **Environmental Kuznets Curves for SO<sub>2</sub> and CO<sub>2</sub>**



Source: Perman et al., 1999, page 34

The lower graph of Figure 4 shows the relation between CO<sub>2</sub> and income: Unfortunately this function shows an untypical shape for a Kuznets Curve; CO<sub>2</sub> concentration grows exponentially as income increases, without a peak yet in view. The shape of the Environmental Kuznets Curve for CO<sub>2</sub> does not prove that CO<sub>2</sub> emissions will increase indefinitely, but it indicates that a peak would only be experienced at very high levels of CO<sub>2</sub> emissions.

This underlines the need of an emission regime pricing GHGs and thereby reducing CO<sub>2</sub> intensity of economic growth. Such an approach is supposed to lead to emission reductions and the generation of new technologies with low carbon intensity. In order to achieve these goals, the Kyoto Protocol was established as described in the following section.

## 3.2. The Idea of Kyoto – A Global Answer to a Global Problem

*“...a milestone in global efforts to protect the environment and achieve sustainable development”*

*(UNEP, 2004)*

### 3.2.1 Climate Change – A Race to the Bottom

In the nineties, when the problem of anthropogenic climate change was recognized by policy makers and by the public at large it was not immediately tackled for several reasons: Besides a lack of knowledge about precise interrelations of climate aspects, the problem consists of several components:

At first, emission reductions usually require financial investment<sup>29</sup>. For example, an enterprise will face higher costs, if it tries to reduce its emissions. The lower environmental standards, the higher the profits which the enterprise will make compared to enterprises taking care of ecological issues. As the atmosphere is a global public good<sup>30</sup> (Michaelowa, 2001b, 307), which basically means that GHGs may be emitted for free, profit maximizing enterprises, bearing positive marginal costs in mind, will seek to have high emission levels. So market forces may thrive enterprises to low environmental standards.

Second, anthropogenic climate change is characterized by the fact that, although emissions take place locally, consequences will show up on a global scale<sup>31</sup>. Though advanced countries have the biggest share of GHG emissions, developing countries will have to face most of the adverse impacts<sup>32</sup> of climate change (Beerbaum, 2001, 61). Consequently there are relatively few incentives to tackle emission reductions on a national level. Every country, establishing high environmental standards will face disadvantages, reducing its competitiveness. This problem is commonly addressed as being a “race to the bottom” (Narr, Schubert, 1994, 153), which generally refers to the

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<sup>29</sup>Environmental economists often stress the important fact that *green technologies* need not necessarily involve higher costs than business as usual technologies. Unfortunately, as section 3.1. shows, additional efforts are needed in order to direct markets towards a sustainable emission level.

<sup>30</sup>Please refer to section 2.1.2

<sup>31</sup>Because of diffusion, longitudinal variations of GHG concentrations are on annual average typically below 1 ppm (IPCC, 2001b, 211).

<sup>32</sup>Developing countries are expected to be severely exposed to floods, droughts, increased occurrence of malaria and other diseases etc. (Butzengeiger et al., 2004, 1).

fact that in a world, characterized by increasing economic integration, the possibilities of nation states to set their own environmental standards have decreased significantly.

Moreover, many regions are likely of having to cope with the adverse effects of climate change, some of them are potentially irreversible, yet some are likely to be beneficial (Butzengeiger et al., 2004, 1). The existing diversity of effects of climate change impact on countries was considered as an obstacle to climate negotiations.

### **3.2.2 The Kyoto Protocol and its Flexible Mechanisms**

#### **The United Nations Convention on Climate Change**

As a consequence of the recognition of anthropogenic climate change it was urged to cap/reduce the emission of GHGs in order to guarantee an environmentally sound development and an efficient social market outcome. The framework to achieve these goals was created by the United Nations and is called the Convention on Climate Change (UNFCCC).

The UNFCCC itself was founded at the United Nations Conference on Environment and Development in Rio de Janeiro, 1992 (Beerbaum, 2001, 37) known by its popular title *The Earth Summit*. The UNFCC entered into force March, 24<sup>th</sup> in 1994 and by now it counts 189 countries (UNFCC, 2006). Under the UNFCCC the parties to the Convention basically pursue three aims: At first, they gather information on greenhouse gas emissions and on their national policies. Second, the parties develop national strategies to tackle greenhouse gas emissions. Finally they “cooperate in preparing for adaptation to the impacts of climate change” (UNFCC, 2006c).

#### **The Kyoto Protocol and its Commitments**

The Kyoto Protocol is the outcome of the third Conference of Parties<sup>33</sup> (CoP) of the UNFCCC, being held in Kyōto, Japan. The third CoP agreed that Annex B<sup>34</sup> countries have to reach binding and differentiated emission targets (UNFCCC, 1997, Art. 3) as illustrated in Table 1. Overall emission commitments of Annex B countries account up to

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<sup>33</sup>The CoP is the supreme body of the UNFCC. It is the highest decision making authority and it comprises all nations that have ratified the UNFCCC. “The CoP’s role is to promote and review the implementation” (Koch, Michaelowa, 2001, 23) of emission reduction measures. Conferences are scheduled yearly. The last CoP was held in Montreal 2005 (UNFCCC, 2006d).

<sup>34</sup>Since the Kyoto Protocol with its emission targets is a separate legal instrument, and also had to be ratified, this created a new list of countries. Countries with binding emission reductions are referred to as

a reduction of -5%; individual targets vary from -8% (for most countries) to +10% and are listed in Annex B to the Protocol (UNFCCC 1997).

**Table 1: Countries Included in Annex B to the Kyoto Protocol and their Emissions Targets**

<b>Countries</b>	<b>Target 2008-12</b>	<b>Countries within the EU</b>	<b>Target 2008-12</b>
<b>EU-15</b> <sup>35</sup> Bulgaria, Czech Republic, Estonia, Latvia, Liechtenstein, Lithuania, Monaco, Romania, Slovakia, Slovenia, Switzerland	-8%	Luxembourg	-28%
		Denmark, Germany	-21%
		Austria	-13%
		Great Britain	-12,5%
		Belgium	-7,5%
		Italy	-6,5%
US*	-7%	Netherlands	-6%
Canada, Hungary, Japan, Poland	-6%	Finland, France	+/- 0%
Croatia	-5%	Sweden	+4%
New Zealand, Russian Federation, Ukraine	0	Ireland	+13%
Norway	+1%	Spain	+15%
Australia	+8%	Greece	+25%
Iceland	+10%	Portugal	+27%
* The US has indicated its intention not to ratify the Kyoto Protocol			

Source: UNFCCC, 1997, Annex B

As can be seen from Table 1, it was agreed upon differentiated reduction targets. This was made in order to consider two problems. First, most countries do not face the same emission reduction possibilities, e.g. France has few potential to expand hydro power, in order to meet its increasing energy need. Consequently its emission reductions targets are lower compared to other countries in the EU. Second, countries are characterized by different levels of economic development. In order to catch up with more developed countries, some countries, e.g. Portugal are allowed to emit more GHGs compared to others.

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Annex B countries (UNFCCC, 1997, Art.3).

<sup>35</sup>Please refer to Bubbles, section 3.2.2

### Greenhouse Gases under the Protocol

Those targets apply for a bundle of GHGs, so the Kyoto Protocol not only covers CO<sub>2</sub> emissions but also considers other GHG emissions like methane, nitrous oxide, sulfur hexafluoride and hydrofluorcarbon. Strictly speaking, hydrofluorcarbon-23 is a specific gas and most representative, but the Kyoto Protocol covers a wider range of hydrofluorcarbons.

Table 2: Average Lifetime and Global Warming Potential of Selected GHGs<sup>36</sup>

	<b>Carbon Dioxide</b>	<b>Methane</b>	<b>Nitrous oxide<sup>37</sup></b>	<b>HFC-23<sup>38</sup></b>	<b>Sulfur hexafluoride</b>
<b>Average Lifetime (in years)</b>	<i>variable</i>	12 +/- 3	120	264	3200
<b>Global Warming Potential (GWP) in 100 years</b>	1	21	310	11700	23900

Source: UNFCCC, 2005;

### Global Warming Potentials

As can be seen in Table 2, different GHGs are characterized by different Global Warming Potentials (GWP) which are expressed in carbon dioxide equivalents (CO<sub>2</sub>e). The carbon dioxide equivalent for a gas is derived by multiplying the tons of a specific gas by the associated global warming potential. Thereby carbon, with a GWP of one is used as the reference. One ton of e.g. HFC-23 equals 11 700 tCO<sub>2</sub>e. The huge GWP of non CO<sub>2</sub> greenhouse gases is an important factor for the financial viability of emission reduction projects<sup>39</sup>.

### The Protocol's Flexible Mechanisms

In order to achieve the emission reduction targets, the Kyoto Protocol offers four flexible mechanisms allowing Annex I countries to buy emission reduction certificates from Non Annex I countries or to invest in emission reduction projects abroad respectively. These mechanisms are:

<sup>36</sup>For a complete list of the GHGs which are of relevance under the Kyoto Protocol, please refer to UNFCCC, 2005.

<sup>37</sup>For an explanation of Nitrous oxide in the context of emission reduction projects please refer to section 5.1.2

<sup>38</sup>For an explanation of hydrofluorcabons in the context of emission reduction projects please refer to section 5.1.2

<sup>39</sup>Please refer to section 5.1.3

- **Clean Development Mechanism (CDM)**

The basic rules for CDM were agreed upon in Art. 12 of the Kyoto Protocol. CDM project activities relate Annex I<sup>40</sup> to Non-Annex I<sup>41</sup> countries, although recently also unilateral projects showed up. CDM projects aim to generate Certified Emission Reductions (CERs) in countries without emission targets which are sold to countries being bound by those targets. For this reason the CDM is considered to connect developing and industrialized countries to battle climate change. The fact that host countries have no commitments also creates incentives for those involved to inflate the amount of CERs generated (Yamin, Depledge, 2004, 160).

Thus, in order to create real measurable emission reduction credits the CDM projects are required to complete a specific project cycle, pictured in Appendix I. First project developers need to elaborate a Project Design Document (PDD)<sup>42</sup>. Among others, the PDD requires the elaboration of a baseline, i.e. what would be the emission scenario without the realization of the project. Based on this concept, emission reductions are calculated. In a next step, the project needs to achieve the host country's approval (see section 4.2). Thereafter the project needs to apply for a Operational Entity's validation<sup>43</sup> which basically approves the baseline elaboration and the emission reduction calculation.

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<sup>40</sup>Annex I countries are considered to be the wealthier countries; they consist of the members of the Organization for Economic Cooperation and Development (OECD) in 1992 as well as countries with economies in transition. (UNFCCC, 2006b) For a list of Annex I countries see:

[www.unfccc.int/parties\\_and\\_observers/parties/annex\\_i/items/2774.php](http://www.unfccc.int/parties_and_observers/parties/annex_i/items/2774.php)

Annex II countries consist of the OECD members of Annex I without countries in transition. They are required to provide financial resources to enable developing countries to undertake emissions reduction activities and to assist them in order to adapt to adverse effects of climate change (UN, 1992b, Art 4.3).

<sup>41</sup>Non-Annex I countries are those countries that are not listed in Annex I of the UNFCCC; those are the so called developing countries and some countries in transition. For the list of all Non-Annex I countries please refer to: [http://unfccc.int/parties\\_and\\_observers/parties/non\\_annex\\_i/items/2833.php](http://unfccc.int/parties_and_observers/parties/non_annex_i/items/2833.php)

<sup>42</sup>The Project Design Document (PDD) is a standardized document, available at the UNFCCC Secretariat, completed by project developers in order to register a project activity under the CDM. The design of the PDD is in conformity with the Marrakesh Accords, especially referring to its decision 17 (UNFCCC, 2002).

<sup>43</sup>Designated Operational Entities (DOE) are designed to validate CDM project activities independently as well as verify and certify emission reductions (UNFCCC, 2004b, 3).

In a further step the project needs to be registered by the CDM Executive Board<sup>44</sup>. If the project has passed these steps, it finally starts generating CERs. Therefor emission reductions must be monitored, thereafter they need to be verified and certified by a DOE before finally being issued by the EB (UNFCCC, 2002, Dec. 17)

The CDM is an attractive option for compliance as it may help Annex I countries to meet their emission targets in a cost efficient way.

- **Joint Implementation (JI)**

Basic rules for JI were agreed upon in Art. 6 of the Kyoto Protocol. A JI project is defined as an emission reduction project located in an Annex I country, aiming to generate Emission Reduction Units (ERUs). The JI project allows Annex I countries to exceed their emission cap as defined in Article 3.1 of the Kyoto Protocol by the amount of ERUs purchased from the project activity.

CoP 6 in Bonn provided first guidance on how to institutionalize the JI. It states that Annex I parties need to meet reporting and review requirements. The Marrakesh Accords (Decision 17/CP.7) interpreted the Bonn Agreement so to create two tracks. Track 1 and Track 2 are available when the host Annex I party is in conformity with its reporting and review requirements. In this case the host is allowed to issue and transfer ERUs (Yamin, Depledge, 2004, 187f). But if the host country does not meet reporting and review requirements, it can only engage in Track 2 JI project activities. Such a project requires international supervision by the Article 6 Committee (Yamin, Depledge, 2004, 188).

- **International Emission Trading (IET)**

If a country does not need all of its emission budget on a national level according to Art. 3 of the Kyoto Protocol, it may trade its surplus emission rights as so called Assigned Amount Units (AAUs) to other countries which emit more than they are allowed to. International emission trading is only possible between Annex B countries and as well under the restriction that emission target achievement via IET is supplementary to

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<sup>44</sup>The CDM Executive Board is established in Art. 12 of the Kyoto Protocol (Michaelowa, Koch, 2001, 33). It consists of a 10 member panel elected for the first time at COP-7 which supervises the CDM and has begun operation in advance of the Protocol's entry into force (UNFCCC, 2006e). Its main task is to supervise the CDM and to control operational entities which certify CERs (Michaelowa, Koch, 2001, 33).

domestic action.

- **Bubbles**

Like IET, bubbles are only possible between Annex B countries. Countries forming a bubble may redistribute beforehand their targets as long as the sum of all individual countries' emission targets is not exceeded. Currently the European Union is the only group of countries forming such a bubble (see Table 1). The EU has redistributed its overall emission target of -8% in such a way that e.g. Portugal can increase its emissions by 25% while Luxembourg needs to cut them by 27% (Table 1).

Those mechanisms provide Annex I countries with flexibility to achieve their quantitative emission reduction targets. It is assumed that all mechanisms combined get close to textbook models of trading schemes (Perman et al., 1999, 367) which is supposed to achieve the same environmental benefits at lower costs. This is one reason why the Kyoto Protocol is called a “cap to emission, not a cap to growth”<sup>45</sup> (Discussion at Carbon Market Insights, 2005);

Second, during the ongoing of climate negotiations carbon markets and its conditions were designed. In order to foster the development and implementation of green technologies<sup>46</sup>, the essential question remains if these markets will successfully harness market forces to achieve green development. Whether this aim will be achieved depends on the limitation of CERs up to a certain percentage of the emission reduction target (UNFCCC, 1997, Art. 12.3b). In the Marrakesh Accords<sup>47</sup> it was agreed that countries need to set this quota individually, but up to now, as emissions of many countries keep increasing, a lot of them have not made any clear statement yet.

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<sup>45</sup>The fact that sustainability does not necessarily mean no economic growth was pointed out by the UNDP (2002) in the study *Tomorrow's Markets* by underlining the growth potential of green technologies.

<sup>46</sup>In the context of the Clean Development Mechanism this aspect seems to be suspicious because projects need to prove their additionality. As Clean Development Mechanism projects can only do so by showing that they are not as financially viable as business as usual projects they tend to foster green technologies which are not competitive.

<sup>47</sup>CoP 7 took place in Marrakesh, decisions 2-24/CP.7 are commonly known as the Marrakesh Accords. Those agreements incorporate and build on results of the CoP 6 and set various rules for operating the complex provisions of the Kyoto Protocol. Among other things, the accords include details for establishing a greenhouse gas emissions trading system, but it was also agreed about specific rules on implementing and on monitoring the Protocol's Clean Development Mechanism (UNFCCC, 2006e).

### **3.2.3 A Legal Framework**

As GHGs are emitted locally but climate change is a global phenomenon, nations have low incentives to reduce emissions, which can be considered as a free rider problem. Consequently climate change needs to be tackled on a global scale (Michaelowa, Dutschke, 2002, 2).

This is what the Kyoto Protocol is trying to accomplish: It is a multilateral agreement in which all Annex B countries agreed on binding reductions of GHGs. But the Protocol is not only a commitment to reduction (UNFCCC, 1997, Art. 3), it features also penalties for non-compliance of emission reduction goals which qualifies it as something special: Besides the WTO, the framework on climate change is the only multilateral treaty with a consent on penalties. Many regard it as a step forward towards what is called “global governance” (Hummel, 2004, 1), although climate negotiations turned out to be awkward<sup>48</sup>.

The potential penalties are supposed to guarantee that countries will meet their targets. Therefore the framework is considered to be consistent and not an empty shell.

### **3.2.4 Dealing with Externalities**

By being a consistent framework the Kyoto Protocol solves from an economic point of view the free rider problem discussed in chapter 2: Annex B countries face a cap of their emissions to limit their major CO<sub>2</sub>e emitting sectors.

CO<sub>2</sub>e emissions get priced, consequently enterprises seek to reduce them until their marginal cost of emission abatement equals the price of an emission certificate purchase. Thus, the Kyoto Protocol tackles anthropogenic climate change by solving the free rider problem. As discussed later this dilemma still prevails to some extent within the CDM.

## **3.3. The CDM and its Sustainable Development Dimension**

This section tries to demonstrate several things: First, it will give a brief introduction into the CDM and its goals. In a further step it will screen CDM's key challenges by shortly stressing the concept of additionality before turning to its aim to achieve

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<sup>48</sup>Sherman called the Kyoto negotiations “the most complex economic negotiations ever conducted under United Nations auspices” (Sherman, 2000, 1).

sustainable development.

Moreover, as sustainable development seems to get more and more marginalized, this chapter tries to underline the importance of the CDM projects' contribution to sustainable development. Consequently this section tries to show two things. First it demonstrates that the projects' contribution to sustainable development is a concession made by Annex I countries in order to achieve a compromise between so called developing and developed countries in the process of the negotiations concerning JI/CDM. Second, this section will point out the need for positive sustainable development impacts by comparing CDM projects solely focusing on CO<sub>2</sub>e emission reduction with reductions achieved exclusively in Annex I countries.

Finally it will try to merge the two concepts of additionality and sustainable development to show minimal requirements for the CDM in order to achieve both of its goals.

### **3.3.1 Introduction – One Mechanism but two Objectives**

According to the Kyoto Protocol the CDM aims at two separate goals:

*“The purpose of the clean development mechanism shall be to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under Article 3”*

UNFCCC, 1997, Article 12.2;

The CDM was designed with two separate goals; first, it aims to contribute to the sustainable development of the host country, second it focuses on creating cheap emission reductions, helping Annex I countries to achieve their emission target in a cost efficient manner. This is based, putting negotiation aspects aside, on the assumption that there exist synergies between both goals, although several experts question the CDM's ability to fulfill both goals (Sutter, 2003, 64).

The framework of the CDM is crucial for successfully achieving both goals. Only if the CDM rules ensure both aspects, it is guaranteed that all projects show a sustainable

development impact as well as CO<sub>2</sub>e emission reductions. CDM's sustainability framework will be analyzed in chapter 4. But first the goals of additionality and contribution to sustainable development will get screened separately.

### **3.3.2 Additionality – Creating Real, Non-Business as Usual Emission Reductions**

The notion of additionality generally focuses on the question if CDM projects create real emission reductions or if they are rather business as usual projects. To avoid fictitious reductions is a main challenge to the CDM; As a brief introduction, it may help to have a short look at the definition set out in the Kyoto Protocol:

*“Reductions in emissions that are additional to any that would occur in the absence of the certified project activity”*

UNFCCC, 1997, Art. 12.5(c)

Nevertheless the concept of additionality still was far from being clearly defined, thus the Marrakesh Accords precise:

*“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.”*

UNFCCC, 2002, Art. 43

Thus, according to the Marrakesh definition CDM projects need to create real measurable long term emission reductions which are additional to a business as usual scenario. Being additional to a business as usual scenario, as specified by the EB, means that the project should not occur without the CDM project activity. In other words, the project, in the way it is described in the Project Design Document should not be the financially most attractive alternative. But this does not necessarily preclude projects from being profitable without carbon revenues.

This aspect is of importance: If a project gets registered under the CDM, it will create CO<sub>2</sub>e emission certificates, so called Certified Emission Reductions (CERs). These CERs help Annex I countries to reach their emission target, more precisely they may exceed their emission targets by the quantity of emission certificates purchased. If those emission

reductions are not real or if these reductions would have happened anyway (Bode, Michaelowa, 2001, 13), the creation of emission certificates would undermine the emission targets of Annex I countries. If on the one hand CERs allow Annex I countries to exceed their emission targets but on the other hand there are no real reductions beyond the certificates of CERs, then the system actually increases GHG emissions.

Since in host countries no emission cap exists and thus everybody would benefit from an overestimation of reductions (Butzengeiger et al., 2004, 15), this possible effect is most problematic. Consequently the topic of additionality attracted a lot of attention.

Some serious misunderstandings of the concept of additionality lead to controversies. For example the Prototype Carbon Fund (World Bank, 2003b), a major player in CDM capacity building, used the term *environmental additionality* in association with additional emission reductions and was forced to publish a clarification in this regard.

Although the Marrakesh Accords included more general guidance on how to assess additionality of projects (Ellis, Gagnon-Lebrun, 2004, 7), difficulties in proving additionality persisted. As to that time no CDM projects were registered, there was a lot of uncertainty. During the same period efforts were made to get projects registered before December 31<sup>st</sup>, 2005<sup>49</sup>. Due to this situation, additionality raised a great deal of annoyance. During CoP 10 for example, India "launched fierce attacks against the Executive Board" (Brouns et al., 2005, 87) for its work to ensure additionality.

Finally in 2004 the CDM Executive Board published a *Tool for The Demonstration and Assessment of Additionality*<sup>50</sup>. In five steps this tool provides guidance on how to prove additionality: First a project needs to pass a preliminary screening, before project alternatives, consistent with existing laws, are identified. Thereafter it can be chosen between an investment- and a barrier analysis. If projects also pass this sensible step, they can move on to be screened with common practice. Finally the impact of the project registration needs to be cleared. Only if a project successfully passes all of these steps, it is proved to be additional. So far, this publication has calmed down discussion.

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<sup>49</sup>According to CoP 9, projects which are registered after 31 December 2005 may generate CERs only after their date of registration (EEP, 2004, 23).

<sup>50</sup>See UNFCCC, 2004; <http://cdm.unfccc.int/EB/Meetings/016/eb16repan1.pdf>

### **3.3.3 Sustainable Development – Creating Sustainable Emission Reductions**

Sustainable development is not merely a requirement for the CDM, it should be seen as the driving force for developing countries in participating in the CDM (UNEP, 2004, 7). As the UNEP study shows, the CDM, if directed wisely, has the power to support major development goals<sup>51</sup>.

Although sustainable development is a broad concept, the way how the CDM should “assist (...) in achieving sustainable development” (UNFCCC, 1997, Art.12.2) was interpreted and analyzed in chapter two. Consequently a CDM project must not create any major adverse impacts on the social, ecological and economic pillars. And as development needs to be understood as a change for the better, at least one of these pillars needs to be improved. Subsequently, as the formulation “contributing to sustainable development” is based on values, that differ from person to person, an adequate stakeholder process is of great importance.

### **3.3.4 Clearing the Significance of Sustainable Development within the CDM Development of the CDM**

The perception and role of CDM has significantly changed from the first introduction as Joint Implementation in 1991 up to the formulation of well elaborated CDM rules in the Marrakesh Accords in 2001. From its introduction by Norway (Hanisch, 1991) until the agreement on its fundamental rules at Kyoto in 1997 the concept of JI/CDM was strongly debated. During negotiations developing countries expressed their concerns<sup>52</sup> lead by the G 77 and China<sup>53</sup>:

- One concern was that industrialized countries, those with the highest emission level achieve their quantitative emission targets without taking adequate action at home (Michaelowa, Dutschke, 2002, 5) by focusing solely on relatively cheap emission reduction potentials in developing countries.
- Furthermore, JI<sup>54</sup> could reduce the incentives for structural change in industrialized

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<sup>51</sup>For alignment of CDM, Millennium Development Goals and Poverty Reduction Strategy Papers (PRSPs) see UNEP, 2004, 25f.

<sup>52</sup>In the following only concerns of relevance for the argumentation of this chapter will be presented. For a more complete list of concerns see Michaelowa, Dutschke, 2002, 5.

<sup>53</sup>The Group of 77 and China (G 77) was founded during earlier UN conferences and seeks to harmonize negotiation position of developing countries (Koch, Michaelowa, 2001, 39).

<sup>54</sup>At that time, JI had a broader meaning including also the CDM; until CoP 3 it was an umbrella term for

countries (Michaelowa, Dutschke, 2002, 5), since cheaper emission reductions in Non-Annex I countries diminish the pressure on industrialized countries to create new, low emission technologies.

- Another concern focused on the possibility that JI may exploit cheap emission reduction potentials of developing countries and when they have to face emission targets at a later date, they would have to bear higher costs ( Michaelowa, Dutschke, 2002, 5).

During several meetings of the UNFCCC the G77 and China stayed firm and opposed JI. But in 1997 Brazil came up with the proposal of the Clean Development Fund marking a turning point. This fund was supposed to direct fines, paid by industrialized nations for non-compliance with their emission targets to climate change mitigation projects in developing countries (Dixon, Mintzer, 1999, 410). Those measures would clearly benefit the developing countries.

Industrialized countries, among these the United States, opposed such a system and advocated JI instead (Michaelowa, Dutschke, 2002). After several bilateral negotiations in the run-up to the Kyoto Protocol, Brazil finally changed its proposal from a fund into a market based mechanism (Grubb et al. 1999, in Sutter 2003, 51); – the CDM was born. It has to be considered as a merger of former negotiation positions: The Clean Development fund constitutes its development dimension whereas the mechanism represents the request for cost efficient reductions.

Finally, basic rules for the CDM were established in Article 12 of the Kyoto Protocol. It was the outcome of last minute negotiations at the close of COP 3 and it constitutes the essential connection between Annex I and developing countries;<sup>55</sup> both Annex I as well as developing countries are supposed to benefit from the CDM.

CDM's first goal therefore is to contribute to Non-Annex I countries' sustainable development which should induce developing countries to participate in the CDM.

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emission reduction projects abroad. Consequently here the term JI is also employed for the CDM.

<sup>55</sup>Here the common but imprecise assumption is adapted that developing countries equate Non-Annex I countries; for a list of Non-Annex I countries see:

Second, it aims to create GHG reductions in Non-Annex I countries that help Annex I countries to meet their emission targets in a cost efficient way. It must be clearly stated that both parties, developing countries and Annex I countries agreed upon the CDM because of its design to create win-win situations. And indeed, if CDM projects are designed according to both goals, there may be a lot of synergy.

The differentiation between those two goals also shows how sustainable development has to be interpreted in the context of the CDM: Certainly, GHG emission reductions per se contribute clearly to sustainable development; but since emission reductions and sustainable development are separate goals, sustainable development must be understood as something distinct from emission reductions; GHG emission reductions are consequently not eligible as an argument for a project's contribution to sustainable development. Sustainable development within the CDM must be understood as a project's contribution to a sound way of development within the host country. It is a remuneration for the host country's participation in the CDM and not just an optional add on. Therefore sustainable development must be seen as an essential element of a project.

#### **Reductions in Annex I Countries vs CDM Project Activities without Positive Sustainable Development**

Another argument, already mentioned as one of the developing countries concerns against the CDM/JI, underlines the significance of sustainable development within the CDM:

Some argue that, if Annex I countries reduced their emissions at home this would create incentives for structural change in industrialized countries (Michaelowa, Dutschke, 2002, 5). If Annex I countries do not have the possibility to reach their emission targets by implementing already existing CO<sub>2</sub>e emission reduction technologies in developing countries, they would be forced to create new, low-emission technologies in order to achieve such necessary reductions. Implementation of new technologies bears several advantages: First, if they are produced at large scale production cost would significantly decrease<sup>56</sup> and this would give way to further inventions. Second, these new technologies could subsequently be easily implemented in developing countries.

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[http://unfccc.int/parties\\_and\\_observers/parties/non\\_annex\\_i/items/2833.php](http://unfccc.int/parties_and_observers/parties/non_annex_i/items/2833.php)

<sup>56</sup>This argumentation is based on the assumption of positive, diminishing marginal costs.

Consequently on several occasions it was argued that Annex I countries are wise in not relying too much on the CDM/JI in order to reach their targets: The Kyoto Protocol states that “acquisition of certificates shall be supplemental to domestic actions” (UNFCCC, 1997, Art.6.1(d)). This paragraph is also included in article 12.3(b) of the Protocol and was affirmed in the Marrakesh Accords (UNFCCC, 2002, 2f). In addition the WWF and other NGOs (The Gold Standard, 2002, 1, see also Langrock, Sterk, 2003, 2) stress the importance of focusing on domestic action. More recently this aspect was on the agenda again as the European Union (Council of the EU, 2004, Art. 7) recommended a limitation of CERs and ERUs purchases.

The arguments for national emission mitigation hold true if CDM projects only create CO<sub>2</sub>e emission reductions; in such a case mitigation measures taken at home would clearly show the advantage of the development of new techniques and their spin off effects, compared to the maintenance of the technical status quo through the CDM. Thus, from a macroeconomic view to tackle of climate change mitigation on a national level is clearly preferable to a CDM without sustainable development impacts.

But if CDM projects generate reductions *and* contribute to the host countries sustainable development this would create positive development impacts besides CO<sub>2</sub>e emission reductions. Thus, like in the development context of the CDM, it can also be shown that sustainable development is an obligatory element to the CDM.

### **3.3.5 Merging Emission Reductions and Sustainable Development**

So far chapter 3.3 showed that CDM projects need to be additional in order to create real emission reductions. Moreover projects need to show a positive sustainable development impact. By now it is time to merge those two concepts: Putting these requirements together shows a CDM. Every project differs in abatement costs, transaction costs, revenues from CERs and positive or negative sustainable development impact from any other project. These aspects are illustrated in Figure 5.

The vertical axis maps net costs (in US\$ per ton CO<sub>2</sub>e) arising from CDM project activity, consisting of the sum of abatement and transaction costs: Every project has to face emission abatement costs (AC/CO<sub>2</sub>e), e.g. a hydrofluorcarbon (HFC) emission reduction project has to bear the costs of installing a thermal decomposition chamber in

order to reduce HFC-emissions. Furthermore every CDM project activity is bound to bear transaction costs<sup>57</sup> (TC/CO<sub>2</sub>e), costs which arise, generally speaking, from completing all CDM procedures and from offering CERs at carbon markets. Transaction and abatement costs are standardized, i.e. in units per ton CO<sub>2</sub> equivalent.

Monetary benefits arise from selling CERs to the market, the price for one CER ( $p^{\text{CER}}$ ) is indicated by the vertical line. It is possible to set a minimal requirement for project developers: Projects are only financially viable if

$$\text{Requirement 1: } p^{\text{CER}} \geq AC/\text{CO}_2\text{e} + \text{TC}/\text{CO}_2\text{e}$$

revenues of one CER equals or exceeds the sum of abatement costs and transaction cost, measured in US\$ per CO<sub>2</sub>e. Furthermore, as described by requirement 2, projects, characterized by a negative sum of abatement and transaction costs would be clearly non-additional, projects under the horizontal axis are not eligible.

$$\text{Requirement 2: } AC/\text{CO}_2\text{e} + \text{TC}/\text{CO}_2\text{e} > 0$$

This does not imply that all projects with positive net costs are per se additional, but these projects can possibly prove to be additional whereas projects with negative net costs would be clearly business as usual projects<sup>58</sup>. Finally CDM projects sustainable development impact ( $Sd^{\text{actual}}$ ) needs to meet a certain minimal sustainable development standard ( $Sd^{\text{min}}$ ).

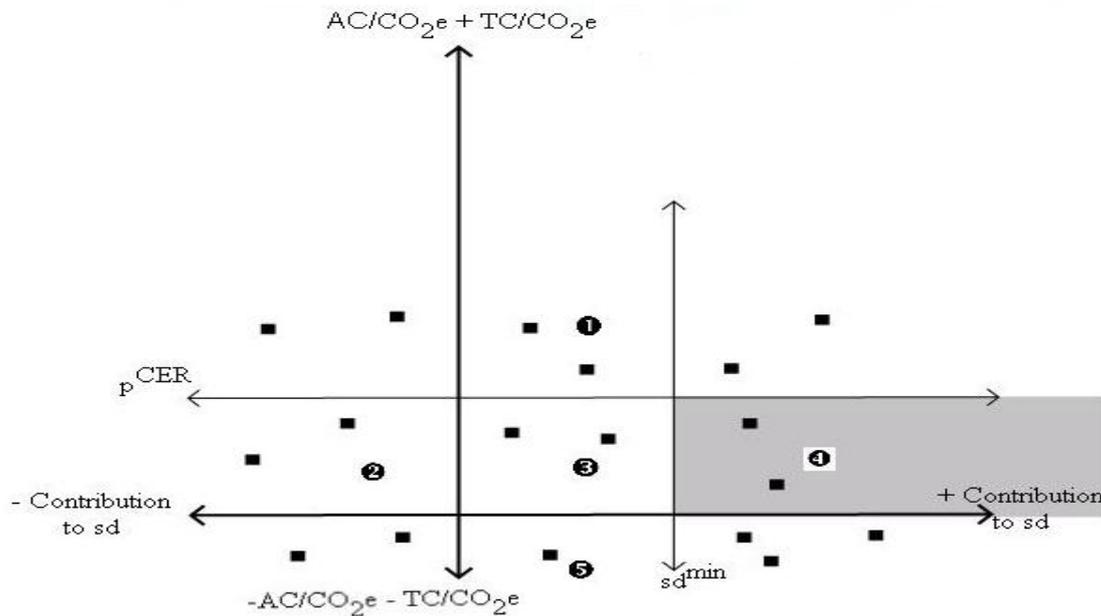
$$\text{Requirement 3: } Sd_{\text{actual}} > Sd_{\text{min}}$$

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<sup>57</sup>According to Krey (2004, 38), transaction costs are composed by Market Transaction Costs (search for buyers, negotiations), Pre-Implementation transaction costs (PDD design etc.) and Implementation Transaction Costs (costs accruing from Monitoring, Ver- & Certification, etc.). For a detailed discussion of transaction cost see Krey, 2004, chapter 4.

<sup>58</sup>This argument is based on the assumption of perfectly volatile capital which is problematic, especially in the context of developing countries.

Figure 5: Hypothetical Distribution of CDM Projects with Respect to CER Revenues and Sustainable Development



Source: Adapted from Sutter, 2003, page 66

As discussed in chapter 2, the CDM employs a relative concept of sustainability. The focus does not only lie on the fact whether projects are sustainable or not, but the focus lies on their contribution to sustainable development compared to a certain baseline. Consequently, as shown in Figure 5, only projects are eligible which have positive sustainable development performance compared to the minimal requirements set by the approving body (will be discussed in chapter 4.2).

If these outcomes are summarized, the following picture can be drawn: Projects above  $p^{CER}$  will not be realized because they would create financial losses. Projects below the horizontal axis, contribution *to sd*, are obviously not additional, those projects are marked by the five. Only quadrants 2, 3 and 4 are potentially additional, whereas among these only sector 4 fulfills minimal sustainable development requirements. Consequently only projects located in sector four are eligible for the CDM.

## **4. Analysis of the CDM Framework – Ensuring Sustainable Development?**

This chapter tries to analyze the existing framework which is supposed to have the potential to ensure sustainable development. After generally stressing the need for minimal requirements, it deals with the Letter of Approval issued by the host country, confirming the projects' contribution to sustainable development. This proceeding is examined for its ability to guarantee projects good development performance. Furthermore it analyzes monitoring rules with regard to their application at ecological aspects. Moreover this chapter examines the need for an adequate stakeholder process and screens it with existing CDM practice before finally drawing conclusions.

### **4.1. The Need for a Framework to Guarantee Minimal Sustainable Development Standards**

Negative external effects such as CO<sub>2</sub>e emissions and positive externalities such as contributing to sustainable development are by definition not incorporated in the pricing mechanisms which lead to an inefficient market output.

When the UNFCCC set out to create carbon markets CO<sub>2</sub>e emissions got priced whereas CDM projects various co-benefits are not valued. Nevertheless, those co-benefits contribute to sustainable development in Non-Annex I countries (Burian, Schmitz, 2005). Assuming that those co-benefits exhibit positive marginal costs and are not strictly bound to the project activity, projects showing those benefits will face significant disadvantages and get finally crowded out of the market. In order to achieve CDM's first goal, there exists an imperative need for requirements ensuring sustainable development.

Moreover there is another striking argument underlining the need for minimal standards within the CDM:

To show that an environmental sound implementation is not ensured in the context of Non-Annex I countries, a short digression to Environmental Impact Assessments (EIA) practice in developing countries is highlighted. EIAs are carried out to evaluate projects interference with nature and are therewith essential element of a sustainable development assessment. If there are no standards at all, or if an EIA is carried out poorly, this does not

imply that the project itself is characterized by bad environmental performance, but this signifies that it is not guaranteed that all the project's implications on nature are considered well.

EIA performance of developing countries falls far behind that of developed countries (Wood, 2003, 2) and was criticized by several authors (for a list of authors see Wood, 2003, 3). For a discussion of both, missing EIA legislation and weaknesses in existing EIA practice in the context of developing countries please refer to Schmitz, 2006, chapter 3.5.3.

Linking international EIA standards with CDM projects seems the obvious conclusion to draw. For example it was thought of linking CDM hydro projects with World Commission on Dams guidelines. Also Thorne and LaRovere presented six indicators and some kind of minimal threshold to policy makers at CoP 5 for assessing CDM project's sustainable development<sup>59</sup> impacts (Begg et al. 2000, 28). Policy makers were unwilling to include these indicators; later at CoP 7 it was decided that for the sake of national sovereignty host countries are responsible for sustainable development and its assessment.

## **4.2. Host Country Approval**

### **The Letter of Approval**

Within the Framework on Climate Change it was agreed that Non-Annex I countries participating in the CDM are to establish Designated National Authorities (DNA) which are mostly integrated in the host countries' environmental ministry. According to the Marrakesh Accords, the host country's needs to confirm that project participation is voluntary (UNFCCC, 2002, Art. 28) and “that the project activity assists it in achieving sustainable development” (UNFCCC, 2002, Art. 40a). To affirm that these requirements are met, the DNA prior to the project's submission for validation<sup>60</sup> sends a Letter of Approval (LoA) to the Designated Operational Entity. The LoA has to be identified as the CDM's focal point for guaranteeing sustainable development.

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<sup>59</sup>For a detailed discussion of the South South North Matrix please refer to chapter 6.1

<sup>60</sup>For an overview of the several steps of the CDM project cycle please refer to Appendix I.

This procedure enables developing countries to evaluate the impact of projects on local environment, social and economic development. Subsequently it empowers those countries to “influence project selection according to their development priorities” (Michaelowa, Dutschke, 2002, 13). As discussed in chapter 4.1 this should provide the needed guidance in order to maximize the benefits for the host country (UNEP, 2004, 7).

### **No Centralized Criteria for Approval**

To avoid rent seeking between DNAs, leading to detrimental competition and degrading minimal sustainable development standards, several initiatives for a centralized set of evaluation criteria were made. Michaelowa, Dutschke argue (2002, 13) that such an approach would create bureaucracy and screening costs. Moreover such a procedure would stand for a limitation of national sovereignty. Due to these reasons it was concluded that national authorities are responsible for approval of CDM projects.

### **Expectations not Fulfilled**

There was great optimism that the CDM will boost the development of renewable energy projects in developing countries. E.g. the UNEP (2004, 25ff) outlines connections between CDM and the Millennium Development Goals.

As the LoA is unable to guarantee a certain minimal development impact standard, these hopes proved to be unjustified. Some evidence exists for this charge:

- First of all the current dominance of gas capture and destruction projects<sup>61</sup>, hardly having any development impact, demonstrates that the existing sustainable development framework including the LoA is not sufficient.
- Furthermore several projects received a LoA although NGOs objected CDM projects because of adverse negative ecological or social impacts<sup>62</sup>.
- Moreover the World Bank, a major player in capacity building, named the LoA a “pro forma Letter of Approval” (World Bank, 2003). While it is true that this is only an indication, it nevertheless gives a hint on current practice.

### **Sustainable Development Survey at Carbon Expo 2005**

In order to evaluate claims accusing DNAs of issuing LoAs despite the project's lack

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<sup>61</sup>For a detailed discussion of gas capture and destruction projects see chapter 5.1

of any sustainable development impact Dominik Schmitz and the author of this thesis conducted a survey among DNAs at Carbon Expo 2005<sup>63</sup>. Results showed that

- All polled DNAs<sup>64</sup> employ criteria for sustainable development assessment of CDM projects. Some focus mainly at poverty alleviation, others have a more precise set of criteria. Cambodia even adapted the South South North development matrix<sup>65</sup> to assess project activities (Cambodian DNA, 2005).
- Seven projects were partially rejected so far. Several reasons for these rejections were given:
  - Sri Lanka rejected two projects for non-compliance with national environmental laws at an early stage of project development. Both projects were hydro power projects and were expected to have severe negative impacts on nature reserves.
  - Morocco rejected three projects because of major stakeholder conflicts.
  - China refused to accept two projects due to badly elaborated PDDs; but those projects are invited for resubmission. The Chinese DNA does not consider this denial as a formal rejection.

None of the DNAs named missing positive sustainable development impacts as a reason for rejection.

It also should be pointed out that many DNAs guide projects through the CDM process, avoiding official rejections since project developers may be informed off the record that the project activity/design is not appreciated.

Begg et al. (2000, 28) criticized this procedure because it is based on the assumption that host countries have the capacities and resources to exercise such a sustainable development assessment. But as all DNAs established some criteria for project impact assessment this seems to be a wrong conclusion to draw. If DNAs have the capacity for an adequate assessment but at the same time the existence of some projects clearly shows

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<sup>62</sup>Personal communication with Patrick McCully, International River Network on June, 21<sup>st</sup>, 2005.

<sup>63</sup>Carbon Expo is a fair, trying to connect participants of carbon markets. Carbon Expo 2005 took place in Cologne, Germany at the beginning of May and had over 1000 participants.

<sup>64</sup>DNAs interviewed: Argentina, Bolivia, Brazil, Cambodia, Chile, China, Ecuador, Honduras, Kenya, Morocco, Mexico, Philippines, Senegal, South Africa, Sri Lanka, Uganda and Vietnam.

<sup>65</sup>Discussed at more detail in chapter 6.1

that the LoA does not ensure projects contribution to sustainable development, this poses the question why the system is not working properly. Conclusions are drawn in chapter 4.5 after all aspects of the CDM's sustainable development framework are analyzed.

### **4.3. Stakeholder Rules within the CDM – Guaranteeing Sustainable Development?**

#### **Existing Framework**

As the concept of sustainable development is based at least to some extent on individual values<sup>66</sup> the stakeholder process, as an instrument for influencing CDM projects, is of great significance. The Rio Declaration on Environment and Development (United Nations, 1992, Principle 10) emphasized the importance of public participation for sustainable development<sup>67</sup>; Baumert and Petkova (2000, 4) state that “public participation will help the CDM deliver its stated objectives”.

It may be helpful to have a short look at CDM rules set out for stakeholder participation so far: According to the Marrakesh Accords (2002, Annex A) stakeholders are defined as the public including individuals, groups or communities “affected, or likely to be affected, by the proposed Clean Development Mechanism project activity”. The CDM stakeholder process takes place on a local and a global level.

On a local level the DOE is required to confirm that “comments by local stakeholders have been invited, a summary of the comments received has been provided, and a report to the designated operational entity on how due account was taken of any comments has been received” (UNFCCC, 2002, Art. 37b).

Moreover, on a global level the Marrakesh Accords require that for the project's validation the PDD has to be made publicly available (UNFCCC, 2002, Art. 40b) and that it shall be open for comments on the validation requirements from international CDM community for a period of 30 days (UNFCCC, 2002, Art. 40c). So the CDM is a transparent mechanism, project related documents are internationally available.

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<sup>66</sup>Please refer to section 2.4

<sup>67</sup>It must be stated that even under perfect conditions, if all stakeholders are well informed and if they influence the project outcome, this does not ensure sustainable development. There may still be intergenerational conflicts neither would such a situation reflect an intrinsic value of nature.

### **Needs to Ensure Sustainable Development**

The intention for a high degree of stakeholder involvement lies in the fact that this leads to CDM projects featuring a high level of sustainable development. From a game theoretic point of view there is need for clarification: Let's assume that the project owner tries to make money, the local stakeholders are interested in a sound implementation. For a good outcome (a win-win situation) there is first of all the requirement that all affected stakeholders are well informed.

But also a second requirement can be identified: There is not only need for public hearings and information. In addition it must be guaranteed that local people may have influence in the decision making process. Only a stakeholder process which fulfills both requirements assures that the project outcome reflects interests of those involved.

### **Critique**

Does the CDM meet both requirements? NGOs such as World Wildlife Fund and South South North (SSN)<sup>68</sup> heavily criticize the stakeholder process for a missing or an inadequate involvement of local stakeholders. Critics bemoan that

- There is no requirement that documents are available in a language familiar to stakeholders, or that adequate action is taken (The Gold Standard, 2002, 5).
- There are CDM activities which do not take all stakeholders into account. The projects should be presented not only to local authorities, but to the actual stakeholders (Rumberg, 2005).
- With respect to the global stakeholder process NGOs criticize that there is no opportunity for further comment on project developers' and DOEs' replies to stakeholder comments (The Gold Standard, 2002, 5).
- Some critics argue that although the global stakeholder process is transparent and well designed, NGOs do not frequently engage in the mechanism.

This shows deficits in both requirements. First it is not ensured that all stakeholder are well informed which is surely the main problem. Stakeholder are often not well informed about adverse and positive project impacts. This is also underlined by missing comments in PDDs – approximately 83% of hydro power projects (projects which surely

have significant impacts on their environment and which normally need an EIA) analyzed in chapter 7.2 state that there have been no adverse comments on projects. As discussed in Schmitz (2006, chapter 7., see discussion of the hydro power project *Kanyara Village*) there are also CDM hydro projects with no local stakeholder consultation at all. Rumberg from TÜV SÜD states that local stakeholders “contribute rarely to the global stakeholder process”(Rumberg, 2005).

Second, the end of the process is determined by the DOE's and project developer's comments. This design feature attributes a disproportional share of influence to the project's main beneficiaries.

Generally it must be concluded that CDM's stakeholder process faces significant needs of improvement.

#### **4.4. Monitoring Process**

The CDM monitoring rules only require the control of CO<sub>2</sub>e emission reduction activities. Consequently actions which are implemented in addition to the core project activities such as environmental education, afforestation and other community development actions are not monitored within the CDM.

Nevertheless, this monitoring process, controlled by the DOE, can be applied to ecological and social aspects directly related to the project activity as well. In the context of e.g. hydro power projects the monitoring process might include the supervision of minimal water flows or endangered endemic species. There exist several projects including Environmental Management Plans (EMPs) (sometimes EMP are not included in the PDDs) but, since these measures are not controlled by DOEs they are non-binding.

The application of monitoring rules for ecological and social matters is not a common practice<sup>69</sup>, they are rather exceptional. The only project known for employing monitoring for sustainable development is Fozal (PDD Fozal, 2003), none of the projects analyzed in chapter 7.2 employ monitoring in such a way.

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<sup>68</sup>For information about SSN please refer to chapter 6.1

<sup>69</sup>Application of monitoring for environmental/sustainability matters has been empirically analyzed in chapter 7.2

#### **4.5. Conclusion: Structural Dysfunction – A Race to the Bottom**

Neither the LoA, nor stakeholder rules, nor monitoring procedures ensure minimal requirements as discussed in chapter 4.1. Consequently it must be concluded that there exists a structural dysfunction in terms of achieving minimal sustainable development performance of CDM project activities.

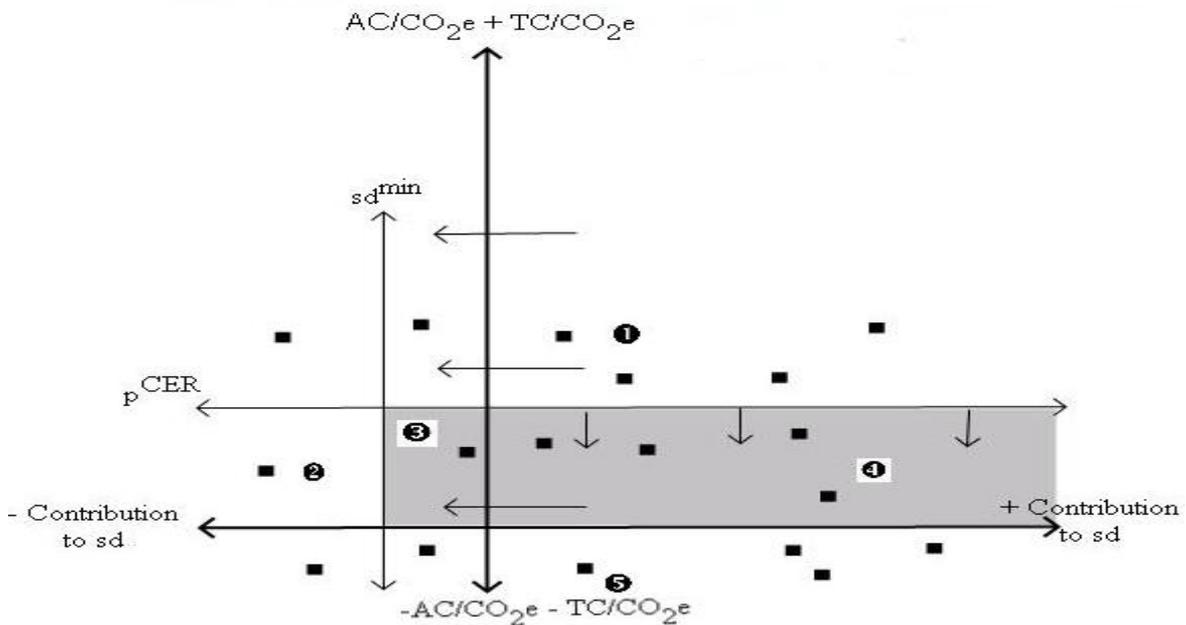
Although this has not been systematically analyzed so far, this outcome is no surprise. Thorne and Raubenheimer note (2002, 12) already at an early stage of the CDM that “since there is no clear guidance and no specific requirements regarding sustainable development in the Monitoring, Verification and Certification texts there is not even a minimal standard for sustainable development and nothing to prevent a “race to the bottom” among CDM host countries competing for investors.”

The race to the bottom argument theory adequately explains the actual development in the CDM project portfolio, experiencing the fast growing of non-renewable energy CDM projects. To outline this problem, it is necessary to take a look at host countries' interest. According to Michaelowa and Dutschke (2002, 18) the host country's main incentives for participating in the CDM are capital transfer, capacity building, job creation and reduction of local pollutants. Most developing countries are indebted and in deep need for Foreign Direct Investments (FDI). With respect to the CDM it is consequent to expect developing countries to focus mainly on capital transfer while other incentives mentioned above are of secondary importance.

CDM projects generate capital flows to host countries for up to 21 years for emission reduction projects and up to 60 years for re/afforestation projects (Ellis et al., 2004, 28). As carbon finance normally covers only a part of project costs, the CDM is moreover expected to leverage investments. Ellis et al. (2004, 7) estimate the degree of leverage six to eight times the amount of CER revenues.

But FDIs are considered to be extremely volatile: The CDM is more or less a global market; project developers may freely decide where to realize a project, they are by no means bond to a specific country. Therefore Michaelowa (2003, 1) predicted that “host countries will have to compete intensively for CDM investments.”

Figure 6: Consequences of Missing Sustainable Development Standards



Source: adapted from Sutter, 2003, page 69

These market settings put host countries in a situation where they can not act like Hobbes' almighty Leviathan, freely dictating market conditions leading to projects showing a good sustainable development performance; rather they find themselves in a *prisoners dilemma* where they need to compete for strongly needed FDIs. If all host countries require high sustainable development standards, all countries would be better off; but if a host country requires high sustainable development standards in a race to the bottom dilemma, CDM projects will be realized somewhere else. This can be illustrated by an adaption of Figure 5; Figure 6 shows how competition successively erodes minimal standards and may also lead to approval of projects having negative project impacts. The reduction of minimal standards means an extension of projects eligible for the CDM. Sherman concludes (2000, 3) that "no tools are put in place to secure that CDM projects are sustainable and contribute to development". Graphically it can be seen that this increases the range of possible CDM projects which would lead in a further step to a drop of CER prices. Consequences for renewable energy projects are analyzed in chapter five.

## 5. Sustainable Development Problems in the CDM

The following pages try to emphasize sustainable development problems within the CDM on two levels: This chapter is restricted to a market analysis of renewable energy projects focusing at a *crowding out* argumentation. For a discussion of CDM sustainable development aspects on a project level please refer to chapters six and seven.

### 5.1. Market Survey – The Crowding Out

Several authors connect the question of CDM's contribution to sustainable development to the question whether it promotes renewable energy projects in developing countries. Some argue that the promotion of renewable energy projects leads to a substitution of fossil fuels and thereby show desirable sustainable development impacts<sup>70</sup> on a large scale. Such an argumentation connects CDM's capability to achieve both goals to the existence of renewable CDM projects.

This proceeding is strongly based on logical principle of induction. There is no guarantee that a renewable project activity per se shows good sustainable development performance<sup>71</sup>; at this general level it is just possible that they potentially do so. For example to decide whether a hydro project contributes to sustainable development several criteria like a minimal water flow, impact on the local ecosystem, job generation etc. need to be assessed<sup>72</sup>. The sole fact that it substitutes fossil fuels by a renewable energy source does not make the project necessarily a sustainable one. Consequently in order to judge the sustainable development impact of some project types an assessment is imperative.

Nevertheless, the above mentioned approach can still be employed in a useful way. By comparing the number of project activities and quantities of CERs generated from renewable energy projects with the respective figures of other project types, the project classes that potentially show a good development performance can be compared with project classes that do not show any development impact. For this purpose the following

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<sup>70</sup>Several studies have certified that renewable energy projects are characterized by positive development impacts. See Factor AG, 2001 *SSC Obstacles and Opportunities*, and Afgan, Carvahlo, 2002, *Multi Criteria assessment of new and renewable energy power plants*.

<sup>71</sup>Please refer to Schmitz, 2006, chapters 3.3.1 and 3.3.2 for a discussion of positive and negative development impacts of hydro power projects.

<sup>72</sup>For a detailed discussion please refer to Schmitz, 2006, chapter 4.3

pages will provide an overview about actual development in the CDM.

### **5.1.1 Project Pipeline**

Following results are based on an analysis of the project pipeline in July 2005 of the Hamburgian Institute of International Economics (HWWA). The study contains projects from several development stages: projects to be submitted, projects submitted, projects under review and projects registered<sup>73</sup>.

The following project activity aggregation is based on the Gold Standard eligibility screen (Appendix V) which emerged from the *positive list* negotiation position of the EU up to CoP 6 (Langrock, Sterk, 2003, 3f). This screen has been applied to scope the two general project classes of renewable- and non-renewable energy projects.

A broad definition of renewable energy projects containing biomass, small scale (SSC)<sup>74</sup> hydroelectric, solar, wind, geothermal energy, as well as projects which are not renewable in a narrow sense such as energy efficiency and fuel switch projects has been adapted. Wind, geothermal energy, solar are defined as being the residuals and denominated as "Other Renewables".

Non-renewable energy projects contain land fill gas (LFG), HFC- and nitrous oxide (N<sub>2</sub>O) reduction, Waste Treatment and Wastewater Treatment as well as normal scale (NSC (> 15 Mega Watt (MW))) hydroelectric power projects. Waste treatment and wastewater treatment are denominated as *Fugitive Emissions*. Several LFG projects generate electricity and thereby contribute in a relative manner to sustainable development. In the following analysis, energy generated from the collection and the burning of landfill- and sewerage gas is not considered to be renewable as these projects apply as gas capture and destruction activities under CDM rules. All projects are classified according to their main GHG mitigation effect.

The pipeline contains 181 CDM projects generating 322,6 million CERs.

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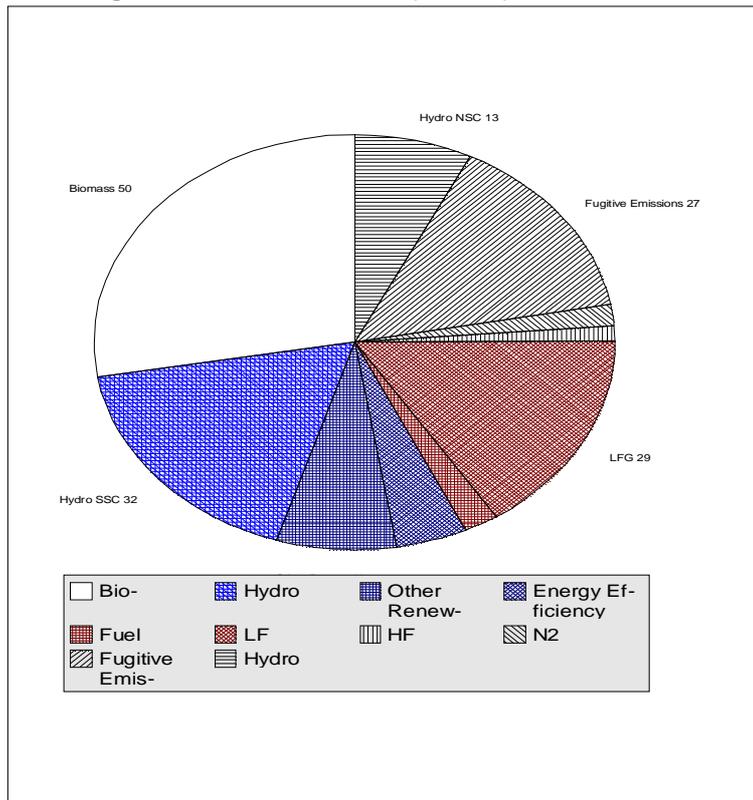
<sup>73</sup>For an overview of the several steps of the CDM project cycle please refer to Appendix I.

<sup>74</sup>Small Scale CDM Projects are defined in the Marrakesh Accords, UNFCCC, 2002, Decision 17/6c as renewable energy projects with an output maximum of 15 MW, energy efficiency projects with an energy consumption reduction equivalent of 15 gigawatt hours per year or project activities that reduce emissions directly and emit less than 15 kilotons of carbon dioxide equivalent.

Michaelowa's and Jotzo's estimation of the overall need for emission reductions of Annex B countries amounts to 1105 million tons of CO<sub>2</sub>e emissions (Michaelowa, Jotzo, 2005, 9). The present project pipeline consequently satisfies about 29.2% of emission reduction needs of Annex B countries. The project portfolio analysis shows two completely different pictures:

First, differentiation by the number of projects, aggregated in classes, as shown in Figure 7, demonstrates the dominating position of renewable energy projects which make up 59.1% (107 projects) of the total number of projects. Non-renewable energy projects constitute 40.9% (74 projects) of projects lead by LFG 16% (29 projects) and fugitive emissions with 14.9% (27 projects). For the complete data set please refer to Table 5, appendix VIII.

Figure 7: Number of Projects by Classes



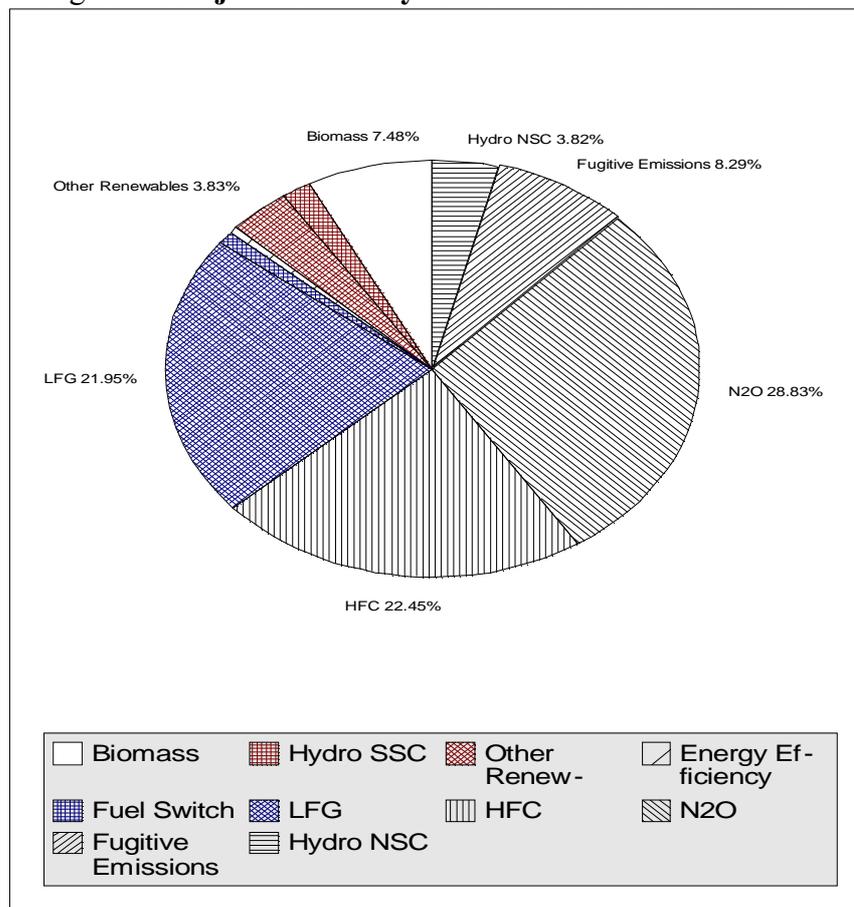
Source: Data from HWWA Project Pipeline

Focusing at CERs generated, differentiated by project classes, as shown in Figure 8, gives a completely different picture. Such an approach outlines the significant predominance of non-renewable energy projects making up 85.3% (275,3 million CERs)

of CERs whereas renewable energy projects generate 14.7% (47,3 million CERs).

N<sub>2</sub>O- and HFC projects dominate the CDM pipeline. Two N<sub>2</sub>O projects generate 93 million CERs, the N<sub>2</sub>O emission reduction project in Onsan, Korea (57,2 million CERs) easily outmatches the total amount of CERs (47,3 million) generated by all 107 renewable energy projects. Three HFC projects generate 72,4 million CERs and 29 LFG projects account for 70,8 million CERs.

Figure 8: Project Classes by CERs Generation until 2012



Source: Data from HWWA Project Pipeline

The dominance of non-renewable over renewable energy projects prevails in all parts of the world. As can be seen in Table 5 (Appendix IX), in whatever region, non-renewable energy projects generate two to ten times the amount of certificates compared to renewable energy projects.

Moreover, as the CDM project portfolio is changing fast, this supremacy may expand

further on. Ellis and Gagnon-Lebrun (2004, 7) note that the volume of expected certificates from non-renewable energy projects generated up to 2012 tripled from the end of 2003 to July 2004.

On the other hand this is not a foregone conclusion, since the sites for HFC-23 and N<sub>2</sub>O CDM projects may soon be depleted. Therefore, if no other gas capture and destruction project opportunities are identified<sup>75</sup>, it is likely that the share in both, the overall number of project activities and the amount of CERs generated of renewable energy projects will increase in medium term.

These results show that the scale of non-renewable energy projects is huge; renewable energy projects on the other hand are numerous but generate relatively few certificates. To understand the reason for this dominance of non-renewable energy projects and their implication for sustainable development it is by now time to take a short look at some characteristics of these dominant project classes.

### **5.1.2 Fundamentals – Gas Capture and Destruction**

The following digression does not assert claims to completeness and solely focuses on projects hardly showing any development impact:

#### **HFC-23**

Hydrofluorcarbon (HFC)-23 originates mainly from two production processes: It is a low-toxicity byproduct of the HCFC-22 production which is used as a refrigerant. Moreover HFC-23 also serves as feedstock of Teflon production (Pearson, 2005, 23). HCFC-22 production for non-feedstock purposes is controlled by the Montreal Protocol and is expected to phase out until 2040.

HFC-23 is decomposed when heated over 1200°C in a thermal oxidation chamber. Decomposition yields CO<sub>2</sub>, HCl and HF in a hot stream of off-gas. This stream is cooled down and acids and moisture are absorbed in an aqueous solution. Afterwards it is neutralized with slaked lime yielding CaCl<sub>2</sub> which get deposited. The remaining cooled and neutralized gas containing nitrogen, oxygen and carbon dioxide is vented into the

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<sup>75</sup>Since the CDM is not restricted to specific project classes or methodologies, it is possible that new GHG mitigation activities, profitable under the CDM, are identified. For example, according to the HWWA pipeline of July 2005, no sulfur hexafluoride CDM projects were developed.

atmosphere (PDD Ulsan, 2005, 7f).

HFC-23 is a GHG with a global warming potential of 11,700 which means that one ton of HFC-23 has a 11,700 times higher impact on climate than one ton of CO<sub>2</sub>. Consequently, the reduction of HFC-23 emission by one ton creates 11,700 CERs<sup>76</sup>. Abatement costs for the generation of one CER in HFC projects are estimated to be € 0,25 (Pearson, 2005, 24) whereas prices for CER actually range from € 5 to € 10 (Liptow, Michaelowa, 2005) making those projects financially attractive.

### **N<sub>2</sub>O Decomposition Projects**

Adipic acid (C<sub>6</sub>H<sub>10</sub>O<sub>4</sub>) is used as a main constituent of nylon, in the manufacture of some low temperature synthetic lubricants, synthetic fibers and coatings. It is produced by a two stage process. The first stage usually involves the oxidation of cyclohexane in order to produce a cyclohexanone/cyclohexanol mixture. In a second step this mixture is oxidized with nitric acid to produce the final good which creates Nitrous Oxide (N<sub>2</sub>O) as a byproduct. The N<sub>2</sub>O normally would be vented into the atmosphere. The CDM N<sub>2</sub>O decomposition activity plans to install a facility which converts N<sub>2</sub>O into nitrogen at high temperature (PDD, Onsan, 2005, 2).

Currently there exist two N<sub>2</sub>O CDM projects: Onsan in South Korea plans to generate 57.2 million CERs until 2012; the second project is located in Paulína, Brazil and will create 35.8 million CERs until 2012.

### **Conclusion**

Gas capture and destruction projects are financially attractive and are capable to reduce huge amounts of CO<sub>2</sub>e. HFC-decomposition and N<sub>2</sub>O reduction projects were not originally foreseen under the CDM (Ellis, Gagnon-Lebrun, 2004, 38). But as those low investment-, end of the pipe projects are financially attractive, although showing low development impacts, they develop fast under the CDM. Ellis et al. (2004, 32) note that “a large and rapidly growing portion of the CDM project portfolio has few direct environmental, economic or social effects other than GHG mitigation, and produces few

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<sup>76</sup>For a list of GHGs and their GWPs please refer to Table 2, section 3.3.2

outputs other than emission credits.”

The existence of these project classes is problematic because gas capture and destruction projects' contribution to sustainable development is more than questionable. Although it is the prerogative of the host country to approve their contribution to sustainable development, according to the Carbon Market Insight Newsletter (PointCarbon, 2005c, 2) there was a debate within the EB about HFC projects and their missing developmental and environmental benefits which lead to a delay of several projects.

### **5.1.3 Renewable Energy- vs Gas Capture and Destruction Projects**

Within the CDM framework, renewable energy projects face several disadvantages compared to gas capture and destruction projects. First, they are generally relatively capital intensive and provide low rates of return (Pearson, 2004, 5) whereas end of the pipe projects are characterized by relatively small investments and a short payback period (e.g. less than one year for HFC-23 projects (Ellis, Gagnon-Lebrun, 2004, 7))

Moreover, since renewable energy projects reduce only a small amount of CO<sub>2</sub>e compared to gas capture and destruction projects focusing on CO<sub>2</sub> emission reduction by substitution of fossil fuels and carbon, whereas non-electricity projects mainly reduce high potential GHGs like methane, N<sub>2</sub>O and HFC-23<sup>77</sup>, they consequently create a relatively small amount of certificates. As a result, a World Bank study demonstrates, as shown in Figure 9, that revenues from selling CERs stemming from renewable energy projects are small and do not significantly improve the projects' internal rate of return.

Furthermore, as transaction costs are not directly proportional to the amount of CERs generated, renewable energy projects bear significantly higher transaction costs<sup>78</sup> per CER. Outcomes in tables three and four show that 107 renewable energy projects generate 47.3 million CERs until 2012 which results in an average size of 442,178 CERs per project. 74 non-renewable energy projects create 275.3 million CERs until 2012 leading to an average project size of 3,720,378 CERs. If this is set in contrast with

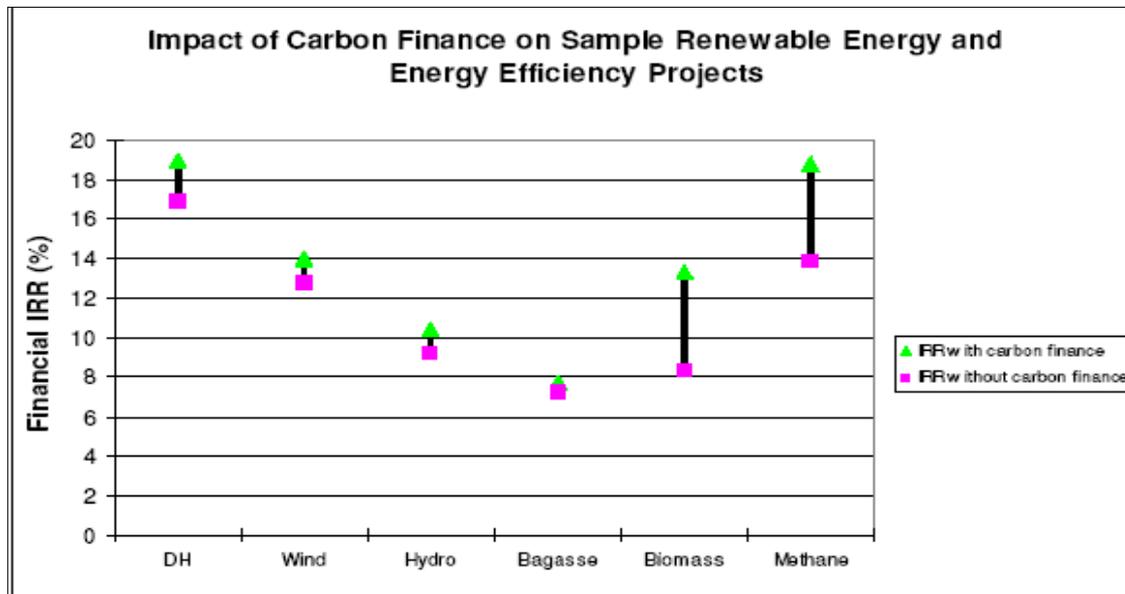
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<sup>77</sup>The global warming potential of methane is 21 times (N<sub>2</sub>O 310 times, and HFC-23 11,700 times) the CO<sub>2</sub>'s potential; for a list of GHGs and their GWPs please refer to Table 2, section 3.3.2

<sup>78</sup>For a short explanation of transaction costs please refer to section 3.5.2

minimal fixed transaction costs of € 150,000 as projected by Michaelowa et al. (2003b, 15), renewable energy projects are charged with € 0.34/CER whereas non-renewable energy projects carry a burden of € 0.04/CER.

Figure 9: **Impact of Carbon Finance on a Sample of Projects**



Source: World Bank in EEP, 2004, 33

All these arguments indicate considerable disadvantages of renewable- compared to non-renewable energy projects in the carbon market. As demand for CERs is not completely inelastic, it must be concluded that the existence of gas capture and destruction projects showing hardly any development impact, (making up of 85.3% of CERs ) decreases the CER price significantly and thereby reduces CDM's capability to co-finance high impact renewable energy projects in Non-Annex I countries.

#### 5.1.4 Sustainable Development vs Additionality

Renewable energy projects not only suffer from significant disadvantages in financial matters, they also encounter difficulties in proving additionality. For example not a single renewable energy project of the Dutch CERUPT<sup>79</sup> program has demonstrated additionality (Pearson, 2004, 2). One of the Clean Development Community Fund<sup>80</sup>

<sup>79</sup>The Certified Emission Reduction Unit Purchase Tender (CERUPT) of Denmark of the Netherlands engaged at an early stage in the CDM and its capacity building.

<sup>80</sup> The Clean Development Carbon Fund (CDCF) is associated to the World Banks Prototype Carbon Fund and has the aim to purchase GHG emission reductions and thereby promote development in Least Developed Countries. More specific, the fund focuses at (World Bank, 2003c, 16)

- Reduction of poverty and improve quality of life in local communities
- Help to build emission reduction projects in disadvantaged countries

projects, the project La Esperanza experienced considerable problems when getting registered. After five members of the EB voted against its registration because doubts persisted that it was not additional, the project was put under review<sup>81</sup>.

There are strong signals that there exists an inverse correlation between clearly additional and sustainable projects. End of the pipe projects like HFC-23, CH<sub>4</sub> and N<sub>2</sub>O reductions have lesser troubles proving their additionality. The reason for that phenomena is that gas capture and destruction project activities involve investments whose *only* return are CERs (Ellis, Gagnon-Lebrun, 2004, 2). Thus, they would never have occurred without the CDM. Whereas for example small hydro power projects, generating few credits and bearing relatively high transaction costs occur both, with and without CDM funding. Here an additionality proof is much more difficult. But those projects tend to create demonstrable positive development impacts, such as supplying electricity in remote regions, thereby creating business opportunities, jobs etc.

An additionality prove is more difficult for renewable energy projects because, as discussed above and shown in Figure 9, the impact of carbon finance on CDM renewable energy projects is limited and thus the difference from business as usual projects is hard to prove.

Moreover there is another aspect hampering the additionality proof for renewable energy projects. If for example a small hydro project relied on revenues from CERs, increasing IRR by 1-2%, the project is most unlikely to be realized. This situation also adequately explains the fact that renewable energy projects rarely employ an IRR analysis in order to prove their additionality.

Furthermore, this situation is even worse, since banks normally do not accept CERs

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- “Leverage private capital flows for sustainable development” (World Bank, 2003c, 16)
  - “Offer information to the Parties to the UNFCCC and other interested parties for the further development of the Clean Development Mechanism” (World Bank, 2003c, 16).

To achieve this goal, the CDCF actively seeks countries and communities that are actually not involved in carbon finance (World Bank, 2003c, 16) and commits to invest 25% of the first tranche of its funds “in Least Developed Countries or other poorer countries with a population of less than 75 million” (World Bank, 2003c, 2)

- purchases CERs from SSC projects (World Bank, 2003c, 17)
- is willing to pay higher prices for certificates than from larger CDM project activities in well established countries.

<sup>81</sup>A CDM project activity is listed *Under Review* if there are objections by at least three board members or

as collateral for loans (Pearson, 2004, 6) which is especially true for renewable energy projects bearing higher risks of not passing the additionality test.

Consequently renewable energy projects face a priori difficulties to prove financial barriers, an important constituent for the additionality prove. If prices for CERs increased, there would be more potential to design a CDM activity differently from a business as usual project, facilitating the additionality proof. But as long as the CDM market is dominated by low cost gas capture and destruction projects creating relatively cheap certificates such a development is most unlikely.

## **5.2. Sustainable Development Assessment on the Project Level**

Here it need to be stated that the fact that a project activity is a renewable energy source does not ensure that it contributes to sustainable development. As such projects typically feature strong interrelations with social, economic and environmental dimensions, they bear both, a great potential for sustainable development but also the ability to create adverse impacts. Sutter (2003, 161) summarizes this with the words “renewable does not mean sustainable”.

To exemplify the observation mentioned above and to highlight the ongoing debate over controversial hydro projects, which are relevant to the CDM as well, their negative impacts are examined in Schmitz 2006, chapter 3.3. This will show that missing best practice standards such as the World Commission on Dams (WCD) guidelines potentially have some negative implications.

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one party involved concerning “issues associated with the validation requirements” (UNFCCC 2004c, 2).

## 6. Sustainable Development Assessments for CDM Projects

Since the capability of CDM projects to contribute to sustainable development has been questioned, several approaches to assess and/or to ensure sustainable development impacts of CDM projects were developed so far. This chapter provides an overview of existing assessments models and tries to appraise their suitability to evaluate the effects of CDM projects and to solve the race to the bottom dilemma<sup>82</sup>.

More precisely, the assessment models are examined on following aspects:

- **Consistency of Results**

Does the application of an assessment guarantee valid results?

- **Completeness**

Does the assessment include a complete list of indicators to be checked, or has a way been chosen which leaves the determination of indicators to the assessment process itself, e.g. through a stakeholder process?

- **Efficiency**

Does the assessment algorithm contribute to solving the race to the bottom problem e.g. through a framework of checks and balances?

In order to guarantee optimal efficiency of application, attention has also be drawn to the avoidance of an assessment of criteria which are already ensured by applying CDM rules.

If an assessment tool fulfilled these criteria, it would ensure that the results of the project's impact assessments correspond to real changes in social, economic and environmental systems, being caused by project activity. Moreover this would guarantee that all relevant impacts are examined. If all relevant impacts are assessed and results are true, this excludes the possibility that project impacts are negative but assessment results show a positive outcome. Finally, a well conceptualized assessment tool does not collect non-relevant data and therefore it does not waste resources in the assessment process. A sustainable development assessment which fulfills these criteria can therefore be

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<sup>82</sup>See chapter 4.5

considered as an ideal approach.

All methodologies presented here are so called Multi Criteria Approaches, since they assess not just a single aspects of development, but multiple ones. This multidimensional character allows for a consideration of a broader concept of development, as discussed in chapter two.

## **6.1. South South North – Sustainable Development Appraisal Tool**

South South North (SSN) is a non-profit non-governmental organization (NGO) (Thorne, Raubenheimer, 2002, 56), with its principal office in South Africa, financed by the Netherlands<sup>83</sup>. The SSN activities are located in South Africa, Brazil, Bangladesh and Indonesia. The organization<sup>84</sup> focuses on good implementation of CDM and engages in capacity building (SSN, 2005).

The Matrix tool has been developed in three steps: First, at an early development stage of the CDM, Helio (SSN's parent organization) and SSN provided a survey of *good operating* indicators for CDM projects, which are also applicable for sustainable development assessment (La Rovere, Thorne, 1999, 11ff). In a second step those first indicators have been refined and published as a tool in order to make the assessment of sustainable development operational (see Thorne, Raubenheimer, 2002). This tool consisted of an eligibility screen, a sustainable development test and an additionality test. Finally, SSN published the Sustainable Development Appraisal & Ranking Matrix Tool, which will be analyzed below. This tool is designed to rate sustainable development impacts only. The eligibility screen was excluded and is now published separately in a distinct SSN CDM development tool<sup>85</sup>. Since many CDM projects were failing to prove their additionality, the CDM Executive Board has published strict guidelines<sup>86</sup> for proving projects being additional, therefore an additionality test would be redundant and was excluded as well.

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<sup>83</sup>Information from the Gold Standard Side Event at Carbon Expo, Cologne, 2005.

<sup>84</sup> See [www.southsouthnorth.org](http://www.southsouthnorth.org) for further Informations.

<sup>85</sup>See [www.cdmguide.com](http://www.cdmguide.com)

<sup>86</sup>CDM Watch, Greenpeace and IRN approve that so far CDM shows good practice in excluding non-additional hydro power projects, see Pearson et al. 2003, 2.

The Matrix Tool was created for “appraising and rating projects at the time of project design and approval” (SSN, no indication of time, 3) and to guide DNAs' evaluation of sustainable development contribution of projects<sup>87</sup> (SSN, no indication of time, 8).

### **The Approach**

The SSN Sustainable Development Appraisal & Ranking Matrix Tool is designed as a top-down approach. It consists of three pillars, which cover social, economic and ecologic impacts and are screened by a list of indicators (see Appendix IV). That means that the list of indicators is neither adjustable to specific situations of environmental, economic and social systems nor to specific assessment needs of different types of CDM projects (see Appendix IV). Such a top-down proceeding bears advantages and disadvantages.

On one hand (under the assumption that indicators are well chosen; please refer to Discussing Indicators) this kind of approach eliminates the possibility to evaluate indicators of no relevance and to ignore indicators which are relevant. So, if indicators are well chosen, the top-down approach means a big step towards good assessment results because at the level of choosing appropriate indicators it does neither depend on the assessors knowledge about sustainable development nor on her good will.

On the other hand this leaves the assessor without any possibility to react on very heterogeneous environmental conditions in Non-Annex I countries. Those conditions range from tropical to cold temperature, so project assessment is confronted with very different needs.

Neither does this approach allow a specification of CDM project impacts. Thus, all the different impacts are assessed by using the same indicators. As it is conceptualized for CDM energy projects only, not for land use and forestry (SSN, no indication of time, 3), this limitation allows a more precise selection of indicators.

The Matrix Tool features an evaluation process allowing to assess the target score of

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<sup>87</sup>For two case studies of an application of the SSN Matrix Tool see UNEP, 2004, chapter 8.2.2

indicators. The scoring system ranges from -2 to +2, whereas the subtotal of each pillar needs to score at least -1 and each indicator must score better than -2. It was stated above that at the level of choosing indicators valid results do not depend on the assessors good will. But does this also hold true for the level of evaluation? In order to answer this question it is necessary to clarify the group interests of the two kinds of stakeholders who are expected to apply the scoring scheme:

First, the project developer has to prove that the project under consideration contributes to sustainable development. If she rates an indicator -2, the project fails to comply with the eligibility criteria of the Matrix Tool and cannot be rated as a CDM project. But as the project designer has an interest in designing projects, generating revenues for her, she will try to avoid the exclusion criteria. And as there are no explicit criteria which impacts should be rated as -1 and which as -2 there is no way to prove a rating to be false. Consequently it is unlikely that the project designer would really evaluate an indicator -2 even if the indicator should be rated so. Therefore project developers applying the Matrix Tool, can not be seen as a guarantor that the project in question will contribute to sustainable development.

Moreover the DNAs are expected to use the Matrix Tool in order to assess the project's contribution to sustainable development. As there are no relevant differences between DNAs in general and DNAs applying the Matrix Tool from a game theoretic point of view, please refer to chapter 4.2 and 4.5 for a discussion of DNAs interests towards sustainable development.

The Matrix Tool does not only consist of a weighing of achievement of indicators, in a further step the indicators are summed up to illustrate the project's total contribution to sustainable development (Appendix IV). This implies that all indicators deserve the same weights which does not necessarily reflect decision makers values<sup>88</sup> (Sutter, 2003, 39). This deficit is just relevant in case of a quantitative assessment whereas no problem occurs, if the only assessment goal is to determinate whether a project contributes to sustainable development or not. In this case, according to definition of sustainable development in chapter 2.3 the subtotal of each of the three pillars should be nonnegative

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<sup>88</sup>For discussion of values, see chapter 2.3

and at least one subtotal should be positive.

### **Discussing Indicators**

The Matrix Tool features a list of indicators which are arranged in concordance with the above mentioned three pillars. As this indicator matrix has also been adapted by the Gold Standard (SSN, no indication of time, 3), the indicators incorporated are discussed in more detail.

As already stated, the criteria are assigned to the three pillars: environmental, social and economic development (SSN, no indication of time, 5, see Appendix IV) and indicators are assigned to these pillars.

Environmental criteria are differentiated in these groups: local, regional and global environment. Criteria such as air and water quality are of a very general nature, with the result that it is not ensured that relevant indicators are employed. The criteria *Air Quality* with proposed indicators *Emissions – other than GHGs* avoids a double collection of data and demonstrates thereby an orientation which is complementary to the CDM framework. This prevents additional costs.

Social criteria have a clear poverty alleviation orientation, so that the poorest in society get better off. The social pillar features education, empowerment, gender issues, access to energy services a.s.o.

Economic and technological criteria feature employment, balance of payments and technological self reliance (which seems to be a luckier formulation than the imprecise *technological transfer* which is employed by the UNFCCC).

Overall it should be stated that as a consequence of the great range of application, SSN chose broad criteria to assess sustainable development. As criteria cover a wide range of aspects and, since they are quantifiable, they can be considered to be well chosen. But the criteria are too general in order to quantify project impacts precisely and consistently. Thus, the Matrix tool should be seen as comprehensive introduction in sustainable development but cannot be applied as a complete measurement.

### **Ability to Solve the Race to the Bottom Dilemma?**

The SSN Matrix Tool provides a comprehensive methodology and has been successfully applied in several CDM projects (SSN, no indication of time, 8; see also

chapter 4.2). It is an appropriate tool to guide CDM project developer and provides even more valuable advice to DNAs in how to scope project impacts. The active promotion of the Matrix Tool among DNAs (SSN, no indication of time, 8) is likely to result in a more precise application of the sustainable development concept within the CDM.

But for reasons discussed above, this tool is neither suitable to evaluate precisely the sustainable development impacts of a project nor does it guarantee a strict application of CDM's first goal of sustainable development.

## **6.2. The Gold Standard**

The Gold Standard (GS) is a framework for the creation of high quality CERs and ERUs, (The Gold Standard, 2002, 1) thus, basically it can be seen as an independent quality label for CO<sub>2</sub>e emission reductions. These high quality certificates reach higher prices than the standard market price for CERs/ERUs, e.g. the United Kingdom government paid € 14.7 for 10 000 CERs from the Kuyasa Gold Standard project (Liptow, Michaelowa, 2005b, 2). Therefore the GS claims that its framework creates financial incentives for promoting paradigm shifting technologies (The Gold Standard, 2003, 2). The GS was developed by the Standards Advisory Board (The Gold Standard, 2003, 2f) which consists of the WWF, several other NGOs, academics and private sector experts (The Gold Standard, 2003, 7).

The GS aims to achieve a “balance between environmental rigor with practicality in terms of application by project developers and operational entities” (The Gold Standard, 2002, 7). Therefore the GS claims to combine sustainable development and the avoidance of elevated transaction costs<sup>89</sup>.

In order to be eligible for the GS label, GS requirements have to be met in addition to the standard CDM demands and need to be met in order to. Those requirements are

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<sup>89</sup>Additional transaction cost for compliance with the GS requirements are estimated at 50 cents US\$ per ton CO<sub>2</sub>e (personal communication with Michael Schlup, Base Energy, March 15<sup>th</sup>, 2005). Although this projection is problematic because real costs are strongly related to specific ecological and social circumstances it gives a rough idea of what additional costs will be.

incorporated in a standardized GS-Project Design Document (GS-PDD). This procedure features the advantage that all the information of relevance, also for sustainable development issues, can be found in a standardized document.

In March 2005 a new GS-PDD (adapted to CDM-PDD version 2) draft was released, which during the time of writing still has to be approved by the GS-advisory board<sup>90</sup>. As the draft is complete and well elaborated, discussed in the following section.

The GS has two principal objectives: First it focuses to create credible emission reductions. This shall be achieved by reducing uncertainties about additionality (The Gold Standard, 2003, 2) through a strict additionality proof, using UNFCCC's "Tool for the demonstration and assessment of additionality"<sup>91</sup> (The Gold Standard, 2005, 4) and through strict official development assistance (ODA) rules (The Gold Standard, 2005, 5).

Second, the GS aims to promote sustainable development. The approach chosen will be discussed in the subsequent section.

### **Approach**

In order "to ensure that sustainable development aspects of CDM project activities are maximized" (The Gold Standard, 2003, 5), the GS employs a combination of three ways of making CDM project impacts sustainable: An eligibility screen, the sustainable development matrix and a stakeholder procedure.

### **Eligibility Screen**

First, sustainable development shall be guaranteed by using an eligibility screen (The Gold Standard, 2005b, 8, see Appendix V) which excludes unsustainable types of projects (projects which do not feature sustainable development aspects beyond CO<sub>2</sub>e emission reduction) from applying for the GS (The Gold Standard, 2005, 3). This eligibility screen defines a positive list of project categories which corresponds largely to the negotiation position of the EU up to CoP 6<sup>92</sup> (Langrock, Sterk, 2003, 3f). Project

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<sup>90</sup>See <http://www.cdmgoldstandard.org/downloads.htm>.

<sup>91</sup>See <http://cdm.unfccc.int/EB/Meetings/016/eb16repan1.pdf>

<sup>92</sup>As the EU designed the *Linking Directive* (linking CDM/JI to the European emission trading system (ETS)), the community still had the possibility to establish a positive list (Greenpeace, IRN. 2003). Astonishingly at that point of time the political will for implementation of a positive list has faded.

categories excluded are activities which bear great risks in terms of sustainability and additionality<sup>93</sup> such as large dams, sinks (The Gold Standard, 2002, 5) and gas capture and destruction projects.

Although there is no reason why this screen can improve the additionality dilemma, as argued by NGOs (Michaelowa, 2001, 9), it is most likely<sup>94</sup> that such a positive list will ensure sustainable development impacts of GS-projects.

### **Participation Procedures**

According to the GS, “adequate stakeholder consultation is key to ensuring that the project brings real sustainability benefits” (The Gold Standard, 2003, 6). Consequently the GS incorporates explicit public participation procedures, which are wider, compared to CDM requirements: In order to fulfill the GS stakeholder process, “comments must be actively invited” (The Gold Standard, 2005b, 18) and meetings need to be carried out in local languages (The Gold Standard, 2005b, 18). Furthermore in the course of the consultation process an Environmental and Social Impacts Checklist must be addressed (The Gold Standard, 2005b, 15ff). This procedure ensures adequate information of local stakeholders about project impacts and about the idea of sustainable development. Finally stakeholders can influence the decision making process by conducting an EIA (The Gold Standard, 2005b, 11; see Appendix VI)

These requirements guarantee, if applied, the integration of stakeholders in the project's development process. Therefore GS project outcomes will probably reflect both, the project developers interests and the needs of local population.

### **Discussing Indicators**

Finally, project developers need to elaborate the SSN Matrix Tool (The Gold Standard, 2002, 10) in order to be eligible for the GS. The Matrix Tool can be seen as a good indicator for sustainable development impacts, but it is not eligible to use it for a quantitative assessment of project impacts. For further discussion please refer to chapter 6.1. In addition to the SSN Matrix Tool, the GS features a list of indicators which have to

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<sup>93</sup>The Gold Standard was criticized for its eligibility screen (Bode, 2004, 2), which excludes projects which can clearly prove their additionality and provide cost efficient emission reductions. But this critics did not consider the environmental purpose of the eligibility screen.

<sup>94</sup>Sustainable development impacts of these project categories have been empirically proved; see for example Factor AG, 2001, *Small-Scale CDM Projects: Opportunities and Obstacles*.

be considered as minimal criteria by an EIA. These requirements are specified for run of the river (The Gold Standard, 2005b, 12) and dam projects (The Gold Standard, 2005b, 13) and are based on the World Commission on Dams guidelines<sup>95</sup> (The Gold Standard, 2005b, 13). As the World Commission on Dams guidelines are widely accepted, this procedure ensures at least a minimum consideration of ecological and social needs of the local environment<sup>96</sup>.

### **Control**

In order to guarantee the application of those three sustainable development measures, the GS provides additional control features: The DOEs are obliged to certificate that the project “demonstrates compliance” (The Gold Standard, 2003, 7) with GS rules. Furthermore a GS steering committee (The Gold Standard, 2003, 7) will control single projects to audit compliance with GS rules.

### **Ability to Solve the Race to the Bottom Dilemma?**

If applied, the eligibility screen, the efficient stakeholder process, the SSN Matrix tool and additional control provide a consistent framework to ensure sustainable development. These measures will create strong positive project impacts on social and ecological environment. Furthermore the flexible stakeholder process ensures efficient use of resources during project development and therefore avoids a further increase of already elevated transaction costs (The Gold Standard, 2002, 7).

Thus, the GS itself can be regarded as a consistent tool to ensure sustainable development. Nevertheless it is questionable if it will succeed in the carbon market. By March 10<sup>th</sup>, 2006 so far four GS projects are registered in the GS database (GS, 2006).

Its success is bound to one question (Langrock, Sterk, 2003b, 16): Can the GS create credibility? As promotion has just been relaunched<sup>97</sup> after a period of non-activity, it still has to establish itself in the market. Market penetration is crucial, since, only if the standard is well known, it will be possible to achieve a higher willingness to pay for premium certificates and thus cover higher fixed costs.

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<sup>95</sup>See Dams [www.dams.org/report](http://www.dams.org/report)

<sup>96</sup>For a discussion of the Gold Standard dam and run of the river indicators please refer to Schmitz, 2006, chapter 5.2.3

<sup>97</sup>After over one year of inactivity the Gold Standard is now administered by Base brought up to date and

### 6.3. Sustainability Check-Up

Christoph Sutter is one of the few authors who is seriously dealing with the already discussed aspects of sustainable development within the CDM. In addition he is an expert in evaluating projects in Non-Annex I countries. In his book *Sustainability Check-up for CDM* Sutter introduces a specific instrument to assess CDM projects, called Multi-Attributive Utility Theory for CDM Assessment (MATA-CDM) which is based on the multi-criteria decision approach, but in contrary to other assessment methodologies introduced in this chapter, it is an open approach. The assessment procedures are focused on a possible application by DNAs.

MATA-CDM has been developed and tested by the Swiss Federal Institute of Zürich (Sutter, 2003, 78) which means that the Sustainability Check-up benefits from practical experiences gathered by this institute. Based on those findings the approach was refined even further.

#### Approach

In general Multi Criteria Methodologies choose various criteria for sustainable development aspects. In a further step specific indicators are associated with these categories. To be more explicit, if the decision has to be made whether a project contributes to sustainable development or not, different impacts need to be assessed. In a final step to evaluate the project's overall outcome, assessment results have to be judged. If this final step is omitted, the assessor would have data about the project's implications but she would be unable to say, if the project as a whole is sustainable.

Out of all methodologies discussed in this chapter, the MATA-CDM is the only approach that reflects what Sen calls “constitutive plurality<sup>98</sup>” (Sen, 1985, 2). This is for two reasons: First, it reflects the multi-dimensionality (Sutter, 2003, 74) of sustainable development because MATA-CDM deals with multi objective and multiple decision

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again promoted actively. See [www.cdmgoldstandard.org](http://www.cdmgoldstandard.org)

<sup>98</sup>In his lectures to the standard of living, Sen introduced the two counterparts constitutive and competitive plurality. Competitive plurality tries to reduce the standard of living and therewith inherently connected, development on one fixed indicator. In these approaches there exists only one single factor which determines the standard of living like for example the GDP. In contrary, constitutive plurality is an approach which assesses the standard of living by employing a multitude of indicators.

makers. (Sutter, 2003, 76). Second, it reflects the subjectivity<sup>99</sup> of sustainable development because local stakeholder can participate in the stakeholder procedures and thereby influence the assessment outcome.

Through MATA-CDM decisions can be made even when the whole set of alternatives is unknown. This is a typical decision situation of DNAs. Since DNAs have to decide if a project contributes to sustainable development without knowing all other alternatives, this reflects the standard decision making situation (Sutter, 2003, 76).

### **Methodology**

The MATA-CDM consists of five steps<sup>100</sup> which will be discussed in the following:

Since no fixed criteria in the MATA-CDM exist (Sutter, 2003, 80), criteria have to be identified in a first step (Sutter, 2003, 80) reflecting environmental and living conditions in Non-Annex I countries and the project impacts, arranged to the three pillars of sustainable development. The fact that there exists no fixed set of criteria allows a feasible implementation, but in the same time this bears the risk of an inadequate adaption to any specific situation.

In the second step indicators have to be defined. As in the first step, these indicators have to be chosen according to the assessment needs as well. For an example of a set of indicators, please refer to Appendix II. Indicators can be characterized as quantitative, semi-quantitative or qualitative (Sutter, 2003, 82). Quantitative indicators use a cardinal scale to assess impacts. E.g. fossil energy resources substitution is a clearly quantitatively measurable indicator (Sutter, 2003, 82f). A semi-quantitative indicator is based on quantitative data which are subject to an expert judgment. For example Regional Economy is a semi-quantitative indicator; the regional economy structure is quantitatively analyzed. Based upon this results an expert estimates the project impacts qualitatively (Sutter, 2003, 83). Finally qualitative indicators are applied to those criteria where a quantitative assessment is not possible or where sufficient data is not accessible. Qualitative Indicators are assessed according to a scale from good to bad (Sutter, 2003, 83f).

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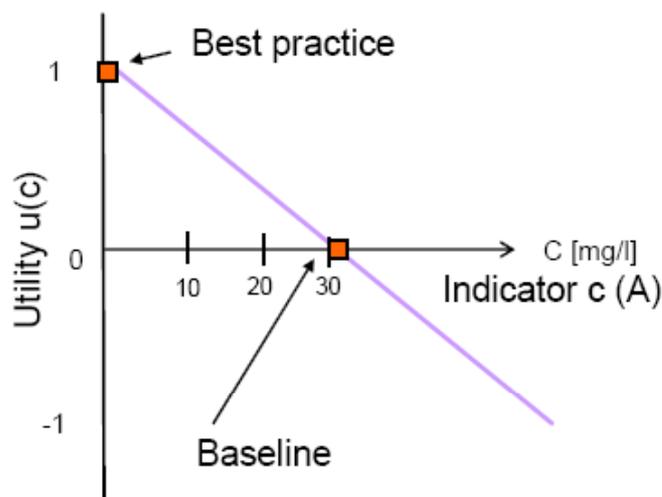
<sup>99</sup>For discussion of normative values see chapter 2.4

<sup>100</sup> For an overview about steps and their central equations please refer to Sutter, 2003, 79.

Assessed indicators should get transformed in an utility function whereas the output of the function varies from -1 to +1 in order to reflect positive or negative project impacts compared to a baseline. The example in Figure 10 shows a linear, downward sloped utility function which reaches from -1 to +1 whereas +1 is the best practice solution for the criteria C, measured in mg/l. The baseline with a utility of zero is set at 30 mg/l (Sutter, 2003, 85). A value of indicator ranged somewhere between zero and 30 mg/l will consequently create a positive project impact and an utility located between zero and one.

In a third step, criteria and indicators have to be defined through an assignment of weights. The weighing of an indicator should reflect the arithmetical average of preferences of all stakeholders (Sutter, 2003, 86).

Figure 10: Procedure to Define a Utility Function



Source: Sutter, 2003, page 85

Using the arithmetical average of preferences implies that all stakeholders are equally affected by project impacts. As a result, assessment outcome is most likely to be distorted, since it is probable that stakeholders are unequally affected. According to the principle of equity, the utility function needs to reflect this imbalance. But as this is probably beyond the scope of reasonable efforts, an average weighting is employed.

MATA-CDM proposes two weighing methods: Direct Weighing and the Analytic

Hierarchy Process. In the direct process, evaluators need to specify weights numerically (for an example see Heuberger, 2003, in Sutter, 2003 page 87) whereas in the hierarchical process weighing is conducted through ordinal rankings. For accurate discussion of methods see Sutter, 2003, page 87 for direct weighing and pages 88-91 for analytic hierarchy process.

Once the first three steps are completed, the methodology is ready to be applied to CDM proposals in a fourth step. For each project all criteria and indicators should be measured by an assessment team or by a stakeholder inquiry (Scholz and Tietje, 2002, 162, in Sutter, 2003, 91).

In a last step project ratings get aggregated to a number that should represent the total utility of a project during the crediting period with regard to sustainable development (Sutter, 2003, 91). The MATA-CDM employs an additive model to aggregate utilities from indicators which implies that a weak indicator can be compensated through a high scoring of other indicators.

It is strongly recommended that minimum utility levels for criteria are defined in order to exclude massive and irreversible negative project impacts.

Furthermore, the MATA-CDM offers the possibility to define a threshold of a minimal overall utility. This utility level has to be defined by a political process. In order to reflect the projects need to have a positive impact, only projects should receive the LoA which pass a certain utility scoring.

### **Critique**

In the MATA-CDM weighing process the arithmetical average of all individual preferences is reflected. Since it is not ensured that assessment results are true, if not the interests from all parties are reflected, this requirement tends to be problematic, for at least two reasons:

At first, in bigger projects, taking all stakeholder interest into account may turn out to be difficult. In a dam project for example, there may be a lot of different affected groups: People which profit from electricity supply, locals which can use the reservoir for irrigation purposes, others which may have less water supply downstream, caused by groundwater decrease, fishers whose livelihood may be affected because the continuum

of ecosystems is disconnected, people which have to be relocated because their homeland will be flooded etc. Consequences of these projects are not only limited to local environment but may also affect more distant regions. Therefore it may be difficult to account for all stakeholders preferences.

Moreover, even if all of these interest groups are represented, a pure stakeholder approach will ignore at least two aspects: At first it will not take needs of future generations into account. Second, such an approach may have difficulties in handling positions based on an intrinsic value of nature<sup>101</sup>.

The second reason is that microeconomic theory proved interpersonal utility comparison, as employed in generating utility functions to be problematic. In theory this is called theorem of “Nonuniqueness of Utility Measures” (Nicholson, 1998, 70). Any value of an indicator can be assigned to numbers of utility. But there is no way that these arbitrary assigned numbers or utility levels will be unique. A certain value of an indicator A can be assigned to any number; e.g. utility from indicator A,  $U(A) = 0.5$  or can as well be  $U(A) = 1000$ . If this is also true for indicator B, then there is no difference between  $U(A) = 0.5, U(B) = 0.6$  and  $U(A) = 0.5, U(B) = 1000$ . In either case these numbers only imply that B is preferred to A. So, as assignment of utility level is arbitrary, utility is only defined up to order preserving, monotonic transformation (Nicholson, 1998, 71). Consequently, the lack of uniqueness shows “that it is not possible to compare utilities between people” (Nicholson, 1998, 71). This implies that the generation of utility functions based on cardinal comparisons with respect to the MATA-CDM is not eligible for analytical reasons.

#### **Ability to Solve the Race to the Bottom Dilemma?**

The MATA-CDM strongly relies on the approving body. DNAs are responsible for choosing criteria, indicators and for generation of utility functions. If these steps are completed carefully, assessment will have valid results and approval/refusal of projects will be accomplished correctly.

## **7. Sustainable Development Analysis of Hydro CDM Projects**

### **7.1. Methodological Approach**

At an early stage of the CDM Begg et al. stated (1999, 1) that “the essential feature of implementing the CDM will be to balance the aim of contributing to the sustainable development of the host countries with the need of the donor countries to achieve GHG emission reduction”. As by now the first CDM projects got registered, the time has come to take a look at the projects to judge if they achieve both goals, GHG emission reductions as well as contribution to sustainable development.

In order to deal with this question this chapter applies two distinct approaches:

First, the result of a survey concerning PDDs from the UNFCCC pipeline are discussed. Due to limited resources this research had to focus on a specific CDM project class. For several reasons hydro projects are analyzed: As hydro activities comprise huge financial investments<sup>102</sup> and imply massive social and ecological consequences, they are among the most promising project types in terms of positive development impacts. At the same time, if badly designed, they bear a considerable potential for environmental disasters. Larger hydro projects often get heavily criticized for being non-additional. Thus, hydro projects promise to be an interesting field of research.

Consequently all hydro projects available at the UNFCCC homepage are screened, enabling to focus on projects which are already in an advanced stage of completing the CDM project cycle. Only projects that are either in the validation process, under registration or are already registered are taken into account. Since substantial efforts and costs are required to advance projects to the level of validation, an analysis at this stage guarantees that only legitimate projects are considered. Thus this procedure allows to exclude projects which give it a try under the CDM and often proved to be non-additional.

Such an approach only allows to examine the argumentation given in the PDDs, but not the actual project impact itself. It is still possible that projects do not adhere to

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<sup>101</sup> See chapter 4.3

<sup>102</sup> Hydro projects stand for large investments compared to other CDM activities. A World Bank study

statements given in the PDDs as well as it is possible that some of the projects sustainable development aspects are not mentioned so that the projects real performance is better than the survey's results.

Second, as this procedure is purely based on desktop research so far, the author visited the Rio Blanco hydro project. The project visit allowed to check if the PDD's sustainable development argumentation holds true and if there are important aspects not mentioned in the PDD.

## 7.2. Analysis of UNFCCC Pipeline

As mentioned above, Table 3 shows the list of all hydro CDM projects available at the UNFCCC homepage up to the June 17<sup>th</sup>, 2005. Those projects are:

Table 3: **Project Name and Host Country of CDM Hydro Projects**

<i>Nr.</i>	<i>Project Name</i>	<i>Methodology</i>	<i>Host Country</i>
<b>Project Status: Validation</b>			
1	<i>Los Algarrobos Small-Scale Hydroelectric Project</i>	<i>AMS ID</i>	<i>Panama</i>
2	<i>Aqua Fresca Multipurpose and Environmental Services Project</i>	<i>AMS ID</i>	<i>Columbia</i>
3	<i>Project for the Refurbishment and Upgrading of Dolega Minihydro Power Plant, Panama.</i>	<i>AMS ID</i>	<i>Panama</i>
4	<i>20 MW Kabini Hydro Electric Power Project, SKPCL, India</i>	<i>ACM 02</i>	<i>India</i>
5	<i>Project for the Refurbishment and Upgrading of Macho de Monte Minihydro Power Plant, Panama</i>	<i>AMS ID</i>	<i>Panama</i>
6	<i>Vaturu and Wainikasou Hydro Projects</i>	<i>AMS ID</i>	<i>Fiji</i>
7	<i>Yuzaikou Small Hydro Power Project</i>	<i>AMS ID</i>	<i>China</i>
<b>Project Status: Registered</b>			
8	<i>Corecito and San Carlos</i>	<i>AMS ID</i>	<i>Honduras</i>
9	<i>Cuyamapa Hydroelectric</i>	<i>AMS ID</i>	<i>Honduras</i>
10	<i>E7 Buthan Micro Hydro</i>	<i>AMS ID</i>	<i>Buthan</i>
11	<i>Rio Blanco</i>	<i>AMS ID</i>	<i>Honduras</i>
<b>Project Status: Under Review</b>			
12	<i>La Esperanza Hydroelectric Project</i>	<i>AMS ID</i>	<i>Honduras</i>

Source: Data adapted from various PDDs, see List of Literature, PDDs

Table 3 gives an overview of analysis results of certain key features of the projects listed above, indicating to their contribution to sustainable development and, to some extent to their GHG emission reduction activity. The table comprises general information of projects, aspects which are used for the PDDs' sustainable development argumentation

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showed that internal rates of return are improved through carbon finance by 1-2%. See Figure 9.

and finally important design feature influencing the projects impact scale. E.g. there is a big difference to the ecosystems downstream, if the project also covers irrigation needs. These indicators are aligned to two distinct groups: The first one outlines potential negative impacts and possible mitigation measures, whereas the second focuses on positive project impacts.

Table 4: Sustainable Development Impacts of CDM Hydro Projects

Project Data			Potential negative Impacts and Mitigation							Positive Impacts	
Name	MW	CERs/y	RoR	Leakage	Monitoring	Water Supply	Minimal Water Flow	Relocation	Stakeholder	Reforest.	CD
<i>Los Algarrobos</i>	9.73	38600	Yes	No	No	No	No	No	No	No	Yes
<i>Agua Fresca</i>	7.49	30194	Yes	No	No	Yes	No	No	No	No	Yes
<i>Dolega</i>	3.12	15200	Yes	No	No	No	No	No	No	No	No
<i>Kabini</i>	20	44968	No	No	No	Yes	No	No	No	No	No
<i>Macho de Monte</i>	2.4	11520	Yes	No	No	No	No	No	No	No	No
<i>Vaturu and Wainikasou</i>	9.5	24928	Yes	No	No	Yes	No	No	No	No	No
<i>Yuzaikou*</i>	15	40480	No	No	No	No	No	Yes	Yes	No	No
<i>Corecito and San Carlos</i>	9.3	37419	Yes	No	No	Yes	Yes	No	Yes	Yes	Yes
<i>Cuyamapa</i>	12.2	38522	Yes	No	No	No	No	No	No	Yes	Yes
<i>Buthan E7</i>	0.07	524	Yes	No	No	No	Yes	No	No	No	Yes
<i>Rio Blanco</i>	5	17800	Yes	No	No	No	Yes	No	No	Yes	Yes
<i>La Esperanza</i>	12.73	37031	Yes	No	No	No	No	No	No	Yes	Yes

Source: Data adapted from various PDDs, see List of Literature, PDDs

\* argued with no tech transfer, only local technologies

### Distribution of CDM Hydro Projects

As can be seen in Table 3, seven out of twelve projects are located in Central America. The main reason for Central America's dominance can be found by Finland's coverage of transaction costs (Pearson, 2004, 6) for several projects in Honduras aiming at a reduction of risks at an early stage of the CDM.

In addition Finland is engaged in capacity building by forming a partnership with the Central American Commission on Environment and Development (CCAD) and the American Integration System (SICA). One of the cooperation's outcome was a market study pointing out opportunities for renewable energy projects in Central America.

Besides Europe, which is almost negligible for the CDM, Africa is the only continent not showing any hydro project activities.

Central America's development demonstrates the importance of an early Emission Reduction Purchase Agreement (ERPA) which reduced significantly the projects carbon finance risks.

### **Nominal Power**

SSC CDM Projects are defined in the Marrakesh Accords, Decision 17/6c as renewable energy projects with an output maximum of 15 MW, energy efficiency projects with an energy consumption reduction equivalent of 15 gigawatt hours per year or project activities that reduce emissions directly and emit less than 15 kilotons of carbon dioxide equivalent<sup>103</sup>. As can be seen from Table 4, all projects except one are SSC activities.

Since several studies have corroborated that SSC renewable energy projects are characterized by positive development impacts (See e.g. Factor AG, 2001), this indicates to a good development impact of those projects<sup>104</sup>.

### **CERs**

Macho de Monte, Dolega and especially Buthan E7 are the smallest hydro projects in the pipeline. Due to low nominal power those projects will substitute only few coal and diesel fuel units from the national electricity grid and thereby generate only few CERs. According to Michaelowa et al. (2003b, 15) fixed transaction costs are projected to be € 150,000. Since those costs are relatively independent from project size, small projects bear considerable risks of not covering their expenses.

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<sup>103</sup> For a discussion of CDM and international SSC hydro standards please refer to Schmitz, 2006, chapter 4. and 5.3

<sup>104</sup> On several occasions project developers employ the idea of SSC hydro projects showing good development impacts. Sometimes they do so even if the project is not a SSC activity neither to CDM rules nor to international hydro standards. E.g. the project developer of the Hydroalbanico, Ecuador (with 37 MW nominal power) claimed for his project to be a SSC activity (CMI, Cologne, 2005). Such an argumentation is based on local laws (e.g. Honduras' SSC hydro project definition includes projects up to 50 MW) and presumably aims at building a good reputation in order to realize good CER prices.

This definitely holds true for Buthan E7<sup>105</sup> but as CDM projects face several uncertainties also Macho de Monte and Dolega might not pay off as well. The reason that these projects were realized anyway under the CDM was mainly to develop capacity (an important objective at the early stage of the CDM) and to create positive examples for the CDM projects to come.

Since in the meantime the CDM has become more profit oriented, it is most likely that more profitable projects will be realized (which possibly marginalizes sustainable development aspects).

### **RoR vs Dam**

All hydro power projects can be divided in the two groups of Run of the River<sup>106</sup> (RoR) and dams. Due to their different construction needs, dam and pen stock, they are characterized by a different sustainable development potential whereas normally RoR projects are considered to be less ecologically problematic<sup>107</sup>.

Approximately 92% of all projects in the pipeline fall in the RoR group.

### **Leakage and Hydro Power Projects**

Emission leakage is a sensitive topic with regard to emission reduction projects. It is defined as the problem that “emissions abatement achieved in one location may be offset by increased emissions” (Koch, Michaelowa, 2001, 30) “outside the project boundary, and which is measurable and attributable to the CDM project activity” (UNFCCC, 2004b, 4).

For CDM hydro projects this is most problematic. Due to reservoir construction, land is inundated which almost necessarily puts organic substances under water leading to its decay. Moreover, further carbon inflow from the catchment may occur creating emission of GHGs, among those also Methane which is characterized by a high GWP. The World

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<sup>105</sup> A concise overview of the financial assessment: According to Liptow and Michaelowa (2005) CER prices range between € 5 and € 10. Buthan E7 generates 524 CO<sub>2</sub>e per year which makes

$$10 * 524 = 5240$$

in the very best case € 5,240 per year under optimal conditions. From the project start in 2005 up to 2012 the e7 faces seven and a half years of operation which amounts to

$$7,5 * 5240 = 39300$$

€ 39,300. This figure is far from meeting transaction costs given by Michaelowa et al. (2003b, 15).

<sup>106</sup> For a discussion of international RoR and dam definitions and their applicability for CDM projects please refer to Schmitz 2006, chapter 2.

<sup>107</sup> For a discussion of potential adverse impacts of hydro projects in the context of GHG mitigation please refer to Schmitz, 2006, chapter 3.3

Commission on Dams cites a case study of a hydro power dam in Brazil which shows “that the gross level of these emissions is significant relative to emissions from equivalent thermal power plants” (WCD, 2000, 15). However, the scale such of GHG emissions is highly variable and needs to be measured over a long period which is relatively cost intensive.

GHG emissions from rotting vegetation is a problematic especially in the case of dams. Although RoR projects proved to be more favorable with regard to this problem, they still may generate GHG emissions since they create backwater in the area of water intake (Moog et al. 1993, 198f)<sup>108</sup>.

All of the projects examined claim to create zero emissions. The pipeline analyzed is dominated by RoR projects and thereby bears only a low GHG emission potential. Yuzaikou, the only dam project, states that it is characterized by a small reservoir (3.44 ha) and therefore just by small inundated areas which will be cleared of organic substances before being flooded.

### **Monitoring**

Not a single project of the pipeline makes use of the PDD monitoring scheme to ensure compliance with environmental or social regulations as discussed in chapter 4.4.

### **Water Supply**

Some hydro power projects are also build to cover irrigation needs of local population. As these projects permanently extract water from the river without returning it, they are considered to have significantly higher impacts on ecosystems downstream than other hydro projects. They alter the amount of water in the river system, which may significantly alter temperature and velocity of the remaining water. This change in living conditions may favor other species of micro flora and micro fauna which potentially changes the hole ecosystem bottom up. Moreover, a decreasing amount of water may have an impact downstream groundwater levels etc. Therefore projects with an irrigation component should introduce some kind of environmental management system. 25% of projects examined cover irrigation needs.

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<sup>108</sup> For a detailed discussion of leakage in the context of hydro projects please refer to Schmitz 2006, chapter 3.3.3

### **Minimal Water Flow**

Maintaining an ecological water flow is an essential aspect for RoR as well as for dam projects<sup>109</sup>. Projects not considering a minimal water flow show impacts as discussed above within the project boundaries. Moreover, this measure is easy to implement and to maintain. Consequently, a minimal water flow is enforced by law in many countries.

Nevertheless minimal flow requirements of developing countries are often insufficient (Schmitz, 2006, chapter 3.5.2).

In the current pipeline only Corecito and San Carlos, Buthan E7 and Rio Blanco mention the concept of an ecological flow at all. Corecito and San Carlos nor Buthan E7 do quantify the amount of minimal water remaining in the river bed. However, none of the projects mentions how the ecological flow is monitored.

### **Relocation**

As Yuzaikou is the only dam project, it is also the only project having to relocate local residents. More precisely, the government provides all 76 farmers who need to be relocated, with new houses<sup>110</sup>. “Forty-nine of them will be given 1.68 hectares in total and 27 will be educated and given jobs in the secondary or tertiary sector in local economy” (Yuzaikou, 2005, 26).

The PDD does not give enough information to follow the relocation process in detail. The fact that 1.68 ha is definitely too less to make a living from, one must ask, if farming land is inundated as well. The question, if the land is of the same quality is not answered by the PDD.

According to the stakeholder process all persons affected were finally satisfied with the project outcome.

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<sup>109</sup> RoR projects usually feature a minimum water flow (a certain percentage of the river's water flow which is left in the river bed) in order to avoid a complete disconnection of ecosystems above and underneath the project.

A dam project usually comprises a fish ladder in order to allow for fish mitigation.

<sup>110</sup> A government compensation of locals, which experience negative project aspects, is problematic from

### **Stakeholder Process**

The results of Table 4 show that two out of twelve projects faced concerns from local stakeholders. According to the PDDs, at the end of the process all stakeholders were satisfied with the project outcome.

### **Reforestation**

Four out of twelve projects comprise some kind of reforestation activity although these are also referred to as land quality improvement or river basin conservation. The scale of reforestation activities varies strongly from the planting of trees at the river side to huge plantations, compared to which the actual project activity appears to be small<sup>111</sup>.

### **Community Development**

Moreover, 58% of all projects pursue some kind of Community Development activity comprising environmental education programs, the construction of infrastructure such as roads, support of local schools and the improvement of health services.

Reforestation and community development are positive project impacts, but not directly related to a hydro power project activity. Those arrangements are helpful and contribute to sustainable development without any doubt. In order to determine the motivation of those efforts, two answers are evident:

One possibility is simply, that project parties are sincerely aligned with sustainable development. They might be convinced that those measurements are important for the further development of local people. But still why are those activities carried out within the actual project? In order to realize a plantation project, it is not necessary to develop a CDM hydro power plant (with the possible exception that the hydro project is just part of a large scale development scheme, as it is the case for Rio Blanco and Cuyamapa).

Another possible answer is, that project developers may think that those actions help them complying with the strictly controlled criteria of additionality. But this idea is misguided, since, if a hydro project gets registered for a certain methodology it gets registered for the CO<sub>2</sub>e emission reduction and not for reforestation or community development.

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a distribution political perspective.

<sup>111</sup> See the Rio Blanco reforestation project, chapter 7.3.1

## **7.3. Case Study Honduras**

### **7.3.1 Rio Blanco Small Hydroelectric Project – Screening of Sustainable Development Impacts**

The following discussion is based on the Rio Blanco PDD and information obtained during a visit to the project site at July 1<sup>st</sup>, 2005, guided by plant manager and co-owner Mr. Cortalezio.

Rio Blanco was the first hydro power project and the second overall to be registered<sup>112</sup> under the CDM. It was supposed to be a best practice model concerning sustainable development, claiming several positive project impacts. The PDD states that “special care was devoted in analyzing the direct and indirect impacts” (PDD Rio Blanco, 2003, 20).

First, this chapter tries to analyze project aspects which according to the PDD will contribute to sustainable development. In a second step, project aspects, which the PDD does not use for its sustainable development argumentation, but are nevertheless of relevance, get discussed. Both aspects are screened with data and information obtained during the visit in order to roughly estimate the projects real contribution to sustainable development.

#### **General Information**

The Rio Blanco Hydroproject is owned by the *Sociedad Hidroelectrica Rio Blanco*, a group of local landlords who decided to use the hydroelectric potential of their land. It seems as if these landlords, in the tradition of old dueños, assumed the stewardship in order to keep their estate fertile for future generations to come.

The 5 Mega Watt RoR hydro project was constructed as a SSC project according to both the CDM rules and the international hydro power standards. On average the power plant is projected to generate 32 Giga Watt hours (GWh) per year and will thereby reduce 17,800 t CO<sub>2</sub>e/year. Although the visit took place during rainy season at that moment the turbines generated ~3.5 MW, significantly missing its full working load. Mr. Cortalezio forecasts a 100% plant utilization at the end of rainy season.

## **The Projects Sustainable Development Aspects as mentioned in the PDD**

- **Energy Supply**

According to figures given in the PDD, 40% of Honduras final energy needs for cooking purposes is still covered by non sustainable extraction of fire wood (PDD Rio Blanco, 2003, 1). Consequently, an improvement of electricity reduces firewood needs and fosters sustainability. Moreover, the PDD claims that the project activity will improve “the productive use of electricity in communities that still don't have it” (PDD Rio Blanco, 2003,2).

It is important to point out that although the project will increase the quality of energy supply in the region (under the assumption that the additional electricity supply does not get overcompensated by Honduras' increasing energy demand) it does not increase the availability of energy services to communities which are not yet connected to the grid.

- **Reforestation**

Besides renewable energy supply, the reforestation aspect is surely the project's biggest advantage. The area of Lago de Yojoa, a ecosystem characterized by a large biodiversity, has to bear the consequences of massive deforestation, like a reduction of precipitation, an increase in erosion leading to more sedimentation in the lake, resulting in its siltation and shrinking<sup>113</sup>.

The project intends to plant approx. 5,000,000 trees in the project area, partly financed by revenues gained from CERs. More precisely, it is planned to spend all CER revenues on reforestation which will nevertheless just cover parts of the plantation costs. The other part of the investment needed will be carried by the project owners. Plantation activities are carried out by teenagers between the age of 12 to 15 years, who just finished their compulsory education. Two reasons led to the strategy employing kids: One, helping them to bridge the time gap till they find a proper job. They receive a remuneration for their work, transportation and alimentionation are arranged at the expense of Sociedad Hidroelectrica Rio Blanco.

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<sup>112</sup> Date of registry: January 11<sup>th</sup>, 2005 (UNFCCC, 2005b).

<sup>113</sup> According to the manager of the Eco-archaeological park Los Naranjos, the water level during the raining season in 2005 is three meters below that of the year before.

Second, participating in the plantation activities is supposed to sensitize younger generations for environmental problems. Moreover, since the plantation mixes timber and fruit trees, monocropping is avoided. The focus lies on fast growing types of timber and exclusive woods.

As it turned out during the visit, plantation activities already take place, although the first revenues from the Ministry of Foreign Affairs of Finland which are expected within the next two months are not yet transferred. The project owners, la Sociedad Hidroelectrica Rio Blanco still intend to stick to its initial commitment to spend all CER revenues on reforestation.

- **Generation of Permanent and Temporary Jobs**

During the projects construction phase several temporary jobs were created. Since the launch of Rio Blanco in November 2004 seventeen persons have been permanently employed.

- **Serve as a Small Demonstrative Project**

Rio Blanco's claim to serve as a best practice example is certainly satisfied, since downstream another SSC hydro project is already in planning stage.

- **Redundant Aspects**

The PDD points at several additional benefits contributing to sustainable development but they are redundant and/or directly related to projects CO<sub>2</sub> emission reduction and will therefore not be discussed in further detail. Those benefits include: helping to reduce Honduras' oil bill; contributing to balance of payments; reducing GHG emissions; supporting the community by paying of local taxes and generating indirect employment in the area. Those arguments were not discussed during the project visit.

### **Other Aspects**

- **Additionality and Financial Barriers**

The construction costs of approximately 8,000,000 US\$ were financed by the Central American Bank of Economic Integration under relatively unfavorable conditions. An interest rate of 12% p.a. might turn out to be a real obstacle to any hydro power project due to high initial costs leading to a long payback period.

Nevertheless, first plans were drawn up in 1996, one year before the first conceptualization of the CDM emerged. This fact casts the project's additionality argumentation into doubts. This does not mean that the project does not create real emission reductions but it indicates that the project would have happened anyway, even without the CDM. Moreover the PDD states that impact of carbon finance improves the IRR by 1.03% (PDD, Rio Blanco, 2004, 10) which theoretically only slightly enables Rio Blanco to differ from business as usual projects<sup>114</sup>.

- **Minimal Water Flow**

The PDD states that the project will at least maintain a minimal water flow of 0.46m<sup>3</sup>/s (PDD Rio Blanco, 2003, 12) amounting to 10% of the original basin flow (a requirement enforced by Honduran law). Nevertheless, even such a minimal flow causes significant changes in biodiversity of the river basin.

Since there is no installation measuring the ecological flow it was unfortunately not possible to control this aim during the project visit. According to Mr. Cortalezio's opinion the alteration of the water level in the river basin is the projects only major adverse impact.

The project's pen stock is 1,500m leading to an increase to the water body's temperature and therefore changing micro flora and -fauna (Moog et al., 1993, 198). As a result all other elements in the rivers food chain are affected as well.

Nevertheless, the projects adverse impacts are limited due to two reasons: first, the river basin was heavily polluted and was over fished, hence there were barely any fish left to be affected by the change in the water regime. Second, the project is located near a waterfall which is a natural barrier like the project itself reducing the effective impact of the artificial barrier.

- **Backwater**

The creation of backwater was identified as one of the main problematic issues of RoR projects (Moog et al. 1993, 199f), but, since in the area of the water intake the river moves with high velocity, changes can be considered to be irrelevant.

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<sup>114</sup> For a discussion of renewable energy projects' difficulties in proving their additionality please refer to chapter 5.1.4

- **Stakeholder Comments**<sup>115</sup>

The main impact for local citizens would have been the diversion of the water over the stretch of the pen stock. Nevertheless, the project was not rejected by them, as they did not benefit from the river's natural resources as beforehand. As the river basin is deep and difficult to access and did not contain any fish and as water supply is covered by water pipes, there were no rejections to the project.

### **7.3.2 Honduras**

During the period of research, Honduras, a rather small Latin American country, became the world leader in terms of registered projects being at par with India.<sup>116</sup> So far four projects have been registered: Rio Blanco, Cuyamapa, La Esperanza, Corecito and San Carlos; five more projects are submitted, all of them are SSC hydro projects. Besides the nine hydro projects, Honduras is also developing the SSC reforestation activity Pico Bonita and one transportation project.

Being small, decentralized sustainable energy projects, they have a large potential to contribute to the host country's sustainable development. Moreover, some of the projects are embedded in larger community development plans. Several reasons for Honduras good performance can be identified:

First of all, there is good data availability on the grid facilitating the identification of baselines. Honduras electricity market experienced several stages of decentralization during the last decade. The law called *Marco del Subsector Electricidad* from November 26<sup>th</sup>, 1994 opened the market for decentralized energy production and has provided renewable energy with a 10% bonus on the actual price for electricity.

Second, since Honduras was actively involved in the Activities Implemented Jointly-pilot phase<sup>117</sup> and was supported by Canada from 1999 to 2002 (Liptow, Michaelowa, 2005), its DNA is well established. The DNA applies established criteria and indicators according to social, environmental and economic categories for the LoA and guide

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<sup>115</sup> For an analytical discussion of the stakeholder process please refer to chapter 4.3

<sup>116</sup> If not indicated, following information is from an interview with Señor Salgado Ochoa, Head of the DNA lead at July 18<sup>th</sup>, 2005 in Tegucigalpa.

<sup>117</sup> Activities Implemented Jointly (AIJ): Under the AIJ pilot phase emission reduction activities, implemented jointly between Annex I- and developing countries could be carried out. AIJ's purpose was to "test the challenges involved in implementing joint projects and to foster technology and know how

projects from the level of project interest notes (PIN) towards registration. No capacity building was carried out by World Bank or GTZ.

Moreover, the capacity of local actors proved to be very important. The Asociación Hondureña de Pequeños Productores de Energía Renovable (Honduran Association of Small Producers of Renewable Energy, (AHPPER)) plays a major role in the development of Honduran CDM projects. AHPPER, financed by membership fees, is a local NGO aiming at the promotion of renewable energy production in Honduras by assisting the realization of local initiatives. It advised all nine Honduran CDM hydro projects (AHPPER, 2005) but also engages in non CDM projects.

Finally, Finland contributed significantly to the success of Honduran CDM projects by forming a partnership with the Central American Commission on Environment and Development (CCAD) and the American Integration System (SICA). One of the cooperation's results included a market study pointing out opportunities for renewable energy projects in Central America. Moreover, Finland covered the transaction costs for several hydro projects in Honduras (Pearson, 2004, 6) helping to reduce the uncertainties for project developers at an early stage of the CDM.

#### **7.4. Drawing Conclusion from the Analysis of Hydro CDM Projects**

On a general level it must be concluded that the projects examined contribute significantly to sustainable development by being a self-sufficient source of renewable energy. By utilizing hydro power those projects support the host countries' energy autonomy fostering economic stability. Yet the results from section 7.2 and 7.3 draw a heterogeneous picture:

On the one hand, most of the projects are decentralized, small scale hydroelectric power plants employing (low impact) run of the river technology. In addition, four out of twelve projects comprise some kind of reforestation activity; seven out of twelve projects pursue some kind of community development activity comprising environmental education programs, the construction of infrastructure such as roads, support of local

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transfers”(Michaelowa, Koch, 2001, 7).

schools and the improvement of health services. The only dam project tries to avoid emission leakage by clearing the water reservoir of organic substances.

On the other hand none of the projects employs the monitoring scheme, included in the PDD for ecological and/or social indicators. Three out of twelve projects note the concept of an ecological flow but only Rio Blanco quantifies the amount of minimal water remaining in the river bed. However, none of the projects mentions how the ecological flow is monitored.

It may be concluded that the projects examined show a good development performance in general, but even under the most promising projects of the CDM there is still room for improvement by application of international best practice approaches like e.g. the World Commission on Dams Guidelines.

## **8. Conclusions and Recommendations**

### **8.1. Conclusions**

The Clean Development Mechanism (CDM), as established in the Kyoto Protocol has the aim to contribute to both, to the sustainable development of Non-Annex I countries as well as to support Annex I countries to achieve their emission targets in a cost efficient way. The question, if the CDM succeeds in fulfilling its first aim is inevitably bound (assuming positive marginal cost of development impacts) to the establishment of a consistent framework ensuring sustainable development.

To deal with the issue of sustainable development in the context of GHG emission reduction projects the meaning of “assist ... in achieving sustainable development” (UNFCCC, 1997, Art. 12.2) has to be clarified. The UN Framework on Climate Change applies a relative concept of sustainable development. This very approach implies the reference to a baseline scenario; when asked if a project contributes to sustainable development, the question is, if project activities are sustainable compared to a baseline scenario, e.g. a certain level of pollution.

Assessment of a project's contribution to sustainable development has to meet several needs: First, the prevalent concept of development in terms of the GDP has to be contextualized. This is usually accomplished by grouping the project's impacts to the

three categories ecological, social, and economic development. Subsequently, criteria of relevance have to be identified, e.g. *Stakeholder Participation* for the category *Social Development*. In a further step, in accordance with selected criteria, indicators must be chosen, e.g. *Number of Comments Received* may quantify *Stakeholder Participation*. Finally, these indicators need to be aggregated to social, economic and ecological development and if desired, they can be aggregated to a single number in order to represent the projects overall sustainable development performance.

As established in the Marrakesh Accords, the CDM sustainable development framework consists of a local and a global stakeholder process as well as of the Letter of Approval (LoA). Results from chapter four shows that the LoA does not ensure the achievement of sustainable development in all countries. This dilemma is created by a situation which forces host countries to compete for FDIs.

In addition the remaining elements of CDM's sustainable development also exhibit weaknesses. The stakeholder process is not always functioning properly: The local stakeholder process is not necessarily taking all preferences into account, either because not all locals are well informed and/or because local languages are not considered in the official process. On the other hand, NGOs often do not take advantage of the global stakeholder process. Also the monitoring scheme, a transparent mechanism controlled by DOEs, is solely applied for environmental purposes. It must be concluded that the CDM's existing framework is not sufficient to guarantee the project's contribution to the host countries development.

The market analysis in chapter five demonstrates the dominance of non-renewable energy projects (85.3% of CERs generated up to 2012), activities often not showing any other significant development impact than CO<sub>2</sub>e emission reductions, over renewable energy projects (14.7%). This puts the CDM, whose aim is to promote sustainable development, in a market situation marginalizing its development impacts.

Several reasons for generating such a development can be identified: First, gas capture and destruction projects, accounting for the overwhelming share of non-renewable energy projects, are financially attractive. Abatement costs for e.g. HFC-23 projects, generating 22.5% of all CERs until 2012 are estimated to be as low as € 0.25,

whereas prices for CERs actually range from € 5 to € 10. Second, renewable energy projects, focusing on substitution of fossil fuels, reduce only a small amount of CO<sub>2</sub>, whereas gas capture and destruction projects mainly reduce high potential GHGs like methane (GWP of 21), N<sub>2</sub>O (GWP of 310) and HFC-23 (GWP of 11,700) and therefore create significantly more CERs.

But renewable energy projects not only suffer significant financial disadvantages, they also encounter difficulties in proving additionality; there are strong signals that there exists an inverse correlation between clearly additional and renewable energy projects. The reason is that gas capture and destruction projects involve investment whose *only* return are CERs, whereas renewable energy projects, occurring with and without the CDM, have to differ from business as usual, renewable energy projects. Since gas capture and destruction projects depress prices for CERs, they diminish the renewable energy project's potential to prove their additionality.

Chapter six analyzes existing assessments and one best practice approach with regard to their potential to assess CDM projects' contribution to sustainable development. Among those, the Gold Standard, consisting of an eligibility screen, wider participation procedures and a sustainable development assessment tool is identified as a complete framework to ensure good development impacts.

An empirical analysis of selected hydro power CDM projects and a visit of the SSC Rio Blanco project activity demonstrate good development impacts of considered projects in general. Moreover 58% of all projects feature some kind of community development program.

Finally Honduras good development under the CDM has been analyzed; several reasons were identified: Besides good data availability concerning CO<sub>2</sub>e intensity of the national electricity grid, which facilitates the elaboration of baselines, Honduras' DNA is well established and gathered experience since the AIJ pilot phase. Moreover AHPER, a local NGO, plays a major role by promoting renewable energy projects. Finlay Finland contributed significantly to the success of the Honduran CDM projects by forming a development partnership with two local stakeholders whose outcome was a study pointing out opportunities for renewable CDM project activities.

## **8.2. Recommendations – Improving the CDM's Sustainable Development Performance**

In the subsequent section based on this thesis findings proposals are submitted which could be discussed in order to improve the CDM's capability to “assist Parties not included in Annex I in achieving sustainable development” (UNFCCC, 1997, Art. 12.2).

- **Sustainable Development Argumentation**

As GHG emission reductions and sustainable development are separate goals, the fact that a project is reducing CO<sub>2</sub>e is not eligible for the project's sustainable development argumentation. Consequently, in order to clearly separate the two subjects, it may be helpful to create a specific section in the PDD giving room for the project's sustainable development argumentation concerning non-GHG emission impacts.

- **Stakeholder Process**

Since the CDM employs a relative concept of sustainable development, based on individual values, the stakeholder process is a crucial point in order to guarantee sustainable development.

As there seems to be few stakeholder participation on both, on a local and on a global level the process may need to be improved: On a local level, by ensuring that locals are well informed not only that a project will be constructed, but also about possible positive and negative implications for their personal life. In order to create win-win situations as CDM project outcomes, local languages should be considered and the stakeholder process itself should end in accordance with both sides.

- **Monitoring Process**

As the PDD Monitoring is a transparent mechanism, controlled by DOEs, project developers could be encouraged to make quantifiable commitments according to their sustainable development argumentation and subsequently to employ the monitoring scheme (where applicable) for the supervision of these commitments.

- **The Gold Standard**

As the Gold Standard is a consistent framework ensuring a good development performance it may be recommended to both, project developers for realizing high CER prices and to buyers for supporting a good reputation.

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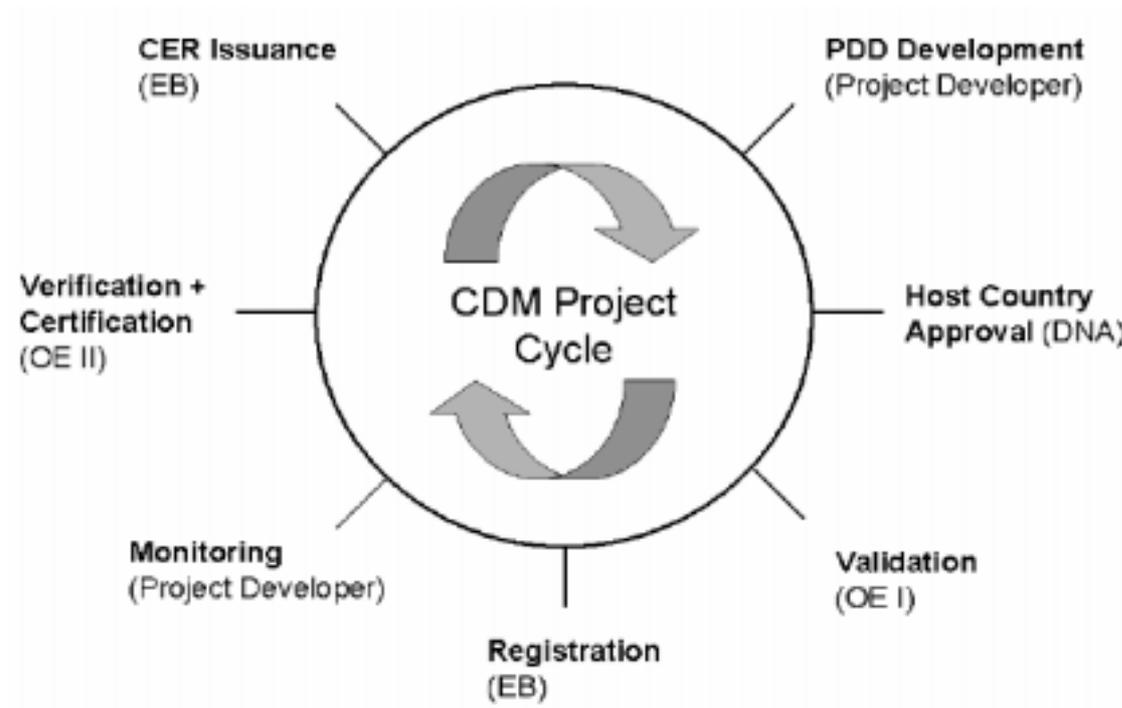
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## Appendices

### Appendix I: The CDM Project Cycle

Figure 11: The CDM Project Cycle



Source: Butzengeiger et al. 2004, 4

## Appendix II: Sustainability Criteria and respective Indicators

Figure 12: Overview of an Example of Sustainability Criteria and Respective Indicators

	Criterion	Classification	Indicator
<b>Social Criteria</b>	Stakeholder Participation	qualitative	qualitativ indicators with descriptive five-step scale
	Improved Service Availability	semi-quantitative	change in availability of services compared to baseline (quantitative compilation and qualitative judgements, see below)
	Capacity Development	qualitative	qualitative indicator with descriptive five-step scale
	Equal Distribution of Project Return	quantitative	share of turnover benefiting people below poverty line, compared to baseline
<b>Environmental Criteria</b>	Fossil Energy Resources	quantitative	MWh coal saved / GHG reduction, relative to baseline
	Air Quality	semi-quantitative	change relative to baseline (quantitative compilation and qualitative judgments)
	Water Quality	semi-quantitative	change relative to baseline (quantitative compilation and qualitative judgments)
	Land Resources	semi-quantitative	change relative to baseline (quantitative compilation and qualitative judgments)
<b>Economic Criteria</b>	Microeconomic Efficiency	quantitative	internal rate of return (IRR)
	Technology Transfer	qualitative	qualitative indicators with descriptive five-step scale
	Regional Economy	semi-quantitative	economic performance of project location (selection of the core aspect by expert judgement followed by quantitative assessment)
	Employment Generation	quantitative	additonal man-month per GHG reduction, compared to baseline

Source: Sutter, 2003, 82

### Appendix III: Data Sources for Figure 3

(blue) Vostok ice core: Fischer, H., M. Wahlen, J. Smith, D. Mastroianni, and B. Deck (1999). "Ice core records of Atmospheric CO<sub>2</sub> around the last three glacial terminations". *Science*, 283, 1712-1714.

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(red) Law Dome ice core: D.M. Etheridge, L.P. Steele, R.L. Langenfelds, R.J. Francey, J.-M. Barnola and V.I. Morgan (1998) "Historical CO<sub>2</sub> records from the Law Dome DE08, DE08-2, and DSS ice cores" in *Trends: A Compendium of Data on Global Change*. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A.

(black) Mauna Loa Observatory, Hawaii: Keeling, C.D. and T.P. Whorf (2004) "Atmospheric CO<sub>2</sub> records from sites in the SIO air sampling network" in *Trends: A Compendium of Data on Global Change*. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A.

(cyan) Siple Dome ice core: Neftel, A., H. Friedli, E. Moor, H. Lötscher, H. Oeschger, U. Siegenthaler, and B. Stauffer (1994) "Historical CO<sub>2</sub> record from the Siple Station ice core" in *Trends: A Compendium of Data on Global Change*. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A.

Appendix IV: SSN Matrix Tool	Score
<b>Component</b> <i>Indicators (example)</i>	-2 to +2
<b>Local / regional / global environment</b> -Water quality and quantity -Air quality (emissions other than GHGs) -Other pollutants (toxicity, radioactivity, POPs, stratospheric ozone layer depleting gases) -Soil Condition (quality and quantity) -Biodiversity (species and conservation) <p style="text-align: right;"><i>sub total</i></p>	
<b>Social sustainability and development</b> -Employment (including job quality, fulfillment of labour standards) -Livelihood of the poor (poverty alleviation, distributional equity, access to services) -Access to energy services -Human and institutional capacity (empowerment, education, involvement, gender) <p style="text-align: right;"><i>Sub total</i></p>	
<b>Economic and technical development</b> -Employment (numbers) -Balance of payments (sustainability) -Technological self reliance (project replaceability, hard currency liability, skills development, institutional capacity, technological transfer) <p style="text-align: right;"><i>Sub total</i></p>	
<p><b>How to use the tool</b></p> <p>Project performance must be assessed against the list of indicators, using the following scoring system:</p> <p><b>-2: Mayor negative impacts</b>            i.e. where there is significant damage to ecological, social and/or economic systems that can not be mitigated through preventive (not remedial) measures.</p> <p><b>-1: Very minor negative impacts</b>            i.e. where there is a measurable impact but not one that is considered by stakeholders to militate against the implementation of the project activity / cause significant damage to ecological, social and/or economic systems.</p> <p><b>0: No (or negligible)</b>            i.e. where there is no impact or the impact is considered insignificant by stakeholders.</p> <p><b>+1: Minor positive impacts</b></p> <p><b>+2: Mayor positive impacts</b></p> <p>Project performance should be considered in terms of each indicator relative to the baseline scenario (i.e. in the absence of the proposed project) as defined in the project design document.</p> <p><b>Result:</b>            Each sub-total must score better than -1            -Each indicator must score better than -2</p>	

Source: SSN, no indication of time, page 5

## Appendix IV: SSN Matrix Tool

### Explanation of the indicators of sustainable development

#### (A) Local / Global Environmental Sustainability

##### **Water**

**Water quantity:** This indicator evaluates the project's contribution to water availability and access locally and regionally. Number of people with access to water supply in comparison with the baseline.

**Water quality:** This indicator evaluates the contribution of the project to locally and regionally in the project's area in comparison with the baseline. Water quality will be measured using concentration of main pollutants (including BOD and others) in any effluents generated by the project activity and their contribution, if any, to local water quality.

##### **Air quality**

This indicator evaluates the project's contribution to local air quality. Air quality will be measured by comparing the concentration of most relevant air pollutants (e.g. SO<sub>x</sub>, NO<sub>x</sub>, particle matters etc.) generated by the project activity with the baseline.

##### **Other Pollutants**

This indicator evaluates the contribution of the project activity to reducing the flow of pollutants not already considered into the environment, including solid, liquid and gaseous wastes.

##### **Soil condition**

This indicator evaluates the contribution of the project activity to the to local soil condition. Soil condition will be measured by comparing the concentration of most relevant soil pollutants, erosions, and the extent of land user changes due to the project with the baseline.

##### **Contribution to biodiversity**

This indicator evaluates the project's contribution to local biodiversity. The change in biodiversity is estimated on a qualitative basis considering any destruction or alteration of natural habitat compared to the without the project scenario. A positive change will be given by previously disappeared species, recolonizing the area, a negative change will be given by species disappearing or by introduction of foreign species. In judging this, inputs from local communities should be considered a key resource.

#### (B) Social Sustainability and development.

##### **Employment (quality)**

This indicator evaluates the qualitative value of employment, such as whether the jobs resulting from the project activity are highly or poorly qualified, temporary or permanent in comparison with the BAU. Take temporary and permanent as qualifications for job quality.

##### **Livelihoods of the poor**

This indicator comprises a number of sub-indicators. Where a sub-indicator is not relevant to the project, it should be ignored. After all the relevant variables have been considered the total score should be non-negative.

**Poverty alleviation:** this sub-indicator evaluates the project's contribution to poverty alleviation. Poverty alleviation will be evaluated by calculating the change in number of people

*living above income poverty line compared to baseline*

**Livelihoods of the poor:** *Contribution to equal distribution and additional opportunity for disadvantaged sectors. This sub-indicator evaluates contribution of the project to equal distribution of wealth and opportunity, in particular marginal or excluded social groups. The indicator combines quantitative changes in estimated earned income (normalized to the project's starting year) compared with the baseline – and qualitative assessment – improved opportunities.*

**Access to essential services:** *(health, education, access to facilities, water, etc.) Access to essential services will be taken as an indicator of social sustainability, measured by the number of additional people gaining access in comparison with the baseline. Access must be directly related to the service and not a spin-off.*

**Access to affordable clean energy services:** *The CDM and JI provide an important opportunity to improve the coverage of reliable and affordable clean energy services, especially to the poor in rural areas. Where of a relevant scale security of energy supply (an indicator of a country's ability to generate the power that is needed for services and the economy in comparison with the baseline), should be taken into account.*

### **Human capacity**

*This indicator is used to assess the project's contribution to raising the capacity of local people and/or communities to participate actively in social and economic development. It comprises three indicative sub-indicators:*

**Empowerment:** *This sub-indicator evaluates the project's contribution to improving the access of local people to and their participation in community institutions and decision making processes.*

**Education/skills:** *This sub-indicator is used to assess how the project activity enhances and/or requires improved and more widespread education and skills in the community.*

**Gender equity:** *This sub-indicator is used to assess how the project activity requires or enhances improvement of the empowerment, education/skills and livelihoods of women in the community.*

## **(C) Economic and technological development**

### **Employment (numbers)**

*Net employment generation will be taken as an indicator of economic sustainability, measured by the number of additional jobs directly created by the CDM project in comparison with the baseline.*

### **Sustainability of the balance of payments**

*Net foreign currency savings may result through a reduction of, for example fossil fuel imports as a result of CDM projects. Any impact this has on the balance of payments of the recipient country may be compared with the baseline.*

### **Hard currency expenditures on technology, replaceability and contribution to technological self reliance**

*As the amount of expenditure on technology changes between the host and foreign investors, a*

*decrease of foreign currency investment may indicate an increase in technological sustainability. When CDM projects lead to a reduction of foreign expenditure via a greater contribution of domestically produced equipment, royalty payments and license fees, imported technological assistance should decrease in comparison with the baseline. Similarly a reduced need for subsidies and external technical support indicates increased self reliance and technology transfer.*

Source: SSN, no indication of time, pages 6-7

## Appendix V: **Additional Requirements for the Gold Standard**

### Project activities eligible under the Gold Standard

For the project activity to be eligible for the Gold Standard, it must fall into one of the types of project activity listed below (see Annex 6 of the accompanying document for further guidance):

#### **Renewable Energy:**

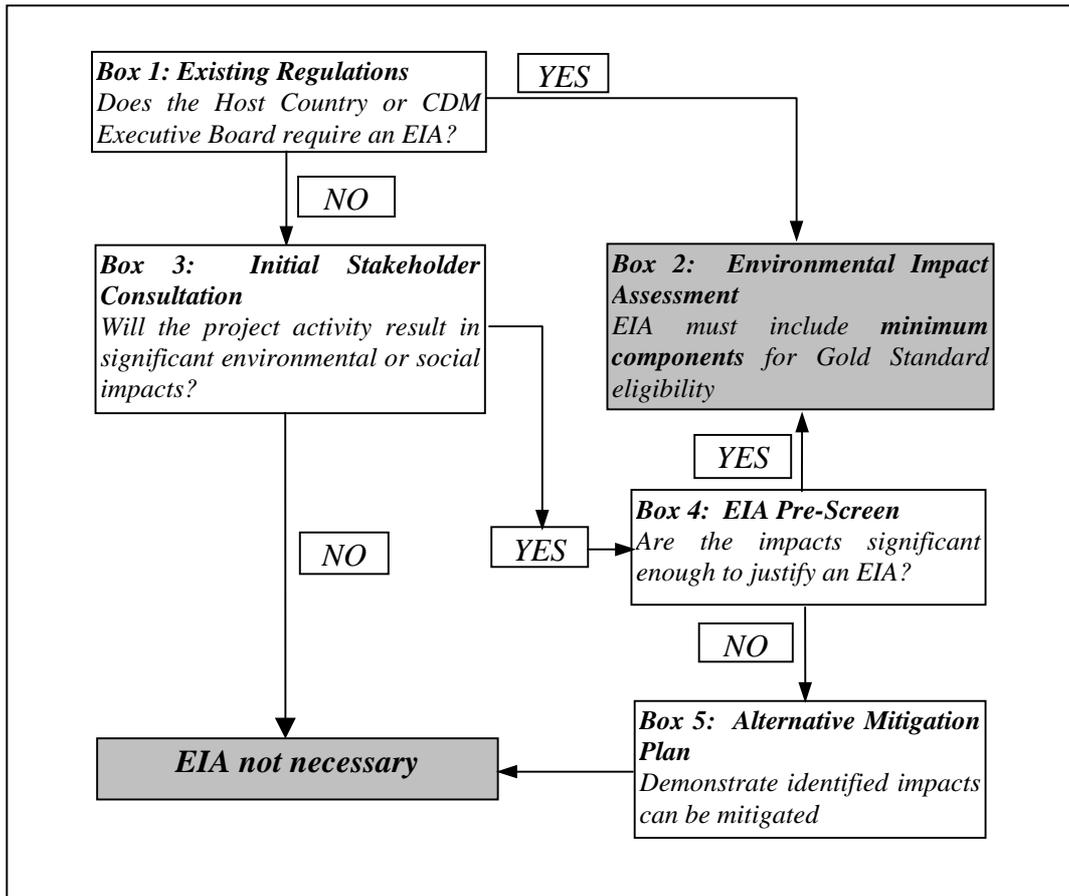
- PV
  - Solar thermal
    - Electricity
    - Heat
  - Ecologically sound biomass, biogas and liquid biofuels
    - Heat, electricity, cogeneration
    - Transport
- Wind
- Geothermal
- Small low-impact Hydro, with a size limit of 15 MW, complying with WCD guidelines

#### **End Use Energy Efficiency Improvement:**

- Industrial energy efficiency
  - Domestic energy efficiency
  - Energy efficiency in the transport sector
  - Energy efficiency in the public sector
  - Energy efficiency in the agricultural sector
  - Energy efficiency in the commercial sector

Source: The Gold Standard, 2005b, page 8

Appendix VI: The Gold Standard EIA flow chart



Source: The Gold Standard, 2005b, page 11

## Appendix VII: Relevant Environmental and Social Aspects of Run of River Projects

<i>Management domain</i>	<i>Basic requirements</i>
<i>Minimum Flow</i>	<p><i>Goal is a dynamic flow regime, which qualitatively simulates the natural hydrological regime</i></p> <p><i>Minimum flow which guarantees habitat quality and prevents critical oxygen and chemical concentrations</i></p> <p><i>No disconnection of lateral rivers</i></p> <p><i>Minimum water depth for fish migration during critical periods</i></p> <p><i>Lateral and vertical connectivity (flood plains and groundwater) shall not be substantially disturbed</i></p> <p><i>Provides sufficient transport capacity for sediments</i></p> <p><i>Landscape compartments shall not be destroyed</i></p> <p><i>Flood plain ecosystems shall not be endangered</i></p> <p><i>Conservation of locally adapted species and ecosystems</i></p>
<i>Hydropeaking</i>	<p><i>Rate of change of water level should not impair fish and benthic populations</i></p> <p><i>Reduction in water level should not lead to drying of the water course.</i></p> <p><i>Protective measures if flood plain ecosystems are impaired.</i></p> <p><i>No isolation of fish and benthic organisms when water level decreases</i></p> <p><i>No impairment of spawning habitat for fish</i></p>
<i>Reservoir management</i>	<p><i>Are there feasible alternatives to reservoir flushing?</i></p> <p><i>Changes in reservoir levels should not impair lateral ecosystems (flood plains, river shores, ...)</i></p> <p><i>Connectivity with lateral rivers should not be impaired</i></p> <p><i>Sediment accumulation areas should be used as valuable habitats, where feasible.</i></p> <p><i>Special protection of flood plain ecosystems if they are impaired</i></p>
<i>Sediment management</i>	<p><i>Sediments have to pass through the power plant.</i></p> <p><i>No erosion and no accumulation in the river bed below storage dams and water intakes because of a deficit in sediments.</i></p> <p><i>Sediment transport should sustain morphological structures, which are typical for the river.</i></p> <p><i>No accumulation of sediments below dams</i></p> <p><i>Riverine habitats have to be established</i></p>
<i>Power plant design</i>	<p><i>Free fish migration upwards and downwards (as far as technologically feasible)</i></p> <p><i>Protection of animals against injury and death stemming from power plant operations (turbines, canals, water intakes, ...)</i></p>
<i>Social impacts</i>	<p><i>Cultural landscapes</i></p> <p><i>Human heritage (including protection of special ethnic groups)</i></p> <p><i>Preservation of lifestyles</i></p> <p><i>Empowerment of local stakeholders in the decision-making process (about mitigation and compensation of social impacts)</i></p> <p><i>Resettlement of local population under similar or better living conditions (than prior to the project)</i></p> <p><i>Build additional social infrastructure, sufficient to cope with population increase (due to migration induced by the project)</i></p> <p><i>Water quality and fishing losses affecting downstream riverside population</i></p>

*Source: The Gold Standard, 2005b, page 12*

## Appendix VIII

Table 5: CDM Projects Distribution by Projects Number

	<i>Asia</i>						<i>Africa</i>	<i>Europe</i>	<i>Latin America</i>				<i>Total</i>			
	<i>India</i>		<i>China</i>		<i>Other</i>				<i>Brazil</i>		<i>Other</i>					
<i>Biomass</i>	16				7		1		25		1		50			
<i>Hydroelectric</i>	5	2	1	1	5				3	3	18	7	32	13		
<i>Renewables</i>	3		2		2		2				4		13			
<i>Energy Efficiency</i>	4		1				1		1		1		8			
<i>Fuel Switch</i>					3						1		4			
<i>LFG</i>			3		6		1	1	10		8		29			
<i>HFCs</i>	2				1								3			
<i>N<sub>2</sub>O</i>					1				1				2			
<i>Fugitive emissions</i>	3				9				6		9		27			
<i>Total</i>	28	7	4	4	17	17	4	1	0	1	29	20	25	24	107	74

Source: Data from HWWA Pipeline, July 2005

## Appendix IX

Table 6: CDM Projects Distribution by CERs Generated (in Thousand)

	<i>Asia</i>						<i>Africa</i>	<i>Europe</i>	<i>Latin America</i>				<i>Total</i>	
	<i>India</i>		<i>China</i>		<i>Other</i>				<i>Brazil</i>		<i>Other</i>			
<i>Biomass</i>	3242				2493		918		16869		608		24130	
<i>Hydroelectric</i>	868	1048	202	2184	1062				726	5441	3103	3644	596	12317
<i>Renewables</i>	2350		1279		2222		992				5506		12349	
<i>Energy Eff.</i>	577		819				45		166		93		1700	
<i>Fuel Switch</i>					2283				731		159		3173	
<i>LFG</i>			2897		3923		3820	681	42483		17028		70832	
<i>HFCs</i>	59829				12600								72429	
<i>N<sub>2</sub>O</i>					57190				35824				93014	
<i>Fugitive Emis.</i>	1489				12773				3391		9103		26756	
<i>Total Renew.</i>	7037		2300		8060		1955		18492		9469		47313	
<i>Tot. NonRenew.</i>	62366		5081		86466		3820	681	87139		29755		275308	

Source: Data from HWWA Pipeline, July 2005