IS THERE A LEVERAGE PARADOX IN CLIMATE FINANCE?

EFFICIENCY OF THE CDM AND THE GEF IN LEVERAGING FUNDS AND REDUCING CO_2

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Executive Summary

Carbon market payments and international public funds for climate change mitigation in developing countries, which we subsume here under "climate finance", have increased to billions of US dollars (USD) per year and will even more increase in the next few years. Given these large financial flows and the need to spend them wisely, a closer look at past efficiency of climate finance is warranted.

Apart from reducing greenhouse gases (GHG) as major indicator of climate finance efficiency, the amount of leveraged private funds is increasingly seen as goal of climate finance by governments and is also more and more studied. While clearly large volumes of private investments will be needed to achieve agreed climate goals (e.g. the 2 degree target), it is not obvious if efficiency in leveraging private funds also means efficiency in reducing GHG emissions.

To explore the correlation between leveraged funds and reduced emissions, we study data of the Clean Development Mechanism (CDM) as market mechanism and the Global Environment Facility (GEF) as public funding instrument. Those two channels are just representing a minority of current climate finance flows (also consisting of bilateral grants, multilateral loans and equity/guarantees). Nevertheless, analysis of CDM and GEF is interesting because of two reasons: First, they provide project level data on CO_2 reductions and leveraged funds, which is missing for other channels. Secondly, they have similarities to other funding channels.

We will in the following present the main results regarding past efficiency of the CDM and GEF in reducing GHG, their efficiency in leveraging funds and the interrelation between the two measures, which is the ultimate goal of the study.

Reducing greenhouse gases: room for improvement
Both the CDM and the GEF seem to have been effective in reducing GHGs, with the CDM being overall clearly more effective and efficient. However, the existing mechanisms have shown major deficiencies and, therefore, policy makers should build upon the experience of both the CDM and the GEF when designing new market mechanisms and public funds.

Effectiveness and efficiency of the GEF and the CDM in reducing GHG may be improved in at least three areas. Firstly, increasing funds for energy efficiency seems to be adequate as abatement costs are generally low. As political and informational barriers are high and can be better removed through policy intervention instead of private funding, public funds (such as the GEF) are especially well-suited to promote energy efficiency, but their channelling capacity may be limited. In the case of market mechanisms, new market mechanisms or a take-off of CDM Programmes of Activities are needed to target energy efficiency in a broad way. Secondly, an increase of funds earmarked for renewable energy may be less efficient (compared to energy efficiency) as costs are high, especially in the case of the CDM. As a minimum, funding should be refocused to renewable energies with high probability of additionality (e.g. biogas). Thirdly, policy changes may be required in case of industrial gases, where the CDM has created significant rents due to the substantial difference between market price and abatement costs. From an overall economic perspective, such rents are part of a well-functioning market. However, in face of scarce climate finance, CDM reforms like discounting or a public funding approach for industrial gases would free resources for other types of mitigation projects where rents are lower.

For the future, quality of GHG reduction data has to be improved in the GEF case, and other public institutions should start to collect data on GHG reductions achieved by their projects as well.

Overestimated ability of climate finance to leverage funds
The efficiency in leveraging funds can be measured by the leverage factor (also called "leverage ratio"). There are different definitions for the leverage factor in the literature (e.g. related to the question if only private or also public funds are leveraged). We define it here as the ratio of leveraged (non-climate related) public and private funding to leveraging climate finance (so public funds or carbon market payments). Leverage factors in the range of 8-15 as reported in the literature are exaggerated. For instance, the CDM has only a leverage factor of 3-4.5 on average and not double or three times this figure as reported in past studies. In the GEF, the official leverage factor is 6-7 but only half of the leveraged co-funding is private

capital, while the other half are public funds, which often will be invested anyway. Therefore, the real leverage of the GEF is probably in the same range as for the CDM.

Hence, policy makers should be less optimistic about the leveraging ability of climate finance: in the end, every funding source claims to leverage the other ones, and high leverage factors are indicating that the private flows may have been invested anyway. Leverage factors of 2-4 as mentioned in the 2009 UN Climate Financing report seem to be reasonable.

Leverage factors as questionable indicator for mitigation

Finally, the leverage factor is not a convincing indicator for mitigation efficiency, as shown by our analysis of the correlation between efficiency in reducing GHG and leveraging funds. In the case of public institutions, leveraging funds may be beneficial for enabling more GHG reduction activities, but the correlation between efficiency in leveraging funds and reducing GHG emissions is not significant in case of the GEF. For the market mechanisms, we even have some indications that there is a leverage paradox: a high leverage factor can mean lower mitigation efficiency. First, industrial gas and methane projects achieve high mitigation efficiency (CO_2/USD) but only low leverage factors. Second, if we take payments for CDM credits as leveraging part, low-mitigation-efficiency projects tend to have the highest leverage factors. Thirdly, if we take payments for abatement as leveraging part, then projects with very high leverage factors have high mitigation efficiency but are also most likely to be non-additional and, therefore, do not reduce emissions at all.

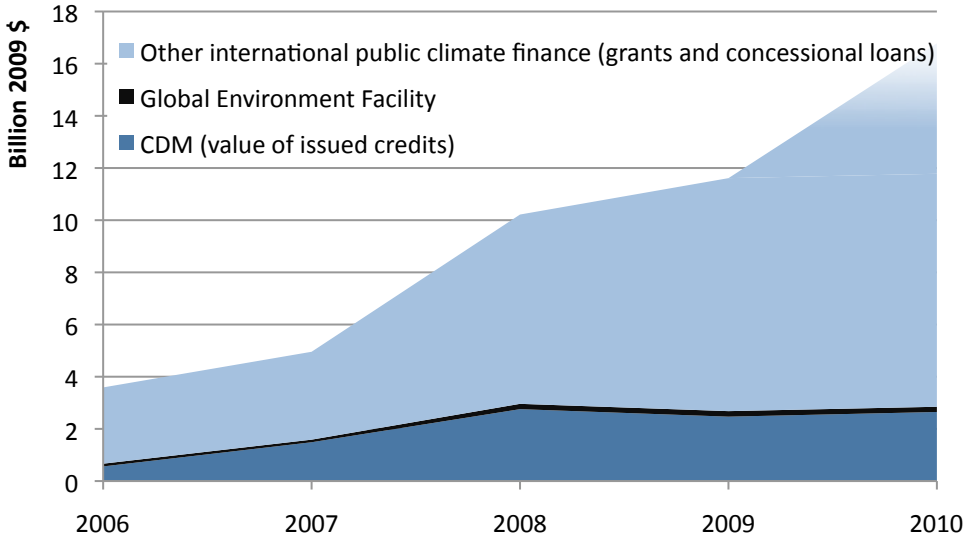
In conclusion, we recommend that policy makers should hesitate setting a high leverage factor as a major goal of climate finance. Such a goal could mean that project types with high abatement cost are promoted and low-cost options are crowded out. While promotion of high cost options with high leverage factors and long-term mitigation potential (e.g. solar energy) is needed as well, this does not mean that high leverage factors are beneficial by themselves. If the negative or insignificant correlation between efficiency in leveraging funds and abatement is confirmed not only for the CDM and the GEF but also for other climate finance means such as guarantees, bilateral grants and loans of bilateral and multilateral development banks, it may be environmentally beneficial to replace the "100 billion USDUSD, private and public funds, by 2020" figure with a lower finance target that only covers public funds.

As the CDM and the GEF are just representing a part of the climate finance architecture, it would be desirable to study the efficiency of other mechanisms and instruments to reduce GHG and leverage private funds. Interesting fields of study are loans of development banks, for which data collection may be feasible, while it may for difficult to receive data regarding public equity and guarantees.

Introduction

Carbon market payments and international public funds for climate change mitigation in developing countries, which we both subsume here under "climate finance"[1], have increased to more than 10 billions of USD per year (see Table 1). While climate finance is projected to increase in the next few years after the promises made at the conferences of Cancun and Copenhagen, effective flows will still remain far away from the (incremental) funding needs, which are more than 100 billion USD per year for mitigation only (WorldBank, 2009). In this context, analysing the efficiency of climate finance becomes important from two perspectives: First, efficient spending will be needed to limit human-induced global warming as far as possible. Second, Northern governments and tax payers ask for wise spending of the substantial and increasing funds.

Table 1: Rise of disbursed international (mitigation-related) climate finance in the last few years.



Source: OECD (2011) for GEF and other international public climate finance (climate-coded Official Development Assistance and multilateral loans). URC (2011) for issued CDM credits[2].

In these days, mobilising (or in other words "leveraging") private funds is seen as a major goal of climate finance by governments, and instruments to leverage private investments are often studied (LSE, 2009; UNEP, 2009). The reason for the interest in "private investments" is clear: annually, on top of the roughly 100 billion USD of public funds (climate finance), several hundred billions USD of private investments will be needed for low-carbon development in the next few years (IEA, 2009; WorldBank, 2009). This need for increased private investments has somehow led to the impression that having large private funds per unit of climate finance is always desirable.

Are funds leveraged a good indicator for the efficiency in reducing GHG emissions?
It is never really questioned if efficiency in leveraging private funds always means enhanced efficiency in reducing GHG. However, if there is no clear correlation, policy makers should probably refrain from using "leveraged funds" as criterion for allocating climate finance.
Therefore, this study explores the effectiveness and efficiency of existing climate finance in reducing GHG and leveraging funds as well as the interrelation between the two measures. We will analyse two major (current) channels for climate finance: the Clean Development Mechanism (CDM) as market mechanism and

1 This definition is not shared by all authors. Some would exclude carbon markets from "climate finance", while others would include private investments. The reason for the definition given here is that we are interested in funds paid to enable climate change mitigation. While private investments are profit oriented and are not aiming at GHG emission reductions, carbon market payments are used to pay the incremental cost of low-carbon technologies and, therefore, enable emission reductions.
2 The 2010 number for "other international public climate finance" is a projection, assuming an increase of 5 billion USD in 2010 following the Copenhagen pledges. An average CDM credit value of 20USD is assumed, while 50% of GEF money is thought to be climate-change mitigation related (the climate change focal area is only accounting for around 1/3 of GEF funding, but biodiversity funds will have climate benefits as well. GEF disbursements are assumed to have remained constant from 2009 to 2010.

the Global Environment Facility (GEF) as public funding institution. These two channels are the only climate finance channels providing project level data on both GHG reductions and leveraged funds. The CDM and the GEF are just a small part of the emerging climate finance architecture, which also encompasses loans of development banks, bilateral grants and public equity (see Table 1). Still, our analysis is seen as relevant: the CDM is currently the major climate finance channel directly targeting the private sector, while the GEF has explored tools, which are similar to the one of other bilateral and multilateral funds. For a detailed description of the GEF and the CDM, as well as other climate finance, see Annex 1.

Throughout the study, we define effectiveness as the ability of a particular climate finance source to reduce GHG emissions and leveraging private funds, and efficiency (or cost-effectiveness) as its ability to do so at lowest cost.

Reducing GHG emissions: limited knowledge

Reduction of greenhouse gas emissions (GHG) has been the shared major goal of most climate finance in the past 20 years. In the case of the market mechanisms like the Clean Development Mechanism (CDM) or Joint Implementation (JI), reducing GHG is a short-term goal, while in case of public funds like the Global Environment Facility (GEF), it is a mid-term or long-term goal.

Given the 20 years of experience with climate finance and its crucial role in the future climate policy regime[3], it is surprising that little is known about the effectiveness of existing climate mitigation finance in reducing CO_2 and other GHGs.

For the market mechanisms (CDM/JI) the main problem related to calculating effectiveness is "additionality". While the CDM has a very well developed procedure of accurately measuring and verifying emission reductions, it has repeatedly been questioned whether the CDM / JI projects are really additional to the business-as-usual case (Michaelowa and Purohit, 2007; Schneider, 2007; Wara and Victor, 2008; Hagem and Holtsmark, 2009; Schneider, 2009).

For public climate funds, the additionality problem may apply as well, but the larger issue is the measurement of reduced emissions, to start with. Public funds have either not estimated the CO_2 reductions at all, as in case of bilateral and most multilateral funds[4], or their way of measuring is inconsistent and rather forward-looking than retrospective, as in case of the GEF (Eberhard et al., 2004; Stadelmann, 2009).

Furthermore, the analysis of the effectiveness of climate finance has until recently been separated between studies of the market mechanisms (e.g. Michaelowa, 1998; Schneider, 2007; Wara, 2008; Hagem and Holtsmark, 2009) and studies of the GEF as public fund (e.g. Fairman, 1996; Heggelund et al., 2005; Lindholt, 2005; Zerriffi and Wilson, 2010), so that no real comparisons are available. Most academics and policy makers consider market mechanisms as cost-effective[5]. However, in the last few years, some scholars (Wara and Victor, 2008; Fein et al., 2010) have claimed that public funds could work better than the existing market mechanisms. Both promoters of markets and public funds base their claims mainly on theoretical arguments rather than empirical studies. Therefore, an analysis comparing the effectiveness of the CDM and public funds in reducing CO_2 emissions, using empirical data, may bring important insights to this debate.

Leveraging funds: the public policy discussion

The issue of leveraging (or in other words mobilising) funds has been discussed in the last years as it became obvious that large amounts of private investments will be needed to substantially lower greenhouse gas emissions. "Leveraging of funds" has also become important in the international negotiations with the Copenhagen Accord agreed in late 2009. In this agreement, the heads of state specified 100 billion USD of climate funds as the annual target to be reached by 2020[6]. Industrialised countries have insisted on the wording "public and private" funds, as they believe that they cannot provide such a huge amount from public sources only. Therefore, to reach the 100 billion USD pledged in the Copenhagen Accord, a large amount of private (and other) funds has to be leveraged by the limited public funds.

[3] See the climate finance sums pledged in the Copenhagen Accord (UNFCCC, 2009a).

[4] Including the World Bank, which was criticized by its own evaluation group (WorldBank, 2010),

[5] For an applied research view, see Carbon Trust (2009). For policy makers' view, see e.g. statements by South Africa (IISD, 2010) and the special naming of markets in the UN climate negotiation sub-group on "Various approaches, including opportunities for using markets, to enhance the cost-effectiveness of, and to promote, mitigation actions" (UNFCCC, 2009b).

[6] This wording was confirmed by the recent Cancun Agreements.

In order to show the amount of leveraged funds, it has become common to report "leverage factors" (or "leverage ratios"), which express the ratio of leveraged funds to leveraging funds. Unfortunately, there is no common understanding which types of funds are leveraged and which ones are leveraging (Brown and Jacobs, 2011). Therefore, the leverage factors as reported in the literature are not totally comparable as they build on different definitions. Nevertheless, we can have a rough discussion on the leverage factors as reported by multilateral institutions and estimated by external studies (see Table 2).

Table 2: Leverage factors according to the literature

Leveraging institution	**Leverage factor**		**Leveraged funds**	**Leveraging funds**	**Source**
	Self reporting	**External estimation**			
GEF	6.2		Private/Public	Grants	GEF (2010a)
World Bank		3	Private/Public	Loans	Cundy (2006)
MDBs		3-4	Public	Loans	UN (2010)
Clean Technology Fund	8.4		Private/Public	Loans	CIF (2010)
General		2-4	Private	Grants/Loans	UN (2010)
Public		3-15	Private/Public	?	UNEP (2009)
CDM		<9-10	Private/ Public investments	Carbon credits	Hepburn (2009), Hosier et al. (2010)

The self-reported leverage factors are around 6 to 9. For instant, the GEF claims that it can leverage around 6-7 times more "co-funding" than the grants it pays in the climate change area (GEF, 2010a). Two scholars (Porter et al., 2008; Zhang, 2009) have repeated this number without questioning the assumptions. Another multilateral institution, the World Bank's Climate Investment Funds, even claims that each USD invested in the Clean Technology Fund leverages another 8.4 USD of private sector and multilateral development bank financing (CIF, 2010). These numbers seem to be very optimistic, and therefore, require a comparison with independent studies.

Most independent assessments clearly give lower leverage factors than the self-reported ones. Cundy (2006, cited in Zhang, 2009) estimates that the World Bank Group achieves a leverage factor of 3 in its renewable energy and energy efficiency portfolio. Similarly, last year's Report of the UN's Secretary General High-Level Advisory Group on Climate Change Financing assumes a leverage factor of 3-4 for Multilateral Development Banks[7] and 2-4 for leveraged private funds compared to invested public funds or carbon market flows (UN, 2010). These numbers show that external analysts are generally more critical regarding the leverage factor, although some exceptions to this pattern do exist.

An example[8] of a high external estimate refers to the Clean Development Mechanism (CDM), a market-based instrument. Two independent authors mention leverage factors of up to 9-10 (Hepburn, 2009; Hosier et al., 2010), without giving details on how they calculated this. If true, this would mean that the CDM is outperforming public mechanisms in leveraging funds, which is even more significant as the CDM leverage factor does not include any leveraged public funds (apart from investments by public institutions). However, a closer look is warranted as the numbers seem to be high and both sources do not provide details how they calculated these leverage factors.

[7] The leverage factor here is the ratio of leveraged MDB loans/grants compared to resources paid-in by industrialised countries. The leverage factor of 3-4 assumes a mix of concessional and non-concessional lending. The Advisory Group (UN, 2010) estimates that the leverage factor is 5 in case of non-concessional and 1.2 in case of concessional lending. If the MDB loans are converted to grants-equivalents, then the leverage ratio (grant-equivalence to paid-in resources) is only 1.1.

[8] Another example is the range of 3 to 15 for public finance mechanisms (UNEP, 2009). As no further details are given, one can only guess that the authors took the range of leverage factors reported in the literature.

Leveraging funds: theoretical discussion and our definition

The issue of "leveraging funds" is theoretically not as straightforward as it may seem. Consider the following situation: an electric power utility in a developing country wants to expand its capacity by 1000 MW and has four options: coal, gas, wind and hydro power (see Table 3).

Table 3: Leverage factors for different power plant technologies (approximate values)

Technology	Investment cost[1]	Government Subsidies	Levelised costs[1]	Additionality	CER revenues[3]	Leverage factor[4]
Efficient coal	2200 million USD	0	6.5 ct/kWh	No[2]	69 million USD	31.8
Gas	1100 million USD	0	7.3 ct/kWh	Yes	311 million USD	3.5
Hydro	4000 million USD	0	7.5 ct/kWh	Yes	467 million USD	4.3
Wind	1500 million USD	300 million USD	8.5 ct/kWh	Yes	259 million USD	5.8

[1]: Data for investment costs for supercritical coal, combined-cycle gas power plants, large hydro and wind are taken from ETSAP (2010c, 2010a, 2010b) and IEA (2008). For the hydro investment costs, instead of the ETSAP figure of 4000 million USD, the lower figure of 2000 USD was taken as the other literature suggests numbers between1000 and 2000 (see e.g. URC, 2011)
[2]: The project in reality is not additional, but nevertheless gets registered.
[3]: Assuming plant load factor of 80% for coal, 60% for gas, 45% for hydro, 25% for wind; emission reductions of 100 g CO_2/kWh for the coal plant, 400 g CO_2/kWh for the gas plant, 800 g CO_2/kWh for wind, hydro and solar. The crediting period would be 10 years and the CER price reach 15 USD, revenues are not discounted.
[4]Leverage factors are calculated here as the ratio between the full investment costs and the (market-based) climate finance that helped to raise this investment: the CER revenues achieved by the project.

The calculation shows several problems with the simple interpretation of leverage factors:

- Additionality: In case of the highest leverage factors (efficient coal), there is the risk that the seemingly "leveraged finance" would also have flown without the (leveraging) climate funds. This problem is, however, still small in case of private funds. It becomes even more problematic in the case of claims to leverage other public funds, which can be considered as largely being given by public budgets, and are likely guided by other (public) interests beyond climate change mitigation (energy security, pollution reduction, job creation, industry promotion, etc.). To a smaller extent, this problem also applies to leveraged multilateral loans[9].
- Baseline investment: How does one deal with the basic investment that would be implemented anyway to achieve a planned goal? In our power plant case, it would be the minimum investment that is required, i.e. the 800 million USD for the gas power solution or even less for an inefficient coal power plant). Should one deduct this level of investment before calculating the leverage, and thereby only using "additional investments"? In all known cases, the full and not the "additional" investment value is taken to calculate the leverage factor
- Type of funds leveraged: in the calculation of the leverage factor as above, only the investment costs are included under "leveraged funding". However, one could also include the government subsidies.
- Assumptions on CER revenues: they critically depend on the emissions baseline (differing from country to country), the assumed carbon price, the project's crediting period, and the discount rate.

This theoretical discussion leads us to two conclusions. First, more detailed studies of leverage factors are needed. To ensure this, we will look at project level data of GEF and CDM projects later on in this study. Second, each calculation of the leverage factors has to be transparent on its assumptions (additionality, baseline investment, included types of funds)

To ensure this transparency, we will use the following definitions in the analysis of GEF and CDM projects: *The leverage factor is defined as the ratio between mobilised funds (without climate purpose) and the mobilising climate finance.*

[9] Interviewed World Bank staff indicated that actually the multilateral loans rather leverage the GEF funds than the other way round. This is (according to World Bank staff) the case because the World Bank as powerful actor is negotiating loans with host country finance departments, and the GEF grant is merely seen as add-on in order to lower risks. While this view that GEF grants are "leveraged" is certainly not accurate (GEF budgets are given, so GEF grants would rather be relocated from one project to the other), it gives some hints that co-finance of GEF projects may not always be additional.

Leverage factor=Mobilised funds (no climate purpose)Mobilising climate finance

Mobilised funds are defined as funds invested in or paid to projects for non-climate purposes (e.g. investment with return as target, or public investment grants/loans with development purposes). The baseline investment is included in the mobilised funds, while mobilising climate funds itself are not part of mobilised funds (some definition of the leverage factors include it).

Mobilising climate finance is defined as funds paid with the aim of reducing CO_2 emissions. This mobilising climate finance can be public (e.g. grants, loans, equity, guarantees), publicly induced (e.g. CDM payments triggered by emission targets) or voluntary (e.g. voluntary carbon market payments or private grants). In case of climate-related loans, the grant-equivalent is seen as mobilising climate finance. In case of equity or guarantees, the average expected loss of funding is the mobilising part.

Regarding additionality, we assume full additionality, so none of the "mobilised funding" as reported by the GEF and the CDM, would have been invested in the climate change projects without the mobilising GEF grants or CDM payments. As this is clearly a simplifying assumption, we will discuss cases where additionality is questionable. For more details of the calculation (e.g. CER price), see Annex 2.

Interrelation of leveraging funds & reducing CO2

Interestingly, according to our knowledge no scholar has ever looked at the interrelation between efficiency in leveraging funds and reducing CO_2[10].. Implicitly, by seeing "leveraged funds" as a positive achievement, policy makers assume that there is a positive correlation between funds and mitigation: the higher the leverage factor, the more mitigation is supposed to happen per USD of climate finance. However, this is not obvious: By promoting solar energy, one has to leverage a large amount of funds to achieve a certain reduction of greenhouse gases. In contrast, in case of industrial gas projects, a limited investment can have a large impact on greenhouse gas emissions.

The wide spectrum of CO_2 saved per unit of investment has been recently shown by the World Bank independent evaluation group (WorldBank, 2010: 81), but a more complete analysis of the interrelation between funds and reduced CO_2 per invested climate finance is missing.

Outline of the Working Paper

This study will first have a detailed look at the effectiveness of the CDM and GEF in reducing greenhouse gas (GHG) emissions, by analysing sector-specific data. This is accomplished by using two datasets compiled by the authors in the past two years. As second step, the funds leveraged by the two mechanisms are analysed per sector. Thereby, the leverage factor, as defined above, is calculated for each sector. Third, the interrelation between efficiency in mitigating GHG and leveraging funds is analysed, again per sector. The study concludes with a set of policy recommendations.

[10] However, te Velde (2011) mentions that leverage ratios "are not sufficient evidence of what works".

GHG reductions generated & related costs

As starting point for evaluating how effective public finance and market mechanisms have been in reducing GHGs, we use official project level data. GHG data can only be found for the GEF and CDM, as other bilateral and multilateral funds do not estimate their mitigation impact at all or only for specific projects.

Table 1 summarises the GHG performance of the GEF and CDM per mitigation project type: industrial gases, methane, energy efficiency, renewable energy, forestry and others. The efficiency (cost in USD per t CO_2 equivalent reduced) and effectiveness (total volume of GHG reduced) of climate finance is very different for the two mechanisms per mitigation type, as shown in the following.

First, with respect to non-CO_2 GHGs such as methane, nitrous oxide or HFCs, the GEF has not been effective at all. The reason for this is the long-term policy focus of the GEF (see e.g. GEF, 2006), aiming at transforming markets and targeting energy-related CO_2 emissions, which are responsible for the majority of global greenhouse gas emissions. Therefore, the GEF has not really targeted the low-cost reduction potential of non-CO_2 emissions apart from the "short term measures" program in the early 1990s. In contrast, the CDM has very effectively reduced non-CO_2 emissions such as HFC-23 and N_2O[11]. Such non-CO_2 gases can be reduced at very low cost, below 1 USD per tonne of CO_2, and this market mechanism has successfully found and exploited these low-cost mitigation options.

Second, when looking at energy efficiency, the CDM has just generated a small volume of GHG emission reductions compared to the GEF. However, the abatement costs (excluding rents to project developers and other intermediaries) per t CO_2 are lower within the CDM. It thus seems that the GEF is better in overcoming the many non-financial barriers for investing in energy efficiency, which are especially abundant in the building sector (Koeppel and Ürge-Vorsatz, 2007), while the CDM is better at finding the cheaper mitigation options within the sector. Reducing GHG through energy efficiency has on average costs in the same range as reducing non-CO_2 gases.

Third, in the field of renewable energy the CDM has been around 50% more effective (per annum in the period 2008-2010) compared to the GEF. This tendency will become even more significant in the future, as there is a large number of registered CDM projects expecting issuance of credits that will dwarf the GEF achievements: the registered renewable projects are expecting credits in the amount of 150 million tCO_2 per year (URC, 2011). According to these project document numbers, the GEF is more cost-effective than the CDM in promoting renewables, which is counterintuitive[12]. But for both the CDM and the GEF renewable energy-related abatement costs are much higher than for energy efficiency and non-CO_2 gases.

Fourth and finally, the forestry field (afforestation and reduced deforestation) has hardly been captured by any of the two mechanisms, both due to political considerations[13]. Thus, neither of the two mechanisms has been effective in the forestry field, while we have no reliable information on potential abatement costs.

Summing up, the CDM has been, according to official data, more effective in reducing CO_2 in all sectors except energy efficiency. Additionally, the CDM has been more cost-effective in all sectors in terms of abatement costs (except for the case of renewable energies).

[11] New studies claim that part of the HFC credits are due to production shifts from industrialised countries and an artificial increase of the rate of HFC-23 generated per unit of production of HCFC (see CDMWatch, 2010). If true, this reduces the efficiency of the CDM in this sector but the overall environmental effectiveness may still be high, if the main reason for CER overestimation is artificial increase of the HFC ratio and not the production shift.

[12] The GEF has a large portfolio half of which covers off-grid renewable projects and also not very successful concentrating solar power projects. Therefore, one may expect low efficiency. The higher relative efficiency of GEF renewable energy projects may be due to low data quality or the wrong assumption that all related hydro projects would not have happened. Overly high expectations cannot be the reason as the evaluated efficiency is even slightly better than the projected one (Stadelmann, 2009).

[13] In the case of the CDM, the EU opposed including forestry. In the end, only reforestation and afforestation but not avoided deforestation was included, but the rules for forestry projects have been very cumbersome, and forestry credits cannot be imported into the EU emissions trading scheme. In case of the GEF, its council never saw forestry as strategic priority.

Table 1: Funding & GHG reductions by mechanisms & project type (annually, period 2008-2010)

Mechanism	Project type	Expenditure in abatement *Million 08USD p.a.*	Reduced emissions *Million tCO_2e p.a.*	Payment years	Abatement costs *08USD/ tCO_2 e*	Payments for credits *08USD/ tCO_2 e*	Rents *Million 08USD p.a.*
GEF[1]	Total	132	68	1991-2010	1.94	1.94	
	Industrial gases	0	0	1991-2010	(0.91)*	(0.91)*	
	Methane	4	2	1991-2010	(2.03)*	(2.03)*	
	Renewable energy	65	12	1991-2010	5.36	5.36	
	Energy efficiency	53	50	1991-2010	1.05	1.05	
	Forestry	0	0	1991-2010	?	0	
	Other	0	0	1991-2010	2.97	2.97	
CDM[2]	Total	202	131	2008-2010	1.54	13.3	1513
	Industrial gases	44	98	2008-2010	0.45	13.3	1257
	Methane / Cement	16	7	2008-2010	2.26	13.3	78
	Renewable energy	121	19	2008-2010	6.44	13.3	129
	Energy efficiency	2	5	2008-2010	0.31	13.3	68
	Forestry	0	0	2008-2010	?	0	0
	Other	54	2	2008-2010	24.16	13.3	-24

[1] Data from (Stadelmann, 2009), using numbers from the official GEF documents. Abatement expenditures are equal to GEF grants (converted to 2008 USD assuming that GEF grant value is given in USD of endorsement year). Co-funding is not counted and, therefore, all CO_2 reductions are directly accounted by the GEF. Projected, not evaluated values of CO_2 reductions are given here. Total expectations of CO_2 reductions were divided by 16, assuming that all reductions happen evenly along the average life time of GEF-project technology (16 years). Only directly measurable reductions ("direct reductions") are included. The GEF itself also estimates indirect reductions through e.g. capacity building, but these are not included here due to their high uncertainty. Abatement costs are calculated as expenditure divided by reduced emissions.

[2] The total expenditure in abatement is calculated by multiplying the amount of issued credits per year (average of 2008-2010) times the abatement costs in USD per tCO_2. It thus does not include the total climate funding (defined by the CER price), but only the costs to mitigate, while rents harvested by project developers, traders and brokers are not considered in this column. The amount of reduced emissions is equal to issued credits (URC, 2011), and for abatement costs from Castro (2010) (median value of abatement costs per project type, roughly 2008 USD as projects registered by the end of 2007).Transaction costs are not included. The abatement costs per tCO_2e include only the costs declared by project developers in their financial analysis, and the abatement payments are based on the CER market prices, thus including the rents for the market players. The 13.3 USD were calculated assuming all unilateral projects (81% of registered CDM projects, according to (URC, 2010a)) receive secondary prices, for which the average 2008-2010 price (Dec 2011 secondary CER)was taken (PointCarbon, 2011) and the bilateral projects receive primary prices, for which data for low & medium risk forwards were taken from (GIZ, 2011) . The last column estimates the total amount of rents generated for market intermediaries.

[3] Data for mitigation related ODA from Roberts et al. (2008), includes most contributions to the GEF, 2008 USD (2005 USD from Roberts et al. converted to 2008 USD, using OECD DAC deflators)

* These numbers are derived from very few projects.

One has to be aware that, for public funds, the results just represent a small part of actual funds. The GEF disburses not more than 130 million USD a year for mitigation purposes, while overall public mitigation funds reach billions: the study by Roberts et al. (2008, see Table 1) identified more than 2 billion USD of official development assistance (ODA) for renewable energy alone. According to the official OECD (2011) figures, the ODA commitments for climate change (mitigation) have even risen from 3 billion USD per year between 2000-2006 to over 9 billion USD per year in the period 2008-2009. Unfortunately, GHG reductions are missing for ODA other than the GEF.

Discussion of the robustness of the GHG reduction calculations

The GHG reduction volumes presented here are rather indicative than exact numbers, because of four main reasons.

The first reason is additionality: the CDM figures assume that none of the projects would have happened without the CDM, which is not the case according to several studies (Michaelowa and Purohit, 2007;

Schneider, 2007; Wara and Victor, 2008). Actually, the additionality question is also relevant for public funds such as the GEF (Stadelmann, 2009).

The second reason is the quality of measuring, reporting and verification (MRV). The GEF's CO_2 measurement system is not very well elaborated and hardly harmonised between different projects (Eberhard et al., 2004; Stadelmann, 2009). We have to be aware that the numbers provided in Table 1 and the results discussed above have been obtained on the basis of the two mechanisms' project documents. These data have not been externally verified in the case of the GEF. In the CDM, even if a complex validation system is in place, there are high incentives for project developers to manipulate financial data to make projects look more additional.

Third, the numbers here are retrospective and not forward-looking. The CDM numbers just refer to issued credits. However, the CDM has a huge pipeline and, according to the project documents submitted, is expected to generate 750 million t of CO_2 per year, if all projects are registered (URC, 2011)[14]. Therefore, the CDM may generate many more credits in the future, while the GEF funding level is projected to remain relatively stable in the future, as witnessed by its evolution so far and the last replenishment (GEF, 2010b).

Fourth, the CDM is an offset mechanism and does not lead to net GHG emission reductions: each metric ton of CO_2 reduced by the CDM is replacing the same amount of reduction of CO_2 in industrialised countries. Therefore, no net reductions occur. However, for a comparison of GEF and CDM, the approach used here is adequate. Furthermore, the analysed mechanisms may be used for different purposes: an Annex-I country can in theory buy CDM credits and cancel them without using them for meeting its target, by which the CDM would resemble public finance. As well, a public fund like the GEF could theoretically use its GHG achievements for offsetting (as long as the used funds are not accounted as ODA).

Outlook: Refocus on energy efficiency and new tools for renewable energies

Our data confirm the widely held view that the CDM is more effective in reducing CO_2 and that its projects are in most cases more cost-efficient than GEF projects. However, improvement in effectiveness can be imagined for all major project types: non-CO_2 gases, energy efficiency and renewable energy.

Non-CO_2 emissions (HFC-23, N_2O, methane) may be reduced at lower costs for the North when reforming the CDM or using public funds. This is due to the fact that credit sales revenues are much higher than the abatement costs (see e.g. Müller, 2007; Wara, 2007; WorldBank, 2010): while the World Bank's Umbrella Carbon Facility paid 7.9 USD/t to HFC-23 project developers in China in August 2006, and in 2009 the chemical company Rhodia even received around 20 USD/t for its credits from N_2O reduction from adipic acid, only slightly declining to 19 USD/t in 2010 [15], the abatement costs are only around half a USD (see Table 1). Thereby, large rents are created: If one assumes that the HFC-23 credits have been sold at a price of 8 USD and the N_2O credits at a net price of 20 USD, and the share of HFC-23 credits is two thirds, around 1.2 billion USD are paid for issued CERs per year (2008-2010). This is very close to the 1.3 billion USD of rents for HFC/N_2O projects when assuming average credit payments (13.3 USD), see Table 1.

From an economic point of view such rents are not to be considered as costs and may improve dynamic efficiency (see Hepburn, 2009). Nevertheless, one may argue that the GEF (or another public fund) would need less money from companies or governments in the North to reduce the same amount of non-CO_2 gases, and could use the saved funds for other mitigation activities. Alternatively, two different CDM reforms may have similar benefits: a discounting scheme (Chung, 2007) for HFC/N_2O projects or an obligation for host countries to invest rents beyond a certain level in mitigation activities[16].

Increased funding for energy efficiency may improve effectiveness and efficiency of mitigation finance because of two reasons: First, the abatement costs are lower compared to other project types[17], and

[14] However, attrition is high so that actual reductions achieved by the end of 2012 are likely to be at the lower end of the interval; estimates for the total period until the end of 2012 stand at 0.95 billion (URC, 2011).

[15] Price for HFC-23 transaction calculated on data in World Bank (2006) and World Bank (2011), for Rhodia prices see Rhodia (2009, 2011). It should be noted that Rhodia has to give a significant share – around 30% - of the credits generated from its Korean project to Korean entities, which can be estimated according to the differences between the credit volume issued to Rhodia's projects and the quantities estimated in Rhodia's financial statements.

[16] Such an obligation would be similar to the current solution of the Chinese government: a 65% tax on HFC-23 credits and a 30% tax on N_2O credits are levied, whose proceeds are to be used for sustainable development activities.

[17] This is, however, not necessarily the case if transaction costs such as information acquisition have to be overcome. However, in case of the GEF, the provision of information is included in the abatement costs, and GEF energy efficiency projects are still very efficient.

second, the abatement potential for energy efficiency is very high (see Barker et al., 2007). In the case of market mechanisms, the shift of funding to energy efficiency is only realistic if the current barriers for Programmes of Activities (e.g. the liability issue for verifiers) are removed, or if new market mechanisms are established that are better suited than the CDM for small and dispersed emission reduction options. In the case of public funds, the shift[18] may be easier as, on the one hand, public funds such as the GEF have shown their ability to overcome non-financial barriers through capacity building, policy change and innovative financing facilities, and on the other, many Nationally Appropriate Mitigation Actions (NAMAs) to be supported with public funds are focusing on energy efficiency.

Renewable energy is a favoured focus of climate finance but in view of efficiency, a substantial increase of the payments may need to be reconsidered because of two reasons. First, the abatement costs are generally high for both public funds and market mechanisms. Secondly, large sums have been paid for renewables through the CDM but the mechanism does not seem to be very efficient when compared to the GEF. While this relative inefficiency may be due to low quality of GEF data, the literature also tends to question the CDM's ability to promote renewables: the CDM income is hardly sufficient to fully cover the incremental costs of additional renewable energy projects (Schneider et al., 2010) and the leverage of the World Bank's CDM wind and hydro portfolio is questionable (WorldBank, 2010). Therefore, a lower *share* of funds for renewables, especially in the case of the CDM, may improve the short-term effectiveness and efficiency of climate finance[19].

It has to be noted that this recommendation takes a short-term perspective. In the long term, renewable energies are very important to achieve the 2 degrees target (see e.g. Pacala and Socolow, 2004; Sims et al., 2007; IEA, 2009). Therefore, research and investments are needed nowadays to bring down costs in the medium and long term. However, it is questionable if CDM finance is the right tool for achieving such a long-term technology transfer and cost reduction for renewable energies.

[18] A shift of funding from renewable energy to energy efficiency rather is also recommended by the World Bank Independent Evaluation Group (WorldBank, 2010).

[19] In case of the GEF and other public funds, reallocation of funds is straightforward. In case of CDM, reallocation of funds would need to come through external incentives for market players. An interesting possibility of such an incentive may be to only credit part of the CO_2 reductions achieved by renewable energies: e.g. only the share of incremental costs financed through the CDM is credited, while the other part can be seen as national achievement of Southern countries (or even as part of Nationally Appropriate Mitigation Actions).

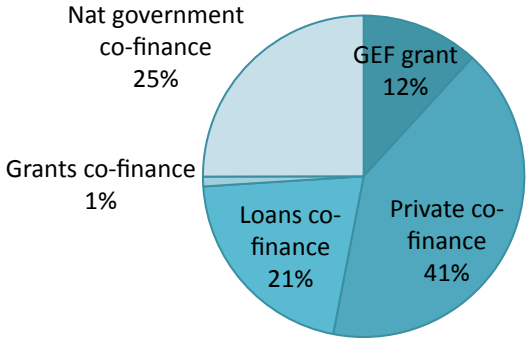
Leveraged private and public funds

Leveraged funds – the non-climate related funding that is mobilised by the provision of "mobilising" climate finance– can be classified into different types of funds: Private investments and public loans and grants. In the following, the different types and the amount of leveraged funds are discussed in the context of the CDM and the GEF. See Annex 2 for details on the calculation, including assumptions.

For the GEF, the types of leveraged funds are varied (see Graph 1). Based on a sample of 68 (out of 370) GEF projects, only about half of leveraged funds ("co-finance" in the GEF jargon[20]) are private, while the other half consists of Southern government contributions and multilateral loans. Bilateral ODA grants are even less important.

The detailed data on GEF projects confirm the leverage factor of more than 6 for GEF grants. However, these numbers are based on the official project documents. One can assume that actually leveraged funds are lower, which can be both derived from statements from implementing agencies and the GEF evaluation office, who has concluded that GEF co-finance numbers are not of high quality (GEFEO, 2002, 2010) and some co-finance may be flowing without GEF grants (GEFEO, 2005)[21]. Concluding, while the high leverage factor (6-7) of GEF grants is consistent with official project documents, the real number may be closer to the CDM number of 3-5.

Graph 1: Financing of GEF projects (68 out of 370 projects)



Source: Project documents of 68 GEF projects (Argentina to China) from the GEF online database (GEF, 2011)

In the case of the CDM, the main type of leveraged fund is private investment[22], which has been reported to be up to 10 times as high as the CDM payments (see the introduction). However, this leverage factor of 10 is overestimated when looking at real CDM data: using technology-specific abatement cost data from Castro (2010) and investment figures as well as expected CDM credits until 2012 from URC (2010a)[23], we estimate a leverage factor of 4.6 when using payments for abatement as mobilising part and 2.9 when using payments for credits (until 2020) as mobilising part[24]). Therefore, the real leverage factor of the CDM is much lower than the one mentioned in the literature.

Wide range of "leverage factors" and questionable additionality

[20] The GEF (2002) has in the past distinguished between co-finance (committed at the time of project approval) and leveraged finance (additional leverage after approval) but in recent communications the two terms are used interchangeably.
[21] This essentially means that some GEF projects may be not or only partially additional.

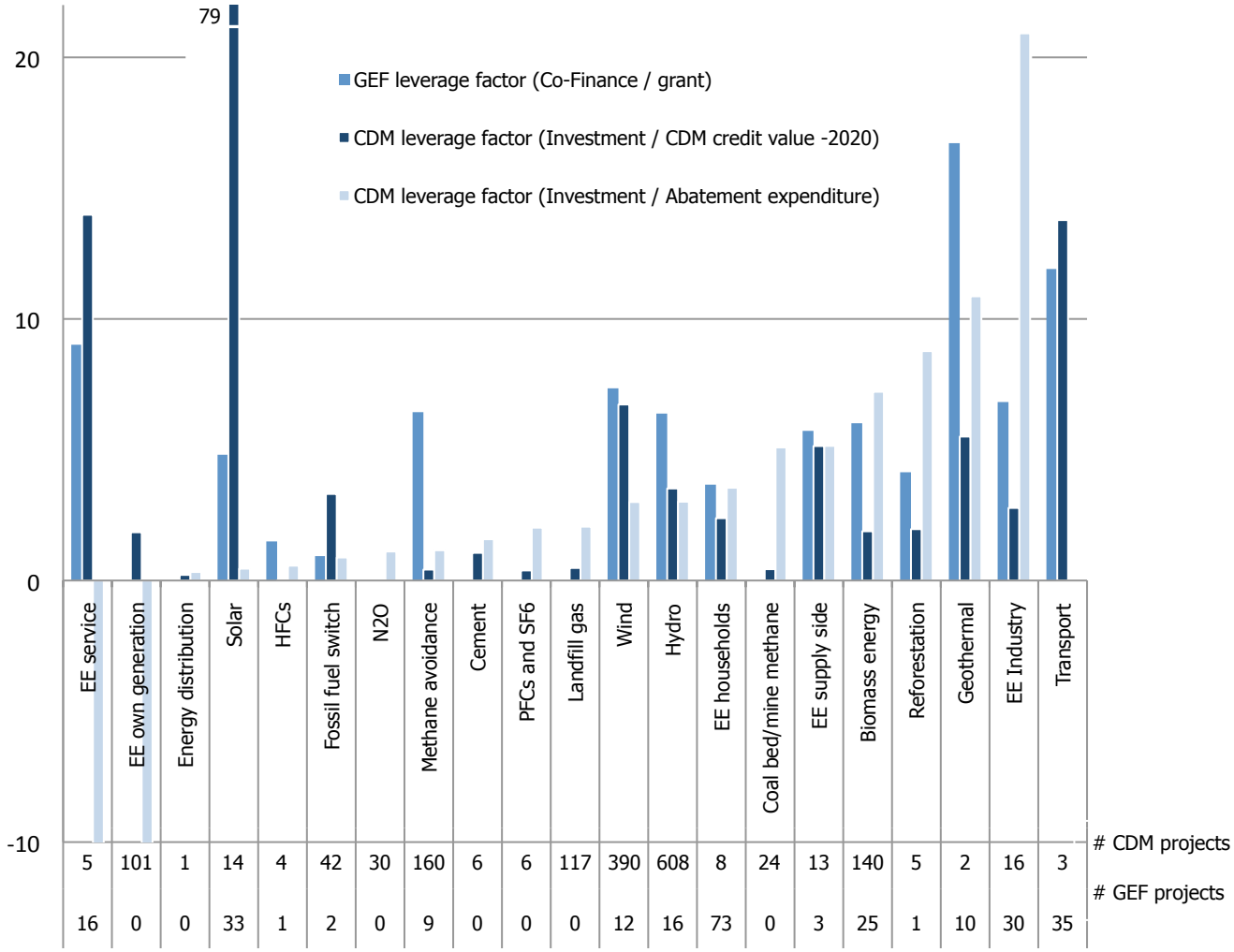
[22] Public funds (e.g. subsidies) do also play a role in CDM projects but they are not regularly reported.
[23] For investment, we took data from all 1692 CDM projects registered by October 2010, as reported in URC (2010a). For the abatement costs level we multiplied expected credits in the 1st commitment period of these projects with the marginal abatement cost calculation by Castro (2010), who analyzed a sample of 234 CDM projects. For the credit value we multiplied the expected credits until 2020 from the 1692 registered with 13 USD for pre-2012 and 5 USD for post 2012 credits.
[24] The ratio is 3.9 if the low-investment projects (HFC-23/N_2O/PFC) are excluded.

When looking at leverage factors from a project type perspective (see Graph 2) we see that they vary a lot. Some project types have leverage factors below 2 (e.g. industrial gases such as HFC-23 and N_2O), while other project types can leverage more than 10 times the funds received through CDM credits or GEF grants (e.g. geothermal, energy services and transport). The numbers do also vary between GEF and CDM funds.

In case of the GEF, the factors only vary between 1 and 17, with geothermal, transport and EE service performing highly. As the data quality is medium, the figures for e.g. methane and geothermal may be overrated. Assuming most public grants (national and international) and around half of loans[25] are not "additional", we can assume that the real leverage factors are around 30-50% lower.

For the CDM, the numbers vary even more: from practically 0 to over 79. We use two approaches for determining the leverage factor. The first approach calculates the leverage on the basis of abatement expenditures (so only the amount of money really needed to abate), so it is the theoretical leverage factor for the case where only the abatement costs are covered. The second approach refers to the market value of credits (until 2020), so it is the actual leverage according to real credit revenues. In the first approach, the project types EE industry, geothermal, wind, achieve the highest values. Applying the second approach, solar, transport and EE service have the highest leverage factors. The high numbers for some project types (e.g. solar) raise doubts whether all CDM projects are additional as the tiny CDM financing component is extremely unlikely to actually mobilise the bulk of financing.

Graph 2: Leverage factor per project type



[25] See footnote 7

Summing up, the CDM and the GEF have similar leverage factors on average (3-7), but leverage factors vary substantially per project type. Some project types such as transport, energy services, and geothermal seem to be favourable from a perspective of raising as many funds as possible for the achievement of the 100 billion USD goal. However, the next section will address the question whether leveraging funds is really a meaningful goal from the perspective of reducing greenhouse gases. Furthermore, the numbers given here have to be taken with caution: the reported funds here are rather accompanied than caused/leveraged by the CDM and GEF. Realistic leverage numbers will probably be lower than the 3-7 given here, especially for the GEF.

Interaction of efficiency in leveraging funds and reducing GHG

The interrelation between leveraged funds and reduced greenhouse gas emissions per unit of climate finance could be both positive and negative from a theoretical perspective. It could be positive, as more leveraged funds will mean more – or larger – climate-friendly activities implemented. However, the interrelation could also be negative as a higher leverage factor might just mean that the project is more costly[26]. Hence, the interrelation cannot generally be deducted from theory.

Positive interaction in case of the GEF and negative one in case of the CDM?
For public institutions (such as the GEF) one may argue that a positive correlation is more probable: public institutions rather start a programme by choosing a sector/technology to be targeted (e.g. energy efficiency in buildings) and then search for further funding sources. Thus, leveraging funds (per GEF grant) should have a positive influence on mitigation activities.

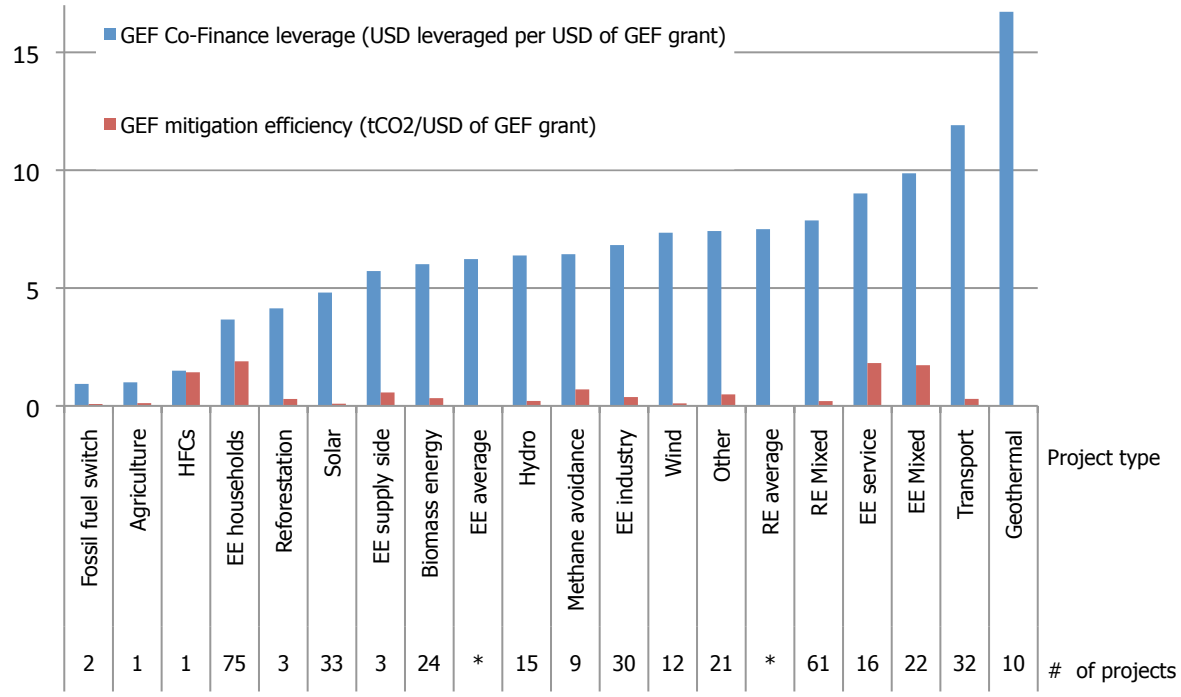
In case of market mechanisms, a negative correlation between efficiency in leveraging funds and mitigation may be more probable. In a market, the funding is not given a priori but different project owners compete for funds. Only the projects with the lowest abatement costs will be funded. Again, low abatement costs are more probable in cases of low investment costs. Thereby, we may expect that projects with low abatement costs will be accompanied by small amounts of leveraged funds. This would mean that we have a leverage paradox: the seemingly positive achievement of leveraging funds may imply lower mitigation efficiency.

We will test these assumptions – positive correlation between funds and GHG reductions in case of public institutions and negative correlation in case of market mechanisms – by analysing the GHG and funding numbers of a sample of GEF and CDM projects.

Interaction in case of the GEF
Graph 3 shows the efficiency in leveraging funds and reducing emissions for the GEF per project type, using projections in project documents of all 370 GEF projects active in June 2009.

Graph 3: Comparison of leverage factor and abatement achievement per project type (GEF)

[26] The reasons for high costs are frequently high investment costs, but could also be high operating costs.



To the naked eye, no clear correlation is visible in case of GEF project types, and the statistical analysis shows a small but statistically insignificant positive correlation between funds and achieved GHG reductions[27]. The more detailed analysis of the correlation of numbers per project gives a similar result: a very small and insignificant positive correlation[28].

This is a very crude view, as all types of GEF co-finance are mixed together. Therefore, a detailed analysis per type of co-finance (public funds, private funds) is useful. We focus here on private funds as they are the main "leverage" target. The correlation between efficiency in mobilising private funds and efficiency in reducing emissions reductions is found to be marginally non-significant[29], when using a sample of 66 GEF projects (all projects from (A)rgentina to (C)hina).

Therefore, this preliminary correlation analysis, not taking into account other influence factors, suggests us to rather reject the theoretical argument that in the case of GEF more co-finance may be beneficial for CO_2 reductions.

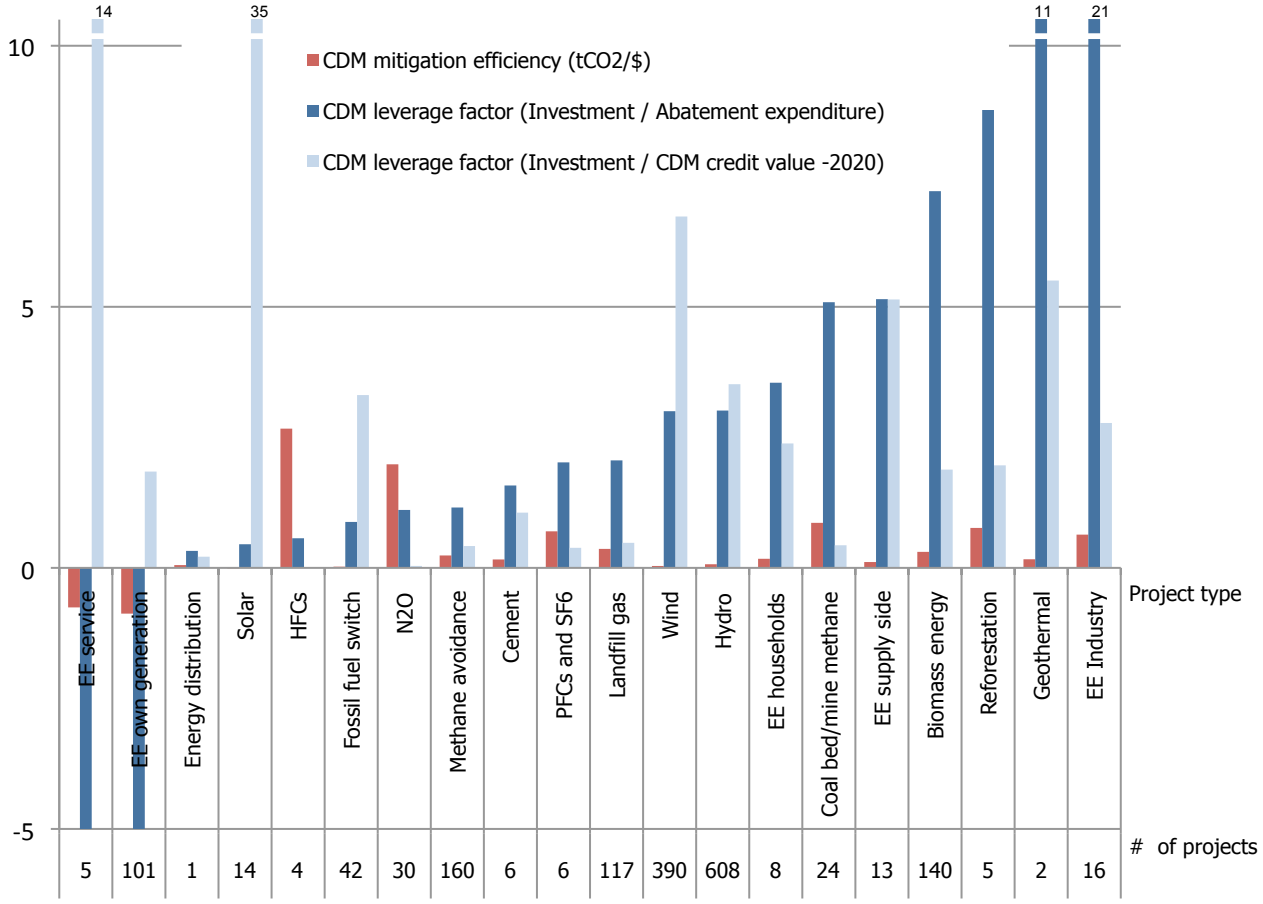
Graph 4 compares the leverage factor and mitigation efficiency for project types in the CDM. Mitigation efficiency is represented by the amount of emission reductions achieved per USD of abatement expenditure per project type, using the abatement cost data from Castro (2010). Again, we show both options for calculating the mobilising part of the leverage factor: abatement expenditure and credit revenues. From naked eye, we do not see any clear correlation between leveraging and mitigation efficiency in Graph 4.

Nevertheless, there are indications for a negative correlation, or in other words a leverage paradox: projects with high leverage factors may actually have a low efficiency in reducing GHG. We find this leverage paradox in three different ways. Firstly, projects with no other revenue than the CDM (e.g. HFC, N_2O) have high mitigation efficiency but low leverage factors. This is especially the case if credit revenues mobilise the projects. Secondly, in case of CER revenues mobilising the projects, projects with high leverage factors are not efficient in mitigating climate change (e.g. solar, wind and geothermal)[30]. Similarly, project types with negative mitigation costs (e.g. EE service), and therefore high probability of non-additionality, have high leverage factors in case of credit payments as mobilising part. Thirdly, in case we look at abatement expenditures as mobilising factor, we see a tendency that projects with high mitigation efficiency also have a

[27] GEF project-type level: cov (covariance) = 0.18; n (sample sise) = 18; p (significance; probability that calculated t-value is larger than the critical t-value |t|) = 0.47
[28] GEF project level (full sample): cov = 0.06; n = 366; p= 0.27
[29] GEF project level (small sample): cov= 0.20; n = 66; p= 0.1 (In a regression, "efficiency in leveraging private funds" even turns more insignificant if we include a dummy for Chinese projects)
[30] Statistically, the negative correlation is not significant: cov = -0.32; n = 20;p= 0.17 (CDM project-type level, case of credit payments as mobilizing part)

high leverage factor[31], which would go against the leverage paradox argument. However, in this case also project types, which are highly probable to be non-additional because non-carbon benefits are high (e.g. energy efficiency on the supply side, in households or in industry) tend to have high leverage factor as well, which is an indication that there may still be a leverage paradox.

Graph 4: Comparison of leverage factor and abatement achievement per project type (CDM)



For finding further empirical evidence for the leverage paradox, we have to move from the project-type-level to the project level, using a sample of 232 projects from Castro (2010). The first indication for the leverage paradox, projects with no other revenue than the CDM have high leverage factors but low mitigation efficiency, is confirmed[32]. The second indication, negative correlation between mitigation and leveraging efficiency in case of looking at credit revenues as basis for leveraging, is confirmed as well[33]. Also the third indication is confirmed: projects with higher probability of non-additionality tend to have high leverage factors when looking at abatement expenditures[34]. In this case, we also clearly see a positive correlation between leverage factor and mitigation efficiency, which makes the leverage paradox argument somewhat less plausible[35].

[31] Statistically, the positive correlation is not significant: cov = 0.39; n = 20;p= 0.09 (CDM project-type level, case of abatement expenditure as mobilizing part)
[32] The dummy for CDM-revenue-only is positively correlated with mitigation efficiency (cov = 0.36; n = 248;p= 0.00) but negatively with the leverage factor (cov = -0.10; n = 227;p= 0.00, in case of abatement expenditures, and cov = -0.24; n = 283;p= 0.00, in case of credit payments as mobilizing part)
[33] CDM project-type level, case of credit payments as mobilizing part: cov = -0.15; n = 232;p= 0.02 (the following data from Castro (2010) are used: investment costs and abatement costs calculated with project-specific discount factor).
[34] The dummy for efficiency projects (where probability of non-additionality) is positively correlated with the leverage factor in case of abatement expenditures as mobilizing part (cov = 0.25; n = 226;p= 0.00). However, this does not change the positive impact of the leverage factor on mitigation efficiency (see next footnote), when regressing mitigation efficiency on both the leverage factor and the dummy.
[35] CDM project level, case of abatement expenditure as mobilizing part: cov = 0.51; n = 232;p= 0.00

High leverage factors do not equal high efficiency in reducing GHG emissions

Given these results, one has to question the benefit of aiming at high leverage factors for funding. In the case of the GEF, the impact of efficiency in leveraging co-funding on GHG reductions is in most cases insignificant, while it can even be negative in case of the CDM (especially in case of calculating the leverage on basis of the credit revenues).

This finding is consistent with the remarks of the GEF evaluation office in its last Overall Performance study (GEFEO, 2010): too much emphasis has been given in the past to achieve high overall co-finance ratio. This policy may provide wrong incentives as some projects with a lower leverage ratio are sometimes more cost-effective in producing global environmental benefits such as greenhouse gas emissions.

Summing up these findings, we can suggest for the GEF that the goal should be to use funding instruments and to leverage types of funds that enable more reductions, rather than aiming at the highest amount of co-funding possible.

Conclusions

Climate finance has increased in the last few years, and even more funds will be paid in the next few years following the Copenhagen and Cancun pledges. Given the political goal of limiting global warming to 2 degrees and the interest from Northern governments to spend the funding wisely, it is warranted to analysis efficiency of existing climate finance.

Leveraging private funds has become a major goal when designing climate finance instruments. Is this a good idea from an efficiency point of view? On one hand, the need for large private sector investments to achieve limiting global warming to 2 degrees is obvious. On the other side, it is not clear if efficiency in leveraging private investments is a good indicator for efficiency in reducing greenhouse gases.

Therefore, we have studied the ability of two climate finance instruments, the CDM and the GEF, to leverage funds and reduce greenhouse gas emissions in developing countries. This helps us to analyse the interrelation between the efficiency of the two instruments in reducing greenhouse gas emissions and leveraging funds.

Reducing greenhouse gases: CDM frequently effective and efficient but not always
Related to reducing greenhouse gas emissions, the study confirms the view that overall the CDM has been more effective and efficient than the GEF. However, effectiveness and efficiency of climate finance in reducing GHG may be improved in at least three areas.

First, increasing funds for energy efficiency seems to be adequate as abatement costs are low. Especially public funds (such as the GEF) are well-suited to promote energy efficiency in principle, while the capacity to quickly channel finance has been shown to be limited for many institutions. In the case of market mechanisms, channelling capacity is more advanced (when considering the recent removal of the registration and issuance bottleneck) but the take-off of new market mechanisms or CDM Programmes of Activities better suited for dispersed and small emission reduction technologies is needed to target energy efficiency in a more encompassing manner.

Second, funds for renewable energies may not have to be increased in the same intensity as for energy efficiency, as short-term costs for renewable energies are high. Especially the promotion through the CDM has to be rethought: the CDM may face some serious leverage problems in case of renewable energies. Two reform options are first, a refocus of CDM funds to renewable energies with high probability of additionality (e.g. biogas), and second, a refocus of funds to capacity building and technology transfer in case of early stage technologies with long-term chances.

Third, policy changes may be required in case of industrial gases, where the CDM has created large rents due to a high differential between market prices and abatement costs. These rents may even be beneficial from a dynamic efficiency point of view. However, in face of scarce resources of Annex I countries, a public approach to reducing industrial gases may catalyse more overall GHG reductions. Alternatively, CDM reforms like discounting or requirements for climate-related use of rents may lead to similar results.

Leveraging funds: overestimated leverage factor
In case of leveraged funds, we define the leverage factor as the ratio of mobilised non-climate dedicated funds to mobilising climate funds. The study shows that leverage factors in the range of 8-15, as reported in the literature, are exaggerated. In the CDM case, the real amount of private investment the CDM can leverage is in the range of 3 to 4.5 USD per USD of CDM contribution. The factor 9-10, as found in the literature, is only achieved by few project types such as geothermal, solar and transport, where the role of the CDM contribution in mobilising the project investment is doubtful. In the GEF case, past projects have even achieved leverage factors of more than 7. However, only half of this co-funding is private capital, while the other half are public funds, which in many cases will be invested anyway. Therefore, we can assume that the real leverage numbers of the GEF are probably in the same range as for the CDM: 3-4.5.

In conclusion, policy makers should be less optimistic about the amount of funds that can be leveraged, and be aware of the fact that "leveraged funding" will often be overestimated by public institutions. Proofing "additionality" is not only a challenge when verifying reduced emissions, as in case of the CDM additionality

tool; "additionality" is also a challenge when estimating the amount of investments leveraged by climate finance such as GEF grants, CDM credit payments or loans by multilateral development banks.

Leveraged funds as poor indicator for mitigation

Finally, the analysis of the correlation between efficiency in reducing GHG and leveraging funds shows that the leverage factor is a poor indicator for mitigation efficiency in case of the CDM and the GEF. In case of the GEF, leveraging funds may have some benefits for mitigating greenhouse gases but the correlation is not statistically significant, when looking at total funds leveraged by 370 GEF projects (all GEF projects active in June 2009). Also when looking at the efficiency in leveraging private funds, the positive correlation with the efficiency in reducing GHG is statistically not clearly significant (sample of 66 projects). In case of market mechanisms, a sample of 232 CDM projects even shows a negative correlation between efficiency in leveraging investment and abatement, when we calculate the leverage factor on the basis of credit revenues. If the factor is calculated on the basis of abatement expenditure, then the correlation between efficiency in leveraging funds and reducing GHG is positive, but projects with high leverage projects tend to also be more prone to non-additionality. Finally, not depending on the definition of the leverage factor, projects with no other revenues than the CDM tend to be highly efficient in reducing GHG but have low leverage factors. Therefore, there is quite some evidence that there is a leverage paradox: projects leveraging large investments per carbon revenue tend to be less efficient in mitigation.

While these findings for CDM and GEF projects are interesting it is not clear if they can be generalised to other channels of climate finance. First of all, the CDM findings are not easy to apply to other channels as the CDM has a very significant difference to most public funding instruments as, within the CDM, public institutions only decide on certification of reductions but payments for credits are market-based. Nevertheless, the analysis of CDM projects provides some interesting insights for public investments, which may target similar technologies: e.g. reducing industrial GHG is cost-efficient but has low leverage factors, while reducing CO_2 through renewables and transport projects is rather expensive but provides high leverage factors.

Second, also the GEF findings may not be fully generalised because of three reasons: the GEF is just a small player in the current climate finance architecture; it applies only grants and not other types of instruments such as loans, guarantees and equity; and finally, it also claims to leverage non-private funding, which is however not a strong problem as the analytical results are similar when only considering leveraged private funds. Notwithstanding these problems for generalisation, the analysis of GEF projects has its merits because some of the results (e.g. questionable additionality in case of high leverage factors, low costs of implementing energy efficiency projects) will be similar for other public funding instruments. One should also not forget that GEF projects are implemented through multilateral institutions, some of which (especially the World Bank) will have an important role in implementing post-2012 mitigation programmes.

Summing up, negotiators and national policy makers should be cautious when using leveraged funds as a major parameter to measure the success of mitigation-related climate finance. In fact, the goal of maximising leverage may even have the perverse incentive to choose projects and programmes with high abatement cost or some that are non-additional. If the negative or insignificant correlation between efficiency in GHG abatement and leveraging funds is not only shown for the GEF and the CDM but can also be confirmed for other climate funding channels such as loans of multilateral development banks, then it may be environmentally beneficial to switch from the "100 billion USD, private and public funds, by 2020" to a lower figure including only public funds, and optionally payments through carbon credits. However, such a solution may be difficult to reach in political terms. A more subtle policy change may be to refrain from striving for high leverage factors and to search for types of programmes and funds that enable more reductions.

From a research point of view, several further studies are required. First, tools to enable more efficient use of public and private funds have to be designed, e.g. by enabling the CDM and new market mechanisms to target the low-cost energy efficiency potential. Second, the additionality of leveraged funds has to be studied to receive more realistic leveraging numbers. Third, the correlation between efficiency in leveraging funds and mitigation should be further studied by analysing more funding channels (e.g. World Bank loans, bilateral grants or equity provided by public institutions) and controlling for other mitigation drivers. To enable this research, we would need (currently not available) data on GHG reductions and leveraged funds, especially from bilateral funding channels and multilateral development banks.

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Annexes

Annex 1: Existing climate finance mechanisms (mitigation)

Since the signature of the United Framework Convention on Climate Change in 1992, billions of funds for climate change mitigation have flown from industrialised to developing countries. Since 2005, when the Clean Development Mechanism (CDM) started its operations, climate funds have not only been channelled through national and international governmental agencies but also through carbon markets.

GEF

Under the UN Framework Convention on Climate Change (UNFCCC) from 1992, the wealthiest countries (Annex II) have the obligation to pay the full incremental costs of any climate change related measures that are agreed between developing countries and operating entities of the UNFCCC's financial mechanism (UNFCCC 1992). The Global Environment Facility (GEF) was chosen to be the operational entity of the financial mechanism, and through the GEF more than 2.5 billion USD of climate change related flows have been committed to developing countries up to 2008 (GEF, 2009). Further 1.35 billion USD have just been pledged for the climate change mitigation area for the period 2010-2014 (GEF, 2010b). While other UNFCCC funds (e.g. the Green Climate Fund established in Cancun) may become more important in the future, the GEF is still the only operational entity of the UNFCCC's financial mechanism for mitigation funds today.

CDM

Under the Kyoto Protocol in 1997 developing countries were, unlike developed countries, not obliged to achieve a greenhouse gas emission targets until 2010. The only way they were substantially involved in the Kyoto Protocol was through the Clean Development Mechanism (CDM), which has two main purposes (UNFCCC, 1997); first, to assist developing countries in achieving sustainable development and contribute to emission reductions, and second to help developed countries in achieving their Kyoto targets in a cost-effective manner through financing projects in developing countries. Emission reductions in the order of 445 Million tonnes of CO_2 have been certified by the CDM Executive Board up to now (UNFCCC, 2010), and around 1.04 billion tonnes of CO_2 are expected to be reduced by the end of 2012 (URC, 2010b).

Public funds other than the GEF

Those official mechanisms under the United Nations represent just a small share of climate change mitigation related flows to developing countries, which occur through various public channels. In the last two years, a whole range of new climate funds have been established, both on bilateral[36] and multilateral terms. The best-funded ones are the World Bank's Climate Investment Funds (CIFs), which originate from a G8 decision to close the funding gap until 2013 when a new climate regime should be in place. Donors pledged more than 6 billion USD for the CIFs. In total, northern governments and multilateral organizations have disbursed around 9 billion USD of climate-dedicated or climate-related flows in 2009, according to reported to their reporting to the OECD (2011). More than 2/3 of this is accounted as Official Development Assistance (ODA), while the rest are loans accounted as "Other Official Flows" as they do not qualify as ODA. The number of those flows is just representing a rough estimation as it is based on donor coding with the so-called "climate change Rio marker". Michaelowa and Michaelowa (2010) have revealed that there is substantial under- and over-coding. While the climate-related flows are probably lower than reported, the order of magnitude of the OECD figures (around 10 billion USD per year) is probably rights.

[36] e.g. EU's Global Climate Change Alliance, Japan's Cool Earth Partnership or Australia's International Forest Carbon Initiative, see http://www.climatefundsupdate.org for a comprehensive overview.

Annex 2: Definition of the leverage factor in this study

Definitions

Leverage factor	Mobilised funds / Mobilising climate finance
Mobilised funds	Funds paid to projects for non-climate purposes (e.g. investment with return as target, or public funds with development as target). Payments for services (e.g. payments for electricity) and "mobilising climate finance" itself are not included.
Mobilising climate finance	International funding paid with the aim of reducing CO_2 emissions. Climate finance is either public (e.g. grants, loans), publicly induced (e.g. CDM payments triggered by emission targets) or voluntary (e.g. voluntary carbon market

Detailed definition of mobilised and mobilising funds

	CDM	**GEF**
Mobilised funds	CDM investment, as reported by URC (2011)	Co-finance of GEF project, as reported by the GEF. This includes not only private investments but also public funds (e.g. loans, international and national grants)
Mobilising climate funds	Two different approaches a) Abatement expenditure: mobilising funds are the payments needed to enable abatement (calculated as expected credits multiplied with the abatement costs in USD/tCO_2) b) Credit payments: mobilising funds are expected carbon credits until 2020 according to URC (2011) multiplied with the expected carbon price (13.3 USD pre 2012 and 5 USD post 2012)	GEF grants, as reported by the GEF

Assumptions when calculating the leverage factor

Assumption	**Relevant for CDM**	**Relevant for GEF**	**Assumption in this study**
Additionality	Yes	Yes	All projects are additional
Baseline investment	Yes	Yes	Baseline investment included in "mobilised funds"
Types of leveraged/ mobilised funding	Yes	Yes	CDM: Investment; GEF: Private sector investment, loans of multilateral development banks, payments of host country government and bilateral donors.
Mobilising part	Yes	Yes	GEF grants in case of GEF, CDM type 1: credit payments, CDM type 2: abatement expenditure
Emission baseline	Yes	Yes	Numbers from project documents
Carbon price	Yes	No	13.3 USD/tCO_2 pre 2012, 5 USD/tCO_2 post 2012
Crediting period	Yes	No	Credits until 2020 (in case of credit payments as mobilising parts) and 1st crediting period (in case of abatement expenditure as mobilising parts:
Discount rate	Yes	No	Project document discount rate

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