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Technical Paper | Investment Additionality in the CDM

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Abstract: The additionality of projects is crucial to the integrity of the Clean Development Mechanism. The CDM tool for additionality produces binary outcomes; projects either pass or fail. This paper uses ΔIRR (the difference between a project's IRR with and without CDM revenues) as a measure of *degrees* of additionality. From a sample of 222 registered CDM projects we find that different project types exhibit different degrees of additionality, with landfill gas and biogas projects having considerably higher median ΔIRR values than wind and hydro projects. We also find that 26% of the projects sampled have a ΔIRR lower than 2%, indicating that CDM revenues only make a small contribution to the overall economic viability of these projects. It is therefore difficult to determine with certainty that these projects would not have happened in the absence of carbon finance. We suggest that the credibility of CDM additionality can be enhanced by adopting a minimum ΔIRR threshold, e.g. 2%, below which the additionality of a project is deemed uncertain and the project is therefore rejected (unless proven to be additional in other ways).

1. Introduction

The Clean Development Mechanism (CDM) is a market-based mechanism which allows emission-reduction (or emission removal) projects in developing countries to earn certified emission reduction (CER) credits[1]. These CERs can be traded and sold, and used by industrialized countries to meet a part of their emission reduction targets under the Kyoto Protocol. The emissions reductions achieved in developing countries should be additional, meaning that the reductions would not have happened in the absence of the CDM. Ensuring additionality in CDM projects protects the environmental integrity of the Kyoto Protocol, as issuing CERs to non-additional projects would increase global GHG emissions relative to the levels agreed within the Protocol (Trexler *et al* 2006).

To demonstrate additionality, CDM projects must pass a number of tests which include a combination of the Institutional, Investment, Barrier and Common Practice tests, as described in the CDM tool to assess additionality (UNFCCC 2008b). However, the most objective and the only quantitative test is the test for investment additionality.

Investment additionality is demonstrated when a project is not economically feasible, or is not the most economically attractive project, without the revenue generated from CERs[2]. Within the CDM

[1] 1 CER = 1 tonne of CO_2e reduction in emissions.
[2] Investment additionality should be distinguished from financial additionality, which relates to whether the project would have been financed anyway through overseas development assistance.

approval process this is judged from the internal rate of return[3] (IRR) of a CDM project with and without revenues associated with the sale of CERs. Investment additionality is achieved if the "internal rate of return of the CDM project activity [without CDM revenue] is below" a certain benchmark percentage, to be approved by the CDM Executive Board (UNFCCC 2000, p.17)[4].

2. Methodology

To observe trends in additionality, investment additionality was chosen as an indication of overall project additionality. There are in total 1,108 registered CDM projects (as of August 2008), of which a sample of 222[5] was taken for detailed analysis, as shown in Table A1 of the Appendix (UNEP 2008). This study focused on the top "grossing" CDM project types[6] that also provided IRRs in their Project Design Documents (these were biogas, biomass energy, fossil fuel switch, hydro, landfill gas and wind energy) and the five countries with the highest share of the CER market (these were Brazil, China, India, Mexico and Malaysia) . All projects with IRR information that fall under both the CDM project types and host countries chosen above were sampled. The sample is approximately 20% of all registered CDM projects. The year that a project is being implemented is taken to be the year of registration for the CDM project.

The IRR of the project with and without CDM revenue was extracted from each Project Design Document. The difference was calculated to give the CDM project's change in IRR (ΔIRR). It is assumed that the larger the ΔIRR of a project, the more additional it is, as it indicates the proportion of total project revenue which is from the sale of CERs[7].

Differences in the average ΔIRR between project types, host countries and across the years were investigated using the Kruskal-Wallis One-way Analysis of Variance (ANOVA) on Ranks, and Dunn's method of pairwise multiple comparison (SigmaPlot 2008).

3. Results and Discussion

Figure 1 shows ΔIRRs for each project sampled (by type) in the form of vertical bars; the bottom of each bar corresponds to the IRR of the project without CDM revenue, and the top end to IRR with CDM revenue. This graph format shows the starting levels of profitability of different project types and also the improvement in profitability expected through the sale of CERs. The median ΔIRR for all projects sampled was 2.72%. However, there were significant differences in ΔIRR

[3] IRR is the discount rate at which the net present value of the project would be zero.
[4] Investment additionality is also shown if the IRR of the project without CDM revenue is below the IRR of alternative investment opportunities which supply the same outputs (comparison analysis), or where there is no other revenue source for the project other than CDM revenue (simple cost analysis).
[5] Of the sample of 222, 122 of them were provided by Joergen Fenhann from the UNEP research centre, through personal communication via email.
[6] In terms of the amount of CERs generated, not the number of projects.
[7] It should be noted that ΔIRR is only an indicator of the degree of additionality as it is possible for a project to have a high ΔIRR but already be economically viable (and therefore not additional). The degree of additionality may also depend on how near the "without CDM revenue" IRR is to the benchmark IRR for economic viability.

between project types (H statistic of ANOVA = 113.8), with wind projects having the lowest ΔIRR and landfill gas projects having the highest of the groups sampled (Table A2).

3.1. CDM Project Types

The results of this study show that there are specific CDM project types that attain a higher degree of investment additionality than others. Landfill gas and biogas type projects show significantly higher ΔIRR values than hydro and wind type projects (Figure 1 & Table A2). Landfill gas and biogas type projects therefore demonstrate a greater degree of investment additionality than wind and hydro type projects.

Table 1: Table of CDM project types and their median ΔIRR*

CDM Project type	Median ΔIRR
Landfill gas	19.4
Biogas	17.2
Biomass energy	5.5
Fossil fuel switch	3.8
Hydro	2.2
Wind	2.2

* For more details, refer to Table A2 in the Appendix

Landfill gas project types have the highest ΔIRRs as methane has a high global warming potential, where every tonne of methane equates to 21 tonnes of CO_2 (Matsuhashi et al 2004)[8]. Also, for landfill gas type projects that just involve flaring of the methane gas produced, the construction of landfill gas capture equipment and its operation and maintenance are the project costs that would not get any financial return except from the CER revenues. Thus, the IRR calculated without CDM revenue involves only costs, and a highly negative IRR would be generated. This is mostly the case for landfill gas projects, which is especially evident in the two largest outliers from this study's results (Figure 1).

The results show that 26% of the projects sampled have a ΔIRR <2%, indicating that CDM revenue makes only a small contribution to the economic viability of these projects. It is therefore difficult to determine with certainty that these projects would not have happened in the absence of carbon finance.

[8] CDM projects use the IPCC Second Assessment Report (1995) global warmings potentials, where methane is given a GWP of 21. The Fourth Assessment Report (2007) gives methane a GWP of 25.

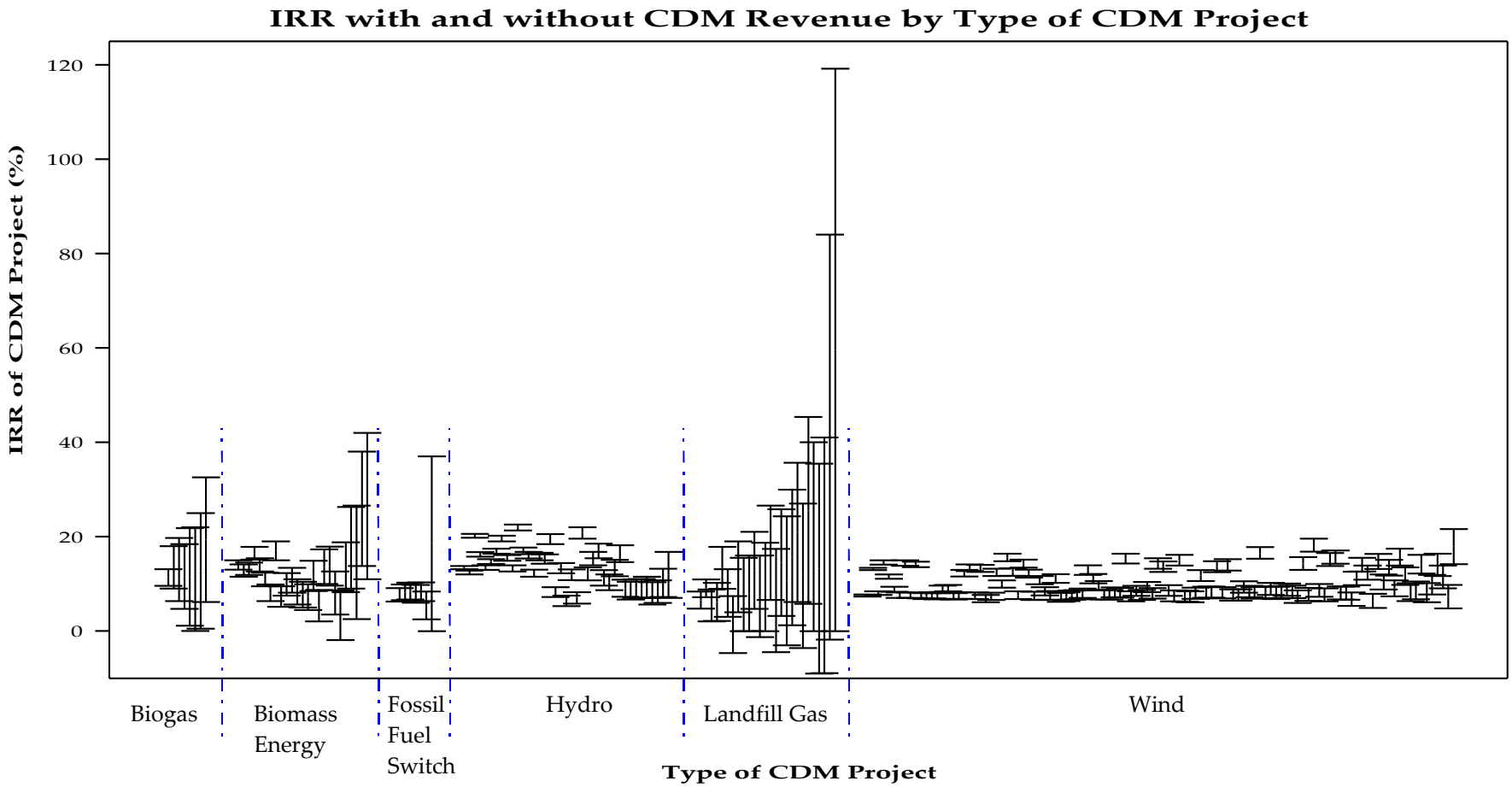

Figure 1: Graph of the ΔIRR bars by the type of CDM project

The ΔIRR bars show the lower and upper limit of the IRR without and with CDM revenue respectively.

3.2. CDM Host Countries

Host countries such as Mexico and Malaysia generally show higher ΔIRR values than Brazil, China and India as they mainly adopt projects that generate high ΔIRR values such as landfill gas, biomass energy and biogas (Figure 2 and Table A3). Further analysis could be undertaken to investigate the effect of host country on ΔIRR values for different project types, e.g. whether there is a statistically significant difference in the median ΔIRR achieved by wind projects in India compared to wind projects in China (due to factors such as the carbon intensity of the grid or wholesale electricity prices).

It is interesting to note from Figure 2 that there is a consistent range for IRR benchmarks in China, whereas other host countries exhibit a wide range of IRR benchmarks, i.e. a single IRR benchmark (~8%) could be used for almost all Chinese projects. This could be shown by a single horizontal line through the vertical bars for almost all Chinese projects. No single horizontal line can be drawn through the vertical lines for other host country projects. This may be explained by the fact that China has a largely centrally planned economy, with investment benchmarks established by government agencies.

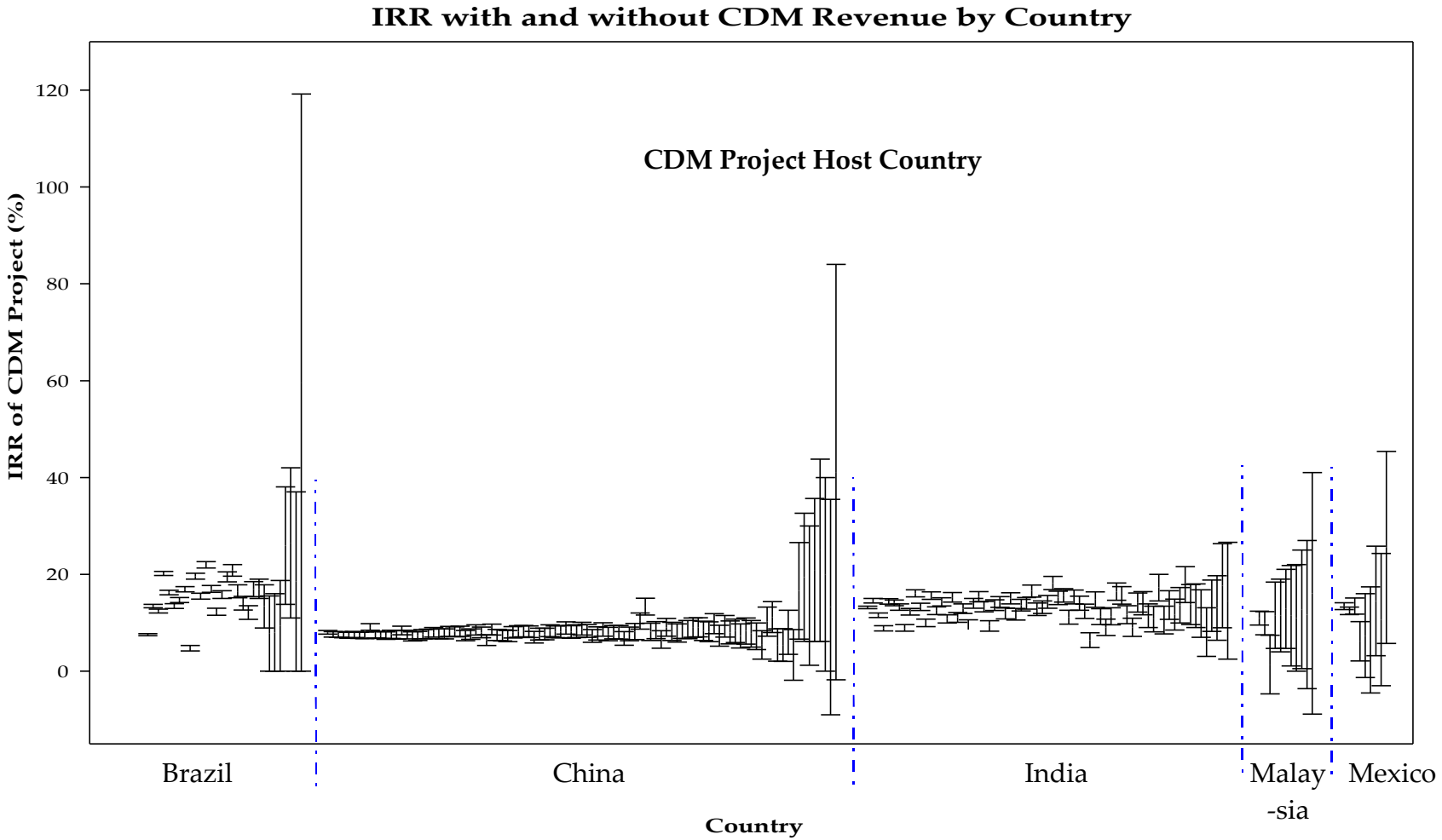

Figure 2: Graph of the ΔIRR bars by CDM project host country

The ΔIRR bars show the lower and upper limit of the IRR without and with CDM revenue respectively

3.3. CDM Project Year of Registration

The results from the Kruskal-Wallis ANOVA on Ranks test showed that there are no significant differences in the median ΔIRR between the years 2005 to 2008. Further Pairwise Comparison testing revealed that no two years were significantly different from each other. This suggests that the criteria for investment additionality have not changed much throughout the years (Figure 3). This is an unexpected finding, as the stringency of the test for investment additionality should have increased across the years, with the constant reforming of this CDM tool to refine its method of assessing and determining additionality. However, this conclusion by observation of the ΔIRR is not definitive, as rejected projects also need to be investigated for their ΔIRR, and its lower and upper limits[9].

[9] The influence of other variables also needs to be taken into account, e.g. the number of projects of each project type will influence the observed median ΔIRR for each year.

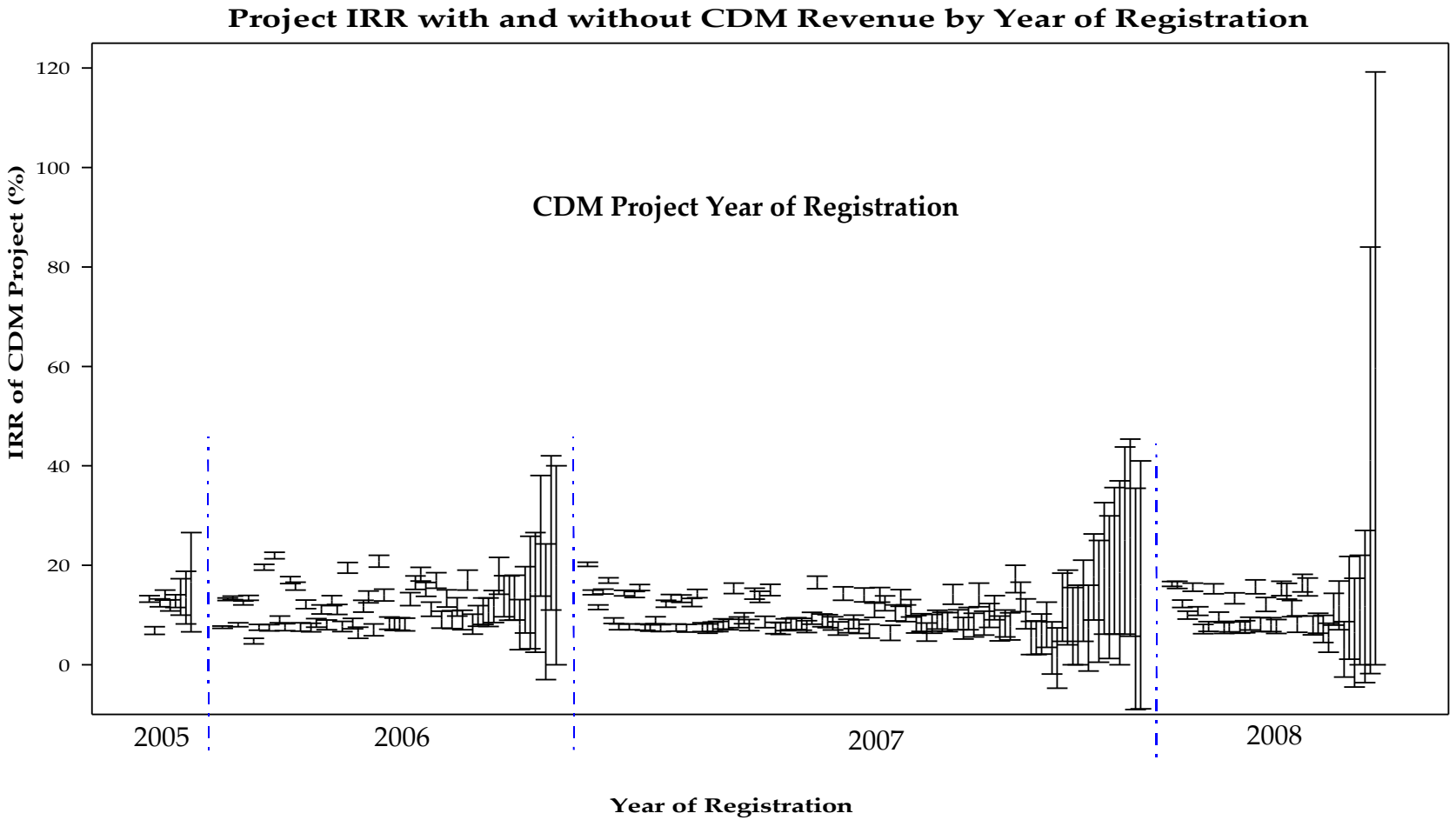

Figure 3: Graph of the ΔIRR bars by CDM project year of registration

The ΔIRR bars show the lower and upper limit of the IRR without and with CDM revenue respectively[10]

[10] Please note that the projects are ranked in order of ΔIRR for each year and are not in chronological order within each year.

3.4. Sustainable Development and Additionality

There is a consensus in the literature that CDM projects either show high levels of additionality or contribute to sustainable development, with the two being almost mutually exclusive (Olsen 2007; Sutter & Parreno 2007).

Table 2: Table of CDM project types and their corresponding average sustainability rating, and median ΔIRR

CDM Project Type	**Average Sustainability Rating** (Source: Sutter & Parreno 2007)	**Median ΔIRR**
Landfill Gas	0.17	19.4
Biomass Energy	0.75	5.5
Hydro	0.50	2.2
Wind	0.33	2.2

It is observed that the project type that has the lowest sustainability rating also has the highest median ΔIRR, which is expectedly landfill gas projects (Table 2). The simple flaring of landfill gas does not contribute much to sustainable development, but would generate large amounts of CERs. However, the project type (biomass energy) that gives the highest sustainability rating does not give the lowest median ΔIRR.

It should be noted that the observed correlation described above does not show a causal relationship between high sustainability and low additionality. It is likely that there are other project types, such as reforestation/afforestation projects, which achieve high sustainability benefits and high levels of investment additionality (as carbon finance is likely to provide a high proportion of total project revenue).

4. Conclusions

Are CDM projects additional?
This study has shown that a large proportion of CDM projects have only a small ΔIRR – with 26% of the sample having a ΔIRR <2%. At such low levels it is uncertain that these projects would not have occurred in the absence of CDM finance, i.e. it is not certain that they are additional. The CDM additionality tool requires a sensitivity analysis to test the robustness of the additionality test, however, the credibility of CDM additionality could be enhanced by adopting a minimum ΔIRR threshold, e.g. 2%, below which the additionality of a project is deemed uncertain and the project is therefore rejected (subject to barrier analysis). Such a threshold would result in approximately 40% fewer wind and hydro projects undertaken by the CDM.

How can degrees of additionality be measured?
The current CDM additionality tests produce binary outcomes, i.e. projects either pass or fail. ΔIRR is a metric which indicates *degrees* of additionality, which can be used alongside the binary outcomes of the existing tests. This information may be useful for offset consumers, most likely non-compliance market

consumers, who wish to ensure the additionality of the credits they purchase (as well as selecting for other project attributes such as sustainable development benefits).

Why are different IRR benchmarks used to prove investment additionality?

It is observed that there is considerable variation in the IRR benchmarks employed by project developers within the same project type and even within the same country. There are a considerable number of projects whose IRRs without CDM income exceeded those of projects with CDM income. This may be explained by factors such as varying risks associated with different locations or project types, and whether the technology is emerging or not, or the difference between public and private investment decision making (where public investment considers total societal welfare rather than purely financial returns, and therefore public investment IRR thresholds tend to be lower). Alternatively it may indicate that project developers manipulate investment thresholds to match the IRR profile of their projects, in order to demonstrate additionality. This issue requires further investigation.

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