The Use of Benchmarks to Determine Emissions Additionality in the Clean Development Mechanism

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INTRODUCTION

The Clean Development Mechanism (CDM) allows countries with greenhouse gas emissions targets (Annex 1) to meet these targets through greenhouse gas (GHG) emission reduction/sequestration projects in countries without GHG emissions targets (non-Annex 1). An essential element of the CDM is that it establishes an implicit bargain between developed and developing countries. Annex I Parties get access to less expensive emission reductions while the sustainable development objectives of developing countries are supported.

In order for CDM to be effective, both environmentally and economically, it must meet several criteria. According to the Kyoto Protocol, creditable emission reductions must be "real, measurable, and long term". The CDM, however, will be effective only if transaction costs are kept low to encourage greater participation. Meeting these goals is largely dependent on setting the correct baseline for a project.

The availability of CDM certified emission reduction units (CERs) are expected to provide an incentive to project developers to operate in a more carbon efficient manner (e.g., purchasing energy efficient equipment, sequestering carbon, capturing and reusing methane) than would have occurred in the absence of the credits (i.e. that the reductions are 'additional'). In order to assure that emission reductions are additional, a baseline must be developed that represents estimated emissions that would have occurred in the absence of CDM credits. Getting the baseline right is very difficult. One of the most difficult factors is accurately estimating what would have occurred anyway. The need for accuracy often competes with retaining low transaction costs and encouraging broad participation.

Baselines construction falls into two broad categories: bottom-up baselines (e.g., project-by-project baselines) and top-down baselines (e.g., benchmarks). This paper explores the use of benchmarks as a means of assessing emissions additionality[1] in CDM projects.

TRADITIONAL BOTTOM-UP BASELINES

Bottom-up baselines have traditionally been used for tracking project-level greenhouse gas emissions tracking. Both the Activities Implemented Jointly (AIJ) pilot phase under the UN Framework Convention on Climate Change (UNFCCC) and the U.S. Energy Policy Act section 1605(b) rely on project-specific baselines. Typically, a project-specific baseline will estimate a "without-project" scenario that is compared to a "with-project" scenario. The difference in GHGs sequestered/emitted between the two scenarios is considered the greenhouse gas impact of the project. For example, if a developer plans to construct a wind farm, the developer would estimate what electricity source the project would displace.

The U.S. experience with both programs has shown project-level counter-factual baselines to be problematic. The main difficulty lies in predicting "without-project" emissions scenarios. It is difficult and time-consuming to try to predict "what would have occurred anyway". Estimating the counter-factual baseline for the above wind project example would entail assumptions of fuel costs, electricity supply and demand, government policies, weather patterns, and a host of other factors. Varying assumptions can drastically alter the amount of emission reductions that are attributed to the project.

US International Joint Implementation (USIJI) experience demonstrates that the right assumption is not always evident. For example, in the Dona Julia hydroelectric project in Costa Rica, the baseline reported to the UNFCCC Secretariat[2] based displaced electricity assumptions on the national energy goal as elaborated by the Costa Rican Ministry of Environment and Energy. The goal was to eliminate fossil fuel electricity generation by the year 2000 and rely solely on renewable energy for electricity generation. Had assumptions been based instead on forecasts for energy demand, resource mix, fuel-cost projections, operation and maintenance costs, and precipitation patterns (affecting hydroelectric generation), the emissions reductions would have been far greater[3].

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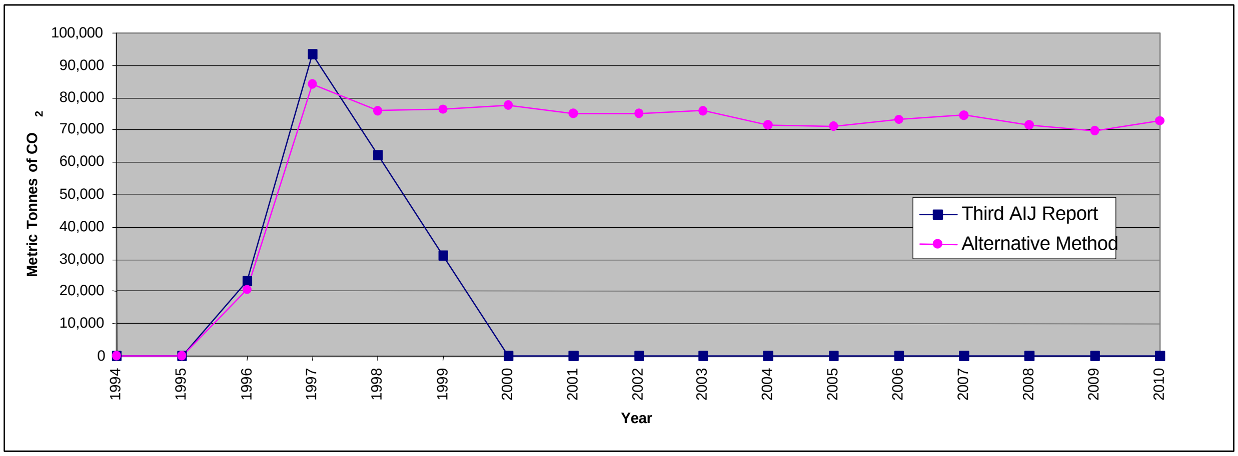
[1] Demonstrating 'additionality' refers to proof that emissions reductions would not have occurred in the absence of incentives provided by the CDM.

[2] United States Environmental Protection Agency. "Activities Implemented Jointly: Third Report to the Secretariat of the United Nations Framework Convention on Climate Change". Volume 2. November, 1998. EPA 236-R-98-003

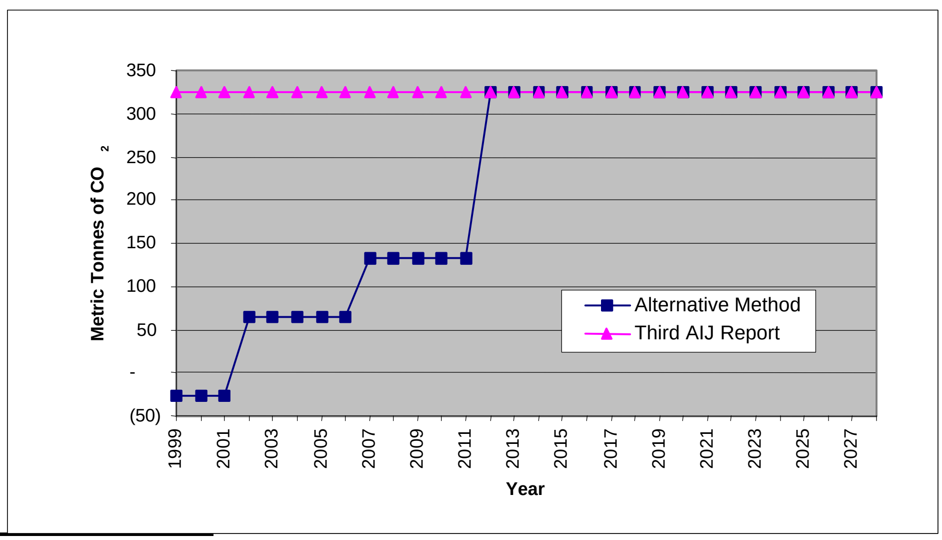
[3]Leining, O'Neill, Venezia, Braatz. Memo to US EPA "Charts Illustrating USIJI Project Baselines" December 18, 1998

Figure 1: Difference Between Reported[4] and Alternative Baseline Calculations (Dona Julia Hydroelectric Project)



In the APS/CFE Renewable Energy Mini Grid Project in Mexico shown below, alternative assumptions would have reduced emission reduction estimates. The town serviced by this electricity generation project currently uses three hours of electricity a day (provided by diesel). The reported reductions were based on the assumption that diesel-based electricity production would increase to 24 hours/day in the absence of the project. An alternative assumption could result in more gradual increases in energy demand, leading to fewer emissions reductions claimed[5].

Figure 2: Difference between Reported[6] and Alternative Baseline Calculation (APS/CFE Renewable Energy Mini Grid Project)



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[4] United States Environmental Protection Agency. "Activities Implemented Jointly: Third Report to the Secretariat of the United Nations Framework Convention on Climate Change". Volume 2. November, 1998. EPA 236-R-98-003

[5] Leining, O'Neill, Venezia, Braatz. Memo to US EPA "Charts Illustrating USIJI Project Baselines" December 18, 1998

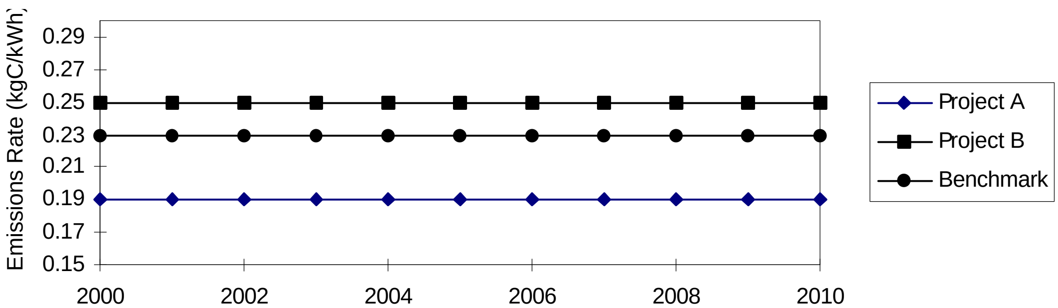
[6] United States Environmental Protection Agency. "Activities Implemented Jointly: Third Report to the Secretariat of the United Nations Framework Convention on Climate Change". Volume 2. November, 1998. EPA 236-R-98-003

BENCHMARK CONCEPT

A benchmark sets a standardized emissions/sequestration performance standard across a sector. Any project that is more carbon efficient than the benchmark can be considered additional. For the CDM, certified emissions reductions (CERs) could be determined based on the difference between the benchmark and the project performance. Thus the benchmark serves as the baseline for an entire sector or sub-sector, eliminating the need for project-specific baselines.

Figure 3 illustrates the benchmark concept for a hypothetical efficient electricity generation project. In this example, Project A would be considered additional and be awarded credits for every 0.04 kgC / kWh of electricity produced or sold. Project B would not be considered additional and would not be awarded any credit[7].

Figure 3. Hypothetical Illustration of the Benchmark Concept



An advantage of a benchmark, rather than a project-specific counter-factual baseline, is to lower transaction costs and reduce subjectivity. The transaction costs are lower because counter-factual baselines need not be produced for each project. Avoiding project-specific baselines is less expensive for both the project developer and for the overall system since each baseline would not have to be negotiated and verified. Using benchmarks also reduces the subjectivity of baselines. In effect, a benchmark would simulate what would have occurred anyway, however, projects within that category and region would be subject to the same assumptions.

BENCHMARK TRADE-OFFS

Once guidelines are established, developing the benchmark could be quite straightforward. Establishing guidelines, however, may be a difficult process. There are few clear answers and most decisions will entail a trade-off between competing goals. Environmental integrity of the benchmark will need to be weighed against low transaction costs and high participation.

Environmental integrity versus low transaction costs

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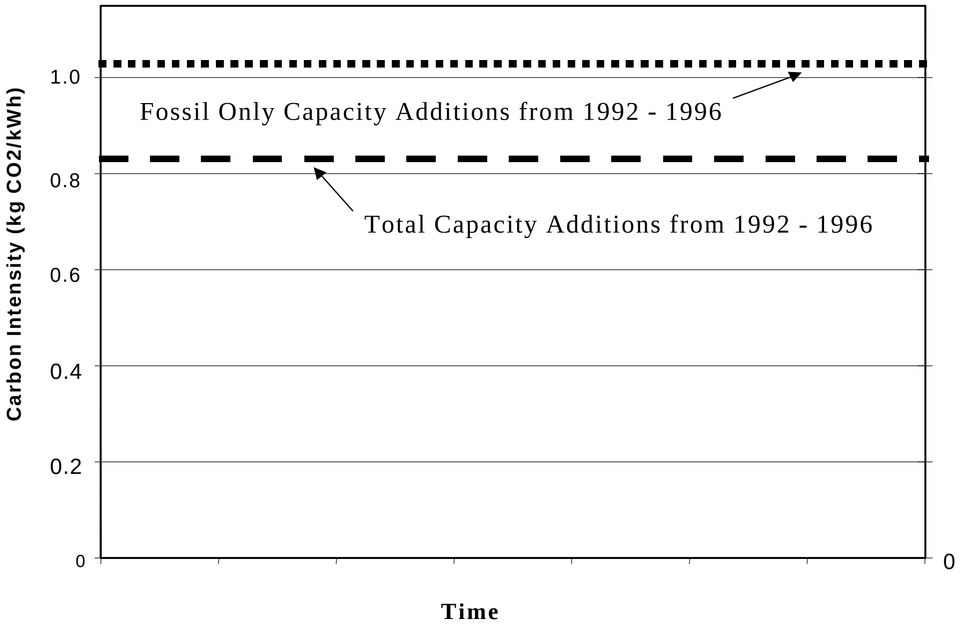
[7] Bilello, Friedman, LeFranc, "The Role of Benchmarks in Assessing Additionality and Emission Reductions under the CDM" . Unpublished draft paper. USEPA. September, 1998

The level of geographic and sectoral disaggregation will greatly affect the benchmark. The greater the aggregation, the lower the transaction costs since fewer benchmarks need to be established. Greater aggregation, however, may also lead to an ineffective benchmark. Higher levels of aggregation do not necessarily lower the benchmark, as illustrated in Figure 4 below. For example, China's electricity generation is largely based on coal and hydro. All capacity additions between 1992 - 1996 in China emitted about 0.83 kg of CO2/kWh, however, fossil only capacity additions from the same years emitted about 1.07 kg of CO2/kWh[8]. In this case a less aggregated benchmark would lead to a higher emissions standard than one more highly aggregated.

Figure 4: Two Benchmark Examples: Varying levels of Sectoral Aggregation in China



The appropriate level of aggregation is likely to differ by sector. Some industrial sectors may need such a high level of disaggregation that benchmarks are not feasible. For example, chemical production is very energy intensive, however, energy intensities differ among many products. In order to construct a meaningful benchmark (one that creates an incentive to produce chemicals more GHG-efficiently) the several benchmarks would be needed. The number of likely projects may not warrant the cost of creating these benchmarks.

Environmental Integrity versus High Participation

High participation in CDM will both lower compliance costs for Annex B countries and increase investment flows for developing countries. Both sides therefore have an interest in high participation. It is important, however, that the emissions reductions that are creditable be real. Figures 5 and 6 below[9] shows the trade-off between high participation and environmental integrity.

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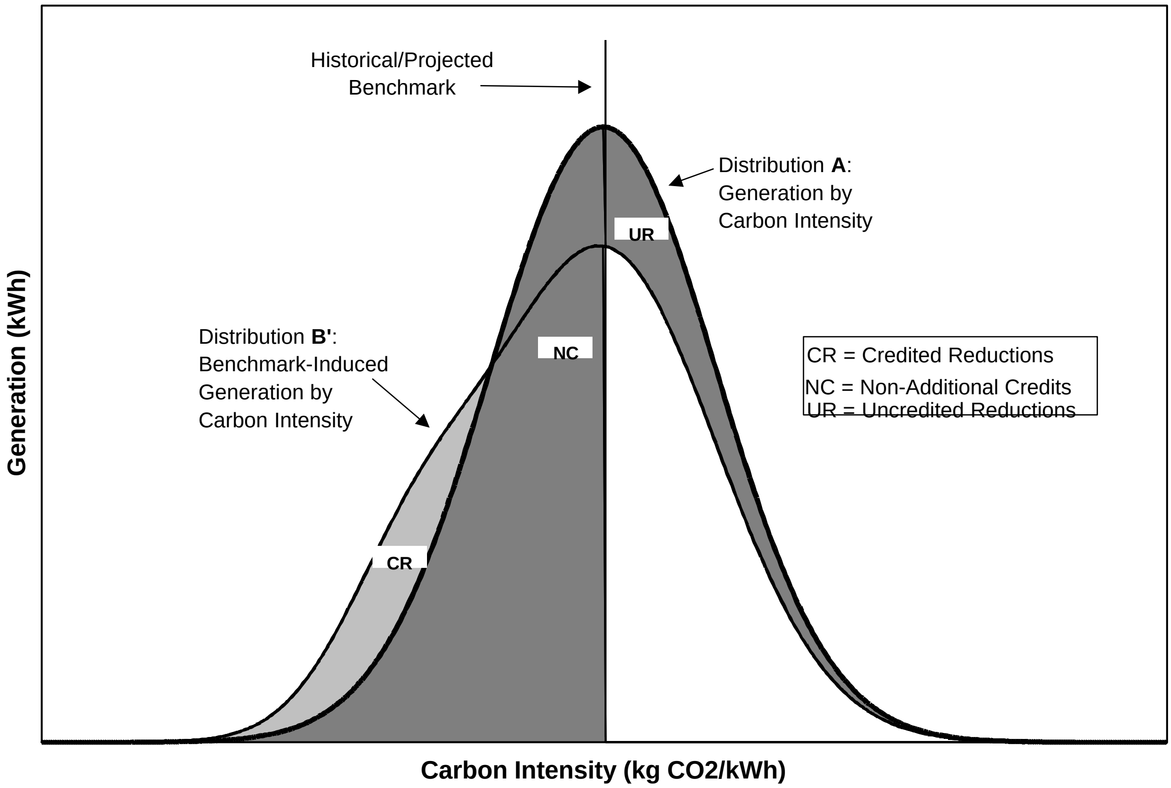
[8]Lazarus, Dunmire, Kartha, Ruth, Bernow. "Clean Development Baselines: An Evaluation of the Benchmarking Approach" Draft Report to EPA. Prepared by Tellus Institute and Stratus Consulting. January 1999

[9]Ibid

Figure 5: Benchmark Example #1: High Participation

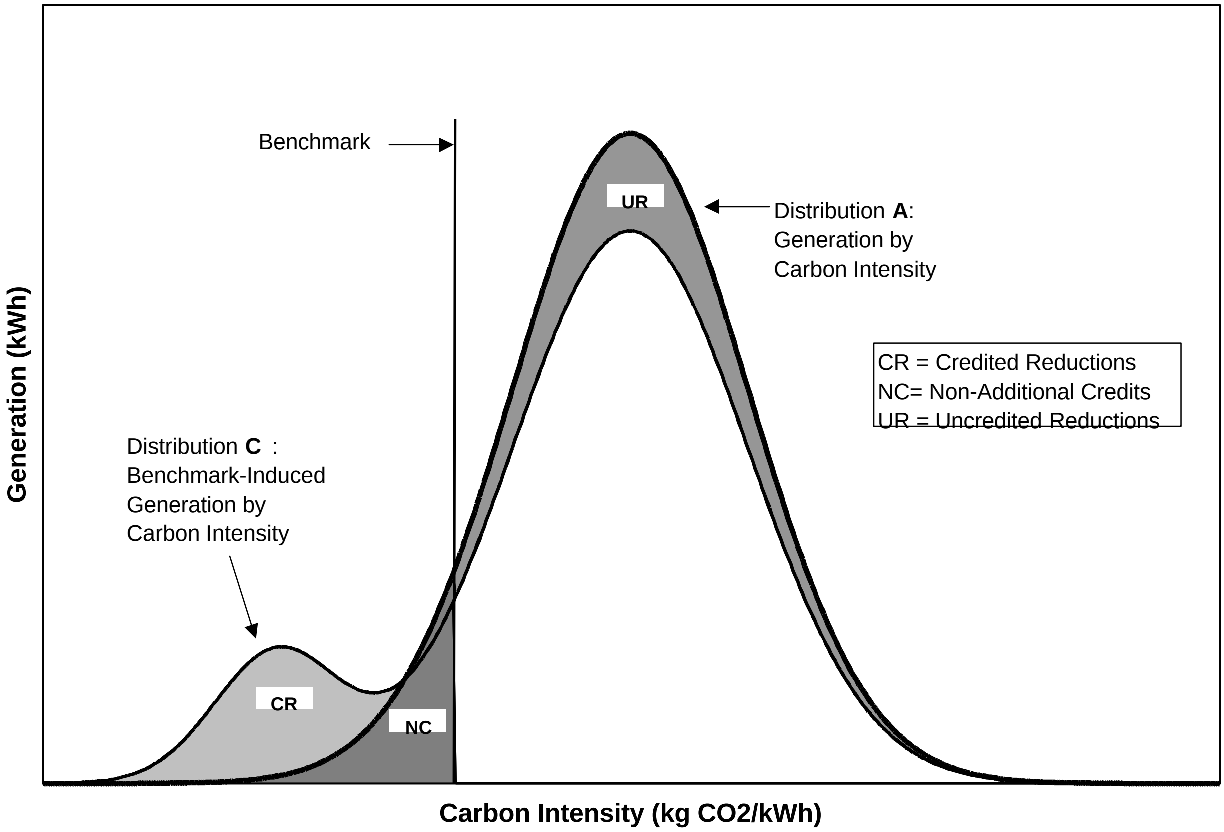


The above illustration shows a theoretical benchmark set at approximately an average carbon intensity. In this example, CDM creates the incentive to move from Distribution A, which has higher aggregate emissions, to Distribution B, which has lower aggregate emissions. The total amount of electricity generation remains the same, but the carbon intensity is lower. Credited reductions (illustrated by the light solid shaded portion of the curve) are emissions reductions that occurred as a result of the CDM. Non-additional credits (the striped portion of the curve) represent electricity generation that is credited because they are below the benchmark, however, no changes in behavior occurred to earn these credits. Uncredited reductions (the dark solid portion of the curve) represents the emissions reductions that are not credited because they are still above the curve. For example, a benchmark set at 0.9 kg of CO2/kWh may create an incentive for a project developer to build a coal plant with an efficiency of 0.8 kg of CO2/kWh over the default choice of a coal plant with an efficiency of 1.0 kg of CO2/kWh. In this instance they reduce their emissions by 0.2 kg of CO2/kWh, but are only credited for 0.1 kg of CO2/kWh. Therefore, 0.1 kg of CO2/kWh is the uncredited reduction.

The benchmark in Figure 5 emphasizes high participation. Although total emissions are reduced, this benchmark allows a significant amount of non-additional generation to be credited.

Figure 6, shows how a benchmark might be created in order to emphasize environmental integrity (crediting only additional emission reductions), that results in low participation. Although the amount of non-additional credits is reduced, the amount of uncredited reductions increases (as shown by the dark shaded area of the curve).

Figure 6: Benchmark Example #2: Fewer Non-Additional Credit
The appropriate choice will depend on objectives established for the CDM.



APPLICABLE SECTORS

Benchmarks are not an appropriate baseline choice for all sectors. Sectors that are most conducive to benchmarks will have the following characteristics:

- *Homogenous output or activity*: A benchmark will serve as the baseline for all relevant projects within a given category. The benchmark cannot be an absolute amount of reductions since productivity within the benchmark category will vary by project. Therefore, the benchmark will need to be based on activity data (e.g.,. kWh sold; tons of steel; value shipments of pulp; tons of biomass; acres of trees; etc.). Homogenous activity data is necessary to construct a meaningful benchmark. For example, the pulp and paper industry has several different types of products, each with distinct markets and energy intensities. Table 1 shows a variety of pulp and paper products and the related average energy efficiency requirements in South Africa.

Table 1: Total production and the energy intensity of the pulp and paper industry in South Africa.

Product	production (tons)	steam (GJ/ton)	Electricity (GJ/ton)	total (GJ/ton)
Tissue	114,000	20	17	37
Uncoated mechanical	61,000	19	10	29
Uncoated woodfree	238,000	19	9	28
Coated woodfree	53,000	24	11	35
Newsprint	320,000	8	8	16
Linerboard	550,000	12	8	20
Fluting	220,000	12	6	18
Paperboard	145,000	16	9	25
Other	108,000	19	9	28
Pulp exports	450,000	8	4	12

Source: Energy Research Institute of South Africa, 1998

Creating one benchmark for paper production would be difficult due to the heterogenous types of output within that sector. It may be possible to create a pulp benchmark since there are fewer types of pulping processes.

- Data Availability: Benchmarks will be based on historical data or on projections (which are typically based on historical data). Therefore, reliable data is essential to constructing the benchmark. In most cases, host country cooperation will be needed to collect the data that may not be readily accessible(for example, unit level electricity data that would be needed to understand the impact of various benchmarks may not be made public, but host countries may have access to it.). In other sectors, data may not be available at all. This is appears to be the case for methane emissions from oil and coal extraction. During extraction, methane is considered a waste product and therefore is not tracked.[10]

  An additional data consideration is equity. Dependable data may not be available for all countries in a given sector. In this case, global benchmarks may be appropriate, or some countries may be aggregated to form a regional benchmark.

- *High Participation.* Constructing a benchmark will require data gathering and analysis. Benchmarks reduce transaction costs only if the cost of constructing a benchmark is less than that of constructing and evaluating project-specific baselines. Therefore, a high volume of CDM projects will increase the cost-effectiveness of the benchmark.

  It is difficult to predict the types of projects that will apply for credits within the CDM. Historically, forestry projects have been popular under the AIJ pilot phase. Electricity production is likely to be an important sector since every country generates electricity and it is tightly linked to development.

Electricity, some industrial demand sectors, energy supply (e.g., natural gas pipelines or coal mining methane recapture), and residential appliance may qualify for benchmarks. The use of benchmarks for forest activity needs further examination.

[10]Ibid

Conclusion

Benchmarks provide an opportunity to increase the efficiency of the CDM by eliminating the need for subjective and time-consuming project-specific baselines in sectors where benchmarks are possible. In sectors for which benchmarks are not possible, alternative baselines will be needed.

Benchmark construction will require difficult decisions regarding the priorities of CDM. International action and cooperation is needed to begin to test benchmarks as a way to determine additionality under the CDM. According to the Kyoto Protocol, projects can begin to accrue credits through the CDM beginning in the year 2000. If we are going to provide early incentives, it is important to begin to address baseline issues, such as benchmarking, now.

REFERENCES

Bilello, Friedman, LeFranc. "The Role of Benchmarks in Assessing Additionality and Emission Reductions under the CDM" . Unpublished draft paper. USEPA. September, 1998

Lazarus, Dunmire, Kartha, Ruth, Bernow. "Clean Development Baselines: An Evaluation of the Benchmarking Approach". Draft Report to EPA. Prepared by Tellus Institute and Stratus Consulting. January 1999.

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