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Inhalt

Abstract

The environmental integrity of the CDM under the Kyoto Protocol depends on the possibility to avoid giving emission credits to projects that would have happened anyway. Whether and how "Investment Additionality" of CDM projects has to be determined is currently part of climate negotiations. We discuss the rationale of companies to invest in projects and analyse possible criteria to determine Investment Additionality from a theoretical point of view. A number of case studies is used to show the implications of the different criteria. The use of a single criterion is not possible, especially due to the importance of non-monetary barriers. However, some criteria are better than others. Moreover, the institutional framework for the selection and application of criteria is very important. Concluding, we suggest a combination of a threshold Internal Rate of Return with a risk factor as primary criterion. To take non-monetary barriers into account, additional criteria could be used such as the existence of similar privately financed projects in the host country. If no explicit criterion is politically feasible, stringent baseline methodologies could at least capture some aspects of Investment Additionality.

Zusammenfassung

Die umweltpolitische Integrität des im Kyoto-Protokoll verankerten CDM hängt davon ab, ob Projekte, die ohnehin stattgefunden hätten, Emissionsgutschriften erhalten können. Ob und wie die "Zusätzlichkeit der Investition" nachgewiesen werden muss, ist derzeit Bestandteil der Klimaverhandlungen. Wir diskutieren die Entscheidungsgründe, die Firmen zu Investitionen in Projekte bewegen und analysieren mögliche Kriterien für die Bestimmung der Zusätzlichkeit aus einer theoretischen Perspektive. Darüber hinaus werden Fallstudien zur Untersuchung der Auswirkungen der verschiedenen Kriterien herangezogen. Sie zeigen, dass die generelle Beschränkung auf ein einzelnes Kriterium nicht möglich ist. Jedoch sind einige Kriterien besser als andere. Außerdem sind die institutionellen Rahmenbedingungen für die Auswahl und Anwendung der Kriterien sehr wichtig. Zusammenfassend befürworten wir die Kombination eines Schwellenwerts für die interne Ertragsrate mit einem Risikofaktor. Um nicht-monetäre Hindernisse zu berücksichtigen, können zusätzliche Kriterien wie die Existenz von ähnlichen, privat finanzierten Projekten im Gastland überprüft werden. Wenn kein derartiges Kriterium politisch durchsetzbar ist, können strenge Regeln für die Referenzfallbestimmung zumindest einige Aspekte der Zusätzlichkeit einfangen.

1. INTRODUCTION

The Kyoto Protocol allows industrial countries to reach part of their greenhouse gas emission targets through investment in projects in countries without emission targets (host countries). The backbone of the rules for this mechanism is found in Art. 12 on the Clean Development Mechanism (CDM). In the last years, there have been intense negotiations on the detailed rules necessary to make the CDM workable. They shall be finalized at COP 6 in the Netherlands in November 2000.

Many analysts see the CDM with suspicion, as they fear that it could undermine the environmental integrity of the Protocol. This is due to the fact that CDM host countries have no emission targets. By comparing project emissions with a constructed baseline scenario a CDM project generates emission credits (Certified Emission Reductions, CERs), that are calculated as the difference in GHG emission between the project activity and the baseline. The reasoning behind is that the baseline shall reflect the business as usual scenario, whereas the CDM project activity shall be one that requires extra-incentives to come into being. However, both the host and the investor have an incentive to overstate the amount of emission reduction achieved by the CDM project as they can then enhance revenues (Michaelowa 1998). If CERs will be created that represent emission reductions that would have happened anyway, "fake" reductions will undermine the emission targets. An easily understandable example for this problem is the increase of energy efficiency achieved by foreign direct investment in a heavy industry company in a developing country that reduces emissions *and* enhances profits. The investor would have done this anyway. If he now gets CERs due to the approval of the project as CDM project, the CERs are "fake" which will lead to an inflation of the Kyoto emission budget.

Thus we need a determination of the "Investment Additionality" of a proposed CDM project[1]. This entails the use of economic arguments in order to demonstrate that the CDM project would not come into being in the absence of the extra incentive stemming from the CERs. This type of reasoning grounds on the assumption that CERs will be valued in terms of money – a sensible assumption given the state of discussion on the various emissions trading schemes. The issue is highly relevant as, for example, Bernow

1 There are other kinds of additionality discussed in the negotiations, such as environmental, financial, technology, regulatory additionality. They partly overlap with Investment Additionality. To avoid confusion, we do not discuss them here.

et al. (2000) see a potential for non-additional CDM projects in the order of several hundred million tonnes of CO_2. It has been focus of the academic discussion on the CDM (Bedi 1994, Carter 1997, Philibert 1998, Baumert 1999) but astonishingly been neglected in the negotiations until the Lyon session of subsidiary bodies in September 2000. Of course, business does not like the idea of Investment Additionality and argues that there are many barriers and risks that make even hugely profitable projects additional (Rentz 1998).

It is the purpose of this discussion paper to illuminate possible formulations to incorporate Investment Additionality into the principles, guidelines, and modalities for the CDM. We will first have a short look at the proposals in the negotiations, then present case studies and, finally propose how Investment Additionality could be implemented.

2. THE THEORY BEHIND INVESTMENT ADDITIONALITY

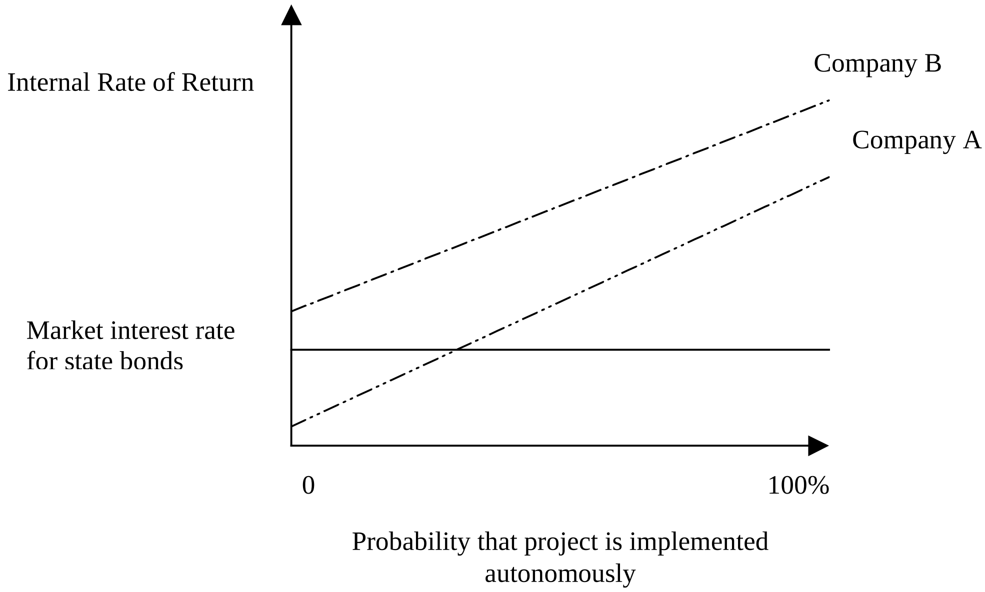
The determination of Investment Additionality amounts to a determination which projects will be implemented by private and public actors autonomously. This means that economic parameters have to be checked that make a project attractive. Usually, these parameters can be expressed in monetary units. However, non-monetary parameters exist that can have an impact on the monetary ones. This for example applies to the different kinds of risk. The non-monetary parameters may be hard to observe and quantify as they often depend on differing perceptions. For example, there are different degrees of risk aversion.

There is a wide range of views how micro-economic[2] Investment Additionality should be defined. The attractiveness of project is no objective, universally applicable feature but strongly depends on the specific situation which project participants face. There often is no single threshold parameter which has to be overcome but a set of parameters

2 Investment additionality can be seen on two levels – a macro and a micro level. Due to externalities, they will differ. A project that is clearly additional from a micro-economic point of view may not be macro-economically additional. Under fossil fuel subsidies, for example, a wind power plant might be clearly additional due to higher costs compared with the subsidised fossil fuel. If the subsidy was phased out, it could become non-additional. Thus non-additionality on a macro-level will enhance the supply of micro-level additional CDM projects while strong macro additionality will reduce it. Macro-economic additionality might be easier to assess than the micro-economic as it is not necessary to account for externalities. Such an assessment would also have the advantage that there are no perverse incentives to prolongate inefficient policies.

whose weights may shift. Two important criteria are minimum profitability requirements of an economic actor and his risk aversion. We try to show them by using a set of figures:

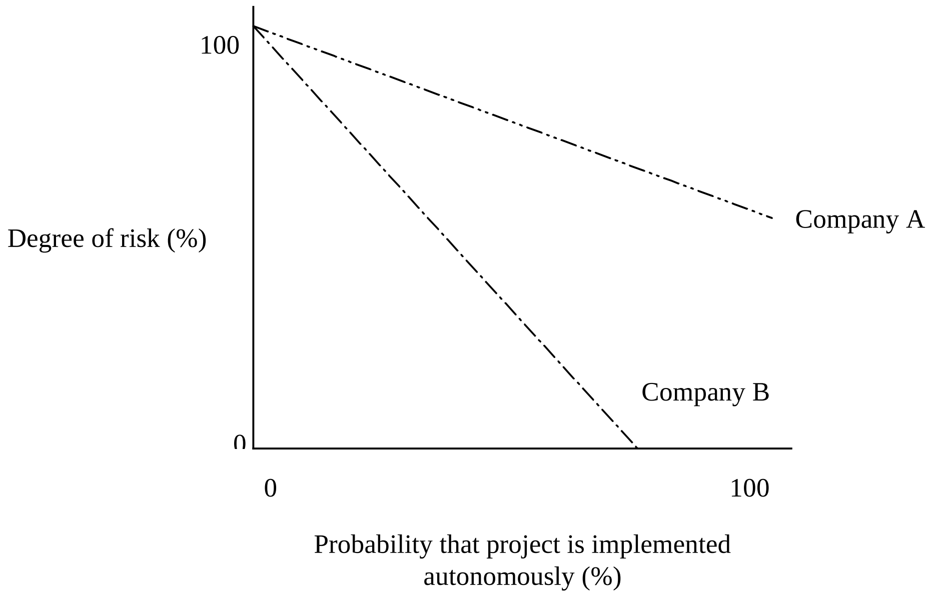
Figure 1: Decision of private actors to invest in a project



We assume two companies A and B and a risk-free environment. The probability of investing in a project rises with the projected Internal Rate of Return (IRR). Company B asks for higher IRR before investing in a project. This can be due to a lower equity ratio, higher profitability thresholds and other company-specific performance parameters.

Now we look at different degrees of risk. At a *given level* of projected Internal Rate of Return, the probability of investing in the project may depend on risk as shown in Figure 2. Note that beyond different reaction on risk companies may have different perceptions of the degree of risk as they weight components of risk in a different way.

Figure 2: Impact of risk on the investment decision at a given IRR



Due to these differences in perception that allow no point estimate of quantitative parameters, business representatives argue that there should be no quantitative determination of Investment Additionality. Similarly, Heller (1998) and Grubb et al. (1999, p. 227ff) argue for not trying to exactly quantify the degree of additionality but only make sure that the project has a dynamic effect leading to a long-term reduction of greenhouse gases.

However, the CDM is not made to account for all intricate differences in company investment behaviour. Instead, it has to safeguard the environmental integrity of the Kyoto Protocol. This calls for a conservative and universal definition of Investment Additionality. A project by a company with high risk aversion and a high IRR requirement would thus be excluded from the CDM even if it were additional for this company. The exclusion of these projects is the necessary price one has to pay for the preservation of environmental integrity. Otherwise one would have free riding by those companies with low risk aversion and low IRR requirements.

3. PROPOSALS CONCERNING INVESTMENT ADDITIONALITY IN THE CURRENT NEGOTIATIONS

Currently, none of the major negotiating groups supports Investment Additionality. Even more surprising, only three Non-Annex I parties – South Korea, Costa Rica and

Uzbekistan support it[3]. Other Non-Annex I countries that delivered relatively detailed submissions like India, China and Guatemala did not include the demand; Brazil even rejected it. Thus, **support for Investment Additionality is relatively weak**.

Among the proponents the quality of commitment varies widely. Clearly, the most committed party is Costa Rica. South Korea also delivered a strong case; however, its call is not supported by a detailed interpretation. The proposal with the lowest degree of differentiation is the submission by Uzbekistan.

The consolidated text (FCCC/SB/2000/4, UNFCCC 2000a) listed the Costa Rican proposal for Investment Additionality in Paragraph 68: „The value of the CERs shall significantly improve the financial and/or commercial viability of the project“. Moreover, paragraphs 78 and 79 state that the baseline should be „The least-cost technology for the activity“. The chairmen´s text for COP 6 (FCCC/SB/2000/10/Add.2, UNFCCC 2000b) goes beyond this wording with very clear (and bracketed) proposals:

1. ”Commercially viable business-as-usual projects should not be eligible as CDM projects“ (preamble)

2. “Projects which are commercially viable without CERs cannot qualify as CDM project (investment additionality)” (para 57 c)

3. “The project participants shall explain why the CDM project activity cannot be considered as the baseline” (para 61; without brackets).

4. DIFFERENT CRITERIA TO MEASURE INVESTMENT ADDITIONALITY

This section shall provide an overview of the various proposed criteria to determine Investment Additionality. In order to do that we feel the necessity to introduce several financial indicators first. We then discuss pros and cons of each criterion before proceeding to case studies to show their real-world implications.

3 Meanwhile further Non-Annex I Parties expressed their interest, e.g. Mexico and Colombia.

4.1 Parameters to derive criteria

To understand the calculation of possible quantitative criteria for Investment Additionality it is worth spending some time on shortly introducing the various terms of investment calculus that will be used later on.

Every investment generates two flows of money - an ***outflow*** consisting of the various payments for expenses and an ***inflow*** consisting of the revenues from sales, capital inflows and others. The sum of all inflows in a period minus all outflows in the same period is called the **cash flow**[4].

These expected inflows and outflows can than be discounted back to the present – using a fixed discount rate. In doing so one receives the ***present values*** of the inflow and outflow. By subtracting the present value of the outflow from the present value of the inflow one obtains the ***net present value (NPV)*** of the investment. It should be borne in mind that this NPV is dependent on the used discount rate.

A concept closely related to the NPV is the **payback period**. Here the subject under consideration is the difference of the discounted outflows and the discounted inflows in a certain period of time after project start. Typically, the shorter this interval of time the more important are the outflows in this interval, as in the beginning of the investment a load of expenses must be paid (mainly investment costs). In the course of time discounted inflows will outweigh the discounted outflows. The ***payback period*** is defined as the number of years after project start that is necessary for discounted inflows in this period to outweigh the discounted outflow in the same period. Similar to the NPV the payback period depends on the used discount rate.

The ***internal rate of return (IRR)*** is very different in character. Here the subject under consideration is the discount rate. It is defined as the discount rate that - when used for discounting – leads to the same value of overall in- and outflows.

Other financial parameters that have also been used throughout the discussion focus on costs only. Here very different cost categories exist. Major concepts used are investment

4 It should be noted that the authors decided the following self-constraint: They only focus on payment oriented financial indicators. In contrast to that one might confine the analysis to expenses and revenues. For the difference compare for example Sell (Sell 1991).

costs and marginal costs of production per unit of output. In more specific circumstances, for example in the energy sector, these cost categories are further differentiated (Auslandssekretariat, 1994).

Obviously, many barriers and risks are non-monetary but influence the investment decision. Otherwise, investment in energy saving would be burgeoning (Ostertag et. al., 2000). There is no set of generally agreed parameters to define such barriers and risks.

4.2 Currently proposed criteria to define Investment Additionality

The following table 1 summarises the various proposals tabled so far and, additionally, criteria that were used during the AIJ pilot phase. If not stated otherwise the financial indicators are calculated without taking the revenue from the CERs into account.

Table 1: Proposed criteria for Investment Additionality

	The CDM project activity meets Investment Additionality if ...
1	... there are barriers to the CDM project that do not apply to the reference case[5]
2	... project developers can show that there are real barriers and name activities to overcome them[6]
3	... investment costs/ average production costs/ overall cost/ costs to the economy for the CDM project activity exceed those of the reference case[7]
4	... $IRR_{reference\ case} > IRR_{CDM\ project\ activity}$
5	... $IRR_{CDM\ project\ activity}$ < market interest rate or other limit[8]
6	... $NPV_{reference\ case} > NPV_{CDM\ project\ activity}$[9]
7	... $FI_{CDM\ project\ activity\ incl.\ CERs} >> FI_{CDM\ project\ activity\ excl.\ CERs}$[10]
8	... $payback\ period_{CDM\ project\ activity}$ > minimum limit

5 Carter 1997

6 Beuermann et. al. 2000

7 This criterion is similar to the incremental cost analysis employed by the GEF.

8 Michaelowa/Fages 1999

9 Manso 2000

10 Here FI stands for financial indicator, i.e. NPV or IRR. The two greater than signs symbol that the difference shall be significant. This criterion also exists with payback periods. However, then the signs have to be reversed. This implementation was proposed by (Manso 2000) and actually found its way into the consolidated text (FCCC/SB/2000/4, paragraph 68 (c)).

Although this table does not exhaust the space of proposed criteria, it outlines what is being discussed. The first two criteria are qualitative, whereas all other ones are quantitative. Further, the table indicates that currently all proposed criteria are fairly theoretical. This is particularly severe, as to our knowledge no studies exist that have tried to check the practicability of the proposed criteria. In the next section these criteria will be applied to case studies. However, it is beyond the scope of this study to apply *all* the listed criteria to each of the case studies.

4.2.1 Discussion of theoretical adequacy of proposed criteria

The *two qualitative criteria 1 and 2* principally make sense but are difficult to operationalize. Due to the fact that they inevitably involve case-by-case judgement, the question is crucial who is in charge of their application in the CDM project cycle.

The third criterion needs a clear definition of costs including all revenue streams as well as of the discount rate used. If it only looks at microeconomic costs and revenues (i.e. not taking into account externalities) it is not different from the sixth criterion. However, it could be used to determine macroeconomic costs. This would be ideal to guarantee overall additionality and prevent perverse incentives for host countries to pursue inefficient economic policies to attract a maximum of investments in CDM projects. However, this approach will surely crowd out many projects with positive private costs, e.g. in the context of fossil fuel subsidisation (Michaelowa/Fages 1999).

The fourth criterion theoretically is convincing. However, in practice it could be subject to manipulation of the following type: the IRR of the reference project can be artificially raised to make a non-additional project pass the criterion. If for example the CDM project has an IRR of 25% it would pass the test if the IRR of the reference project can be raised above this level by assuming a very positive development of revenues or underestimating costs. It is not clear whether certifiers will be able to uncover fraud of this type.

The fifth criterion does not encounter the problem of reference case definition and uses a threshold defined on a higher degree of aggregation (e.g. country- or regionwide), thus reducing manipulability. The criterion very straightforwardly rules that projects are additional if they are unattractive investment options compared to a country- or regionwide average.

The sixth criterion suffers from the same problem as criterion 4 as it involves determination of a reference project. Project proponents can manipulate the NPV by the choice of discount rates, especially if the lifetimes of reference and CDM project differ. Criterion 5, which avoids the determination of a reference project, does not allow such manipulation. The *logic of criterion 7* differs from that of criterion 5. Here a project is deemed additional if the project's performance is significantly increased by the CERs. For this reason the project is no sufficient criterion due to the fact that also an already attractive project could be deemed additional if the CERs further increase its commercial performance. The criterion exists in three different formulations. *Criterion 7a* is based on NPV; i.e. the criterion is fulfilled if the CERs significantly increase the NPV of the CDM project activity. As a measure we use the proportion between the NPV of the CERs and the absolute value of the NPV excluding the CERs. *Criterion 7b* is based on IRR. Here the measure we use is the amount of percentage points that the IRR is increased due to the inclusion of the CERs. *Criterion 7c* is based on payback periods. The measure for significance is the amount of years that the CERs shorten the payback period.

The eigth criterion, the payback period threshold faces the problem that even projects with a long payback period might in some cases be economically attractive. Therefore, there is no guarantee that all non-additional projects will be excluded under this criterion. Consider the following example: Two projects have an identical investment of 1 million $ but different annual revenues and different lifetimes (see Table 2).

Table 2: Differences in payback period and NPV due to differing lifetimes of projects

Project	Initial investment	Annual revenue	Lifetime	Payback period	NPV at 10% discount rate	NPV at 2 0% discount rate
A	1 million	300,000	5 years	3.3 years	0.14 million	-0.11
B	1 million	200,000	20 years	5 years	0.7 million	0

Under a payback threshold of four years, project A would be excluded while project B would be accepted even though the latter has a much higher NPV. This result is robust.

A simplification of additionality determination is the check whether a project has any revenue/cash inflow. If this is not the case the project usually is clearly additional since it could never be commercially viable (compare case study PrimaKlima). However, if it is mandatory to do some project, e.g. in case of national environmental standards (see first case study below), it has to be checked whether the costs of the project are higher than the costs of the reference project.

An argument often used by the opponents of any Investment Additionality determination is the unavailability and confidentiality of financial information. While businesses indeed try to avoid the publication of all figures, they routinely have to deliver these data for bankability assessments. Thus determination of Investment Additionality should be possible under an institutional framework that respects confidentiality. All criteria that use the reference project as basis for the comparison face the problem that international rules for determination of baselines have a decisive influence on the choice of the reference project. Only if project-by project baselines are used, the reference project is likely to be described using a realistic assessment of the situation provided that the rules prevent “gaming” by project developers. If benchmarks are used, there is no definition of a specific reference project and thus the financial parameters cannot be calculated.

5. CASE STUDIES

In the following three case studies will be presented and their additionality evaluated using the different criteria.

5.1 Methane Emission reduction at Waste Water Treatment Plants in Coffee Mills:

Project description:
The AIJ project “Methane Emission reduction at Waste Water Treatment Plants in Coffee Mills” contributes to higher quality of water through end of pipe wastewater treatment (BTG 1997). It has been fully operational for more than one year.

Project developers essentially had the choice between two technical options: the anaerobic lagoon process and the anaerobic reactor process. The two do not differ in the biological degradation process. But in comparison to the lagoon the reactor allows to capture methane, which is then burnt in order to produce electricity and heat. Thus, the project developers could choose between two investment objects that serve exactly the same purpose, but differ in the investment costs. The low cost option, i.e. the open lagoon became the reference case, whereas installing the reactor became the AIJ project activity. According to the project proposal, the project sets off 12,703 t CO_2 eq. per year. In the project proposal, 10 years are stated as economic lifetime, which under these circumstances most likely means the economically optimal time of operation. For the purpose of this study we assumed 11 years of project duration, of which one year is used for construction. The following tables summarise the economic indicators that characterise the project.

Table 3: NPV in Mio. US$ depending on discount rate, CER prices and crediting times

Discount rate	10 %				15%			
CER price	**0 US$**	**5 US$**	**10 US$**	**50 US$**	**0 US$**	**5 US$**	**10 US$**	**50 US$**
5 years [11]	**-1.36**	**-1.12**	**-0.88**	**1.05**	**-1.29**	**-1.08**	**-0.86**	**0.84**
10 years	**-1.36**	**-0.97**	**-0.58**	**2.54**	**-1.29**	**-0.97**	**-0.65**	**1.9**

From the figures in table 3 one can deduce that the methane emissions project, without the CERs is a pure expense for the project developers. This is only little surprising, as the project generates no income stream apart from some energy savings that accrue due to the use of methane for the generation of electricity and heat. If the CERs are taken into consideration, then the NPV increases due to the revenue stream from the CERs. However, only if CER prices go up far above 10 US$, the methane emissions reduction project generates return on investment. This finding is also reflected in table 4 and 5 which show the payback period of the project and the IRR. Whenever the corresponding figure does not exist, a bar is placed in the cells.

Table 4: Payback periods in years depending on the discount rate, the CER price and the crediting time

Discount rate	10 %				15 %			
CER Price	**0 US$**	**5 US$**	**10 US$**	**50 US$**	**0 US$**	**5 US$**	**10 US$**	**50 US$**
5 years	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**4**
10 years	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**4**

11 Crediting time

Table 5: IRR in % depending on CER price and crediting period

CER price	0 US$	5 US$	10 US$	50 US$
5 years	-	-	-	**50.1**
10 years	-	-	-	**58.1**

Criteria that could not be checked: The available information does not allow investigating barriers to project implementation. Therefore, criteria 1 and 2 of the above table could not be tested in this study. According to table 4 and 5 it is void to speak of payback periods and IRR of this project, if CERs are left out of the calculation. Therefore criteria 4, 5 and 8 cannot be applied in the circumstances of this project.

Criterion 3: Criterion 3 was actually employed by the project developers: In their proposal to OCIC the project developers justified the additionality by stating the different *investment costs*[12]. This difference in the investment costs amounts to 399,819 US$. **Thus, the project meets the requirement of criterion 3 when it is based on investment costs.** If more data on the O& M costs of the lagoon was known, criterion 3 could also be checked on the basis of other cost categories.

Criterion 6: Given the available information, the NPV can only be approximated by the investment costs and assumptions on the operating costs. Criterion 6 rules that the NPV of the CDM project activity must be lower than that of the reference case. This would hold, if the operating costs of the reactor were of similar or higher magnitude than those of the lagoon and the revenues from electricity / heat production would only be marginal. Though, on the grounds of the available information, the authors cannot produce the actual figures, the preceding condition will most likely hold. **Thus, the project would most likely pass criterion 6, independent of the employed discount rate**.

Criterion 7: As already pointed out in the circumstances of this project, the analysis is confined to the NPV, i.e. criterion 7a. As can be calculated from table 3 the contribution of the CERs is at least 16 percent of the absolute amount of the NPV. **Thus, the project passes criterion 7a, if significant means an NPV increase due to the CERs of least 16 percent.**

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12 The statements based on offers of the Costa Rican Company that installs lagoons.

5.2 Wood Waste Power Plants in Zimbabwe, Nyanga site

The CDM project activity consists of the installation of a 3.5 MW wood waste fired co-generation plant. At present, this project is at a planning stage. Meanwhile the Zimbabwean Power Company (ZPC) is looking for an investor, who shall provide most of the equity funding.

As most of the wood waste is burnt in the open air, operation of the plant is almost carbon neutral. The climate impact stems from the savings in fossil fuels at other plants. On behalf of the GTZ, a baseline study was conducted (Herold et. al., 2000a). Using generic baselines the project was found to generate 14,480 t CO_2 eq. per year (Baseline A)[13]. According to Herold et.al., the project lifetime will most likely lie between 15 and 20 years (Herold et. al., 2000b: 44). For the purpose of this study we assumed a total project lifetime of 20 years, of which 2 years are used for construction. Herold et al. also report on a possible financing plan for the Nyanga project (Herold et. al., 2000b), which outlines the proportion between equity and commercial loan financing. For this reason the calculation of the Nyanga project includes, as the only case study in this project, capital expenses and capital inflow.

Table 6: NPV in Mio. US$, depending on the discount rate, the CER price and the crediting time

Discount rate	10 %				15 %			
CER price	**0 US$**	**5 US$**	**10 US$**	**50 US$**	**0 US$**	**5 US$**	**10 US$**	**50 US$**
10 years	**2.55**	**2.96**	**3.36**	**6.60**	**0.70**	**1.02**	**1.33**	**3.86**
18 years	**2.55**	**3.09**	**3.63**	**7.95**	**0.70**	**1.09**	**1.47**	**4.56**

Obviously, the Nyanga project generates return on investments even without the revenue from the CERs. Two observations are particularly noteworthy. Firstly, the crediting time has relatively little impact on the NPV, i.e. almost doubling the crediting time, sometimes only moderately increases the NPV. Secondly, the calculation appears to be extremely dependent on the discount rate.

13 The authors of the GTZ funded study explored several generic baselines. For the purpose of this document baseline A was used, which grounds on fairly moderate assumptions (749 CO2 g/kWh).

Table 7: Payback period in years, depending on the discount rate, the CER price and the crediting time

Discount rate	10 %				15 %			
CER price	**0 US$**	**5 US$**	**10 US$**	**50 US$**	**0 US$**	**5 US$**	**10 US$**	**50 US$**
10 years	**14**	**13**	**11**	**6**	**16**	**15**	**13**	**6**
18 years	**14**	**13**	**11**	**6**	**16**	**14**	**13**	**6**

As table 7 reveals, the project reaches its break-even point fairly late, which is the explanation for the high influence of the discount rate on the NPV. The CERs help curtailing the payback period, however, only prices above 10 US$ really make a difference.

Table 8: IRR in %, depending on CER price and crediting time

CER prices	**0 US$**	**5 US$**	**10 US$**	**50 US$**
10 years	**18.3**	**20.0**	**21.7**	**38.0**
18 years	**18.3**	**20.2**	**22.1**	**38.8**

Once again, table 8 confirms the low influence of long crediting times.

Criteria that could not be checked: Criteria 1, 3, 4 and 7 cannot be applied under the circumstances of this project, because no real reference case exists. Due to restricted access to information, it was not possible to check criterion 2.

Criterion 5: According to table 8 the project passes criterion 5, if the maximum allowable IRR lies above 18.3%.

Criterion 7: For the project under consideration, all three discussed financial indicators (NPV, IRR, and PBT) exist, i.e. criterion 7a, b and c can be tested. **Criterion 7a: According to table 6 the project passes criterion 7a if significant means an NPV increase due to the CERs of at least 16%. Criterion 7b: According to table 8 the project passes criterion 7b if significant means in IRR increase of at least 1.7 percentage points. Criterion 7c: According to table 7 the project passes criterion 7c if significant means a reduction of the payback period by at least 1 year.**

Criterion 8: According to table 7 the project passes criterion 8 if the minimum payback period lies below 14 years.

5.3 Silvicultural measures and afforestation in Argentina – The case of Prima Klima e.V.

Prima Klima e.V. – a German NGO – in co-operation with the Fundacion Bosques de la Patagonia implements this forestry management project. The project area is located in Patagonia close to the Chilean border. Of the total area of land forests cover 50,400 ha. Further, the project area comprises 55,000 ha of pasture and mountain regions and 15,000 ha of lakes. This sums up to 120,000 ha of land.

Currently, the forests suffer of large-scale impoverishment and destruction due to man-made fires, unsustainable forest management and forest pastures of cattle and sheep. Switching this mode of operation to more sustainable patterns is the overall goal of the Prima Klima project. In terms of carbon dioxide, this translates into three different impacts:

1. Impoverished Lenga-forests shall receive underplanting. In consequence, there will be a carbon dioxide impact of 124.6 t CO_2 / ha after 50 years on a surface of 4,376 ha.

2. On a total area of 14,234 ha the management regime will be changed towards a more sustainable practice. The project description distinguishes between various categories of forests where the changes in management will occur. Therefore, the authors can only state the average carbon uptake per ha. Additionally, the project description distinguishes between two scenarios – one being the best case and the other representing the worst case. For the calculation the authors use the average of the two scenarios. Then the average carbon impact per ha amounts to around 270 t CO_2 /ha after 50 years. Interestingly, the project developers mention that in their scenarios the actual carbon uptake starts from the 30th year on. Until then this project component is carbon neutral or may even occasion GHG emissions.

3. 300 ha of pasture will be afforested. Here the expected carbon abatement due to biomass accumulation is expected to lie in the vicinity of 440 t CO_2/ha after 50 years.

Costs are also stated in the project description: In total the project developers expect expenditures of 2.5 Mio US$. As the project is described in the description there will be no revenues that accrue to the project developers. Using all these data, the following economic indicators can be found for the PrimaKlima project.

Table 9: NPV in Mio. US$, depending on the discount rate, the CER price and the crediting time

Discount rate	10 %				15%			
CER prices	**0 US$**	**5 US$**	**10 US$**	**50 US$**	**0 US$**	**5 US$**	**10 US$**	**50 US$**
30 years	**-2.5**	**-1.74**	**-0.97**	**5.13**	**-2.5**	**-1.97**	**-1.44**	**2.78**
50 years	**-2.5**	**-1.19**	**0.13**	**10.65**	**-2.5**	**-1.86**	**-1.22**	**3.9**

According to table 9 the Prima Klima project clearly is economically inattractive as long as CER prices are low. Possibly, the costs of this project are underestimated as the project developers assumed zero operation and maintenance costs. In an interview, the project developers expressed their hope to meet running costs by income generated from the different use of land.

Table 10: Payback period in years, depending in the discount rate, the CER price and the crediting time

Discount rate	10 %				15 %			
CER price	**0 US$**	**5 US$**	**10 US$**	**50 US$**	**0 US$**	**5 US$**	**10 US$**	**50 US$**
30 years	**-**	**-**	**-**	**5**	**-**	**-**	**-**	**5**
50 years	**-**	**-**	**45**	**5**	**-**	**-**	**-**	**5**

Table 11: IRR in %, depending on the CER price and the crediting time

CER price	0 US$	5 US$	10 US$	50 US$
30 years	**-**	**-**	**-**	**37.17**
50 years	**-**	**-**	**10.3**	**37.23**

Criteria that could not be checked: In the project description the reference case is only described in terms of numerical scenarios for the different categories of forests.

That is to say, no explicit activities were named that would allow determining financial indicators like the payback period, the net present value or costs of the reference case. Thus criteria 1, 3, 4 and 6 cannot be applied.

Criterion 2: In order to show that a project meets the barrier criterion, project developers need to show that there are barriers to their project that prevent its implementation. In the literature on barriers, a distinction between political, financial, cultural, technical, and other barriers has been made (e.g. Beuermann et al. 2000). However, determining the barriers to implement the targeted more climate friendly use of land in Patagonia is difficult. In the project description the project developer outlines several modules that help to structure the implementation (PrimaKlima, 1999). These modules include, for example, precautionary measures for fire protection, rehabilitation of degraded forests, implementation of new patterns of an economic use of the forests, and improvement of the income situation of local sawmills and peasants. Some of these modules result in carbon uptake of forests, whereas the others can be regarded as preparatory work.

For example, the rehabilitation of degraded forests incorporates bringing out small plants and seeds and taking special care of them. All efforts would be useless, as long as local farmers continue to drive cattle and sheep into the forests which threatens the young seeds. From the farmer's point of view, however, grazing in the forests is economically rational, as there is a shortage of pastureland. To match better the number of livestock and the supply of pastureland flocks and herds must be diminished. Only then the rehabilitation of the degraded forests can begin. Thus, PrimaKlima decided to advice peasants on more sustainable cattle grazing, and to pay compensation for the reduced number of livestock. Thus, the cattle grazing in the forests constituted the barrier to rehabilitation, that PrimaKlima could overcome by advice and contractual agreement with the local peasants. Other such barriers are listed in table 6.

Table 12: Barriers

Description of barrier	Measures to overcome them
Reluctance and scepticism of official authorities	Official approval of local, regional and national administration, contracted sharing of the revenue from selling CERs
General resistance to the project [14]	Distribution of information, open publication policy
Local sawmills depend economically on unsustainable forestry	Advice, compensation payments

Obviously, it is possible to formulate barriers to the PrimaKlima project that would prevent the project from coming into being. Also, one can easily name activities that help to overcome the stated barriers. **Hence, the criterion 2 is fulfilled.**

Criterion 5: According to table 11 the IRR does not exist if CER prices are zero or very low. Thus, criterion 5 cannot be applied as formulated.

Criterion 7: Similar to the methane emissions project in these projects circumstances only criterion 7a can be applied. According to table 9 the project passes criterion 7a, if significant means an NPV increase due to the CERs of at least 20%.

Criterion 8: This criterion does not exist.

14 There are several local NGOs in Argentina that survey the project rather critically. Particularly Greenpeace Argentina has expressed its rejection of the project (ENS 2000).

5.4 Further Case studies

An analysis of several other sources gives an indication about the IRR of several CDM type projects (see Table 13).

Table 13: IRRs and impact of CER accrual

Project	Wind farm (Brazil)[15]	Wind farm (Morocco)[16]	Methane capture in wastewater (Morocco)[17]	PV (Brazil)[18]	Small hydro (Uzbekistan) 19	Small hydro (Uzbekistan) 20
IRR (%)	6.7	11.3	Negative	8.4	Around 11	Above 12
IRR with CERs (%)	7.5-8.5	13.6-17.9	Negative	8.7-10.2	Difference 0.2-2.8	Difference 0.4-4.7

6. CONCLUSIONS FROM THE CASE STUDIES

1. The majority of the analysed projects is not commercially attractive and thus additional under most criteria. CER prices of 10 US$ can already render some projects economically viable. However, some projects are still too far away from profitability in order to take off the ground even if revenues from CERs are included in the calculation.

15 The installed capacity is 40 MW. Investment costs amount to 50 million US-$. Under the assumption that CER prices rise from 1.4 US-$/t CO_2 in 2001 to 5.5 US-$ in 2005 and then 10% p.a., the IRR rises by 0.8 percentage points. A CER price path of 1.4 US-$ in 2001 and 13.6 US-$ in 2005 would yield an increase of 1.8 percentage points (University of Colorado at Denver, 2000).

16 The installed capacity is 50.4 MW. Investment costs reach 50 million US-$, an electricity sales price of 5 c/kWh is assumed while annual production reaches 226 GWh. 230,000 tons of CO2 will be reduced annually. Using CER prices of 5-10 US-$/t CO2, annual revenue from CERs would be 1.15-2.3 million US-$ (Boyé, 1999).

17 The wastewater plant costs 470,000 US-$. Annual operating costs are 27,000 US-$. Revenues from water sales amount to 13,000 US-$. Methane sales raise 7,400 $ (Driouache et al., 1997).

18 The installed capacity is 50 kW. Investment costs amount to 70,000 US-$. The calculation assumes an electricity sales price of 5 c/kWh and an annual production of 117 MWh. Depending on the baseline 40 to 100 tons of CO_2 will be reduced annually. Using CER prices of 5-10 US-$/t CO_2, annual revenue from CERs would be 200-1000 US-$ (Environmental Financial Products, 2000).

19 Yangi Dargom plant with investment costs of 6.6 million US-$. Depending on the baseline, 14,400 to 18,200 tons of CO2 will be reduced annually. Using CER prices of 1 to 10 US-$, IRR will rise by 0.2 to 2.8 percentage points. NPV is positive at discount rates of 8 and 10 %, but negative at 12% (Zayalova, 2000).

20 Paitok plant with investment costs of 1.1 million US-$. Depending on the baseline 4,100-5,200 tons of CO2 will be reduced annually. Using CER prices of 1 to 10 US-$, IRR will rise by 0.4 to 4.7 percentage points. Paitok´s NPV remains positive throughout the range of 8-12% (Zayalova, 2000).

2. If CER prices go up CERs can substantially increase the performance of a project.

3. None of the proposed criteria can be applied universally. It is important to note that this finding is not dependent on the available information or any other practical reason but due to the inherent structure of the different types of projects that will be allowed to participate in the CDM.

4. All case studies underlined the importance of revenue in the first years after the project start. Because of discounting, selling one t CO_2 for 10 $ 20 years in the future is only worth a fraction selling one ton CO_2 today at the same price. Therefore, the time distribution of the revenue from selling the CERs is decisive for the influence on the attractiveness of the project for its developers. The earlier CERs accrue, the higher their value. Even if one expects CER prices to go up, it is still better to receive them early as they can be banked.

5. The crediting period is decisive concerning the amount of CERs generated and thus is crucial for the ecological effectiveness of the CDM. However, contrary to intuition, a long crediting period does not necessarily have a strong impact on the attractiveness of the project compared to a short crediting period. The higher the discount rate, the lower the influence of CERs accruing many years in the future. Even if extending the crediting period from 10 to 20 years doubles the amount of CERs generated; at double-digit discount rates it may only increase the IRR of the CDM project by 1or 2 %.

6. CERs can help to overcome barriers such as restricted access to capital and political uncertainty, because they can be considered additional revenues that help to shorten the payback period. Under the payback criterion only CERs that accrue within the period are useful. However, it is unlikely that project developers use the payback criterion as single criterion as this would lead to an inefficient outcome.

7. The various financial indicators used differ significantly in the data they require. The most difficult and complex indicator is the IRR followed by the NPV. In order to determine both financial indicators, all information, i.e. the entire expected in- and outflow from the project start to the end, must be available. Particularly, the lifetime of the project is decisive. Why? Typically, an investment project generates positive cash flows in its last years. By merely stating a shorter lifetime, project

developers could significantly reduce the IRR and NPV of their investment. Thus, the two financial indicators are prone to manipulation. To determine the payback period requires the in- and outflows of the first years only. Additionally, data in these years are less open to manipulation as the economic situation can be specified more easily for the near future. Even simpler are financial indicators that involve costs only, as than the entire cash inflow can be left aside. However, they can lead to extreme distortions as projects with identical costs can have hugely different revenue streams. Thus cost determination should only be considered if revenues are equal.

8. Criterion 1 could not be applied in the case studies. Given the available literature on projects it seems very unlikely that barriers to the reference case can be described consistently. This makes a universal application difficult.

9. Criterion 2 could only be applied in the PrimaKlima case. The criterion appeared applicable, even though the project structure is rather complex. However, the experience gained in this case study using criterion 2 shows that it necessarily implies - rather arbitrary - value judgements. However, the criterion is interesting due to its process orientation and its applicability in small but complex projects. It could promote the measures that help to overcome barriers, e.g. capacity building etc and thus enhance the probability of successful project implementation.

10. Criterion 3 can only be applied using a macro-economic framework. The GEF has used it in the determination of projects in its portfolio under the term "incremental cost" analysis. However, the methodology used by the GEF is not very clear and we did not have access to a detailed GEF case study.

11. IRR thresholds as foreseen in criterion 5 can clearly be applied with ease in many different project contexts. However, the criterion suffers from the necessity to fix a threshold. The case studies in this study do not allow to deduce which degree of differentiation would be necessary in order to establish a fair system of IRR thresholds that does not punish particular countries or project types. Clearly, a number of our case study projects would be deemed non-additional if the interest rate for securities is used and risk adjustment rates are low. If the market interest rate of private loans were used, most would qualify as additional.

12. Criterion 6 may suffer from the inherent difficulties that arise when the reference case and the CDM project activity differ in size and lifetime.

13. The Costa Rica criterion of "significant improvement" of commercial viability that was numbered criterion 7 in this study presumably has the potential to exclude many projects from the CDM as long as CER prices are low. If CER prices rise this criterion may however become obsolete.

14. Criterion 8 suffers as criterion 5 from the need to fix a minimum threshold. It is beyond the scope of this study to explore the degree of differentiation between countries and project types that is necessary in order to establish a non-discriminating criterion.

7. RECOMMENDATIONS

The discussion of the different criteria and the results of the case studies leads to the following conclusions:

1. The use of a single criterion is not possible, especially due to the importance of non-monetary barriers. However, some criteria are better than others are.

2. The institutional framework for the selection and application of criteria is very important

The political task is to define an optimal combination of criteria that is robust and to ensure their adequate implementation.

7.1 Choice of criteria

Given the difficulties in operationalizing the qualitative criteria such as barriers which had to be overcome one should whenever possible use the financial indicators as first choice. Among the latter the criterion which is least vulnerable to manipulation should be chosen.

The discussion on the theoretical adequacy of the criteria concluded that an absolute threshold financial indicator is less subject to manipulation than the comparison with a (hypothetical) reference project. Moreover, a UNFCCC body or certifiers can easily use it. However, such an indicator has to take into account the existence of non-monetary factors which influence investment decisions such as risks. Risks are strongly related to economic and general policies and should thus be calculated on a country level. We would thus suggest a combination of a threshold IRR with a risk factor as primary criterion:

The Institutional Investor country-ranking list[21] could be used to determine "multipliers" on the threshold discount rate. The multiplier should be proportional to the risk rating. Risk multipliers could be determined by a formula such as 1/Inst.Investor percentage for the respective country. This formula would give a multiplier of around 4 for high-risk countries such as Indonesia and Russia and 7 for the worst non-war torn regimes (e.g. Cameroon).

A differentiation according to project types is thinkable but suffers from the problem that the definition of risk factors would have to be administered by a central body including regular updates. This may lead to high transaction costs.

A mathematical alternative to the IRR determination would be a NPV calculation using the threshold IRR. If the NPV were negative, the project would qualify as additional.

As a payback criterion only covers the risk aspect, it is clearly less adequate and should only be used as secondary if at all. If it was chosen, it should be differentiated between countries. Here the Institutional Investor list could also be used.

Barrier determination should always be a secondary criterion as it is the least rigorous one. If it is accepted, it must be employed carefully. , An operationalization of the barrier approach which allows for more objectivity would be to check whether

- any other projects of this type exist in the country. If not, barriers will certainly exist.
- any other privately financed projects exist. This takes account of public finance.

21 This list is compiled by a private finance journal. It ranks the creditworthiness of 145 countries on the on a scale from 0 to 100 (currently Switzerland tops with 95.6 and North Korea is at the bottom with 6.2). A large group of experts from all over the world is involved in the ranking, which reduces the risk of manipulation. The list is updated twice a year and available at http://www.-iimagazine.com/premium/rr/countrycredit/ccr

An alternative would be to choose a small positive number as threshold.

A possibly stringent but not yet developed alternative for determining investment additionality would be the use of a behavioural model such as proposed by the World Bank (Chomitz 1999). The model would be fed with project parameters in order to determine whether or not the project would be undertaken in the absence of CDM. If designed properly, such a model could be a sensible tool as it is not subject to manipulation if administered by a credible institution. However, a functioning model is still a far way off.

The following table tries to look at the pros and cons of each approach

Table 14: Advantages and disadvantages of different criteria for Investment Additionality

Criterion	**Availability of data for setting of the measure**	**Impact on business data confidentiality**	**Costs to project proponents**	**Biases**	**Manipulability**
Risk adjusted market interest rate IRR/NPV threshold	High	high	Low	Disadvantages project proponents with high risk aversion	Understatement of project IRR possible
Payback period threshold differentiated according to project types	Medium	medium	Low	Advantages projects with long lifetimes	Overstatement of payback time possible
Behavioural model	Low	low	High	Depend on model specification	-

It is often stated that a rigorous definition of baseline rules can automatically solve the issue of Investment Additionality. This is only partly true as one can find zero-emission technologies fulfilling the most stringent benchmark that are still profitable (see Moroccan wind farm in Table 13). However, stringent baseline rules can capture at least some aspects of Investment Additionality and could therefore be considered as second-best solution (see Table 15).

Table 15: Impacts of baseline rules on Investment Additionality

Measure	Availability of data for setting of the measure	Impact on business data confidentiality	Costs to project proponents	Biases	Manipulability
Frequent baseline revision	High	low	high	-	-
Minimum technology standards for baseline	High	low	low	No systematic link between performance of technology and costs	-
Benchmark based on most recent additions	High	low	low	Low	-
Percentile thresholds for efficiency[22]	Medium	low	low	No systematic link between performance of technology and costs	-

7.2 Institutional allocation of tasks in additionality determination

The avoidance of manipulation is a crucial issue concerning determination of Investment Additionality. If the decision which method to use was left to the project participants, we would surely witness the choice of the least rigorous standard possible for such a project. For example, projects with long lifetimes would choose a payback criterion and qualitative criteria would clearly dominate as surely a certifier would be found who gives his o.k. for whatever barrier description.

The right procedure for selecting parameters and methods is thus as crucial as the exact definition of the criteria themselves. We would like to propose the following institutional setting for selection of the criteria:

7.2.1 Responsibility of the COP

- Definition of the underlying principle for the criterion/criteria, e.g. use of thresholds instead of reference projects, , risk adjustment or not

22 This has been suggested by the U.S. (2000) as sole criterion for definition of Investment Additionality.

- Definition of prioritisation of criteria (e.g. first order/secondary order criteria)

7.2.2 Role of the CDM Executive Board

- Using the principles defined by COP, the Executive Board calculates the parameters. If, for example, an IRR threshold with risk adjustment is chosen by COP, the Executive Board quantifies the IRR threshold for each host country as well as the risk multiplier which is derived from the Institutional Investor list. If the primary financial criterion is not fulfilled, project proponents can submit a detailed analysis which barriers will be overcome for consideration of the Executive Board.

- If qualitative criteria are decided upon, the Board defines the rules for the certifiers to check the fulfilment of these criteria.

- Any registered observer of the UNFCCC process should have the right to file a complaint with the Executive Board if they doubt additionality of a project. The Board then decides to open an enquiry. If a complaint is found to be grossly unjustified, the complainant could lose his right for future complaints.

7.2.3 Certifiers's tasks

- Certifiers check whether project proposals are additional by using the rules as defined by the Executive Board. To alleviate the fear that confidential data may be obtained by competitors, certifiers have to keep confidentiality, unless the Executive Board waives confidentiality in case of a dispute.

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