International Journal of Advanced Research in
Management and Social Sciences ISSN: 2278-6236

A CRITICAL STUDY OF INDIAN CDM PROJECTS: WITH SPECIAL REFERENCE TO THE ASSESSMENT OF ADDITIONALITY CRITERION

Renuka S Nifadkar*

Dr. Anil P Dongre**

Abstract: *The researcher has attempted to cover 65 Indian CDM projects registered until May, 20, 2012 & conducted an in-depth analysis of the select projects with respect to the testing of additionality. While almost all projects do additionality testing, only half of them identify alternatives. Barrier testing is almost universal but only a third of the projects do an investment analysis. Small scale projects are less likely to look at the impact of CDM registration. A sub-sample of 19 projects is looked at in detail regarding barrier argumentation and treatment of the additionality test by the validators. Independent data sources are only used by one third of projects. Only about a fifth of projects provide a common practice analysis in sufficient detail. Less than half of large projects provide the relevant information on additionality in their PDD. While a technology barrier is mentioned most frequently, technology and institutional barriers, feedstock variability and lack of experience each affect a third of projects. Validators have problems in transparently evaluating barriers. The detailed case studies of two projects show that additionality assessment by the CDM Executive Board varies; if the project developer can obfuscate the attractiveness of the project, it is more likely to pass.*

Keywords: *- CDM, Additionality, Baseline, GHGs, Sustainability*

*Assistant Professor, Singad Institute of Business Administration & Research, Pune

**Department of Management Studies, North Maharashtra University, Jalgaon

1. INTRODUCTION

The Clean Development Mechanism (CDM) as such does not reduce net global greenhouse gas emissions. For every tonne of emissions reduced in a host country, an investor is allowed to emit one tonne more at home. If a CDM project does not reduce emissions compared to what would happen anyway ("business as usual scenario"), then the net effect is an increase of global emissions. Therefore business-as-usual CDM projects do not just not contribute to overall greenhouse gas emission reduction; they actually will increase net emissions. The additionality principle is thus of fundamental importance in the CDM context.

While the economy of a CDM host country as a whole does not benefit from the relabelling of business-as-usual projects, additional revenues may be raised through Certified Emission Reductions (CERs) or taxation of CERs accruing to host country entities. This is obviously the case in the context of unilateral projects where the whole CER revenue remains with the host country project developer. In the pure bilateral case where no CER revenue remains in the host country, non-additional projects are unattractive.

There has been substantial debate about how to interpret additionality and whether additionality should apply to investments that are profitable in their own right, as economic theory states that rational investors will make such investments without further incentives. The business viewpoint of additionality is that the project developer's intent should not be evaluated and that any project with emissions below the baseline should automatically qualify as additional (IETA, 2005). On the other side, researchers and environmentalists consider additionality to be an imperative tool that is necessary to preserve the environmental integrity and successful implementation of the KP. They argue that "Without additionality, the CDM results in increased global emissions and thus the additionality criteria should be strict and the enforcement must be effective" (WWF 2005).

The first rule-setting on additionality was done by the CDM Executive Board (EB) with respect to small-scale projects, where the so-called barrier test was established. A small-scale project has to show that it overcomes a barrier to investment, application of technology or the project not being common practice. After a phase of uncertainty for large projects the EB in October 2004 defined a *Tool for the demonstration and assessment of additionality*, (UNFCCC 2004) which is separate from the baseline methodologies, meaning that even if the baseline scenario has higher emissions than the project scenario, it has to be checked whether the project passes the additionality test. Despite being required in all consolidated baseline methodologies, formally the additionality tool is not mandatory. It has nevertheless become common practice and consists of the following steps:

Step 0. Preliminary screening based on the starting date of the project activity

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a. Define the alternatives to the project activity

Sub-step 1b. Enforce applicable laws and regulations

Step 2. Investment analysis

Sub-step 2a. Determine appropriate analysis method

Sub-step 2b. – Option I. Apply simple cost analysis

Sub-step 2b. – Option II. Apply investment comparison analysis

Sub-step 2b – Option III. Apply benchmark analysis

Sub-step 2c. Calculation and comparison of financial indicators (only applicable to options II and III)

Sub-step 2d. Sensitivity analysis (only applicable to options II and III)

Step 3. Barrier analysis

Sub-step 3a. Identify barriers that would prevent the implementation of proposed project activity

Sub-step 3 b. Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity)

Step 4. Common practice analysis

Sub-step 4a. Analyze other activities similar to the proposed project activity

Sub-step 4b. Discuss any similar options that may be occurring

Step 5. Impact of CDM registration

The projects that use this tool have to follow these steps sequentially to prove the additionality of the proposed project. The EB, in its 22nd meeting, modified this tool with respect to step 0 above - “evidence of CDM consideration while conceiving the project”, essentially weakening it.

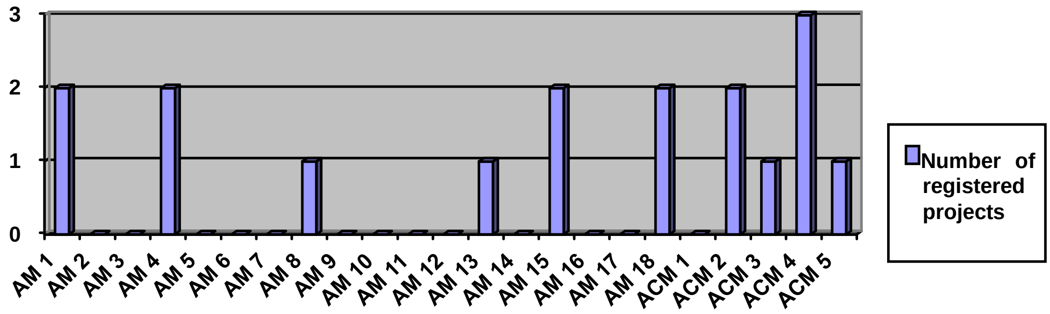
Projects that do only generate costs but no revenues will pass all additionality tests discussed. There are some project categories with those characteristics that can generate large emission reductions such as N_2O reduction from adipic and nitric acid production or HFC-23 reduction from HCFC-22 production. These project types are high-tech end of the pipe applications with limited employment and local environmental benefits.

Since the establishment of the Registration and Issuance Team (RIT), more and more projects have been criticized for not being additional despite having used the additionality tool and been validated by a DOE. This has culminated in the rejection of four projects by the EB, two of which are from India. Is India becoming the black sheep of the CDM? To answer this question, the researcher analyzes all 65 Indian projects registered until the end of May 2012, 19 of which in detail. Moreover, two case studies will highlight projects with doubtful additionality.

3. QUANTITATIVE ANALYSIS OF ELEMENTS OF ADDITIONALITY TEST USED BY INDIAN CDM PROJECTS

Of the 65 registered projects from India, only 17 are large. These have utilized approved baseline methodologies as shown in Figure 1.

Figure 1: Baseline methodologies used by large-scale registered projects from India



The methodologies AM 3,6-11, 13 and 16 require an investment test. 1 of the 17 projects uses these methodologies (6%). Methodologies AM 4, 5, 12, 14 and 17 require a barrier test. 2 projects (12%) use those methodologies. AM 1 and 2 do not require an additionality test; they are used by 2 projects (12%). The AT is required by AM 15, 18 as well as all consolidated methodologies. They cover 11 projects (65%).

On the basis of a quantitative analysis of the 65 projects it is observed that all but 2 projects have carried done an additionality or barrier test. It is not possible to differentiate which projects are following the consolidated additionality tool as this is not always specified. I thus analyse which elements of the additionality tool have been used. 50% of projects do *not* identify alternatives. In only 17 projects (33%), investment analysis has been carried out whereas in 49 projects (94%) barrier analysis is presented to demonstrate the additionality. Table 1 presents which elements of the additionality test were used by the registered CDM projects.

Table 1. Use of additionality test elements by registered Indian CDM projects

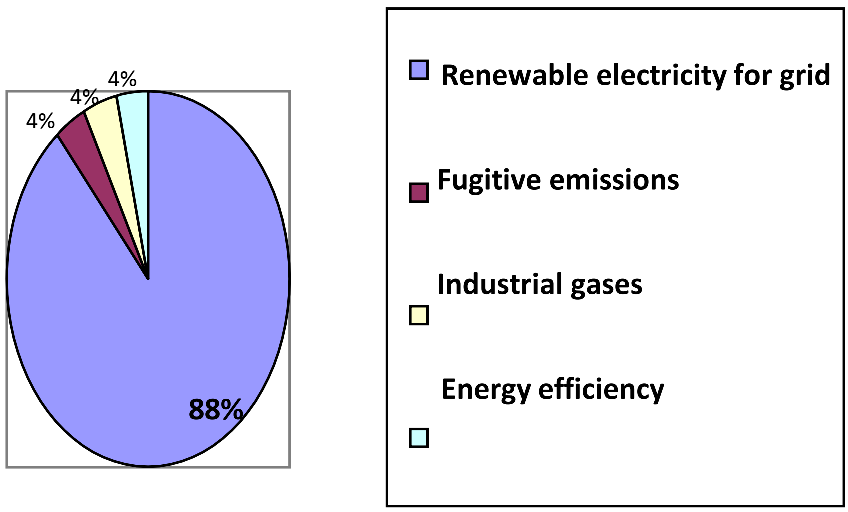
Test element	Total number (share) of projects using the element	Large scale projects	Small scale projects
Identification of alternatives	26 (50%)	14 (82%)	12 (34%)
Investment test	17 (33%)	5 (29%)	12 (34%)
Barrier test in general	49 (94%)	16 (94%)	33 (94%)
of which Institutional Barriers	28 (54%)	8 (47%)	20 (57%)
of which Technology Barriers	27 (65%)	13 (76%)	14 (40%)
Common Practice Analysis	43 (83%)	14 (82%)	29 (83%)
Impact of CDM registration	29 (56%)	13 (76%)	16 (46%)

For each element, an analysis according to project types is done below.

3.1 Identification of alternatives

The 26 projects that do not identify alternatives are distributed among project types as shown in Figure 2. Renewable electricity for grid is strongly over-represented

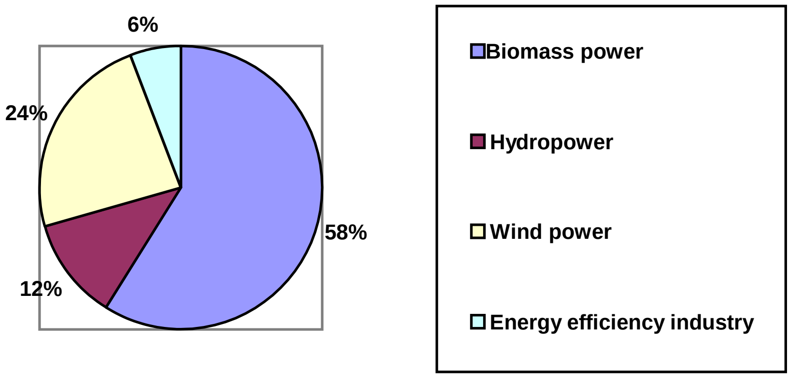
Figure 2: Shares of general project types in projects that do not identify alternatives



3.2 Investment test

Only renewable electricity projects and one energy efficiency project do an investment test. With respect to detailed technologies (see Figure 3) wind power is over-represented.

Figure 3: Investment analysis according to detailed technology of projects

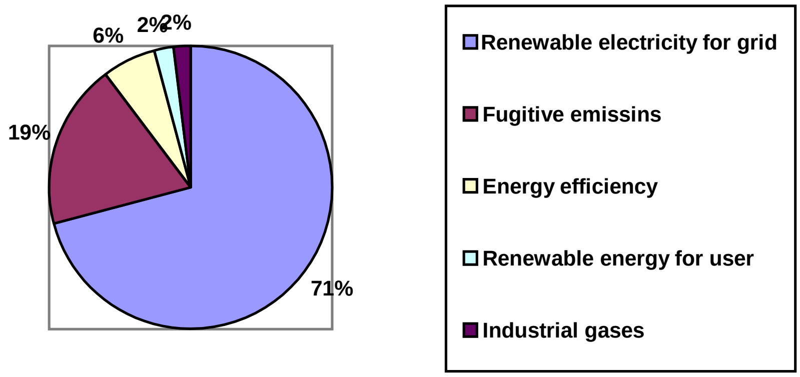


3.3 Barrier test

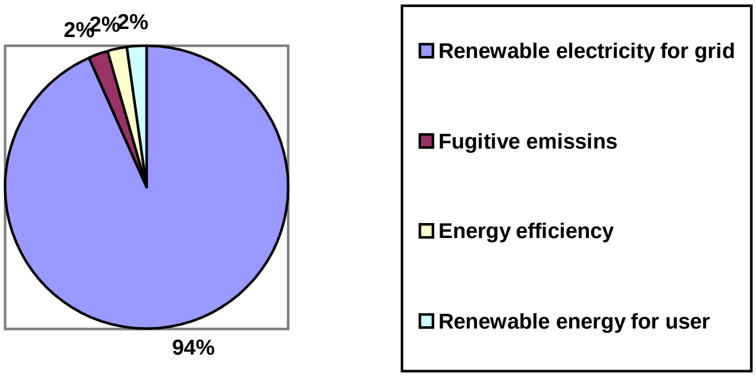
As for both small-scale and large-scale projects the barrier test is almost universal, there is no need for detailed analysis. However, for the sub-components of the barrier test, the analysis yields interesting results. For both large and small-scale projects, there is a strong over-representation of renewable electricity arguing for institutional barriers (see Figure 4) whereas renewable electricity is not overly prone to face a technology barrier.

Figure 4: Institutional and technology barriers

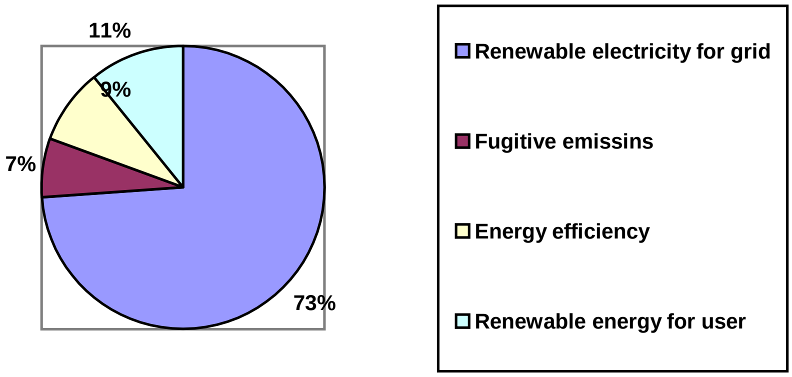
Large projects arguing for an institutional barrier



Small projects arguing for an institutional barrier



Small-scale projects arguing for a technology barrier



In the barrier analysis, almost all the CDM projects indicate that investment is a major barrier for the continuation of the project activity. Investment barriers were mostly compared with institutional barriers and other risks involved in the continuation of the project activity. For example, in most of the biomass projects, it is stated that "investment barrier is due to high investment cost, uncertainty of the price of biomass etc". However, a proper investment analysis is missing. The input parameters for the investment analysis are not provided in most of the cases and only an incremental internal rate of return is provided.

3.3 Common practice test

Similarly to the barrier test, the common practice test is almost universal.

3.4 Impact of CDM registration

For large projects, testing for the impact of CDM registration is nearly universal, but not so for small-scale projects. There, energy efficiency projects are lacking completely. Due to the decision of the EB at its 17th meeting to allow qualitative arguments, only about 20% of projects have calculated the impact quantitatively (see Table 2 in Section 4).

4. Detailed evaluation of a project sample regarding additionality testing

The researcher analyzed a sample of 19 projects (10 large and 9 small ones) with regards to the following criteria

- Do the project participants refer to independent sources when arguing for barriers?
- What type of barrier is argued?
- How detailed is the common practice analysis?
- Is all information for additionality testing available in the PDD?
- How do the validators assess the implementation of the additionality test in the PDD?

The sample is reflecting the distribution of projects according to technologies and the temporal distribution with respect to the date of registration.

Table 2: Detailed evaluation of additionality testing of 19 registered projects

Note: Projects in italics are examples of a very detailed and well-argued additionality test. Shaded projects have problematic argumentation and would probably have triggered a review request for lack of additionality by me if they had been presented to me in the context of my RIT work.

Name	Project type (in detail)	Project Size	References to independent sources	Barriers listed	Detail in common practice analysis	Public availability of information	Validators' evaluation of additionality testing
Biomass in Rajasthan - Electricity generation from mustard crop residues	Biomass	Small	×	Investment costs (IRR of 10-11%), technological risks such as corrosion;	None	√	Reliable evidence for technological barrier
5 MW Dehar Grid-connected SHP in Himachal Pradesh, India	Hydro	Small	×	Investment cost overrun, refusal of banks to provide additional loans, unknown	High	√	IRR increase from 12.9 to 13.9% through CER revenues. Normally project
Clarion 12 MW (Gross) Renewable Sources Biomass Power Project	Biomass	Small	×	Risk of biomass price increase and feed-in tariff decrease (reduction of IRR from 31 to 13%), technology, CER	None	×	Feed in- tariff decrease found to be prohibitive
3.5 MW rice husk cogeneration at Nahar Spinning Mills	Biomass	Small	√ (decrease in rice farming, common	Biomass availability and price. Lack of power generation experience of project developer	Medium (20.5 MW rice husk installed, but no. of plants not	√	Just repetition of arguments in PDD
24 MW installed capacity biomass based renewable electricity generation and consumption by Gujarat Ambuja Cements Limited at its facility in	Biomass	Large	×	Investment costs higher than for coal- fired boiler, little experience with technology	Medium (one 10 MW rice husk plant, not operational)	× ("Documents can be reviewed by the project validat	Check of data on additional capital cost and higher cost of generation. CER revenue increases IRR by 1%
20 MW Kabini Hydro Electric Power Project, SKPCL, India	Hydro	Large	×	IRR 10.8% which is below the threshold of 15.8% (WACC,	High	×	Financial analysis provided by the project developer to the validator was
Energy Efficiency through installation of modified CO2 removal system in Ammonia Plant	Energy efficiency in industry	Large	×	Operational characteristics of technology unknown	Low. Letter from technology supplier stating "first of its	×	Validator required more detailed description of risks of shutdown due to unfamiliarity with technology
Methane Extraction and Fuel Conservation Project at Tamil Nadu Newsprint and Papers Limited (TNPL),	Wastewater	Large	√ (on technology barrier but not	Subsidy for untested technology was given. Wastewater may not be available	Low. "One of the first of its kind" without further specificati	×	Confirm that this subsidy alone was not sufficient to remove the technological barrier

Name	Project type (in detail)	Project Size	Referen ce s to indepen de nt sources	Barriers listed	Detail in common practice analysis	Public availab i lity of inform a tion	Validators' evaluation of additionality testing
Optimal Utilization of Clinker" project at Shree Cement Limited (SCL), Beawar, Rajasthan	Cement blending	Large	×	Cement users need training. Low acceptance by users to be overcome by large meetings of masons. Increased sales and advertising budget. Need for experimentation to	Medium. Blending in Northern Region 7-20%.	√	Validator required project developer to exclude investment analysis unless more detail was provided (!) as" investment barrier is in fact an example of investment analysis." "Presence of market barrier is
Ugar Sugar Project	Biomass	Large	×	High investment costs and price for power higher than for coal- based power. New technology used. Bagasse availability	Medium. 8 out of 25 mills in Karnataka state deliver electricity to the	×	"Investment barrier analysis indicates that procuring funding for the project was not easy and cheaper option like producing power using coal as fuel
5 MW Wind Power Project at Baramsar and Soda Mada, district Jaisalmer, Rajasthan, India.	Wind	Small	×	Private banks not willing to give loans. Uncertainty about tariff policy. 1.25 MW turbines were untested at the time	None	×	Remote desert terrain lacks infrastructure, Inability of securing soft loans and investment Possibility of having higher annual
Aleo Manali 3 MW Small Hydroelectric Project , Himachal Pradesh, India	Hydro	Small	×	Investors not experienced in small- hydro projects Planned large scale hydro project	None	×	No assessment at all
Energy efficiency projects- Steam system upgradation at the manufacturing unit of Birla tyres	Energy efficiency in industry	Small	×	Utilization of the condensate can lead to contamination. Disruption of the thermal equilibrium of the system possible. Expenses for automatic control system needed.	None	×	Arguments seen as sufficient except the argument of slowdown in tyre industry
Energy efficiency through steam optimisation projects at RIL, Hazira	Industry	Large	×	Entire design of the depropaniser column has been developed 'in–house' by RIL's technical team.	Medium. Project unique in Indian petroche mi cal	×	Validator makes no assessment of barriers

Biomass based independent power project at Malwa Power Private Limited,	Biomass	Small	×	Tariff policy risk	Medium. No biomass power generation	×	First privately financed biomass project in the state of Punjab. Supporting documentation

Name	Project type (in detail)	Project Size	References to independent sources	Barriers listed	Detail in common practice analysis	Public availability of information	Validators' evaluation of additionality testing
6.5 MW biomass based (rice husk) power generation by M/s Indian Acrylics Ltd. and replacement of electrical power being imported from state electricity grid/	Biomass	Small	√ (common practice)	Corrosion of boiler. Biomass availability unclear. Storage of rice husk entails risks.	Medium. One 10 MW plant in Punjab, 65 plants in India	√	Validator raised issue that at no point of time the cost of generation by the project activity is more than the variable cost of supply by the state electricity
Bundled wind power project in Chitradurga (Karnataka in India) managed by Enercon (India) Ltd.	*Wind*	*Large*	*√ (IRR threshold, wind share in electricity generation)*	*IRR of 12.8% below 16% threshold. CER revenues increase IRR by 2.4%. Risk of feed-in tariff decrease, no power offtake during windy*	*High. Argues for statewise assessment (1% wind in Karnataka)*	√	*Validator states that during the initial period of operations the projects are likely to earn less than their cost of generation and thus investment*
Waste Heat Recovery Power Project at JK Cement Works (Unit of JK Cement Limited), Nimbahera, Chittorgarh, Rajasthan	*Energy efficiency in industry*	*Large*	*√ (arguments about technology barrier, standby*	*High dust content of waste gases. Standby charges for emergency supply from grid*	*High. One of 45 plants (2%).*	√	*Validator accepts barriers*
Partial replacement of fossil fuel by biomass as an alternative fuel, for Pyro-Processing in cement plant of Shree Cements	Renewable energy for industry	Large	√ (fuel use by Indian cement industry)	Production losses are anticipated, no trained staff available, unstable biomass supply, need for additional infrastructure.	Medium. "First of its kind in Rajasthan"	√	Main barrier for the project activity is technology (production losses) SCL will be amongst the first companies to use

Only 6 projects (32%) provide independent sources; the share is 40% for large and 22% for small projects. This shows that developers have serious problems in substantiating their claims. Even if independent sources are provided, they may not be relevant.

Common practice analysis is rather uneven, with 3 large projects (30%) and 1 small project (11%) giving an analysis with high degree of detail. No large and five small projects (55%) do not provide any common practice analysis. The interpretations of common practice have a wide range. There is also a widely varying interpretation of the boundaries of the common practice analysis both spatially and with regards to the technology. Some project developers have developed the strategy to draw a very narrow technological line which obviously reduces the "risk" of being labeled as common practice.

Both four large and small projects provide the relevant information publicly, thus less than half. Validators have never raised lack of publicly available information as a basis of a corrective action request or need for clarification in their validation reports, which shows that they do not take the CDM rules seriously in this respect.

All projects list one or several barriers. They can be grouped in four major clusters:

Technology. 13 projects describe a technology-related barrier in some detail. Many more projects give vague indications about technology issues that are not counted here.

- Institutions. Seven projects describe an institutional barrier in some detail. The barriers mostly refer to the feed in tariffs for renewable electricity.
- Feedstock variability (flow for hydro, biomass for biopower plants) is mentioned by seven projects.
- Investment (six projects); a surprisingly low share.
- Lack of experience, mentioned by six projects.

5. CASE STUDIES: JSW STEEL WASTE GASE USE AND BAJAJ AUTO WIND POWER

Two Indian case studies are outstanding with regards to their additionality characteristics as they highlight the importance of transparency and understanding of situation-specific arguments as well as differential treatment by the CDM EB. One relates to a very large energy efficiency project in the steel sector, the other one to wind power built in the classical Indian style as a project operated by the windmill producer on behalf of an industrial company.

5.1 JSW steel waste gas use – how company accounting tricks ensnare the EB

Jindal South West Steel (JSW Steel), before 2005 Jindal Vijayanagar Steel, is operating a large integrated steel plant at Vijayanagar in the state of Karnataka. Current capacity is 2.5 million t per year which is being expanded to 4 million t in 2006. Further expansion to 10 million t is scheduled in the near future. JSW Steel and its affiliate JSW Energy (formerly

Jindal Thermal Power Company Limited) have developed three CDM Project Design Documents for large scale waste heat recovery projects. All projects use the consolidated baseline methodology ACM 4, have been supported by the consulting company PricewaterhouseCoopers (PwC) and are validated by SGS.

The first project "Use of waste gas use for electricity generation at Jindal Thermal Power Company Limited (JTPCL)" was submitted on September 23, 2005. It relates to a 260 MW power plant with two units partially fired by gases from the Corex iron smelting process. Imported coal is used for co-firing and about 50% of the power is sold to Karnataka Power Transmission Corporation Limited (KPTCL). Annual emission reductions are estimated at 1.3 million CERs. The 10 year crediting period started in January 2001. The plant was originally owned by Tractebel. Its plant load factor reached 84% in 2001, 96% in 2002-04 while falling back to 86% in 2005 due to lower electricity demand. The share of coal reached 30% in 2002-2004 but rose to 65% due to commissioning of the second project that has the priority in using Corex waste gases. CER volumes would be reduced accordingly.

Electricity generation from COREX gases was always a key element of the project investment (this is a well known fact in India) and thus the assertion that "during March 2001, JTPCL management took the decision for the current project activity" is blatantly wrong. Moreover, the first tranche (130 MW) of the project started production well before 2000 and thus that tranche is not eligible for the CDM. My arguments were supported by Ghorai et al. (2001) who did not mention the CDM at all which is another indicator that CDM was not seriously considered A lengthy exchange of views with the validator followed. On December 21, SGS formally announced that it would go ahead with validation despite my comment. In January 2006, representatives of JSW invited me to visit their plant and to discuss my comment. The subsequent analysis is based on the plant visit[2].

The CDM has a cut-off-date of Jan. 1, 2000; projects that started before that date are not eligible. According to Ghorai et al. (2001) the first Corex plant for iron smelting as well as the first 130 MW unit of the power plant was operational in August 1999. The second unit followed in mid-2000. According to the documents available in the plant, the planning process for using Corex gas in the power plant already started in the mid-1990s. Karnataka Pollution Control Board (KPCB) approved the use of 80% of Corex gases and 20% coal in the power plant on March 6, 1996. While the plant was standing in 1999, it was only fired by coal.

The first Corex waste gas was fired on January 28, 2000. So eligibility depends on the interpretation of project start date. If the power plant commissioning date is used, the project would not be eligible; if the first operation of the process (i.e. gas firing) is used, the project would pass the test.

Overall, the argument about the role of CDM in decision on investing in the tank seems sound and the timeline is convincing. One could not have asked the companies to start writing CDM project documentation before the ink on the Marrakech Accords was dry. However, it is surprising that local stakeholder consultation was only done on April, 7, 2005 despite the rules on stakeholder consultation being clear from 2002 onwards[5].

Under normal circumstances, use of waste gases instead of imported coal should reduce the costs of power production, making the power plants the commercially most attractive alternative for power production. This is confirmed by Ghorai et al. (2001): “More than 40% of the total energy input in the COREX process is subsequently available as a valuable export gas. COREX export gas can be used for the generation of electricity, enabling the steelworks to be run independently of external electricity supplies. The economy of the process is therefore improved strongly when this export gas can be put to use.” According to the plant operators, coal-fired power costs 4.5 ct/kWh; so the investment in the gas storage tank pays off after just 100 GWh of electricity produced from Corex gas.

JSW Energy now cleverly avoids a reduction of its electricity sales price this by asking JSW Steel to charge a price for delivery of Corex gas which is equivalent to the coal price in terms of energy content. Such a price can be charged according to the rules defined by Central Electricity Authority. Obviously this means that JSW Steel increases its profits due to the sale of the Corex gas while JSW Energy increases its costs accordingly; the total cost level at the JSW company group level remains unchanged. Thus the validator’s conclusion “This meant that there was no incentive for JTPCL to invest in additional equipment to facilitate the burning of the COREX gases” is incorrect from a JSW company group standpoint where the cheapest option is to maximize use of Corex gas.

While a request for review was launched by the EB, the project was allowed to get registered after an insubstantial correction (making clear the link to the other two projects). It has thus become a key precedent for allowing large non-additional energy efficiency projects in the CDM.

5.2. Bajaj Auto: How glowing reporting on the attractiveness of a project led to its rejection

The two wind projects of Bajaj Auto share common characteristics of Indian wind power inasmuch an industrial company is providing finance for wind turbines that are built and operated by the turbine manufacturer. This reduces electricity costs for the industrial company that would otherwise face very high electricity tariffs and allows tax reduction through accelerated depreciation of the wind turbines. A large number of these projects have been submitted for validation. The Bajaj projects were unusual as the annual report of Bajaj Auto (2002) provided a glowing description of the wind projects: "The wind power project has been completed in the current financial year. A total of 138 windmills have been set up in Supa (Ahmednagar district, Maharashtra) and Vankusavade (Satara district, Maharashtra). With the completion of these windmills, Bajaj Auto has a total installed capacity of 65.2 MW of power. [...]The project is extremely beneficial on a standalone basis and has a payback period of three years with an internal rate of return in excess of 28 per cent. In addition to hedging Bajaj Auto's power costs, this investment also provides sales tax incentives and an income tax shield." Moreover, Bajaj made the mistake of not mentioning CDM or carbon credits in the context of the projects.

6. CONCLUSIONS

Non-additional CDM projects are only beneficial for a host country if the CER revenue accrues to host country entities. This is the case for unilateral projects. Thus one would expect India with its high share of unilateral projects to submit many non-additional projects. Indian project developers prefer the barrier test. The two case studies JSW Steel and Bajaj Auto show that "packaging" of information plays a decisive role in additionality assessment by the EB. While both projects are clearly non-additional, only the second one was rejected as the project developer himself praised the project's attractiveness in the absence of the CDM. Validators so far have not been able or willing to thoroughly check the additionality argumentation of project developers, especially regarding the barrier test. We thus will get more non-additional projects from India registered in the future unless the EB sharpens the barrier test.

REFERENCES

1. Matsuhashi, R., Fujisawa, S., Mitamura, W., Momobayashi, Y. & Yoshida, Y., 2004. Clean development mechanism projects and portfolio risks. *Energy*, 29, p.1579-88.

2. Olsen, K. H., 2007. The clean development mechanism's contribution to sustainable development: a review of the literature. *Climatic Change*, 84, p.59-73.
3. SigmaPlot, 2008. *SigmaPlot statistics user guide*. SigmaPlot software, Version 11.0, Systat Software, Germany.
4. Sutter, C. & Parreno, J.C., 2007. Does the current Clean Development Mechanism (CDM) deliver its sustainable development claim? An analysis of officially registered CDM projects. *Climatic Change*, 84, p.75-90.
5. Trexler, M.C., Broekhoff, D.J. & Kosloff, L.H., 2006. A statiscally-driven approach to offset-based GHG additionality determinations: What can we learn? *Sustainable Development Law & Policy*, 4 (2), p.30-40.
6. UNEP, 2008. *UNEP Risoe Centre*. [online]. (Updated 1 Aug 2008) Available at: http://cdmpipeline.org/
7. UNFCCC, 2000. *Preparations for the first session of the Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol*, Article 12, Kyoto Protocol. (FCCC/CP/2000/CRP.2/Add.1). UNFCCC. Available at: http://unfccc.int/resource/docs/cop6/crp02a01.pdf
8. UNFCCC, 2008a. *Clean Development Mechanism (CDM)*. [online]. (Updated 20 Aug 2008) Available at: http://cdm.unfccc.int/index.html
9. UNFCCC, 2008b. *Tool for the demonstration and assessment of additionality, version 05.2.* [online]. Available at: http://cdm.unfccc.int/methodologies/PAmethodologies/AdditionalityTools/Additionality_tool.pdf
10. Bajaj Auto 2002 **Annual report 2001-2002** Pune
11. Ghorai D., Bräuer,F., Freydorfer, H. Siuka, D. 2001 **COREX operation at Jindal Steel - a success story** Millennium Steel, 20-25.

Appendix 1

LIST OF ANALYZED PROJECTS SORTED BY DATE OF REGISTRATION Projects included in the sample for detailed analysis are marked in grey

Name	Project type sector	Project type (in detail)	Project Size	Project using AT	Invest. Analysis	Barrier Analysis	Identification of alternatives	Institut. /Regulat. Barriers	Tech. Barriers and TT	Common Practice Analysis	Impact of CDM registration
Project for GHG Emission Reduction by Thermal Oxidation of HFC23	Industrial gases	HFC	Large	X	×	√	√	×	√ TT	√	√
Biomass in Rajasthan - Electricity generation from mustard crop residues	Renewable electricity for grid	Biomass	Small	√	√	√	√	√	√	√	√
5 MW Dehar Grid-connected SHP in Himachal Pradesh, India	Renewable electricity for grid	Hydro	Small	√	×	√	×	×	×	√	×
Clarion 12 MW (Gross) Renewable Sources Biomass Power Project	Renewable electricity for grid	Biomass	Small	√	×	√	×	√	√	×	×
Shree Renuka Sugars Bagasse Cogeneration	Renewable electricity for grid	Biomass	Small	√	√	√	√	√	×	√	√
DSL Biomass based Power Project at Pagara	Renewable electricity for grid	Biomass	Small	√	×	√	√	×	×	√	×
APCL proposed 7.5 MW Mustard Crop Residue based Power Project	Renewable electricity for grid	Biomass	Small	√	×	√	√	√	√	√	×
4.5MW Maujhi Grid-connected SHP in Himachal Pradesh, India	Renewable electricity for grid	Hydro	Small	√	√	√	×	×	×	√	√
JCT Phagwara Small Scale Biomass Project	Renewable electricity for grid	Biomass	Small	√	√	×	×	×	×	×	√
Bagepalli CDM Biogas Programme	Fugitive emissions	Ag Waste	Small	√	×	√	×	×	√	√	√
3.5 MW rice husk cogeneration at Nahar Spinning Mills	Renewable electricity for grid	Biomass	Small	√	×	√	×	×	×	×	×
10.25 MW Chunchi Doddi Grid-connected SHP in Karnataka, India	Renewable electricity for grid	Hydro	Small	√	×	√	×	√	×	√	√
3.5 MW rice husk cogeneration at Oswal	Renewable electricity	Biomass	Small	√	×	√	×	×	×	√	×

Woolen Mill	for grid										
24 MW installed capacity biomass based renewable electricity generation and consumption by Gujarat Ambuja Cements Limited at its facility in Rupnagar district (Ropar), Punjab, India	Renewable electricity for grid	Biomass	Large	√	√	√	√	×	√	√	√
18 MW Biomass Power Project in Tamilnadu, India	Renewable electricity for grid	Biomass	Large	√	×	√	√	×	√	√	×
GHG emission reduction by thermal oxidation of HFC 23 at refrigerant (HCFC-22) manufacturing facility of SRF Ltd	Industrial gases	HFC	Large	×	×	×	×	√	×	×	×
20 MW Kabini Hydro Electric Power Project, SKPCL, India	Renewable electricity for grid	Hydro	Large	√	√	√	√	×	×	√	√
Energy Efficiency through installation of modified CO2 removal system in Ammonia Plant	Energy efficiency	Industry	Large	√	×	√	√	×	√ TT	√	√
Methane Extraction and Fuel Conservation Project at Tamil Nadu Newsprint and Papers Limited (TNPL), Kagithapuram, Karur District, Tamil Nadu	Fugitive emissions	Wastewater	Large	√	×	√	√	×	√	√	√
RSCL cogeneration expansion project	Renewable electricity for grid	Biomass	Large	√	√	√	√	√	√	√	√
Rice Husk based Cogeneration projectat Shree Bhawani Paper Mills Limited (SBPML), Rae Bareli, Uttar Pradesh, India	Renewable electricity for grid	Biomass	Small	√	×	√	√	×	×	√	×
Rice Husk Based Power Project, India	Renewable electricity for grid	Biomass	Small	√	×	√	√	√	√	√	×
6MW Somanamaradi grid-connected SHP in Karnataka, India	Renewable electricity for grid	Hydro	Small	√	×	√	×	√	×	√	√

Nagda Hills Wind Energy Project (India)	Renewable electricity for grid	Wind	Small	√	√	√	√	√	√	√	√
Optimal Utilization of Clinker" project at Shree Cement Limited (SCL), Beawar, Rajasthan	Energy efficiency	Cement blending	Large	√	×	√	√	√	√	√	√
3.75 MW Small Scale Grid Connected "Demonstration Wind Farm Project" at Chalkewadi, District Satara, State Maharashtra, India.	Renewable electricity for grid	Wind	Small	√	×	√	×	√	√	√	×
Rithwik 6 MW Renewable Sources Biomass Power Project	Renewable electricity for grid	Biomass	Small	√	√	√	√	√	×	×	√
Ugar Sugar Project	Renewable electricity for grid	Biomass	Large	√	×	√	√	×	√	√	√
Thermal Efficiency Improvement Initiatives in Coal Fired Boiler System	Energy efficiency	Industry	Small	√	×	√	√	√	√	√	×
5 MW Wind Power Project at Baramsar and Soda Mada, district Jaisalmer, Rajasthan, India.	Renewable electricity for grid	Wind	Small	√	×	√	×	√	√	×	×
14.8 MW small-scale grid connected wind power project in Jaisalmer state Rajasthan, India by RSMML	Renewable electricity for grid	Wind	Small	√	√	√	×	×	√	√	×
Aleo Manali 3 MW Small Hydroelectric Project, Himachal Pradesh, India	Renewable electricity for grid	Hydro	Small	√	×	√	×	×	×	×	×
Energy efficiency projects-Steam system upgradation at the manufacturing unit of Birla tyres	Energy efficiency	Industry	Small	√	√	√	×	×	√	√	×
Demand-side energy efficiency programmein the 'Humidification Towers' of Jaya Shree Textiles	Energy efficiency	Industry	Small	√	×	√	√	×	√	×	×
Waste heat based 7 MW Captive Power Project Godawari Power and Ispat Ltd (GPIL)	Energy efficiency	Industry	Large	√	×	√	√	√	√	√	√

Energy efficiency through steam optimisation projects at RIL, Hazira	Energy efficiency	Industry	Large	√	×	√	√	×	√	√	√
12.3 MW wind energy project in Tamil Nadu, India	Renewable electricity for grid	Wind	Small	√	√	√	×	√	√	√	√
JCT Hoshiarpur Small Scale Biomass Project	Renewable electricity for grid	Biomass	Small	√	√	√	×	×	×	×	√
Biomass based independent power project at Malwa Power Private Limited, Mukatsar, Punjab	Renewable electricity for grid	Biomass	Small	√	×	√	√	√	×	√	×
Babanpur, Killa and Sahoke Mini Hydroelectric Projects	Renewable electricity for grid	Hydro	Small	√	×	√	×	√	×	√	×
Lohgarh, Chakbhai and Sidhana Mini Hydroelectric Projects	Renewable electricity for grid	Hydro	Small	√	×	√	×	√	×	√	×
Dolowal, Salar and Bhanubhura Mini Hydroelectric Project	Renewable electricity for grid	Hydro	Small	√	×	√	×	√	×	√	×
Ajbapur Sugar Complex Cogeneration Project	Renewable electricity for grid	Biomass	Small	√	√	√	×	√	×	√	√
6.5 MW biomass based (rice husk) power generation by M/s Indian Acrylics Ltd. and replacement of electrical power being imported from state electricity grid/ surplus power supply to grid	Renewable electricity for grid	Biomass	Small	√	×	√	×	×	√	√	×
LHSF Bagasse Project	Renewable electricity for grid	Biomass	Small	√	√	×	×	√	×	√	√
Pandurang SSK RE Project	Renewable electricity for grid	Biomass	Small	√	√	√	×	×	×	√	√
Chambal Power Ltd (CPL) proposed 7.5 MW biomass based power project at Rangpur, Kota District, Rajasthan, India.	Renewable electricity for grid	Biomass	Small	√	×	√	√	√	√	√	√
TSIL – Waste Heat Recovery Based Power	Energy efficiency	Industry	Large	√	×	√	√	√	×	√	√

Project											
Bundled wind power project in Chitradurga (Karnataka in India) managed by Enercon (India) Ltd.	Renewable electricity for grid	Wind	Large	√	√	√	√	√	√	√	√
Vajra and Chaskaman small hydro projects of Vindhyachal Hydro Power Ltd., Maharashtra, India.	Renewable electricity for grid	Hydro	Small	√	×	√	×	√	×	√	×
Waste Heat Recovery Power Project at JK Cement Works (Unit of JK Cement Limited), Nimbahera, Chittorgarh, Rajasthan	Energy efficiency	Industry	Large	√	×	√	√	×	×	√	√
Partial replacement of fossil fuel by biomass as an alternative fuel, for Pyro-Processing in cement plant of Shree Cements Limited at Beawar in Rajasthan, India	Renewable energy for user	Renewable energy for industry	Large	√	×	√	√	√	√	√	√