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Measuring Emissions Against an Alternative Future: Fundamental Flaws in the Structure of the Kyoto Protocol's Clean Development Mechanism

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Energy and Resources Group Working Paper ERG09-001

University of California, Berkeley

http://erg.berkeley.edu/working_paper/index.shtml

December 2009

Executive Summary

The Kyoto Protocol's Clean Development Mechanism (CDM) enables industrialized countries to partially meet their emissions reduction targets by reducing emissions in developing countries. An appeal of the CDM is its perceived efficiency as a market mechanism. The CDM theoretically creates value for carbon reductions and allows the market to find the cheapest reductions anywhere in the world. A key challenge to the environmental integrity of the CDM is filtering out business-as-usual, or "non-additional," projects. The CDM should only generate carbon credits from activities beyond business-as-usual. Each business-as-usual project that is allowed to generate carbon credits under the CDM will permit an industrialized country to emit more than their Kyoto targets by paying developers in developing countries to do what they were doing anyway rather than actually reducing emissions. The poor quality of the arguments and evidence used to prove project additionality in CDM application documents, and the resulting large-scale registration of non-additional projects, have been well documented. Proposals for reforming the CDM range in scope, from making the CDM's rules stricter and/or more objective, to a more fundamental shift away from project-based offsetting.

This paper examines the possibility of improving the CDM's environmental integrity and effectiveness as a project-based offsetting mechanism by studying how the CDM is working in practice in the Indian power sector. It is based on interviews conducted in India during 2004 and 2009 with over 80 CDM and renewable energy professionals involved in CDM project development, including project developers, consultants, validators (hired to audit each project applying for CDM registration), carbon traders, bank employees, government officials, members of the CDM governance panels, and others involved in renewable energy and hydropower development in India. It also draws on analysis of the UNEP Risoe CDM project database, and analysis of documents from 70 CDM projects comprising all of the large (over 15 megawatt) wind, hydro, and biomass projects registered in India since 2007 and the 20 most recently registered hydro projects in China. This paper presents the following findings:

- The majority of CDM projects are "non-additional" and therefore do not represent real emissions reductions.
- A reasonably accurate project-by-project filter for non-additional projects is infeasible.
- The need to test project additionality, which is inherently difficult and inaccurate, adds uncertainty and time to the CDM application process, compromising its effectiveness in supporting truly additional projects.
- Beyond the problems with additionality testing, the structure of project-based offsetting leads to the over-generation of credits and limits its ability to reduce emissions.
- The large-scale use of offsetting hinders global efforts to mitigate climate change in the coming decades.

The following is a section-by-section summary of the analysis in this paper on which these findings are based.

Widespread opinion in India that the CDM is not working

It is the widely held belief among CDM and renewable energy professionals in India that many if not most CDM projects are non-additional and that the CDM is having little effect on renewable energy development in the country. At least twelve developers and consultants told me that the CDM projects that they proposed would have been built regardless of the CDM. Many more developers and consultants responded to my probings with general statements that very few CDM projects are additional. Validators, tasked with auditing CDM additionality claims, believe that additionality testing procedures are subjective and can be manipulated, with many "knobs you can turn." Several validators suggested ways to lessen the manipulation, but did not believe that it is possible to prevent it. It is commonly understood in India that banks are not taking carbon credits into account in their lending decisions due to the uncertainties associated with CDM registration and carbon credit revenues. Interviewees commonly made statements such as: CDM revenues are just "cream on the top"; developers decide to build projects "on their own terms" rather than based on the small and uncertain financial benefit from carbon credit sales; and "any project can be registered under the CDM."

If business-as-usual projects are registering under the CDM, we would expect to see evidence of manipulation and fraud as developers seek to prove that their projects require CDM revenues to go forward when in fact they do not. Indeed, evidence of fraud was surprisingly easy to find. A murmur of agreement went through the audience at a carbon markets conference in Mumbai when a panelist mentioned that board minutes documenting early consideration of the CDM in decisions to build projects are being forged and post-dated. One CDM consultant told me that he presented two sets of investment analyses to a bank for a single project – one for the CDM application showing that the project would not be financially viable without carbon credits, and a second for the loan application showing that the project is financially viable on its own. Only one of the seventeen large wind CDM projects in India that make their financial assessments publicly available uses and correctly calculates the tax benefits offered to wind power developers by the Indian government.

An accurate project-by-project additionality test is infeasible

The "investment analysis" is the means for demonstrating project additionality that is viewed as having the most potential to accurately test project additionality if it is made more rigorous. The investment analysis presumes that it is possible to accurately predict whether a project would be built based on the sign (positive or negative) of a single number – the difference between the expected financial returns from the proposed CDM project and a benchmark defining the boundary between viability and lack of viability for that project type. If the returns are below the benchmark, the project would not likely be built; above it, it would. One indication that the investment analysis has been inaccurate is that just under half of the 29 Indian projects examined in this analysis that make their financial assessments publicly available calculate financial returns below the benchmark even with carbon credit income. This predicts that the projects would not have been built even with income from carbon credit sales. Yet all of these projects were still built.

The main challenge to implementing an accurate investment analysis is that developers have incentives to choose the benchmark and project cost and revenue inputs that show that their proposed CDM project is additional, so that when a range of values is possible, the values are suspect. Analysis of financial assessments for wind and biomass projects in India reveals assumptions that can be varied within reasonable ranges to change the expected financial returns of the projects more than the amount that the returns are above or below the benchmark. Even the best cases for an investment analysis – wind projects in India in which all of the main inputs into the financial assessment are typically documented in formal agreements before project construction starts – still have room to vary assumptions (for example the tariff after the end of the power purchasing agreement) within ranges equivalent to the effect of the carbon credit sales. For the investment analysis to be accurate even at this level, supply and loan agreements would need to be signed before the start of the CDM application process. For most other project types there is even more room for manipulation of cost inputs. For example, assumptions about future biomass prices affect the expected financial returns much more than carbon credits do for biomass projects purchasing biomass from neighboring farms.

Large hydropower in India is inappropriate for additionality testing for several reasons. First, large hydropower development is decided by a government planning process and involves a wide range of considerations that are not easily predicted. Second, the per-kilowatt hour tariff provided to large hydropower producers is calculated periodically on a cost-plus basis to ensure that the producer receives a pre-agreed return on their equity investment. The investment analysis is meaningless in this context. Third, financial assessments have not been a good predictor of hydropower development in the past, nor have they been a good predictor of actual project costs. Affecting most project types is the lack of a single accurate benchmark since project development decisions can be based on multiple factors and project risk assessment is inherently subjective. This analysis suggests that an accurate project-by-project additionality test is infeasible for most projects and another means for determining which projects are worthy of receiving international support through international climate change agreements is required.

The CDM has little influence on project development

While additionality testing is not very effective in preventing non-additional projects from registering under the CDM, the need to conduct a test that is inherently imprecise and subjective limits the ability of the CDM to support truly additional projects. The CDM's ability to influence the decisions of developers, lenders and investors is compromised by a combination of the length of time it takes to validate and register a proposed CDM project (seventeen and a half months on average for projects registered over the last two years) and the uncertainties associated with CDM validation and registration and carbon credit issuance.

Developers are not waiting to make sure that their projects are successfully validated or registered under the CDM before deciding whether to build their projects. Three-quarters of all registered CDM projects were operational by the time they were registered as CDM projects. Construction on 17 of the 70 projects reviewed in this analysis began before the Kyoto Protocol entered into force in February 2005 and before the first project was registered under the CDM in November 2004. Two of these projects were registered within the last year. Developers do not seem to view a positive validation or CDM registration as helpful in acquiring project financing. Developers of 66 of the 70 projects started the CDM validation process around the time of or after the beginning of project construction.

It is likely that most of these developers did not make their decisions to go forward with their projects based on the expectation of CDM income because of the substantial uncertainties associated with CDM revenues. Uncertainties include the possibility that the project would not pass validation or be accepted for CDM registration, fluctuating carbon credit prices, and uncertainties about the value carbon credits will have post-2012. A large proportion of the risk, time and complexity of the CDM application process is because of additionality testing.

Beyond additionality, the fundamental structure of the CDM leads to the over-generation of credits and limits its ability to reduce emissions

Looking beyond additionality testing, the structure of project-based offsetting in a number of other ways contributes to the generation of more credits than actual reductions and limits its influence on emissions. The CDM should result in reductions in emissions in developing countries at least as large as the credits it generates. Therefore, since each CDM project is allowed to produce carbon credits for its full lifetime, defined either as a single 10-year period or 21 years (3 consecutive 7-year periods) without retesting additionality, the CDM should only support projects that would not have been built for 10 or 21 years without the CDM. Hydropower, wind and other low-carbon electricity generation technologies are generally developed in order of their cost effectiveness. A preferred support mechanism would accelerate the development of all of these plants rather than change the order in which they are built. The CDM as it is currently structured could work in one of two ways. It could support a portfolio of projects that would not otherwise have been built for more than a decade, a portfolio of unattractive projects, enabling less attractive projects to be built before more attractive ones. Alternatively, the CDM could accelerate the building of all plants, generating more credits than the emissions actually avoided. Neither is a good option.

The CDM can only fund activities for which it is believed that emissions reductions can be reasonably estimated. Therefore, the CDM is unable to support many measures that are needed or are more cost effective for the deployment of technologies and the decarbonization of sectors but for which it is especially difficult to measure emissions reductions, such as policy, research and development, demonstration projects, and information dissemination. A long-standing criticism of the CDM is that it may create perverse incentives for governments not to implement climate-friendly policy in order to maintain a high baseline against which domestic facilities can prove additionality and generate carbon credits.

The large-scale use of offsetting credits hinders global efforts to mitigate climate change

Scenarios put forward by the Intergovernmental Panel on Climate Change (IPCC) suggest that a reduction in carbon emissions in industrialized countries by 25% to 40% below 1990 levels by 2020, on a path towards 80% to 95% reductions by 2050, will still result in a 2.0-2.4 degree Celsius temperature increase. The large quantities of offsets being proposed for use by industrialized countries post-2012 would put them far away from these reduction pathways, hindering global mitigation efforts in the coming decades.

Any offsetting mechanism in developing countries, whether it is project- or sector-based, involves measuring emissions against an alternative business-as-usual growth scenario and therefore the quantity of emissions reduced is inherently uncertain. Further, the use of large quantities of offsets in one commitment period makes it harder for industrialized countries to accept meaningful reductions in the next, since industrialized countries will be more dependent on the uncertain availability of credits through the carbon market to meet deepening targets. If industrialized countries are to use the quantities of offset credits they propose post-2012, the majority of global reductions over the next ten years will occur in developing countries. Industrialized countries are therefore committing either to steeper annual reductions in the future, or to long-term inequalities in emissions between the North and the South. Both options make future cooperation more difficult. Major shifts in high emitting sectors in industrialized countries require time to allow for changes in behavior and in support industries, for experimentation and learning, adapting technologies to diverse local contexts, research, development and deployment. The use of offsets postpones these processes in industrialized countries. We live in a globalized world with a widely shared linear view of development and progress. Deep in urban and rural India, visions of "development" and symbols of high status are heavily influenced by images of lifestyles in the global North. In a world dominated by a single vision of progress, the vision of progress that we are striving towards must be sustainable. Ultimately, promoting low-carbon development in the South requires demonstrating it in the North.

The way forward

Our inability to accurately measure the emissions reduced by individual projects, compounded by the large-scale use of offsetting credits by industrialized countries to meet their reduction commitments, risk substantially undermining the effectiveness of the post-2012 climate change regime and our ability to control global greenhouse gas emissions. Any offsetting mechanism included post-2012 will need to:

- include an alternative means for targeting projects and activities without testing additionality on a project-by-project basis, a process which is essentially subjective and inaccurate;
- be predictable, providing certain benefits to those depending on it; and
- be small in the context of deeper Annex 1 targets.

The first point is practically difficult, the third, politically difficult. We have seen little indication that countries will agree to an offsetting mechanism that is small enough and targeted enough, with conservative enough baselines, to preserve its environmental integrity, and the environmental integrity of the whole agreement. Attention must be refocused on reductions in countries with emissions caps, with non-credited support for mitigation efforts in developing countries.

Measuring emissions against an alternative future: fundamental flaws in the structure of the Kyoto Protocol's Clean Development Mechanism

Abstract

Proposals for reforming the Clean Development Mechanism (CDM) range in scope, from making the CDM's rules stricter and/or more objective, to a more fundamental shift away from project-based offsetting. Interviews conducted in India during 2004-2009 on how the CDM is working in practice in India's electricity sector, an analysis of the project documents from 70 registered CDM projects in India and China, and analysis of the UNEP Risoe CDM project database together indicate fundamental limitations to improving the outcomes of the CDM within its basic structure as a project-base offsetting mechanism. I find: (1) The majority of CDM projects are "non-additional" (would have gone ahead regardless of support from the CDM) and therefore do not represent real emissions reductions; (2) Due to the subjectivity inherent in project development decisions, a reasonably accurate filter for non-additional projects is infeasible; (3) The need to test project additionality, which is inherently difficult and inaccurate, adds uncertainty and time to the CDM application process, compromising its effectiveness in supporting truly additional projects; (4) Beyond the problems with additionality testing, the fundamental structure of the CDM leads to the over-generation of credits and limits its ability to reduce emissions; (5) Taking a step back, the large-scale use of carbon credits generated in developing countries by industrialized countries to meet their emissions targets hinders global efforts to mitigate climate change over the next decades. Both the large-scale use of offsetting to meet industrialized country targets and the continuation of project-based offsetting risk undermining the ability of global climate change agreements to control greenhouse gas emissions.

1. Introduction

Industrialized countries have two sets of obligations under current international climate change agreements: to reduce their own emissions, and to support climate change mitigation and adaptation in developing countries. The Kyoto Protocol's Clean Development Mechanism (CDM) is critical for meeting both sets of obligations. The CDM in principle allows industrialized countries to invest in projects in developing countries that reduce emissions, and use the resulting emissions reduction credits towards their Kyoto Protocol targets. Any project registered under the CDM is able to produce carbon credits, called certified emissions reductions, or CERs, totaling the estimated tons of CO_2-equivalent emissions avoided by the CDM project. The CDM is the most used of the Kyoto Protocol's "flexibility mechanisms," which are meant to lower compliance costs by allowing industrialized countries to partially meet their emissions targets through reductions outside of their own borders. It is also the main instrument under current climate agreements supporting climate change mitigation in developing countries, currently passing around three billion Euros per year to developers of low-emitting projects in developing countries.[1]

A key regulatory challenge of the CDM is calculating the emissions reduced by a single project. This requires comparing the emissions from the project with emissions from a counterfactual scenario of what would likely have happened without the CDM project. The biggest challenge in determining the counterfactual baseline scenario is assessing whether the project itself is in that counterfactual scenario, or in other words, if the proposed CDM project would have gone ahead anyway, without the expected revenues from the CDM. The CDM should only generate credits from activities beyond business-as-usual (BAU), since any carbon credits generated by BAU CDM projects allows an industrialized country to emit more than their Kyoto targets by paying developers in developing countries to do what they were doing anyway, rather than actually reducing emissions. Each project applying for CDM registration must demonstrate their "additionality," that the project would not likely have gone forward had it not been for the expected CDM income.

Another key regulatory challenge of the CDM relates to the nature of the market it creates. A common appeal of the CDM is that it is a market mechanism meant to create a global market for emissions reductions, lowering the cost of compliance by allowing industrialized countries to reduce emissions wherever in the world it is least expensive to do so. In practice, the CDM does not create a market for emissions reductions. It creates a market for emissions permits, since it is the permit to emit that is the primary interest of most CER buyers, as they seek low cost options of complying with domestic climate regulations. For the most part, neither the buyer nor the seller of CDM credits is primarily concerned with emissions reductions, such that neither have a strong interest in ensuring the environmental benefit represented by the permits sold. In addition, these permits to emit are wholly human created, numbers in databases, such that no extra cost is incurred from producing more permits. CDM project proponents not only have little incentive to protect the environmental integrity of the permits, they have a financial interest to exaggerate the number of carbon credits generated by CDM projects. Therefore, the integrity of this market in terms of emissions reductions relies almost entirely on effective regulation. These features – the buyer is unconcerned with the quality of the underlying physical thing represented by the wholly human-made tradable asset – are also features of many of the financial instruments whose deregulation in the US caused the current global financial crisis, reminding us of the importance of regulation for markets to function. As mentioned above, the market in CDM credits is especially difficult to regulate because it involves calculating emissions reductions against a hypothetical scenario, and most importantly, determining if the project itself is a part of that scenario.

The poor quality of the arguments and evidence used to prove project additionality under the CDM have been well documented (Michaelowa & Purohit 2007, Schneider 2007). Schneider (2007) concludes that "for about 40% of the registered CDM projects additionality is unlikely or questionable." Wara and Victor (2008) estimate that bona fide emissions reductions compose "only a fraction of the real offsets market," based on a range of evidence including the high proportions of hydropower, wind and natural gas power plants being built in China that are in the CDM pipeline, despite China's active promotion of these technologies. Various proposals have been put forward for controlling the number of carbon credits generated by business-as-usual

[1] The CDM projects currently registered under the CDM would produce 319 million tons of CERs a year if they meet the expectations in their PDDs (Fenhann J. 2009. October 1, CDM Pipeline Overview. UNEP Risø Centre. http://www.cdmpipeline.org/). Primary CER prices are currently around 10 Euro per CER.

projects. Many of these involve continuing the CDM in its current form, and improving the rigor of its additionality test (some of the ideas put forward by Schneider 2009, and by Wara & Victor 2008).

This paper explores how the CDM is working in practice in the Indian power sector. It examines the proportion of CDM projects that are non-additional, and how effective the CDM is at supporting truly additional projects. It also considers whether it is possible to substantially improve the outcomes of the CDM within its current structure as a project-based offsetting mechanism. This paper also explores how the substantial use of offsets purchased from reductions made in developing countries currently being proposed by most industrialized countries post-2012 might help or hinder global efforts to control greenhouse gases to levels needed over the next forty years.

This paper presents the following findings:

- The majority of CDM projects are "non-additional" and therefore do not represent real emissions reductions.
- A reasonably accurate project-by-project filter for non-additional projects is infeasible.
- The need to test project additionality, which is inherently difficult and inaccurate, adds uncertainty and time to the CDM application process, compromising its effectiveness in supporting truly additional projects.
- Beyond the problems with additionality testing, the structure of project-based offsetting leads to the over-generation of credits and limits its ability to reduce emissions.
- Taking a step back, the large-scale use of offsetting hinders global efforts to mitigate climate change in the coming decades.

In what follows, section 2 provides background information on the current state of the CDM and how it works, as well as why our ability to effectively filter out non-additional CDM projects has implications for the success of the global climate change regime. Section 3 describes the methods used in this analysis. Section 4 delves into the analysis with stories from my research interviews indicating widespread skepticism among CDM and renewable energy professionals in India regarding the impacts the CDM is having and describing instances of fraud used to demonstrate project additionality. This is followed by analyses of the feasibility of substantially improving the CDM's additionality testing procedures (section 5) and how effective the CDM is in supporting truly additional projects (section 6). Stepping away from additionality testing, section 7 presents a number of other ways that the CDM structure leads to the over-generation of credits and compromises the CDM's ability to reduce emissions. Taking one more step back, section 8 asks if it is helpful or harmful to long-term international cooperation for industrialized countries to use large amounts of offset credits towards their near-term targets. Finally, I discuss alternatives to the current CDM in a post-2012 climate change regime.

2. Background

2.1 How the CDM works

Developers of low-carbon projects in developing countries can submit their projects to the CDM Executive Board (EB) for CDM registration. An application for CDM registration includes a Project Design Document (PDD), a validation report from an independent validator, and a letter of approval from the host country government. The PDD gives a detailed description of the project, including an estimation of the emissions that it will reduce following an accepted "methodology" for doing the estimation, and evidence that the project is additional. The developer must hire a certified third party auditor, called a validator,[2] to validate that the project meets all of the requirements of the CDM. After a project is approved by the CDM Executive Board, the developer chooses how often to submit requests for the issuance of CERs. Typical end buyers of CERs are governments of and regulated facilities in countries that have Kyoto Protocol targets. Often the first buyers of CERs from the developer are intermediary companies that trade in carbon credits. The developer can choose to enter into a CER purchasing agreement with a buyer before or after credits are generated. Figure A-1 in the Appendix presents the key steps in the process of registering a project under the CDM and applying for CER issuance.

2.2 The current state of the CDM

As of October 1, 2009 there were a little over 1,800 registered CDM projects, and another 2,800 proposed CDM projects in the validation process. The total number of registered CDM projects is presented by country in Figure 1, and by type in Figure 2. China and India host 60% of all registered CDM projects, with few projects registered in Africa and in many other smaller developing countries. 31% of all registered CDM projects are renewable energy projects and 27% are hydropower projects. Non-CO_2 gas projects make up 4% of all registered CDM projects but are expected to produce 61% of the credits generated through 2012 because of their relatively high potency as greenhouse gases, if all projects were to produce the amount of credits predicted in their PDDs (see Figure 3).

2.3 The *Additionality Tool*

The "Tool for the demonstration and assessment of additionality,"[3] is the most common method used for proving the additionality of proposed CDM projects. The *Additionality Tool* requires developers to demonstrate the additionality of their proposed CDM project by an investment analysis, a barrier analysis, or a combination of both.

- The investment analysis is based on the idea that that carbon credit revenues improve the financial returns of projects, making losing or marginally profitable projects viable. It assesses the financial returns of the proposed project, most commonly in terms of project or equity internal rate of return (IRR).[4] A benchmark is defined that represents the threshold financial returns, or hurdle rate, defining whether the project would go forward. If the expected financial returns are below the benchmark, then it is assumed that the project most likely would not have gone forward without carbon credits and the project is considered additional. It is optional to show that CERs bring the financial returns of the project above the benchmark.
- The barrier analysis describes and presents evidence for the existence of one or several barriers that prevent the proposed CDM project from going forward without the additional income from carbon credit sales.

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[2] A validator is also called a Designated Operational Entity, or DOE.

[3] The *Tool for the demonstration and assessment of additionality*, and a version of this tool that is combined with a baseline identification methodology - *Combined tool to identify the baseline scenario and demonstrate additionality* - can be found here: http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

[4] Internal rate of return (IRR) is the discount rate that would be applied to the cash flow of a project so that the net present value of the project is zero. A higher IRR indicates better financial returns.

Figure 1: Registered CDM projects by host country

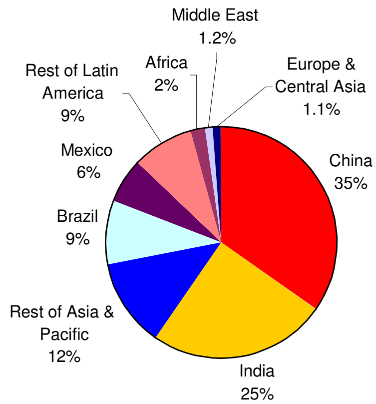


Figure 2: Registered CDM projects by type

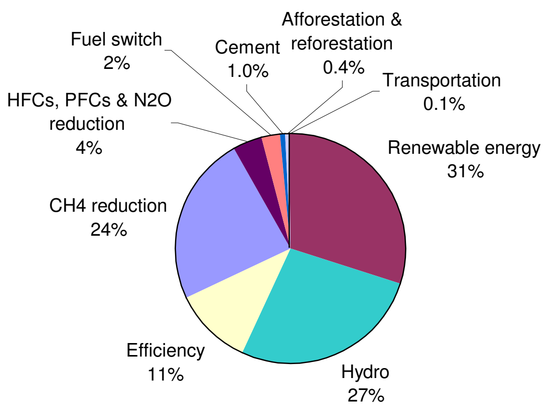
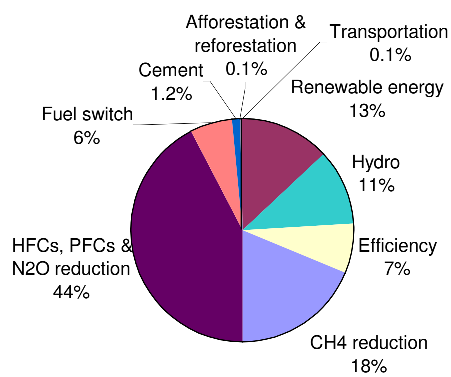


Figure 3: Expected CERs through 2012 from registered CDM projects by type



2.4 Why we should be concerned about additionality

Certainly additionality is a challenge for any climate mitigation program. Estimation of emissions reduced by policies, programs, and projects is often highly inexact in a complex world in which there are multiple influences on behavior and industrial and consumer choices. International funds that pool contributions to support emissions reduction projects in developing countries, the main alternative to crediting mechanisms, could also end up supporting activities that would have happened anyway. There is an important difference between crediting mechanisms and funds in this regard. When a fund supports a BAU project, it fails to reduce emissions through that project; when the CDM supports a BAU project, it also, in effect, weakens an industrialized country target by the amount it claimed to have reduced in the developing country. Secondly, the various risks involved with distributing funds to projects is more transparent. Proponents of project-based offsets commonly assume that emissions reductions from individual projects can be measured accurately enough. The complex and technical nature of the CDM, and a general trust in the efficiency of market mechanisms, masks the uncertain nature of measuring emissions reductions in an offset program. To have a high likelihood of keeping global temperatures below a two degrees increase, substantial efforts are needed in both industrialized and developing countries. Industrialized countries need to both substantially reduce their own emissions and support mitigation in developing countries. To the extent that CERs are over-credited to CDM projects, the CDM fails in both regards at the same time.

3. Methods

The analysis in this paper is based on over 80 interviews conducted in India during 2004 to 2009, an analysis of project documents from 70 CDM projects registered in India and China, and analysis of the UNEP Risoe CDM project database containing information about all projects currently registered under the CDM and in the application process.[5] I interviewed individuals involved in CDM project development in various capacities (mostly in India), including project developers, CDM consultants, validators (hired to audit projects applying for CDM registration), carbon traders, employees from banks lending to renewable energy projects, government officials, and members of the CDM governance panels, as well as others involved in renewable energy and hydropower development in India. Some interviews were carried out in the interviewees' offices, and some involved less formal discussions in carbon and climate conferences.

I also analyzed the additionality arguments used to register 70 projects. These projects comprise all of the large (over 15 megawatt (MW)) wind, biomass, and hydro projects registered in India since 2007 and the 20 most recently registered hydro projects in China. The specific analyses performed are described below in the paper sections alongside their results. These four projects types are among the most numerous in the CDM pipeline (see Table 1) and together represent one third of projects (registered and in the validation process). I chose to review only "large" projects since the additionality testing procedures for projects above 15 MW are more rigorous than for "small" projects. I chose to review only projects registered from 2007 because additionality testing was weaker in 2005-6, and has gradually been strengthened with various guidances.

Table 1: Projects analyzed

	Projects analyzed	Total projects in CDM pipeline	
Wind in India	20	320	7%
Biomass in India	16	297	6%
Hydro in India	14	130	3%
Hydro in China	20	819	18%
TOTAL	70	1566	33%

[5] UNEP Risoe CDM/JI Pipeline Analysis and Database, October 1st, 2009 http://www.cdmpipeline.org/

This paper focuses on CO_2 reduction projects, for which CDM credits are typically one among several project benefits, and improve project financial returns by a relatively small amount. Renewable energy, hydropower, coal and natural gas projects, and many efficiency projects are all CO_2 reductions projects, which compose approximately 72% of all registered CDM projects (see Figure 3). In contrast, CERs are often the sole revenue source from HFC and N_2O reduction projects, making these projects more likely to be additional. However, these industrial gas projects pose other problems documented elsewhere (Wara 2007, Wara & Victor 2008) and discussed in brief with the fourth finding of this paper.

4. Wide-spread opinion in India that the CDM is not working

It is the widely held belief among CDM and renewable energy professionals in India that many if not most CDM projects are non-additional and that the CDM is having little effect on renewable energy development in the country. Research for this paper started in the summer of 2004 when I was told by managers of three sugar factories in India that their sugar mill cogeneration plants, being proposed as CDM projects, would be or would have been, built without the CDM. Each manager told the arguments they were using to demonstrate that their projects were additional, even though they had told me they were planning to build the projects regardless of CDM funding. They treated the additionality proof as a bureaucratic hoop they had to jump through to access this funding source, a sentiment repeated often in later interviews.

Since those early interviews, at least nine more developers and consultants told me that the CDM projects that they proposed would have been built anyway, without the CDM. It was surprising how easy it was to find developers who would say this, given their interest in defending the additionality claims in their CDM application documents. Many more developers and consultants responded to my probings with general statements that very few CDM projects are additional. The strongest evidence that a project is non-additional is the admission of developers themselves.

Interviewees commonly made statements such as: CDM revenues are just "cream on the top"; developers decide to build projects "on their own terms," not based on the small and uncertain change in IRR from carbon credit sales; "any project can be registered under the CDM." Validators, tasked with auditing CDM additionality claims, believe that current additionality testing procedures are subjective and can be manipulated. One validator described the many "knobs you can turn" to change the results of the financial analysis. Several validators suggested ways to lessen the manipulation, but did not believe that it is possible to prevent it. It is commonly understood in India that banks are not taking carbon credits into account in their lending decisions, due to the uncertainties associated with CDM registration and CER revenues. Representatives from three banks that lend to renewable energy projects confirmed that the CDM is having no or very little effect on their lending decisions. At a carbon markets conference in 2007 in Mumbai, a carbon buyer in the audience criticized a panelist for saying that it is possible to prove the additionality of just about any project. The buyer went on to say that he could agree to the panelist's statement if they were chatting at a bar, but that the panelist should not make such statements in a public forum where he could be quoted.

If business-as-usual projects are registering under the CDM, we would expect to see evidence of manipulation and fraud as developers seek to prove that their projects require CDM revenues to go forward when in fact they do not. Indeed, evidence of fraud was surprisingly easy to find in project documents and to hear about in the halls of carbon conferences and workshops.

A murmur of agreement went through the audience at the carbon markets conference in Mumbai when a panelist mentioned that board minutes documenting early consideration of the CDM in the decision to build proposed CDM projects are being forged and post-dated. One validator proudly told me how he discovered one of these forged documents. One CDM consultant told me that he presented two sets of investment analyses to a bank for a single project – one for the CDM application showing that the project would not be financially viable without carbon credits, and a second for the loan application showing that the project is financially viable on its own.

In India, wind power is generally considered a good investment, due in large part to tax benefits offered by the central government. India offers wind power developers the ability to take 80% depreciation for wind project capital costs in the first year of operation along with a 10-year tax holiday. 25 large wind projects totaling 1,600 MW of wind power in India are registered under the CDM. 17 of these use an investment analysis to prove additionality, make the analysis spreadsheet publicly available, and were registered since 2007. The project design documents for each of these 17 projects proves additionality by showing that the project is not financially viable without CER sales revenues. Only one of these projects includes the full tax benefits provided by the government in their financial assessments. This one project uses an unrealistically low estimate of the amount of electricity to be generated by the project.[6] Only 6 of the other 16 projects justify their failure to account for the full tax benefits offered by the government. They claim that the depreciation benefits are not useful to the developer because of their low profits.[7] But this claim is not credible for all of these projects.[8]

5. An accurate project-by-project additionality test is infeasible

The poor quality of the *CDM Additionality Tool's* barrier analysis and investment analyses being used to prove project additionality has been well documented (Michaelowa & Purohit 2007, Schneider 2009). These two studies describe how barriers used are highly subjective, not credible, poorly documented, or are so general that they are common to a wide range of CDM and non-CDM projects. Investment analyses leave out or do not document important values affecting the feasibility of the project. Another example of the poor quality of additionality testing is how IRR analyses for wind projects in India commonly leave out or incorrectly calculate the tax benefits provided to these projects described above. Many of these problems could be avoided by stricter standards for additionality arguments and evidence and more rigorous validation requirements. But the question still remains, could additionality testing be made substantially more accurate with stricter standards? That is, are there reasonably accurate and auditable indicators of the decisions of developers, lenders and investors? I

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[6] CDM project titled *22.5 MW grid connected wind farm project by RSMML in Jaisalmer* uses a plant load factor of 16% when the average plant load factor in the state was later determined to be 19% according to a wind project consultant.

[7] I learned about this problem from Axel Michaelowa.

[8] For example, the largest of the projects is a 468 mw wind project on three wind sites in Tamil Nadu state in southern India, with 209 separate owners. The investment analyses for this set of projects does not include depreciation benefits. It is very likely that at least some, if not all, of the owners chose to invest in wind in part to avail of the depreciation tax benefits.

examine the ability to test the additionality of wind, biomass and hydropower projects in India. This analysis starts with a brief discussion of the barrier analysis but focuses on the investment analysis, considered to have the higher potential for being accurate, if made more rigorous.

5.1 Barrier analysis

The CDM *Additionality Tool's* barrier analysis presents barriers, often described in terms of risks, which prevent a project from going forward. The CDM can offset those risks by improving the expected returns from the project. The PDDs reviewed that use the barrier analysis, either alone or with the investment analysis, list barriers facing the project, and then as required by the *Additionality Tool*, describe an alternative to the project is not prevented by those barriers.

The most common barriers cited in the reviewed PDDs by project category are: Hydro in India: water flow uncertainty, difficult terrain, small private sector developer new to the power industry; Wind in India: regulatory uncertainty regarding the amount and timing of tariff payments; Biomass in India: technological risks due to little experience in India with the technology, lack of skilled manpower, risk that the electricity utility would lower the tariff; Hydro in China: water flow uncertainty, electricity demand uncertainty during the flooding season, tariff uncertainty, increased investment cost due to new government rehabilitation policies.

It is certainly feasible that any of these risks could be important enough to prevent the developer from going forward with the project without the ability to sell carbon credits. It is also completely feasible that such project risk would not prevent the project from being built. Certainly many projects have been developed with these barriers, but without the help of the CDM.

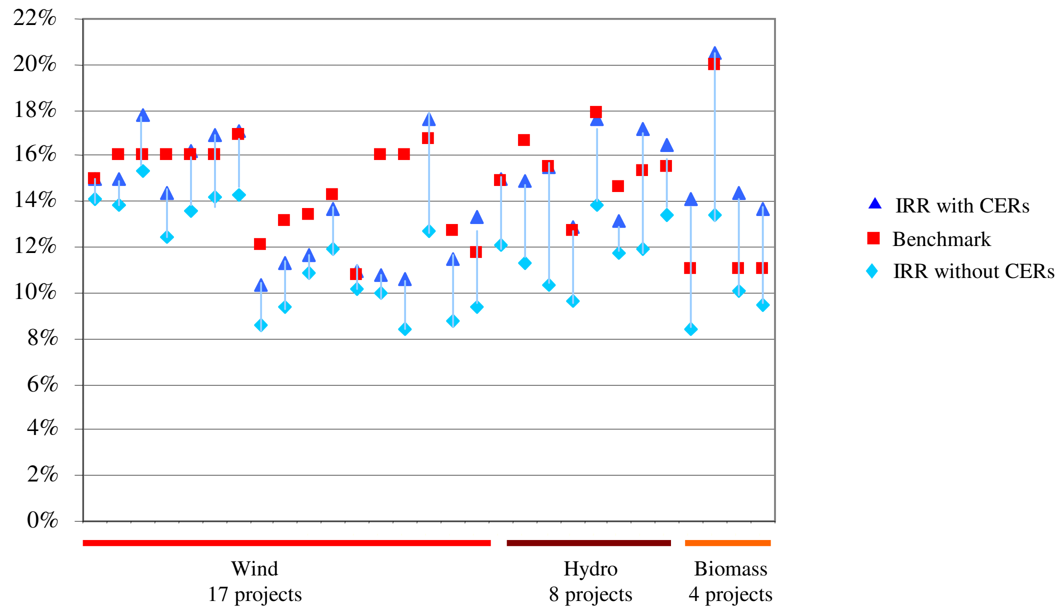
Typically the validator positively validates the project if there is documented evidence that (1) the stated barrier exists and (2) it is significant. They judge if it is feasible that the barrier could have prevented the project from going forward, not that there is a high likelihood that it actually did.

An example might illustrate the subjectivity inherent to the barrier analysis. One of the barriers used to prove the additionality of Patikari Hydro Electric Power Project in India was the difficult terrain where the project is developed posing challenges to project construction. The validation report notes that the validator asked the developer to "provide documentary evidence that these investment barriers are particular to this project activity and not general risks associated with all hydro projects in mountainous regions." The developer provided a geo-technical report depicting the poor nature of the terrain that might result in the caving in of the tunnel. This report was accepted by the validator as evidence of the existence of this barrier. It is certainly feasible that the risk of tunnel collapse could be important enough to prevent the developer from going forward with the project at its without-CER returns. Or it could be possibly that this risk did not affect the final decision. The validator does not seek to answer that question, for there is little evidence that could document the deliberations of the project developer. Such evidence would be needed for the barrier analysis to be accurate.

5.2 Investment analysis

The investment analysis presumes that it is possible to accurately predict whether a project would be built from the sign (positive or negative) of a single number – the difference between the expected returns from the proposed CDM project and the benchmark. If the returns are below the benchmark, the project would not be built, above it, it would. For illustration, Figure 4 shows the results of the benchmark analysis all of the Indian projects examined for this paper that use the investment analysis to prove additionality and which estimate both with- and without-CER financial returns. Most of the projects analyzed for this paper that use the investment analysis use project or equity IRR as the financial indicator and show with- and without-CER IRRs sitting on either side of the benchmark.

Figure 4: Benchmark investment analysis for all Indian projects analyzed
In chronological order of registration date for each type



It is important to keep in mind that the financial assessment is of a proposed project for which many of the costs and revenues are future projections. The investment analysis indicates additionality only to the extent that developers are unable to choose values to get the desired result – a without-CER result below the benchmark, and a with-CER result above it. That is, it is accurate to the extent that each expected cost and revenue input into the financial returns calculation for the proposed project is a unique and determinable value; and it is accurate to the extent that there is a single benchmark that verifiably tests a decision to go forward with a project. Developers have incentives to choose the benchmark and project cost and revenue inputs that show that their proposed CDM projects are additional, so when a range of values is possible, the values are suspect.

In India, CERs improve the IRRs of wind projects by 0.8% - 4.9% with most between 1.7% and 2.7%. For hydropower the gain is 3% - 5.2%, and the four biomass projects that use the investment analysis show an increase in IRR of 4.2%, 4.3%, 5.7% and 7.1%. These investment analyses argue that by improving project IRRs by these amounts, the CDM is able to make non-viable projects viable. Therefore, if a developer is able to vary the assumptions that go into the investment analysis enough to lower the expected IRR or raise the benchmark by these amounts, they can show that some viable projects are non-viable in order to demonstrate that they are additional. The rest of this section examines the extent to which the benchmark and IRR assessments can be manipulated by amounts similar to the expected CDM benefits.

Notable in the above Figure 4 are fourteen projects (just under half) that have with-CER IRRs below the benchmark, some by several percentage points. Yet each of these projects was built. This means that the investment analysis was wrong for each of these projects, since it predicted that these projects would not be built even with CDM revenues. This indicates that something is wrong with the investment analysis or the way it is being performed.

Wind projects

Wind in India is a best case for an accurate investment analysis because of the structure of the industry. As described above, wind power is generally considered a good investment in India in large part because of the tax benefits offered by the central government. As a result of these benefits, a common organizational arrangement for wind development involves an agreement between two sets of actors: a wind manufacturer who identifies and secures a site with good wind resources, and single or multiple investors, most often profitable businesses and wealthy individuals who are relatively unfamiliar with the energy industry but wish to avail of the depreciation tax benefits. The manufacturer typically takes full technical responsibility for the project, signing a supply agreement with the investor for the sale of the wind turbines and land, plant construction, and operations and maintenance.

All of the main costs of the project to the investor are typically well documented in the formal supply agreement prior to construction. In addition, this supply agreement often contains a high-end estimate for the amount of electricity the wind turbine is expected to generate to make the project look attractive to the investor. This high-end figure provides a good conservative choice from the perspective of additionality testing. Also, the tariff for the first ten, thirteen or twenty years of the project is signed into a power purchasing agreement with the utility buying the power. The loan interest rate would be documented in a loan agreement.

An analysis of the seventeen available investment analysis spreadsheets for large registered wind projects in India reveals several undocumented assumption that the developer can include from within a range of reasonable values. Most wind developers sign power purchasing agreements (PPAs) with a state electricity utility for ten or thirteen years, leaving the per kilowatt-hour (kwh) tariff unknown after the end of the PPA period. Most of the seventeen wind investment analyses analyzed here assume that the post-PPA tariff will remain the same after the last year of the PPA. Four assume a substantial drop in the post-PPA tariff. If these projects had instead assumed the post-PPA tariff remained constant after the end of the PPA their IRRs would have been 0.7%, 0.9%, 2.0% and 2.2% higher. Lowering the post-PPA tariffs of the other projects by one rupee per kwh, less than three of the four projects that assume a drop, lowers the IRRs of the projects by 0.5% to 2.2%. Table A-1 in the Appendix describes this analysis in more detail.

Second, one project was validated and registered with a deration rate on the assumed production of electricity. The deration rate represents a decline in the amount of electricity generated by the turbine over time as the turbine ages. Without the deration rate the IRR of this project would have been 0.31% higher.

Third, I describe above how almost all large wind developers in India do not account for the full tax benefits available to them in their CDM investment analysis. Several of the PDDs for these projects explain that the investor is unable to avail of the full depreciation tax benefits because they do not expect to earn enough personal income or profits in other parts of their business to absorb the tax benefits. In some cases this claim too can be difficult to audit because it involves assessing an expectation of future profits in another part of the investor's business or personal income. The ability to take 80% depreciation in the first year of the project changes project IRR by 4-5%.

Together these assumptions can alter expected wind project IRRs by amounts comparable with the 1.7%-2.7% expected effect of CERs, or more in cases with uncertain tax benefits. This analysis indicates that some projects whose expected financial returns are already one or two percentage points above the benchmark could vary these assumptions so to bring the expected financial returns to below the benchmark, and then show that CERs bring the returns back up. The investment analysis would prevent the more viable wind projects in India from registering under the CDM, such as those that are able to take the full tax benefits offered by the government, by requiring cost and revenue values to be taken from the supply, loan, and power purchase agreements, and enforcing the correct application of tax benefits. But this means that in order for the investment analysis to be accurate at this level, the decision to build the project would need to be taken before the start of the CDM application process. That is, the supply, loan and PPA agreements should in place before the PDD is finalized, preventing developers from making sure their project is successfully registered under the CDM before making the decision to build it.

Biomass projects

Developers of biomass cogeneration projects typically manage the projects themselves, rather than contracting out project implementation and operations and maintenance through supply agreements as is commonly done for wind projects. The IRR analysis for biomass projects includes many more undocumented or poorly documented values. Biomass prices in particular have been erratic over the past years due to an absence of a developed supply market (Ghosh et al 2006), rainfall variability year-to-year[9] and rising demand for biomass from pulp and paper mills and for electricity generation.[10] Assumptions about future biomass prices affect the IRRs of biomass projects that purchase all or part of the biomass used for electricity generation from near-by farms.

I examine the effect of the assumed future price of biomass on the project IRRs of biomass projects in India.[11] Three registered and one proposed biomass projects purchase biomass from outside their facilities and make their investment analysis spreadsheets publicly available. These four projects use rice husk purchased on the market to supplement the biomass generated by each facility's own rice or sugar processing, and all are in Uttar Pradesh, the Indian state with the most large biomass CDM projects.

The investment analyses of these four projects forecast that future rice husk prices will be 2650, 1200, 1150 and 700 rupees per metric ton with annual escalation rates of 0%, 4%, 2% and 0% respectively. Increasing biomass prices by 300 rupees and increasing the escalation rate by

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[9] Raised in a number of interviews with developers and consultants of bagasse (sugar cane waste) cogeneration projects.

[10] *ibid.*

[11] The idea for doing an analysis of biomass prices comes from Sivan Kartha from the Stockholm Energy Institute.

2%, relatively small changes compared to the variation of prices in these PDDs and those documented in various tariff orders and petitions,[12] decreases project IRR by more than CERs increase it in each of these four projects (see Table A-2 in the Appendix for the details of this analysis). These projects all started construction within a year and a half of one another, and the PDDs were written within a year of one another. So the timing of the project development decision and PDD submission does not explain the large variation in their assumptions about future rice husk prices. Biomass price is only one of many assumptions that can be varied by a developer who wishes to show a lower project IRR in their PDDs.

Hydropower projects

Additionality testing is inappropriate for large hydropower in India for three reasons: the development of hydropower is a government decision, large hydropower developers are guaranteed a specified return on their equity investment making an IRR analysis meaningless, and financial assessments have not been a good predictor of hydropower development in the past, nor have they been a good predictor of actual project costs.

Hydropower development is largely a government decision - The Government of India employs a central decision-making process to determine the development of its rivers, in recognition of rivers as a national resource with multiple competing uses – electricity, irrigation, flood control, fishing, etc. River development is determined through a government planning process involving a range of public and private actors. This planning process identifies potential hydropower sites and determines which specific sites will be developed in what order and by which sector – central, state or private. The private sector participates in hydropower development mainly by responding to bids put out by state and central state-owned companies.

Additionality testing requires predictable indicators that a project would be built. The investment analysis is appropriate when a project would only be built if its financial returns are above a certain benchmark. The barrier analysis assumes that the building of a project could be predicted by the presence of a prohibitive barrier. Additionality testing is not meant to predict the decision-making of governments involving multiple considerations.

Developers of large hydropower projects in India are guaranteed a certain return on their equity investment - Developers of large hydropower projects (over 25 MW) in India are guaranteed a pre-determined return on their equity investment, typically 14% or 15.5%.[13] The

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[12] Uttar Pradesh's 2009 tariff order for biomass cogeneration projects assumes a 6% annual escalation rate in biomass prices (Uttar Pradesh Electricity Regulatory Commission. 2009. Draft "(Terms and Conditions of supply of power from Captive and Non-conventional Energy Generating Plants) Regulations, 09". , http://www.uperc.org/UPERC%20CNCE%20Order%20%20_Final.pdf and the biomass tariff suggested by the Central Electricity Regulatory Commission uses a 5% annual escalation rate (Central Electricity Regulatory Commission. 2009. (Terms and Conditions for Tariff determination from Renewable Energy Sources) Regulations. The expected bagasse prices in Uttar Pradesh in these and other tariff orders and petitions vary between 740 and 2300. See also Uttar Pradesh Electricity Regulatory Commission. 2008. *THE MATTER OF: Suo-moto proceeding on procurement of power through competitive bidding and alternative fuel for use of bagasse based co-generation capacity during off-season.* http://www.uperc.org/Order%20for%20CNCE%20Regulation%202008%20-%201st%20May%202008.pdf

[13] 14% is the return on equity from the Central Electricity Commission's 2005 tariff order and 15.5% is the return on equity from the 2009 tariff order. The CERC order applies to all central plants, and plants whose electricity is traded between more than one state. Each state writes its own tariff policy for its own plants, typically modeled after the CERC policy.

tariff the developer receives per kwh from electricity sales is calculated on a cost-plus basis and adjusted periodically to ensure that the developer receives the agreed return on equity based on their true costs and revenues. This means that most project costs are "passed through," returned to the developer through the tariff. Therefore, unlike most electricity generation projects with a fixed tariff, the IRR of large hydropower does not increase if a project generates more electricity or has lower costs, since the tariff will be adjusted to ensure a fixed return on equity. In such a case, is project IRR a good measure for whether or not such a project would be built? Project IRR does vary among large hydropower projects in India, because the costs that determine the tariff differ somewhat from the costs included in the project IRR analysis. Figure 5 presents the differences between the costs that are typically used to calculate the tariff and project IRR.

One key difference between the way the IRR and tariff analyses address cost is that the tariff calculation takes into account loan interest payments whereas project IRR does not. Second, to incentivize efficient plant operation, operations and maintenance (O&M) costs are calculated as 2% of capital costs annually with an annual escalation rate in the tariff calculation, regardless of the actual costs.[14] The IRR would use the actual expected O&M costs. Capital costs are not always fully passed-through, depending on a reasonability check by the appropriate electricity regulatory commission.

Figure 5 – Comparison of cost inputs used in the tariff calculation and the project IRR analysis for large hydropower projects

The tariff calculation is based on:	**The IRR analysis is based on:**
Interest on loan capital & depreciation	Actual capital expenses at the beginning of the project
Interest on working capital	Interest on working capital
Operations and maintenance expenses at a fixed 2% of capital costs with an annual escalation rate	Actual operations and maintenance expenses
Return on equity, at 15.5% of capital costs	

As a result, large hydropower projects with lower-than-average project IRRs are those that (1) are expected to have a higher ratio of O&M to capital costs such that a portion of the actual O&M costs are not passed through, (2) are judged by regulators to be built or managed inefficiently such that the full capital costs are not passed through,[15] (3) are able to attract *better* loan terms, since loan interest payments are passed through in the tariff calculation, but are not included in project IRR calculations, (4) have longer construction times, which typically is the case with larger projects, projects built under more difficult geological conditions, or projects

[14] For projects commissioned after April 2004

[15] Interviews with hydropower consultants indicate that private hydropower developers that experience costs overruns are typically able to pass through the full actual costs through a higher tariff. Public companies can find it more difficult to get cost overruns passed through in full.

against which there is substantial public protest. Longer construction time lowers IRR because of the way IRR takes into account time. The IRR is the discount rate that could be applied to the project so that the present value of the project is zero, so costs and revenues in the early years of the project affect IRR more than later years. The longer the time between when the investment is made and revenues start to be generated the lower the present value of the project.

Only one of the above four reasons reflects the actual viability of a project and could potentially justify CDM benefits – projects with longer construction times. A high O&M to capital cost ratio and poor project management are not necessarily indicators that a project would not likely be built. *Better* loan terms lower the tariff and therefore also lower the calculated IRR, indicating a lower rather than higher likelihood that a project would be built. Therefore, when the tariff is determined on a cost-plus basis to achieve an agreed return on equity, an IRR analysis is not an appropriate indicator of whether a project would be built.

***Investment analyses do not reliably predict project development and actual project costs* -** In India and throughout the world cost effectiveness has not been a good predictor of the development of large hydropower projects. Large hydropower is often built when it is not the least cost option (e.g. Paranjape & K.J.Joy 1995). Also, a financial assessment of a hydropower is especially difficult given its often large ecological impacts, the multiple competing uses of rivers, and the multiple people who benefit and are harmed by different uses that are difficult to weigh against one another. Further, even a simple financial analysis such as is performed in a CDM investment analysis, ignoring externalities and competing uses of the river, are notoriously inaccurate for large hydropower projects. Of the 81 hydropower projects surveyed for the World Commission on Dams report (World Commission on Dams 2000), the average capital costs were 21% over the predicted costs in real terms, while for some they were much higher. 30% of the projects surveyed by the World Commission on Dams experienced construction delays of a year or more.

For all of these reasons, the CDM's investment analysis does not accurately predict if a proposed large hydropower project would be built.

Is there an objective benchmark that predicts if a project would be built?

Even if the IRR analysis were relatively accurate, the benchmark would also need to reflect whether the project would likely be built for the investment analysis to be accurate. Since the CDM has a relatively small effect on the IRRs of CO_2 reduction projects, typically by 1%-5%, leading to projects being proven additional by even smaller IRR margins, the benchmark has to be reasonably accurate. The latest guidance from the CDM EB on the investment analysis offers four options for determining a benchmark: (1) benchmarks supplied by relevant national authorities (for project and equity IRR), (2) local commercial lending rates (for project IRR), (3) weighted average cost of capital (WACC) (for project IRR), and (4) required/expected returns on equity (for equity IRR).[16] All of these have been used by some of the projects analyzed by this paper. The first option, a government-derived benchmark does not necessarily represent the decision-making of developers, lenders and equity providers. For example, the 16% benchmark commonly used in PDDs for wind projects in India is used by the government to determine promotional tariffs for independent power producers, but are not necessarily the benchmark expectation of investors. The second option, local commercial lending rates, can be too low a

[16] Executive Board Report 41, Annex 45, *Guidance on the Assessment of Investment Analysis*, report from EB meeting on 30 July - 02 August 2008 http://cdm.unfccc.int/Reference/Guidclarif/reg/reg_guid03_v02_1.pdf

benchmark since equity investors generally expect higher returns than the lending rate. WACC, the cost of capital to the developer, is composed of the lending rate for the debt portion, and the returns expected by the equity investors for the equity portion. The fourth option used for equity IRR is simply the expected returns of the equity provider. Of each of these possible benchmarks, the most accurate representations of developer and investor decision-making would be the last two, WACC for project IRR, and the returns expected by equity investors for equity IRR. This is because typically developers will not build a project if the returns are under their WACC and typical equity providers would not invest in a project if the expected returns of the project are under the returns they expect from their investment.

The question then is if the expected returns on equity can be accurately and objectively assessed. The latest CDM guidance on the investment analysis[17] makes the following distinction. A project that could only be carried out by the project proponent, such as the retrofitting of an existing sugar factory or cement plant, would use the WACC specific to the specific company. A project that could be built by many companies, such as a stand-alone wind or small hydropower project, would assess the WACC or expected returns on equity for the whole industry. In the latter case, the expected return on equity would reflect the risk premium associated with the specific type of investment. Both cases have the same challenges. The returns expected by equity investors can be fairly subjective since it involves the assessment of the financial risk associated of the specific project, and an assessment of their other competing investment options at the particular time of the investment. The decision could also be influenced by a range of non-monetary factors or factors that are not easily incorporated into the IRR analysis. For example, it is difficult to assess the financial benefits to a company of the reliability offered by a captive generation unit. Investors might be interested in investing in a project with lower financial returns for a range of reasons, including wanting to invest in a good project in their home community or a community where they want political support, interest in the positive publicity that goes along with doing a green project, or doing business with a relative, etc. The possibility of determining a conservative industry-wide benchmark for expected returns on equity under which projects would most likely not be built for different industries is beyond the scope of this working paper. Challenges associated with this have been raised here.

Allowing the developer to choose among several acceptable benchmarks enables them to choose one that is more advantageous for demonstrating project additionality, rather than one that truly represents the decision that enabled the project to go forward. The Xiaogushan hydropower project (XHP) in China presents a good example of this.[18] The project was registered as a CDM project on the basis of having an IRR under the government defined benchmark of 8% for power projects. However, the Asian Development Bank, in its evaluation of the project, describes the project as the least cost project in the entire province.[19] It also states that the project is financially viable because its financial IRR (FIRR) of 7.5% "is compared against the post-tax company WACC of 4.53%. Since the FIRR is higher than the WACC, the XHP component is financially viable."[20] While the developer argues in the PDD that the project is unviable because the expected IRR is under the government-defined benchmark, the Asian

[17] Executive Board Report 41, Annex 45, *Guidance on the Assessment of Investment Analysis*, report from EB meeting on 30 July - 02 August 2008 http://cdm.unfccc.int/Reference/Guidclarif/reg/reg_guid03_v02_1.pdf

[18] I worked out this example together with independent television news producer and journalist Janet Klein.

[19] Asian Development Bank. 2003. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the People's Republic of China for the Gansu Clean Energy Development Project*

[20] *ibid.*, p 16

Development Bank states that it decided to lend to the project because the IRR is over the WACC of the company.

5.3 Summary and discussion

Even the best case for an investment analysis – wind projects in India – in which all of the main inputs into the financial assessment are documented, there is still some room to vary assumptions within ranges equivalent to the effect of the CERs in some cases. For most other project types there is much more room for manipulation of cost inputs. The choice of the biomass price for biomass projects in India is one example. The hydropower example suggests that it is important to look at the specific conditions under which technologies are developed to determine if the investment analysis is appropriate for that specific technology. For several independent reasons, large hydropower in India is inappropriate for additionality testing. Multiple factors involved in project development decisions and the subjective nature of project risk assessment seem to preclude a single accurate benchmark for most projects that is meaningful within the relatively small improvements carbon credit revenues have on the IRR of CO_2 reduction projects. Both the IRR analysis and the benchmark IRR are adjustable in tandem. In conclusion, an accurate project-by-project additionality test is impractical for CO_2 reduction projects, and another means for determining which projects are worthy of receiving international support through international climate change agreements is required.

6. The CDM has little influence on project development: the effects of uncertainty and the long CDM registration process

Even if the CDM is unable to filter out business-as-usual projects, does it at least enable projects to go forward that otherwise would not? This section explores how the combination of uncertainty and the long registration application process compromises the effects the CDM could have on unviable or marginally viable projects (the types of projects the CDM is designed to support).

6.1 Risks associated with CDM registration and CER value

The CDM is anticipated to improve the financial returns, measured in terms of IRR, of the projects analyzed for this paper by 1% to 6% according to their PDDs. The CDM typically does so, not through assured upfront payments directly providing project financing, but as an additional revenue stream through the lifetime of the project. In the small proportion of cases in India when CER buyers do offer upfront payments to the project developer, these payments come at a substantial discount per CER generated by the project, often between 40% to 75% of the spot market price for carbon dioxide projects, almost always signed after the project has been successfully registered, and only for credits to be generated up through 2012. The CER revenue stream involves a number of uncertainties, which diminish the value of the CERs at the time that development, lending and investment decisions are being made:

Validation risk: Validators reported at the end of September 2009 that they cumulatively rejected 581 projects.[21] This is compared with 2,188 projects that have been submitted for registration with positive validations, putting the risk of a negative validation at approximately 21%. We do not know the total number of projects that received positive validations but which have not yet been submitted for registration, implying the validation risk is lower than 21%. On the other hand, validators regularly decline validation requests when they believe the project will most likely not pass validation, implying a higher validation risk for projects that start construction before contracting a validator.

Registration risk: Approximately 5.5% of all projects submitted for registration were rejected by the CDM Executive Board, and at present another 7% are undergoing a review process after not being accepted upon submission.

CER price risk: Once a project is registered, there is uncertainty regarding the value the carbon credits will have once issued. To give some sense of CER price variability, between January 2007 and October 2009, secondary CER prices fluctuated between a high of 23 Euro in June 2008 to a low of 11.5 Euro in October 2009.[22] China is mitigating some portion of the CER price risk by implementing a minimum CER price for primary CERs purchased from CDM projects in China.[23]

CER value post-2012: At the time that this paper was written, we still did not know the structure of the post-2012 regime and how CER credits can be used under it. There is much uncertainty about the value these credits will have post-2012.

In late 2006 a bank representative expressed his expectation that over time, as banks become more familiar with the CDM, and as more experience is gained with the registration of different types of CDM projects, that his and other banks would start to take carbon credits into account in their loan appraisals. By 2009, the uncertainties associated with the CDM have increased, rather than decreased. Interviewees in 2009 expressed frustration with the increased complexity and time involved in the CDM application process, their perception that the EB's efforts to strengthen the system has led to frequent changes in the CDM requirements and rules, and that the EB is inconsistent and arbitrary in their decisions to reject and review projects. An increase in the number of rejections and reviews, especially over the last year, has also increased uncertainty and risk.

6.2 What does the timing of project development and the CDM application process indicate about the influence the CDM is having?

In light of this uncertainty, the order in which project developers start project construction and submit their projects for CDM validation and registration provides some insight into the effects the CDM is actually having on project development decisions. The process of submitting a project for registration under the CDM, from the start of validation through registration, was seventeen and a half months on average for all CDM projects registered since

[21] Data taken from UNEP Risoe CDM/JI Pipeline Analysis and Database, October 1st, 2009 http://www.cdmpipeline.org/

[22] CER prices are taken from PointCarbon's CDM & JI Monitor. Secondary CERs are CERs that were already purchased from the project developer, and are being sold for a second time, often to the end user of the credit.

[23] China's CER price floor is 8 Euro. Prices of CERs bought directly from the developer, called primary CERs, are below those of secondary CERs because of their additional risks.

the beginning of 2008.[24] It typically takes at least another year before the first credits are issued. Developers must either wait over a year to assure that their projects are successfully registered under the CDM before going forward with the projects, or accept the risk that their projects will not be successfully registered when deciding to go forward with the project. A commonly expressed sentiment among developers was that they cannot put their project on hold for the long CDM review period since it would be too disruptive to the project to do so.

As of October 1, 2009, approximately three-quarters of all registered CDM projects were operational at the time they were successfully registered under the CDM.[25] [26] This means that a higher proportion had started construction before registration. Further, 66 out of the 70 projects I analyzed for this paper started construction before the beginning of the 30-day public comment period, which typically happens in the first few months of the validation process.[27] This indicates that many developers start construction, including acquiring project financing, signing a power purchasing agreement with the government electricity utility, etc., before starting the validation process.

This timing indicates that project developers are not treating the CDM as a part of the necessary financing needed to go forward with a project, and are willing to accept the risk that their projects would not receive CDM revenues. This timing also means that developers probably do not see the CDM as important in helping them acquire a loan or attract investment equity, for if they did, many more developers would start the CDM application earlier, so that if they run into trouble attaining a loan or attracting investment, a positive validation or registration under the CDM could give a boost to the perceived viability of the project. This does not necessarily prove that the CDM is not having an effect on project development decisions. Certainly developers, lenders and investors could be taking the expected but uncertain revenues from the CDM into account when evaluating the viability of a project. The timing does indicate that revenues generated through the CDM are at best having a weak effect. This effect could be strengthened if CER revenues were more certain, and/or if the CDM application process were much shorter.

Construction on 17 of the 70 projects reviewed in this analysis began before the Kyoto Protocol entered into force in February 2005 and before the first project was registered under the CDM in November 2004. The uncertainty at that time regarding whether the CDM would exist as a working mechanism, or how it would work when it did, makes it extremely unlikely that the

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[24] Calculated from the Risoe CDM Pipeline database as the difference between the "date of registration" and the "comment start" date. The comment start date is the date when the validator began the 30-day public comment period. The public comment period generally comes within the first few months of the validation process. Prior to the start of validation, the developer must write the PDD, which involves additional time.

[25] Using data from the UNEP Risoe CDM pipeline database, as of October 1, 2009, 79% of all registered CDM projects have "Credit start" dates equal to, or earlier than, the "Date of registration." A review of over one hundred PDDs confirms that almost all projects were commissioned on or before the credit start date, suggesting that it is reasonable to estimate that at least three-quarters of all projects were completed at the time of registration.

[26] These projects are expected to produce 56% of CERs through 2012 if all registered CDM projects generate the number of credits predicted in their PDDs. The reason the percentage of credits (56%) is lower than the percentage of projects (79%) is that most of the projects that are expected to generate the most CERs – HFC and N_2O projects – are expected to start generating credits at least several months after their date of registration and so are not included in these percentages.

[27] The construction start date was taken from the PDDs. The beginning of the 30-day public comment period is listed in the UNEP Risoe CDM pipeline database as the "comment start" date. Typically the validator puts the PDD up for the public comment period in the first few months of validation.

CDM had much effect on these development decision. Two of these projects were registered within the last year.

The claim that the CDM is having very little effect on project development is also supported by the interview responses mentioned above. Particularly, banks seem not to take CERs into account in their decisions to lend to a project because of the uncertainties associated with CDM registration and CER generation. Consultants and developers commonly describe CER revenues as "cream on the top," and describe developers as building projects on their own merits, not because of a small and uncertain benefit from CER sales.

6.3 Discussion

A high proportion of the risk, time and cost of the CDM application process is associated with additionality testing. PDD consultants and validators describe that a large portion of the time spent writing the PDD and validating the project are devoted to the additionality section. Additionality is the cause of most reviews and rejections by the EB, and is also the most common reason projects do not pass validation.[28]

Project-by-project additionality testing adds time and uncertainty to the CDM application process, compromising the ability for CERs to influence project development decisions. Additionality testing is also only effective at filtering out some of the most clearly non-additional projects. Therefore, another more effective and predictable means of targeting projects and activities that actually reduce emissions is necessary.

7. Taking a step back: The fundamental structure of the CDM, in certain other ways, leads to the over-generation of credits and limits its ability to reduce emissions

Looking beyond additionality testing, a number of other structural flaws also contribute to the over-generation of credits and weaken the effectiveness of the CDM at supporting projects in real need of support.

Supporting projects in the wrong order - In the power sectors of India, China and other countries, plants are often planned for many years before they are actually built. Hydropower and wind sites are often developed in the order of their attractiveness in terms of resource availability, proximity to demand centers, etc. The Indian government is actively supporting renewable energy and energy efficiency mainly for energy security reasons. From the perspective of most effectively developing these sectors, it makes sense to accelerate the pace at which plants are built, building the most cost effective ones first and supporting current domestic efforts to do so. Instead, the CDM is structured to change the order in which plants are built. Plants that are cost effective are considered "non-additional" while only plants that are less desirable are eligible.

Trade off between project viability and the over-generation of credits - The CDM should result in reductions in emissions in a developing country at least as large as the credits it generates. Once registered, CDM projects are allowed to generate credits for 10 years, if they choose the single credit period option, or 21 years if they choose the 7-year crediting period and renewal

[28] Interviews with validators

option. This means that in theory, projects should only register under the CDM if they most likely would not otherwise have been developed for the full crediting period – 10 or 21 years. This would support the development of a portfolio of undesirable projects – the problem mentioned just above. In practice, the PDD requires that projects be tested for additionality at the time of validation only.[29] Projects are therefore able to generate credits for 10 or 21 years even if they would have been built within that period, producing more credits than actually emissions avoided by the CDM project.

Improving the profitability of harmful projects - Crediting emissions reductions rather than charging emissions producers such as through a carbon tax could improve the profitability of projects with negative environmental and social impacts. Examples include many large hydropower projects, clean coal, and HFC destruction in HCFC-22 production facilities. HFCs, a potent greenhouse gas (GHG) regulated under the Kyoto Protocol, is a byproduct in the production of HCFC-22, a temporary substitute for CFCs as a refrigerant. Due to the very high global warming potential of HFCs – 11,700 times that of CO_2 –the value of the CERs generated from HFC reduction projects can exceed the profits from the production of HCFC-22 itself, making HCFC-22 production profitable even without selling the HCFC-22 (Wara & Victor 2008). HCFC-22 is an ozone depletor being phased out under the Montreal Protocol, 5% as potent in depleting the ozone layer as CFCs. An international agreement, with financial support to developing countries, would be a more appropriate way to reduce HFC production from HCFC-22 plants than the current CDM process, which overpays the cost of the HFC burning equipment by 47 times (Wara & Victor 2008). Regulations are in place preventing CDM credits from being generated by new HCFC-22 production facilities, or the expansion of existing ones. Still, the CDM creates substantial disincentivizes for HCFC-22 plant phase out, in direct contradiction with the goals of the Montreal Protocol.

Perverse incentives - One of the early criticisms of the CDM is that it could create perverse incentives for government or the private sector to refrain from implementing policy and taking action to reduce emissions. The need to measure actual emissions against a baseline – a future scenario describing what would likely have happened without the CDM – creates incentives to maintain a high baseline in order to later generate higher amounts of credits per project. Going back to the HCFC-22 example, if a country imposes regulation requiring HCFC-22 production facilities to destroy the HFC gas byproduct, facilities might no longer be able to generate the substantial income from the sale of carbon credits, causing a significant disincentive for such regulation. Of concern is the extent to which the CDM is impeding decarbonization because of perverse incentives that dissuade governments from enacting climate-friendly policies.

Limited in scope - The CDM can only fund activities for which it is believed that emissions reductions can be reasonably estimated, and excludes project types which may have a higher GHG abatement potential at lower cost, but for which emissions reduction estimations are especially complex or uncertain. The CDM is not structured to support many efforts necessary to decarbonize sectors and affect a large-scale deployment of clean technologies – policies, R&D, demonstration projects, information dissemination, etc, because measuring emissions reductions from these efforts may be difficult or infeasible. The dissemination of technologies, such as

[29] This decision was clarified in the report from Executive Board Report 43, from the 43rd meeting of the CDM Executive Board, 22 - 24 October 2008, http://cdm.unfccc.int/EB/043/eb43_repan13.pdf

bagasse cogeneration in India, can be limited by multiple barriers requiring a number of different and parallel support efforts simultaneously and over time, many of which could not be supported through a project-based offsetting mechanism (Haya et al 2009). Efforts to affect sectoral change are often best done in the context of an integrated planning process in which multiple goals and interests are addressed together (Halsnaes et al 2008). Revenues from the generation of carbon credits could be only one part of a much larger set of support efforts for both sectors and specific technologies.

8. The large-scale use of offsetting credits poses challenges to near and long term climate change mitigation

Even if we manage to design an international offsetting mechanism that effectively reduces emissions and accurately credits them, what effects does large scale offsetting have on global efforts to mitigate climate change over the next decades? Scenarios put forward by the Intergovernmental Panel on Climate Change (IPCC) suggest that a reduction in industrialized countries by 25% to 40% below 1990 levels by 2020, on a path towards 80% to 95% reductions by 2050, still corresponds with a 2.0-2.4 degree Celsius temperature increase (Box 13.7 from Gupta et al 2007, Table SPM.6 from Intergovernmental Panel on Climate Change 2007). These scenarios correspond with reductions in developing countries by 15% to 30% below business-as-usual growth projections by 2020 (Höhne & Ellermann 2008). Even deeper reductions would be needed globally if we wish to have a high likelihood, rather than an almost 50% chance, of not exceeding a two degree increase. Further, since these scenarios were published, additional research suggests that climate sensitivity (the increase in radiative forcing resulting from the increase in GHGs in the atmosphere) is higher, and feedback effects even greater than the assumptions used to produce the IPCC scenarios (McMullen & Jabbour 2009).

Industrialized countries are proposing high levels of offsetting post-2012, which if used, would put these countries far away from the 25%-40% reductions by 2020 from the IPCC scenarios. At the time this paper was written, the EU was proposing to cut its emissions by 30% below 1990 levels by 2020 within the context of an international agreement, allowing 68% of those reductions to be met through international offsets.[30] If all of these offsets are used, the EU would achieve a less than 17% reduction compared to 1990 levels by 2020. In the US, a prominent draft climate bill, the Waxman-Markey American Clean Energy and Security Act of 2009,[31] would require the US to cut it's emissions to 4% below 1990 levels by 2020. This bill allows up to two billion tons of CO_2 as offsets, equal to 28% of its 2005 emissions, allowing a half to three-quarters of these, depending on the availability of domestic offset credits, to be from international sources. The international portion, if used in full, would allow the US to postpone making any reductions in its emissions from current levels until 2020 to 2024. This postponement would be even longer if some portion of domestic offsets is non-additional.

Two justifications are commonly given for high quantities of offsets. The first is simple market efficiency. Trade in emissions reductions allows industrialized countries to reduce

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[30] Hanley N. 2009. *EU Climate and Energy Package, December 2008*. Presented at the Energy and Resources Group, University of California, Berkeley. *March 18*. The package recommended 50% of all reductions in the ETS, covering approximately 40% of EU emission, can be met with foreign credits and 80% of reductions in non-ETS sectors can be met with foreign credits.

[31] http://www.govtrack.us/congress/bill.xpd?bill=h111-2454

emissions less expensively than if they were required to reduce them domestically. Second, by providing low cost compliance options, offsets help bring buy-in from domestic industries, making it easier and more likely for industrialized countries to accept deeper targets than they would have otherwise.

However, large-scale access to these potential lower-cost compliance options also introduces risk to present mitigation efforts and would most likely make climate change mitigation more difficult in the future. First, domestic reductions are more certain than international offsets.[32] Any country has more knowledge about and control over activities within its own borders than it does for projects and activities which it funds elsewhere. Also, measuring emissions, as is done in a cap-and-trade program, is easier than measuring reductions in an offsetting program, as described in detail above. As such, offsets introduce various uncertainties regarding the amount of emissions reductions they actually represent. Any offsetting in developing countries, whether it is project-based or sector-based, involves measuring emissions against a BAU growth scenario, which is inherently uncertain, and politically difficult to set at a low level.

Second, cap-and-trade weakens incentives for innovation by allowing a larger portion of compliance to be met with existing and low cost technologies (Driesen 2003). Decarbonization to 80-95% below 1990 levels by 2050 in industrialized countries will require major shifts in all high emitting sectors. Transportation, the electricity sector, buildings, and agriculture all involve complex systems. Major shifts in each of these sectors requires time to allow for changes in behavior and in support industries, for experimentation and learning, research, development and deployment, etc.

The high level of offsets allowed could easily place the majority of global reductions up to 2020 in developing rather than industrialized countries. In the context of meeting the global reductions suggested in the IPCC scenarios, if 50% of all Annex 1 reductions are made through offsets (remember that the EU and the US are proposing substantially higher than that as upper limits) and that these offset projects are performed in addition to the suggested 15%-30% decrease from BAU in developing countries, then around 70% of all global reductions through 2020 would likely come from developing countries rather than the high per capita emitters.[33]

If industrialized countries postpone domestic reductions as they are proposing through the use of offsets, they are either committing to steeper annual reductions in the future, or to long-term inequalities in emissions in the North and the South. Both options make future cooperation more difficult. In industrialized countries, a gradual migration of infrastructure is likely to be less costly than rapid transitions that could require retiring technology and infrastructure before the end of their lifetime. If the costs of mitigation are expected to be high, there will be more resistance from industry.

In addition, a high future dependence of offset credits from developing countries poses compliance risks on industrialized countries. The further actual domestic emissions are in an industrialized country from their targets for a given commitment period through the help of offset credits, the harder it will be for that country to commit to meaningful reductions in the following period. Large quantities of offsets might make it easier for industrialized countries to

[32] Here offsets refer to credited emissions reductions generated by any activity whose emissions are not capped under a cap-and-trade program.
[33] Reductions are defined here as reductions from the Kyoto Protocol caps for industrialized countries, and reductions from BAU in developing countries.

take on deeper commitments now, but could also make it harder for them to accept deeper targets in the future.

We live in a world with a widely shared linear view of development and progress (Norgaard 1994). Deep in urban and rural India, visions of "development" and symbols of high status are heavily influenced by images of consumption from the North. The discourse of development used by the World Bank is also used by country governments, and is disseminated through participants in and those affected by World Bank projects. Developing country citizens have learned that they are "backwards" and "underdeveloped" (Escobar 1995, Gupta 1998). Rural electrification has allowed more and more people to view western lifestyles on TV, and TV commercials spreading a culture of consumerism and awareness of not having (Jacobson 2004). Development in India is highly status driven – beyond getting out of poverty is a pursuit of symbols of high status, such as a big car and a new cell phone. In a world dominated by a single vision of "progress" sustainability requires changing the image of what "developed" means. Ultimately, promoting low-carbon development in the South requires demonstrating it in the North.

Advanced developing countries are being asked to join the global community in accepting obligations to mitigation their emissions below BAU growth projections. Will developing countries commit to controlling the growth in their already low per capita emissions if it is clear that there is relatively little willingness in the industrialized world to reduce their much higher per capita emissions? Developing countries will need to make voluntary reductions before it is fair, given how quickly we need to reduce globally. This can happen only in a regime built on trust and mutual cooperation. Politically, it will be unlikely that developing countries will take calls for global cooperation seriously, if industrialized countries do not take on commitments to curb their own emissions as prescribed by the IPCC.

9. Discussion and conclusions

Industries in industrialized countries are putting pressure on their governments to provide options for controlling costs of compliance with post-2012 emissions limits. The CDM is currently seen as a legitimate way to do so. The CDM also provides a way to engage the private sector in climate change mitigation in developing countries. The private sector is seen as well poised to find efficient and innovative options for reducing emissions, while avoiding some of the concerns over funds – corruption, lack of accountability, conditionality and traditionally donor-weighted decision-making. There is also an interest in taking advantage of existing institutions, rather than disbanding them and starting anew. The CDM was promoted with numerous trainings, workshops and promises, and has attracted many new players and new interest into the clean energy, energy efficiency and other low-emitting industries in India and elsewhere. Admitting the CDM was largely a failure could dampen interest in the next instrument.

Researchers and policy-makers have sought ways to reform the CDM to retain these benefits while improving its environmental integrity. In weighing the pros and cons of various options, we need to honestly assess the possibility of improving the environmental integrity of the CDM as a project-based offsetting mechanism, as well as what we need to do in the next commitment period to be on a path towards a high likelihood of not exceeding a global two degrees temperature increase.

A purpose of this paper is to examine the possibility of substantially improving the CDM's environmental integrity and effectiveness as a project-based offsetting mechanism. This paper shows that reasonably accurate project-by-project additionality testing is infeasible given the subjectivity involved in project development, investment and lending decisions. The need to do a test that is fundamentally difficult and inaccurate is disabling the CDM from being able to support truly additional projects, because of the complexity, uncertainty and time it adds to the CDM application process. As a result, the majority of CDM projects, and a large majority of CDM CO_2 reduction projects, are non-additional, evidenced by a range of analysis presented in this paper. Beyond additionality, the CDM is structured to either over-credit, or support a portfolio of projects that would otherwise be unviable for 10 or 21 years. Neither are good options. Because of the challenge of measuring emissions reductions from specific projects, the CDM is unable to support many measures needed, and sometimes more cost effective, for the deployment of technologies and decarbonization of sectors, such as policy, research and development, demonstration projects, and information dissemination. The CDM can also have the opposite effect, creating perverse incentives against the implementation of policy and for delaying the implementation of projects so that developers are able to maintain a high baseline against which to prove additionality and generate CERs. Even if the environmental integrity of the mechanism were ensured, large scale offsetting introduces various challenges to global climate change mitigation efforts over the next decades, especially considering the very weak post-2012 targets being proposed by industrialized countries.

Any post-2012 offsetting program will need to:

- include an alternative means for targeting projects and activities without testing additionality on a project-by-project basis, a process which is essentially subjective and inaccurate;
- be predictable, providing certain benefits to those depending on it; and
- be small in the context of deeper Annex 1 targets.

This could possibly be accomplished through small, targeted offsetting programs designed to help decarbonize specific sectors and promote specific technologies. Such programs could be custom designed through industrialized-developing country partnerships, at national or sub-national levels, to address what is needed to control emissions and promote technologies in their specific local contexts in line with domestic priorities and the expertise the industrialized country can offer. As opposed to the current CDM, such programs can involve multiple coordinated components, some credited and some not credited, that work together to address the barriers and support needs facing a technology or a sector. These programs would require a commitment to cooperate over many years. Additionality would still be a concern for such a program but would be more easily managed than with the CDM. Under the CDM, developers initiate projects, and the CDM EB and other CDM governance bodies mainly respond when projects and methodologies are submitted to them. As described above, it is very difficult to distinguish additional from non-additional projects individually. In contrast, under the offsetting program suggested here, the administrators of the program actively initiate projects and programs based on analysis as to how their involvement could lower emissions.

Experience so far with the CDM does not bode well for the political feasibility of such an approach. We have seen little indication that countries will agree to an offsetting mechanism that is small enough, targeted enough, and with conservative enough baselines, to preserve its environmental integrity, and the environmental integrity of the whole agreement. So far offsetting has not been effective and imposes uncertainty on global climate change mitigation efforts. Attention must be refocused on reductions in countries with emissions caps, with non-credited support for mitigation efforts in developing countries. Ultimately, promoting low-carbon development in the South requires demonstrating it in the North.

Acknowledgements

Let me extent a very sincere thank you to the many people who gave their time answering my questions and discussing my results. Some of the people who deserve special thank yous include: Paul Baer, Merrill Jones Barradale, Danielle Svehla Christianson, Alex Farrell, Vibhash Garg, Bill Golove, Stacy Jackson, Sivan Kartha, Satendra Kumar, Paddy McCully, Anita Milman, Richard Norgaard, Michael O'Hare, Kate O'Neill, Carla Peterman, Rich Plevin, Malini Ranganathan, Himanshu Thakkar, Mahesh Vipradas, and numerous researchers at The Energy and Resources Institute-New Delhi.

APPENDIX: Figures and tables

Figure A-1: The CDM Project Pipeline Step-by-Step

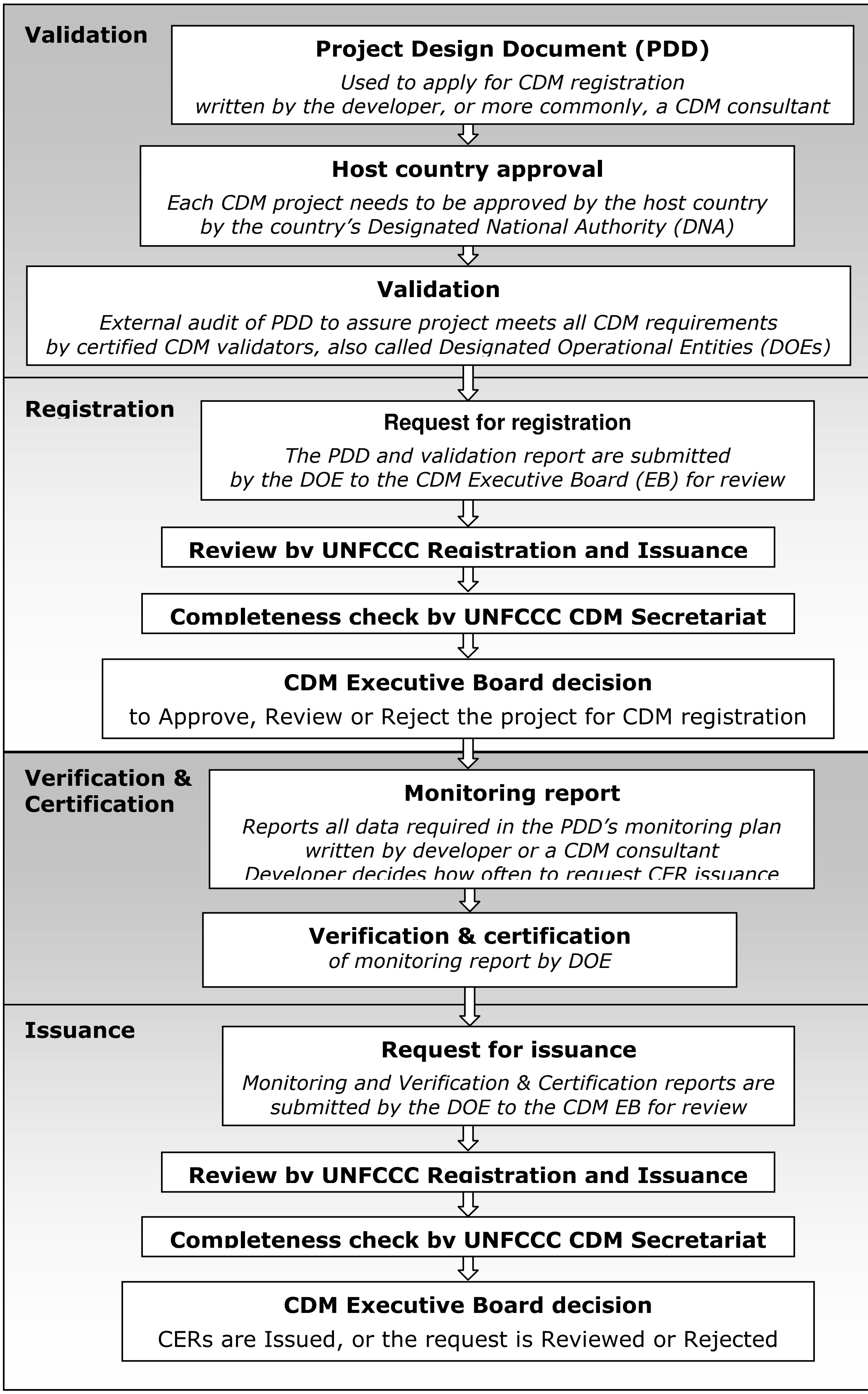

Table A-1 – Effects of the choice of post-PPA tariff and a deration rate on wind project financial returns

Project name	State in India	PPA length (years)	Tariff in year 1 (rp/kwh)	Tariff escalation rate? (rp/yr)	Tariff after end of PPA (rp/kwh)	Tariff escalation rate after end of PPA?	Deration rate?	Change in IRR from: Lower tariff 1 rs/kwh after end of PPA or increase to last PPA year[b]	Change in IRR from: 5% deration rate in year 11
Bundled wind energy power projects (2004 policy) in Rajasthan	Rajasthan	13	3.25	0.06 through year 9	3.79 - same as last PPA year	--	--	-0.80%	
22.5 MW grid connected wind farm project by RSMML in Jaisalmer	Rajasthan	10	3.32	0.06	3.92 - same as last PPA year	--	--	-1.12%	
75MW wind power project in Maharashtra by Essel Mining Industries Limited	Maharashtra	13	3.5	0.15	5.3 - same as last PPA year	--	--	-1.26%	
Wind power project by GFL in Gudhepanchgani	Maharashtra	13	3.5	0.15	5.3 - same as last PPA year	--	--	-0.49%	
40 MW Grid Connected Wind Power Project	Maharashtra	13	3.5	0.15	**3.89**	**2.50%**	--	**0.71%**	
Wind Electricity Generation Project	Maharashtra	13	3.5	0.15	5.3 - same as last PPA year	--	--	-1.07%	
NSL 27.65 MW Wind Power Project in Karnataka	Karnataka	??[a]	3.1	--	3.1	--	--	-2.20%	
Tungabhadra wind power project in Karnataka	Karnataka	10	3.4	--	**Varies, 1.89 is average**	--	--	**2.03%**	
Enercon Wind Farm (Hindustan) Ltd in Karnataka	Karnataka	10	3.4	--	**Varies, 1.82 is average**	--	--	**2.23%**	
29.7 MW Wind Power project in Karnataka	Karnataka	10	3.4	--	3.4	--	--	-1.52%	
Wind power project by HZL in Karnataka	Karnataka	10	3.4	--	3.4	--	--	-1.59%	
42.5 MW Wind Power Project by VRL Logistics Ltd. In Karnataka State	Karnataka	10	3.4	--	**3.06**	--	-5% in year 11	**0.90%**	**-0.31%**
24.8 MW Wind power project by Belgaum Wind Farms Private Ltd. in Gadag, Karnataka	Karnataka	10	3.4	--	3.4	--	--	-1.46%	
150 MW grid connected Wind Power based electricity generation project in Gujarat	Gujarat	13	3.37	--	3.5	--	--	-0.81%	

[a] The PPA length is not mentioned in the CDM project documentation. This analysis assumes a 10 year PPA, the same as the PPAs for the other projects in Karnataka.

[b] Values in boldface indicate cases where the developer chose a post-PPA tariff lower than the tariff in the last year of the PPA. For this analysis, the post-PPA tariffs of these projects are brought up to the tariff in the last PPA year, rather than reduced an additional one rupee

Table A-2 – Effects of biomass price on biomass project financial returns

Project name	CDM Status	PDD Date	Start project construction	Rice husk price in first year Rs./ton	Rice husk price annual escalation rate	Change in IRR or DSCR[a]		
						From CDM	+200 Rs./ton & + 2% esc rate in rice husk prices	+300 Rs./ton & + 2% esc rate in rice husk prices
Rice husk based Co generation project at Dujana unit of KRBL Limited	Registered	Jan-08	Oct-05	2650	0%	0.45	-0.41	-0.53
15 MW Biomass Residue Based Power Project at Ghazipur	Requesting registration	Nov-08	Dec-06	1200	4%	7.86%	<-10%	<-10%
DSCL Sugar Ajbapur Cogeneration Project Phase II	Registered	Feb-07	May-05	1150	2%	7.11%	-7.91%	-10.70%
KM RE project	Registered	Jan-07	Feb-06	700	0%	8.07%	-5.83%	-8.34%

[a] DSCR (Debt Service Coverage Ratio) is a common financial metric used by banks to assess loan applications. A DSCR of less than one means that annual project revenues are less than the annual debt service. Here, the first project uses DSCR to measure project viability, and the other three use project IRR.

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