Demand-side energy efficiency promotion under the Clean Development Mechanism: lessons learned and future prospects

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This paper provides an overview of the significance of end-use energy efficiency improvement for sustainable development and of the status of such projects under the Kyoto Protocol's Clean Development Mechanism. It provides an independent analysis of the relevant decisions that have been taken by the CDM Executive Board/Methodology Panel, with a view to: (1) identifying key issues raised, (2) deriving lessons learned, and (3) evaluating whether issues have been handled consistently. It is clear from the analysis presented that the CDM is only making a very small contribution to promotion of energy efficiency (approximately 140 kt CO_2e (carbon dioxide equivalent) per year), despite significant potential for improvement in developing countries worldwide.

The paper therefore offers recommendations on how to improve the process, including creation of a dedicated energy efficiency working group or practitioner/expert forum to derive international best practice with respect to (1) monitoring and verification of CDM projects, drawing on existing protocols, and (2) common elements in the design of CDM baseline methodologies for end-use energy efficiency projects. The recommendations are based on a detailed analysis of common challenges facing such "demand-side" energy efficiency projects and means of overcoming them.

The paper also argues why the CDM Executive Board and Methodology Panel need to acknowledge and give greater attention to the differing nature of the three efficiency markets – discretionary retrofit, planned replacement, and new installations – when developing guidance and tools.

1. Introduction

Investment in end-use energy efficiency can make an important contribution to economic and social development in all countries, by: making the overall economy more energy- and resource-efficient; delivering the necessary energy services at lower cost than new production capacity; reducing the substantial external costs of local pollutant and greenhouse gas emissions; and promoting technological, economic and financial innovation and related job growth in sustainable and/or high-tech industries. As a result, a more energy- and resource-efficient economy can improve the competitiveness of domestic enterprises, lower the cost of doing business in a given country and moderate the rise in commodity and consumer prices (e.g., as a result of reducing oil imports) [Arquit Niederberger et al., in press].

For developing countries facing the challenge of providing adequate energy services to growing populations and economies, investments in energy efficiency improvements are attractive, because they can often be implemented rapidly [Spalding-Fecher et al., 2004].

Creating framework conditions that put cost-effective investments in energy efficiency improvements on an equal footing with investment in energy supply as one option to meet the energy needs of end-users can offer them a number of advantages, including:

- improved access to and reliability of energy services;
- lower and less volatile energy bills;
- improved private sector competitiveness as a result of decreased energy-supply and price risk and improved overall productivity/process efficiency; and
- avoidance of pollutant and greenhouse gas emissions that are damaging to humans, infrastructure and ecosystems [Arquit Niederberger et al., in press].

However, there are well-documented barriers, which can be particularly pronounced in the developing country context, to investment in energy efficiency: knowledge of energy-saving potential is lacking; access to capital can be a challenge in cases where capital markets are not well developed to support the efficiency market; the motivations and decision criteria of those who make investment/procurement decisions (i.e., up-front capital cost of equipment) and those who pay energy bills are often conflicting; and a strong regulatory and enforcement regime and incentives to make energy conservation efforts profitable are lacking.

Table 1. Registered end-use efficiency projects

Title	Host party	End-use sector	Methodology
Energy efficiency through installation of modified CO_2 removal system in ammonia plant	India	Industry	AM0018
Energy efficiency through steam optimization projects at RIL, Hazira	India	Industry	AM0018
Reduction in steam consumption in stripper reboilers through process modifications	India	Industry	AM0018
Demand-side energy efficiency program in the humidification towers of Jaya Shree Textiles	India	Industry	AMS-II.C
Moldova biomass heating in rural communities (Project Design Document No. 1)	Republic of Moldova	Public buildings	AMS-II.E (AMS-I.C and AMS-III.B)
Moldova biomass heating in rural communities (Project Design Document No. 2)	Republic of Moldova	Public buildings	AMS-II.E (AMS-I.C and AMS-III.B)
Moldova energy conservation and greenhouse gas emission reduction	Republic of Moldova	Public buildings	AMS-II.E (AMS-III.B)
Kuyasa low-cost urban housing energy upgrade project, Khayelitsha (Cape Town, South Africa)	South Africa	Residential buildings	AMS-II.C and AMS-II.E (AMS-I.C)

Source: http://cdm.unfccc.int/Projects/projsearch.html, category: Energy Demand

The Kyoto Protocol's Clean Development Mechanism (CDM) is one potential instrument to overcome such split incentive and other financial and non-financial barriers, and a number of countries – for example, China – have made energy efficiency a CDM priority. The Kyoto Protocol to the UN Framework Convention on Climate Change entered into force in February 2005. This agreement defines obligations for industrialized countries to limit greenhouse gas emissions. Although domestic reductions are required, the targets can be met, in part, by emission reductions achieved through climate protection projects implemented in developing countries under the CDM. This should steer investment to least-cost emission reductions, regardless of where these might be located. The resulting certified emission reductions (CERs) can be traded internationally. National legislation to implement the protocol in industrialized countries enables investors to use the credits purchased from climate protection measures in developing countries to meet their own domestic targets. The World Bank estimated the size of the global carbon market at Euro 8 billion in 2005 and Euro 20 billion in 2006 [Capoor and Ambrosi, 2006].

2. Status of energy efficiency promotion under the CDM

2.1. CDM project registration

The sustainable development benefits of improved energy efficiency are widely acknowledged, yet the Clean Development Mechanism has failed so far to live up to its potential to promote more efficient technologies. Among the 358 CDM projects approved up to October 22, 2006, supply-side cogeneration projects are well represented, but only three large-scale and five small-scale projects – out of a total number of 203 and 155, respectively – are aimed at improving the efficiency of energy end-use (this is referred to as "Sectoral Scope 3", energy demand).

The approved energy efficiency projects are listed in Table 1. These eight projects – representing less than 3% of the total number of projects – are estimated to reduce greenhouse gas emissions by only 140 kt carbon dioxide equivalent (CO_2e) per year, a minuscule share of global energy efficiency potential. This is reflected by their limited geographical distribution and sectoral scope.

2.2. CDM project pipeline

The UNEP Risø Centre on Energy, Climate and Sustainable Development (URC) periodically publishes a compilation of projects at each stage of the CDM pipeline, including projects that have been:

- registered by the CDM Executive Board (EB) (see previous section);
- validated by a designated operational entity (DOE) and requested registration by the CDM EB; or
- submitted to a DOE for validation.

In the most recent compilation from October 20, 2006 [URC, 2006], demand-side energy efficiency projects[1] represent roughly 14 % (127) of the total of 916 projects in the CDM project pipeline (submitted to a DOE for validation, but before decision by the CDM EB). The vast majority of these energy efficiency projects are projects in industry (117 projects) and are hosted by Indian entities (76 projects). They have an annual average emission reduction of approximately 100 kt CO_2e per project, with half falling under the small-scale category (< 15 GWh of savings per year). Of the large-scale projects, the vast majority are cogeneration projects (not addressed further in this paper, which focuses on Sectoral Scope 3).

It is clear from this analysis that the CDM is only making a very small contribution to promotion of energy efficiency, despite significant potential for improvement in developing countries worldwide.

Table 2. Overview of CDM methodology approval and rejection for demand-side energy efficiency projects/programs

End-use sector/scope	Approved (A category)	Under revision (B category)	Rejected (C category)
Consolidated	None	None	NA[1]
Large-scale			
Industry	• AM0017 (steam system efficiency at refineries) • AM0018 (steam system optimization) • AM0038 (energy efficiency of electric arc furnaces)	None	• NM0086 (petrochemical industry) • NM0092-rev (smelter upgrade) • NM0099/NM0101/ NM0137/NM0154 (cement) • NM0100 (unitary equipment replacement) • NM0118-rev (brewery optimization) • NM0119 (process energy integration) • NM0169 (efficient utilization of energy in the form of fuel, power and steam)
Municipal infrastructure	• AM0020 (water pumping system efficiency) • AM0031 (expansion of bus rapid transit (BRT) system)	• NM 0144 (efficiency improvement in boilers for district heating)	• NM0046/NM0103 (district heating) • NM0052 (expansion of bus rapid transit system) • NM0136 (electricity transmission & distribution losses)
Commercial/residential	None	• NM0150 (replacement of incandescent lamps by CFLs) • NM0157 (open-DSM[2] type CDM for green lighting) • NM0159 (improved standard for air-conditioners)	• NM0120 (building efficiency, food retailers and similar commercial activity)
Small-scale			
Specific technologies	AMSII-C	NA	NA
Industrial facilities	AMSII-D	NA	NA
Buildings	AMSII-E	NA	NA
Agricultural facilities and activities	AMSII-F	NA	NA

Sources: http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html and http://cdm.unfccc.int/methodologies/PAmethodologies/publicview.html

Notes

1. NA = not applicable
2. DSM = demand-side management

2.3. Methodology approval

One of the barriers that energy efficiency projects face under the CDM is a lack of suitable approved baseline and monitoring methodologies for normal-size projects. On the supply side, a number of cogeneration methodologies have been approved and many projects registered, but the few methodologies approved for demand-side efficiency are for specialized applications (see Table 2) and have generated very few projects. Only one of these approved methodologies has led to registered Sectoral Scope 3 projects (see Table 1), even from those who originally presented the methodologies[2], perhaps because of limitations introduced in the approval process.

The CDM EB has prepared a comprehensive suite of small-scale energy efficiency methodologies (referred to as "Type II project activities", also listed in Table 2). To qualify as a Type II small-scale project (and take advantage of simplified modalities and procedures), a CDM activity must result in less than 15 GWh of energy savings annually. Despite simplified modalities and procedures – which also include a simplified project design document (PDD) and provisions for environmental impact analysis, as well as lower registration fees and other special arrangements – the transaction costs associated with preparing and implementing a small-scale CDM project activity, relative to the revenue from carbon credits, remain significant. Note, however, that while a large number of small-scale projects have been registered in other project categories, energy demand projects account for only 5 registered small-scale CDM projects (3 % of the total[3]).

3. Energy efficiency CDM: lessons learned

3.1. Baseline and monitoring methodologies for energy efficiency CDM

The approval of CDM methodologies takes a "case law" approach: once a methodology has been approved by the CDM EB, it is valid for use by any project developer to prepare new CDM PDDs for official CDM project registration. It is therefore important to get approved rapidly a critical mass of methodologies that can serve as a basis for energy-demand CDM project development across key sectors and applications. As demonstrated above, the current coverage is limited to small-scale projects and four specialized applications in industry and municipal water supply (the BRT methodology in Table 2 is much broader than energy efficiency). Widely applicable methodologies for sectors and technologies with large greenhouse gas emissions from energy end-use, such as energy-intensive industry, buildings and transportation or industrial motors, lighting, office equipment, and appliances have received limited attention and faced rejection in the past and are therefore lacking.

While the small-scale methodologies are short and simple, the criteria applied to evaluate new methodologies for normal-scale CDM projects have been stringent, and have presented particular problems for energy efficiency methodologies. For instance, the requirement to quantify estimates of free riders in a project to promote energy efficiency was one major factor leading to the rejection of NM0100. Similarly, stringent statistical criteria required for an industrial energy efficiency project could lead to a situation where energy savings might become evaluated as negative (e.g., NM0086).

Given the time pressure to get CDM projects implemented as soon as possible, so as to generate sufficient CERs by 2012 to cover CDM transaction and investment costs, it is imperative to assess "what worked" and "what doesn't work" with respect to CDM methodology approval. Such an exercise is also instructive to the official CDM institutions, because it can help assess the degree of consistency and predictability of decision-making outcomes and uncover potential to provide more precise guidance or tools for methodology development.

3.1.1. What worked: approved methodologies

Since the CDM was launched, a total of 192 full-scale baseline and monitoring methodologies have been submitted for approval by the CDM EB. To date, 10 consolidated and 33 other full-scale methodologies have been approved[4], only 3 of which expressly target reductions in energy demand through improved energy efficiency (Sectoral Scope 3). Two of these deal with steam system efficiency improvements (AM0017, at refineries; AM0018, at an ammonia plant), but they take different methodological approaches. The third approved methodology (AM0020) is for water-pumping system efficiency improvements.

To date, only AM0018 has been used by project developers as a basis for submitting projects for approval, signaling that it is a viable approach in practice.

Given the fact that only three CDM methodologies for demand-side energy efficiency projects have been approved, it is difficult to draw general insights about common factors for successful methodologies. One thing that AM0017, AM0018 and AM0020 do have in common is that they all focus on discretionary retrofits of existing energy-using equipment or systems and therefore apply Baseline Approach 48a ("existing actual or historical emissions") and historical benchmarking of performance. Yet these methods have different applicability (e.g., discrete equipment vs. complete systems), performance measures, benchmarking periods (range from 1 month to 2 years), dynamic elements in the baseline, and monitoring methods (e.g., measurement vs. survey vs. control group).

Furthermore, they are inconsistent in their treatment of autonomous improvement (NM0017 makes use of control groups for this purpose; NM0018 deducts the impact of future retrofits on CDM project activity from claimed emission reductions; NM0020 does not address it at all). And they differ on whether or not the "tool for demonstration and assessment of additionality" is required and whether ACM0002 is the methodology that must be used for estimating the emission factor from grid electricity.

3.1.2. What doesn't work: rejected methodologies

Analysis of the CDM methodologies in Table 2 shows that the CDM EB has given a number of common reasons for the rejection of new methodologies for energy efficiency projects. These can be summarized as a failure to do one of the following.

- Select an appropriate *project scope* or specify how methodology can be applied in different sectors. Some methodologies were deemed to be too general to account for unique methodological attributes of different sectors or processes; for others, algorithms to calculate emissions for specific processes were lacking.
- Provide a *procedure to select baseline scenario.* Many early proposals defined only a single baseline scenario, and suggested that the additionality tool was a substitute for this step or stated why one scenario would best describe greenhouse gas emissions in the absence of the project activity. There appears to be inconsistency between the requirements (1) to provide a baseline scenario selection procedure and (2) to select a baseline approach, since the latter includes approaches (48a and 48c) that pre-define the baseline scenario. Because almost no methodology submissions have chosen

Approach 48c, the use of a baseline scenario selection process in this approach has not been tested yet.
- Clearly define the *project boundary* (e.g., geographical boundary, greenhouse gas sources included/excluded, ownership).
- Specify *data/assumptions* and explain how to determine if these are adequate, reliable and conservative. Very often, methodologies neither make key assumptions explicit nor justify or provide guidance to project developers on acceptable methods to document key variables and assumptions, so that they can be validated by a DOE (e.g., load factor, hours of operation, equipment lifetime). Establishing a baseline in a transparent and conservative manner is crucial.
- Consider *autonomous energy efficiency improvements,* account for planned replacement and address *"free riders".*
- Take into account *factors unrelated to energy efficiency measures* that can affect future emissions. Rejected methodologies have attributed all energy savings in a system to the proposed CDM activities, but there can be other factors – such as fuel choice/fuel price, changes in level of production or product palette – that can lower energy demand.
- Distinguish among *energy efficiency markets* (i.e., discretionary retrofit; planned replacement ("lost opportunity"); new equipment markets).
- Give full consideration to *leakage.* It is not enough to state that leakage is not expected for a given type of project; all potential sources of leakage need to be evaluated and justification provided, if they are regarded as non-material.
- Provide adequate guidance on developing a *monitoring plan.* Whereas the algorithms and data collection tables are often complete, several elements are typically missing: step-by-step information on how to establish the monitoring plan; information to demonstrate that the monitoring methodology reflects good monitoring practice (e.g., application of widely adopted monitoring protocols); and appropriate quality control/quality assurance procedures.
- Provide *level of methodological specificity* sufficient to allow the DOE to verify reductions. In several cases, the proposed methodologies have been so vague that the DOE has no objective basis for validating claims for emission reductions.
- Ensure sufficient *editorial quality.* Proposals sometimes do not define all parameters and explain all formulae, and these are sometimes inconsistent (also with respect to their application in the draft PDD).

In addition, there have been a plethora of unique issues with individual proposed new methodologies, such as failure to: implement changes requested by the Methodology Panel; justify the need for a complex methodology (when simpler, more robust and/or readily verifiable methods are available); limit use of small-scale operating margin methodology for determining grid electricity factors to projects with electricity savings <15 GWh per year; address planned industrial process changes; provide a methodology to handle variable load applications; treat plants or buildings individually; differentiate electricity emission factors, based on distribution of end-use equipment within project boundary (i.e., use regional rather than national grid emission factors); adequately evaluate uncertainties; and demonstrate that efficiency gains are significant relative to uncertainty (signal-to-noise ratio).

3.2. General issues for energy efficiency CDM

Our analysis indicates that methodologies for energy efficiency projects can receive CDM EB approval, but it is difficult to distill the key ingredients shared by approved methodologies (beyond their focus on the discretionary retrofit market and application of Baseline Approach 48a). Furthermore, the success rate for energy efficiency methodologies is relatively low.

The quality of new methodology proposals has varied widely; some proposed new methodologies were simply not prepared well enough to meet the demands of the CDM. Yet there were also many thoughtful and professional attempts to draft credible methodologies that were rejected, a fact that appears to have discouraged the development of new methodologies (in the last two new methodology submission rounds combined, only one Sectoral Scope 3 methodology was proposed).

It also remains to be demonstrated whether the three methodologies approved so far are viable in practice (the exception is AM0018, which is being used by a growing number of projects).

In the following sections, we discuss some of the key challenges of CDM methodology development for end-use energy efficiency and suggest means of overcoming them.

3.2.1. Non-financial barriers, additionality and CDM

A great deal of experience and a vast literature on barriers to the uptake of high-efficiency equipment and practices has been accumulated since the first oil shock in the 1970s. It is crucial for parties to the Kyoto Protocol and members of the CDM EB and Methodology Panel to acknowledge that barriers to energy efficiency projects are generally not strictly financial in nature, yet additional CDM finance can nonetheless provide an important additional incentive.

There are many reasons for this, including the reality that capital investment decisions generally are not made on the basis of what is cost-effective, but rather on the basis of which investments bear the least risk and will give the greatest/most rapid return on investment. Another major barrier is that those who purchase energy-using capital equipment or appliances are often not the ones who pay energy bills; thus their main concern is low equipment purchase price (and in some cases technological factors such as performance or reliability), not operating costs such as energy bills. It is also important to acknowledge that significant barriers to high-efficiency equipment and practices are widespread, even in the most advanced economies.

To qualify for CDM registration, a project/program of activities must demonstrate additionality, that is, it must reduce anthropogenic emissions of greenhouse gases by

Table 3. Energy efficiency markets

Market	Definition
Discretionary retrofit	Decision to prematurely replace existing technology with high-efficiency equipment for the primary purpose of improving energy efficiency
Planned replacement	Decision to replace existing technology at the end of its useful lifetime (e.g., failure, replacement schedule) with high-efficiency equipment
New installations	Decision to select high-efficiency equipment over other alternatives at the time of new installations

sources below those that would have occurred in the absence of the registered CDM project activity. The emission reductions are determined on the basis of a counterfactual baseline scenario, defined at the time of project validation, and a calculation of baseline emissions using algorithms included in the selected approved baseline methodology. This can be very difficult to estimate for energy efficiency projects, especially for dispersed projects.

In considering project additionality, the three major energy efficiency markets need to be treated separately (see Table 3). There are generally greater barriers to discretionary retrofits of existing, well-functioning systems than there are to planned equipment replacements or new installations (see the following section for a discussion). In the field of energy efficiency projects, the targeted efficiency market thus has implications for the selection of an appropriate baseline approach, which, in turn, determines the significance of barrier analysis for baseline scenario selection and additionality determination.

For discretionary retrofits, Baseline Approach 48a is the obvious choice, since such a project is replacing existing, functioning equipment before the end of its useful lifetime. For discretionary energy efficiency retrofits, the key to demonstrating additionality is for project proponents to provide convincing evidence that the retrofit was indeed discretionary and not a planned replacement, i.e., the project/program of activities was undertaken with the primary aim of reducing greenhouse gas emissions.

The planned replacement and new installation efficiency markets pose other issues for additionality assessment, since these generally involve new investment decisions[5]. The fact that investment in high-efficiency industrial equipment, consumer appliances or lighting is cost-effective by some measure (such as least lifecycle cost) should not be taken to mean that end-use efficiency projects are non-additional. On the contrary, the fact that such investments are not being made, despite their cost-effectiveness and often short payback periods, is evidence of significant barriers in the marketplace.

Both the additionality tool and the draft baseline scenario selection tool (BSST) give examples of barriers that could prevent alternative scenarios in the absence of CDM, namely investment barriers, technological barriers and barriers due to prevailing practice. However, these are not the major barriers facing energy efficiency projects. It would be helpful to include in the examples typical barriers to energy efficiency projects/programs, such as those mentioned above. It could be helpful for the EB to provide guidance on barrier analysis techniques for energy efficiency projects, based on the experience of approved and rejected methodologies, as well as inputs from experts in the field (e.g., via a discussion paper, a call for public inputs and/or a workshop).

Another issue related to additionality testing for energy efficiency projects is the difficulty of performing the common practice test in Step 4 of the tool for assessment and demonstration of additionality. This step requires project participants to identify similar projects in the same region/country and to explain why they are different from the proposed CDM project activity. For a single project site or technology, this analysis is relatively straightforward; but for a project or program with a large number of sites, pieces of equipment or even different technologies, as is common in the end-use energy efficiency sector, this is problematic [Sathaye, 2006; Kartha et al., 2005].

3.2.2. Efficiency markets: new installations, planned replacement, discretionary (early) retrofit

With the exception of AM0017 – which has yet to be applied to a registered CDM project – the approved energy demand methodologies target energy efficiency improvements that result from discretionary retrofits by the project owner to their existing, properly functioning equipment or systems. Thus there is a huge gap in coverage, both of the planned replacement market (i.e., replacement of equipment at the end of its useful lifetime, such as when steam traps fail, which is the specific situation addressed by AM0017) and of the new installations market (e.g., expanding an existing, or building a new, facility/system). Particularly in developing countries with rapidly growing and industrializing economies, the new installation market represents the key opportunity for cost-effective energy efficiency improvement.

Methodology developers have not always stated clearly which efficiency market their methodology targets, and in some cases different efficiency markets were targeted implicitly, without respecting the relevant guidance from the EB: the "Guidance regarding the treatment of 'existing' and 'newly built' facilities" states that, "if a proposed CDM project activity seeks to retrofit or otherwise modify an existing facility, the baseline may refer to the characteristics (i.e., emissions) of the existing facility only to the extent that the project activity does not increase the output or lifetime of the existing facility. For any increase of output or lifetime of the facility which is due to the project activity, a different baseline shall apply." This text lumps discretionary retrofits and planned replacements together under "existing facilities", but as described in the previous section, Baseline Approach 48a might rarely be appropriate for planned replacements.

The guidance to methodology developers could be improved by defining the three different efficiency markets – discretionary retrofit, planned replacement, new installations – and by requiring that those submitting proposed methodologies for Sectoral Scope 3 indicate which efficiency market their methodology targets. This could be incorporated into a revision of the respective form for proposed new methodologies or could be included in the "Technical Guidelines for Development of New Baseline and Monitoring Methodologies" discussed later in this paper.

In addition, the draft BSST and the additionality tool need to reflect the distinction in energy efficiency markets. All of the approved methodologies targeting the discretionary retrofit market have appropriately used Baseline Approach 48a, which defines the baseline as actual or historical emissions. Yet the draft BSST requires analysis of alternative scenarios. To be applicable to Approach 48a, the BSST should state that the list of alternatives to be determined in Step 1 may include only the status quo and the proposed project not undertaken as a CDM project, if Baseline Approach 48a (actual or historical situation) is used [World Bank, 2006a]. The status quo under Baseline Approach 48a is to use the existing equipment until its planned replacement. Because this approach to baseline scenario selection is different from what would normally be considered for energy supply projects, the draft BSST (see Section 4.2.4) is not appropriate for methodologies in this market/sub-sector without modification.

For the discretionary retrofit market, Approach 48a is a good match with the decision facing project owners on the ground: to either continue with business-as-usual, or to invest in more efficient technology, before the existing technology needs to be replaced. The methodological challenges are to provide clear guidance on excluding planned retrofits and to agree on whether and how to address autonomous efficiency improvements in the baseline and to minimize the level of free ridership in project/program design, both of which are discussed in separate sections, below.

For the planned replacement and new installations markets, more work needs to be done to explore the applicability of the three baseline approaches (48a/48b/48c). It would appear that each of these approaches could be applicable to the planned replacement market, depending on the situation. In this market, the project owner knows that equipment must be replaced; he/she may use replacement equipment already purchased or purchase any equipment available on the market. If replacement equipment has already been purchased, for example, if a chemical plant keeps an inventory of spare electric motors to prevent plant downtime when motors fail, this would represent an obvious baseline (under Approach 48a), since not employing this equipment would represent a sunk cost.

If the equipment purchase decision is wide open, however – as is also the case for the new installation efficiency market – another approach is needed. The alternatives offered in sub-paragraphs 48b and 48c of the CDM modalities and procedures are difficult to apply to energy efficiency projects, a fact that may explain the lack of approved methodologies for the planned replacement and new installation markets. Approach 48b requires that a baseline technology be defined, which represents an economically attractive course of action, taking into account barriers to investment. As stated above, there is great economic potential for energy efficiency improvement, but other barriers prevent the uptake of efficient technologies. Applying the draft BSST could actually be helpful for this case, as the barrier analysis could make an investment analysis unnecessary. Although the 48b approach should take into account "barriers to investment" it is not at all clear how this is to be done in practice, and more guidance, targeted at energy efficiency projects, is needed.

Approach 48c defines baseline emissions in terms of average emissions of similar project activities undertaken in the past (i.e., within the previous five years, in similar social, economic, environmental and technological circumstances) and whose performance is among the top 20 % of their category. For large, discrete pieces of end-use equipment in industry, such as a boiler in a power plant or a kiln in a cement plant, this approach could work, but many energy efficiency opportunities are associated with small, dispersed efficiency improvements for which comparable performance data are simply not available, not least because the specific setting in which a given end-use technology is deployed can be very diverse. This is the same challenge as applying Step 4 of the additionality tool (see previous section).

Thus, new baseline approaches applicable to the planned replacement and new installation markets may be required to open the door for CDM to promote energy efficiency in these important markets across end-use sectors. Benchmarking, reference to minimum efficiency performance standards and standardization of operating parameters need to be explored.

For each of the three efficiency markets, it would be helpful to develop generic methodological approaches that could result in better methodological guidance for demand-side energy efficiency projects/programs or "methodology modules" (see Section 4.3.5 below).

3.2.3. Discrete equipment vs. systems approach

Whereas the energy efficiency of some types of equipment is relatively independent, more often than not, taking a more systematic approach can uncover greater energy-saving potential. In the case of industrial electric motor systems, the difference is striking. Based on Motor Challenge programs[6] in North America and Europe, it is widely agreed that upgrading the efficiency of the motor alone captures only roughly 10 % of the energy-saving potential [SEEEM, 2006], with the rest attributed to proper dimensioning of the motor; use of adjustable-speed drives, where appropriate; efficient end-use equipment, such as fans, pumps, compressors, or traction systems; and optimization of pipes, ducts, belts, and gears.

Although methodologies have been approved that take both a systems (AM0018, AM0020) and a discrete equipment (AM0017) approach, methodologies for some complex types of systems have been rejected (e.g., building efficiency, cement plant efficiency). One reason is that it is difficult to demonstrate that the energy savings achieved are attributable to the CDM activity alone, rather than to other factors (e.g., NM0120, NM0137). Due to a lack of approved methodologies, other project developers have chosen to focus on the retrofit of discrete equipment to avoid methodological difficulties of addressing complete systems (NM0100), even though much greater CER generation would be possible by taking a systems approach (and also addressing the new equipment market, where it is much easier to consider complete systems).

There is no easy fix to this dilemma. It will be important to develop a consensus on international best practice for the determination of energy savings from different types of energy efficiency projects and programs that could lead to the adoption by the CDM EB of consolidated methodologies for important systems. Industrial electric motor systems in industry and the tertiary sector (buildings, municipal infrastructure), for example, account for at least 40 % of electricity demand worldwide [SEEEM, 2006], yet no approved methodology exists to support high-efficiency motor systems in industry and buildings.

3.2.4. Autonomous efficiency improvements and exogenous factors

In numerous cases, proposed new baseline and monitoring methodologies for energy efficiency activities have been rejected for two related reasons:

- their failure to account for autonomous efficiency improvement trends in the baseline; or
- attribution of emission reductions to the CDM project activity, although they may be the result of exogenous factors not included in the baseline methodology.

Even more importantly, these are two issues that have been dealt with inconsistently. Some approved methodologies do not address autonomous efficiency trends at all (e.g., AM0020), whereas numerous other proposed methodologies were criticized and rejected, in part, for their failure to take efficiency improvement trends into account. More consistent decision-making and clearer guidance on this point (that differentiates baseline approaches and efficiency markets) would be extremely helpful in promoting end-use efficiency under the CDM.

It may be more pragmatic to address the issue of autonomous efficiency improvement through ensuring appropriate crediting periods (taking into account remaining equipment lifetime) and proper provisions for reassessing the baseline under methodologies that select a renewable crediting period than to require elaborate control group studies or market analyses that may not be relevant to the decision process at the level of an individual project owner. In particular for discretionary retrofit projects, an owner has the option of doing nothing (leaving the existing technology in place until its planned replacement), or replacing existing equipment sooner than necessary with high-efficiency technology. If a project is a truly discretionary retrofit, then there is no trend in efficiency improvement in the baseline at the project level. This general rule could be applied to projects that use Baseline Approach 48a and have a non-renewable crediting period.

Baseline Approach 48c inherently addresses the efficiency trend issue, since it defines baseline emissions in terms of average emissions of similar project activities undertaken in the previous five years and requires that only projects whose performance is among the top 20 per cent are taken into account. Therefore there is no need for correction factors to be determined by elaborate control groups or uncertain trend analyses when Approach 48c is selected. Unfortunately, as shown above, this approach is very difficult to apply to actual projects, including energy efficiency projects, because of the difficulty in determining the appropriate benchmark.

With respect to Approach 48b, benchmarking might be a better approach. Some approved methodologies allow a trend to be either (1) determined *ex-ante,* on the basis of control groups or reputable data sources, or (2) assumed, on the basis of a default value.

3.2.5. Free riders/drivers

Under the CDM methodology approval process, concerns have also been raised about “free riders”. The concept of “free riders”/”free drivers” is not mentioned in the CDM rules and procedures. A free rider is an efficiency program participant who would have implemented the program measure or practice in the absence of the program; whereas “free drivers” do not participate in the CDM program, but adopt efficiency measures because of it, for example, as a result of increased awareness of efficiency opportunities [Geller and Attali, 2005].

The concept of additionality does not exclude such free rider/free driver effects; it merely requires that emissions under the project activity or program of activities in the aggregate are lower than they would have been without the CDM activity (i.e., lower than the emissions in the baseline scenario). Where free ridership/drivership is relevant is in the determination of the baseline emissions themselves.

This is important to keep in mind, given that such effects are notoriously difficult to quantify. Methods of determining free rider or free driver levels in conjunction with financial incentives include surveys/interviews with program participants and non-participants; determining whether an investment would also be profitable without financial support (where profitability is judged on the basis of the payback period required by the investor); and research on quasi-control groups [SAVE, 2001]. Some of these approaches are being tested in proposed new baseline and monitoring methodologies and have been subject to Methodology Panel scrutiny, but it is too early to say whether they will be accepted by the CDM EB. Another approach would be to determine trends in autonomous market penetration of high-efficiency equipment targeted by the CDM program, on the basis of survey or sales data, if it is available. The rate of free-ridership could then be assumed to be proportional to the overall market penetration rate. The challenge with this approach, however, is whether past trends are a good indication of future trends, which is not necessarily the case.

It is also possible to design energy efficiency promotion programs so as to minimize potential free riders. Bad experiences in the USA with programs to provide direct financial incentives to purchasers of efficient industrial equipment, for example, have encouraged a shift towards programs that target equipment distributors, rather than end-users [Benkhart, 2006]. Under such programs, distributors that stock and market efficient equipment above status quo levels are rewarded for their performance. In general, the fraction of free riders would probably be lower in the discretionary retrofit market than in the new or replacement markets, because the barriers to retiring equipment prematurely go beyond financial considerations.

It could be helpful to require those proposing new methodologies and CDM project activities/programs of activities under Sectoral Scope 3 to explicitly address free rider/driver effects, analogous to the way that leakage is treated. This could be included in the guidelines for the PDD, or the technical guidelines for new methodologies. If the baseline is conservative, as it should be according to the CDM rules and procedures, and if the energy efficiency project or program is designed with a view to minimizing free riders (and even encouraging free drivers, for example, through related information campaigns), then there may be no need to quantify such effects in baseline and monitoring methodologies. Otherwise, guidance on acceptable techniques, such as those indicated above, could be provided.

3.2.6. Baseline data availability, monitoring and transaction costs

One of the biggest barriers to energy efficiency CDM – and to assessing the impacts of all demand-side management programs – is the difficulty of ensuring credibility while keeping the transaction costs associated with determining baseline and project emissions at viable levels. In contrast to emissions associated with fossil power generation, which can be calculated from fuel use data and CO_2 emission factors, determining emission reductions from demand-side energy efficiency projects and programs is less straightforward.

Energy efficiency projects/programs under the CDM result in reduced demand for electricity or other forms of energy with respect to the baseline to produce the same energy service. For large-scale efficiency retrofit projects, some of the necessary baseline data might already be available as a result of normal monitoring processes (e.g., fuel use), and collecting any additional baseline data required by the CDM (e.g., hours of operation, load factor) is generally neither technologically nor economically prohibitive. However, the vast majority of energy efficiency improvements in terms of numbers will be smaller rather than larger and will derive from all three efficiency markets. When considering industrial electric motors, for example, a higher percentage of efficiency gains is possible as motor size decreases, and there are more small and medium-sized motors than larger ones. In addition, as is the case for all types of CDM projects that result in a reduction in demand for grid electricity, it is often a challenge to obtain the necessary data to calculate grid emission factors accurately.

Some projects are quite simple to monitor directly, such as the retrofit of a single water-pumping system, and there are few exogenous factors that would affect the energy demand of the system. Other systems, however, are far more complex. One unsuccessful methodology tried to address energy efficiency improvements by a food retailer. Emission reductions were to be measured by tracking changes in electricity use recorded on electricity bills. However, the Methodology Panel rejected this methodology for a number of reasons. Some of these were quite specific to the type of business and location of the project activities, for example, failure to account for any changes in the composition (e.g., a greater share of frozen/chilled food in supermarkets as opposed to other types of commercial facilities) and location of shops (climatic impacts on energy demand for cooling).

Monitoring costs can be a significant barrier to dispersed CDM projects in energy efficiency. One set of CDM projects, each grouping several hotels and resorts in a tropical country, was developed through the (small-scale) PDD stage, but was never presented for validation, since the cost of monitoring these small projects (small by CDM standards, not by building energy efficiency standards) at various locations is expected to be too high compared to CDM revenues [Dutt, 2006].

This is an area where a consensus on best practice is essential. A great deal of work has been done internationally, by national governments, by utilities and other private actors, and by NGOs to devise measurement and verification protocols for energy efficiency activities (see Table 4). In addition, many other public and private actors, such as energy agencies and utilities, have developed methodologies to assess the impact of energy efficiency programs. All of these stakeholders need to be brought together to propose best practice monitoring and verification approaches for key sectors and technologies under the CDM.

4. Future prospects for energy efficiency under the CDM

4.1. Programmatic CDM

Programmatic CDM is a new concept, derived from the decision of the parties to the Kyoto Protocol in December 2005 that:

> "a local/regional/national policy or standard cannot be considered as a clean development mechanism project activity, but that project activities under a program of activities can be registered as a single clean development mechanism project activity"

provided that CDM methodological requirements are met. In other words, the adoption of a policy or standard in and of itself cannot be submitted as a CDM project, but the activities that constitute the actual implementation of that policy or standard – such as an incentive program for equipment that meets a voluntary high-efficiency level – can be submitted as a single CDM project activity in the form of a program.

Table 4. Ongoing monitoring, evaluation, reporting, verification and certification (MERVC) activities

Convening organization(s)	Title of initiative	Objective	Focus	Key deliverables
California Climate Action Registry (CCAR)	CCAR Emission Reduction Protocols	To develop protocols for quantifying emission reductions from projects (drawing on WRI protocol effort)	Performance standards approaches	Protocols for quantifying emission reductions from projects (in preparation)
Efficiency Valuation Organization	International Performance Measurement & Verification Protocol (IPMVP)	To develop and promote the use of standardized protocols, methods and tools to quantify and manage the performance risk and benefits associated with end-use energy efficiency, renewable energy and water efficiency business transactions	Development of monitoring and verification protocols	IPMVP Volume I provides general guidance for energy efficiency M&V for buildings and industry. Volume III addresses new construction.
IEA DSM Program	Evaluation Guidebook on DSM and EE[1] Programs related to Kyoto GHG Targets	To develop, test, and promote an evaluation guidebook for governmental and non-governmental energy efficiency programs and also for (utility) DSM programs targeted towards energy end-users and focussed on GHG reductions to meet Kyoto targets	Guidance on evaluation of DSM programs	Evaluation Guidebook on DSM and EE Programs related to Kyoto targets
IEA/OECD Annex I Expert Group	Project-Based Mechanisms Program	Analytical work to support Annex I countries in UNFCCC negotiations and their national climate change policy development with respect to design options for JI and CDM projects	Baseline design issues	Analytical papers on CDM methodological issues discussion in Annex I Expert Group
International Standards Organization	ISO 14064-2 International Standard for Greenhouse Gas Accounting*	To develop international standard for quantification, monitoring and accounting for GHG reduction projects	Project-based emission reductions from all sectors	International standard for quantification, monitoring and accounting for GHG reduction projects
Japanese METI[1]	Future CDM Project	Development of CDM methodologies in previously underrepresented areas	Methodologies for: (1) energy efficiency and (2) transportation sector CDM	Methodologies submitted to CDM EB for approval ("Methodology for Open-DSM Type CDM for Green Lighting" not recommended for approval by Meth. Panel)
WRI/WBCSD[1]	GHG Protocol for Project Accounting	To develop project accounting framework that is program-neutral and compatible with the CDM as well as other programs	Project-based emission reductions from all sectors	GHG protocol for project accounting
WBCSD	CO_2 Accounting and Reporting Standard for the Cement Industry	To provide a harmonized methodology for calculating CO_2 emissions, with a view to reporting	Emission inventories and reporting for the cement sector	Cement CO_2 Protocol

Note

1. EE = energy efficiency; METI = Ministry of Economy, Trade and Industry; WRI = World Resources Institute; WBCSD = World Business Council for Sustainable Development

However, there is little clarity and no guidance from the parties to the Kyoto Protocol or the CDM EB on what constitutes a "program of activities" under the CDM and what the implications are for methodology and project approval. To remedy this situation, at its May 2006 session, the CDM EB requested the Methodology Panel to prepare a tabulation of issues for preparing definitions of terms for CDM project activities under a program of activities (which will be discussed by the EB at its 25th meeting) and launched a call for public inputs on definition of "policy" and "program of activities" (from May 19 through June 16, 2006).

The distinction between a CDM program of activities and a bundle of CDM project activities has been summarized by the World Bank [2006b] in its submission under the call for public inputs. Bundles and programs differ primarily with respect to the function of the CDM project participants and the level of *ex-ante* certainty with respect to the specific activities to be undertaken. Under a program of activities, targeted types of activities and the expected overall volume of emission reductions are known; whereas what, when and where specific mitigation measures are undertaken and by whom can only be determined at the validation stage. Under a program of activities, the CDM project participant operates the program – such as a utility or energy-saving trust running a demand-side management program – but is not necessarily the actor(s) that implement(s) the actual greenhouse gas reduction activities, which are often dispersed end-users in industry or households.

Demand-side energy efficiency programs are a typical example of a program of activities as defined above. This explicit acceptance of a programmatic approach to the CDM opens the door to better address specific methodological issues facing energy efficiency promotion efforts, even if there is no need for the EB to provide additional guidance for programs of activities, as some have claimed [World Bank, 2006b].

The Methodology Panel prepared a list of issues related to "project activities under a programme of activities" at its June 2006 meeting. They noted that there are already 27 registered CDM projects, including both large- and small-scale projects, where the activities occur at different sites and may also involve more than one sector. These include large-scale industrial projects that are at multiple sites but use a methodology developed for a single site. The Methodology Panel has requested further guidance from the EB and also identified key methodological issues that need to be addressed for programs. These include how to address free riders in additionality testing and baseline selection; whether and how projects that implement a mandatory regulation should be considered additional; how to construct a common baseline scenario; how to prevent double counting of activities; the sample size of the activities that must be monitored; and how to apply a crediting period across many activities. All of these issues are directly relevant to energy efficiency programs.

4.2. Initiatives of the CDM Executive Board

During the past year, the EB has undertaken a range of initiatives to improve the process of developing new baseline and monitoring methodologies and revising existing approved methodologies, as well as to improve the quality of the submissions that are evaluated. These processes, guidance documents and tools can accelerate the development of methodologies relevant for end-use energy efficiency.

4.2.1. Methodology pre-assessment

The CDM EB has taken several steps to improve the initial quality of methodology submissions.

- It has introduced a fee for submitting new methodologies, which is deducted from the registration fee, if the methodology and project are approved.
- It has invited DOEs to undertake a voluntary pre-assessment of proposed new methodologies to evaluate their overall quality and completeness. This can be carried out by the Methodology Panel, but having a DOE do the pre-assessment speeds up and can improve the process. By weeding out poor-quality submissions early on, the pre-assessment step can save time and avoid wasting scarce resources on the evaluation of submissions that are unlikely to be approved.

4.2.2. Clarifications and queries regarding approved methodologies

At its 20th meeting, the EB formalised the procedures for a DOE to submit a query related to an approved methodology. These were further updated at its 24th meeting (EB24). The process for these queries is for the DOE to submit the required forms to the Secretariat, which forwards them to the Methodology Panel and EB and makes them publicly available. If the query is received at least 6 weeks before the next Methodology Panel meeting, it can be considered for recommendation at that meeting. One Methodology Panel member drafts recommendations, which are reviewed and approved or rejected at the panel meeting. This means that responses to clarifications should take between 8 and 20 weeks, since Methodology Panel meetings are typically every 3 months and meeting reports are generally available 10 days after the meeting finishes.

DOEs (representing project participants) have used the clarification process extensively; the Methodology Panel has considered more than 31 clarifications so far. Most of these queries are relatively narrow and related to interpretation of the approved methodologies. In some cases, the Methodology Panel has prepared a revised version of the approved methodology based on the response to the clarification, in which additional clarifying text was added into the methodology. In other cases, however, it has simply answered the question of the DOE on how a methodology should be interpreted. It has also indicated in some cases that the approved methodology cannot be applied to the project in question. Where the request for clarification requires changes to the methodology, the EB has directed the project participants to go through the process for revision of an approved methodology (e.g., EB24 report, Paragraph 11).

4.2.3. Technical guidelines for methodology development

To ensure consistency in the submissions of new methodologies, the EB publishes and periodically revises guidelines for the preparation of new methodologies. The EB released Technical Guidelines for the Development of New Baseline and Monitoring Methodologies at its 24th meeting. The purpose of these guidelines is to reduce the time and effort required to evaluate and revise methodology proposals, including the reformatting process after EB approval of methodologies. The most recent revision combines the baseline and monitoring methodologies into a single document, and provides detailed technical guidelines on how to prepare methodologies, as well as pulling together all EB guidance provided at previous meetings on methodological issues. Following these guidelines, there is expected to be greater comparability across methodology proposals, including the transparency of assumptions. For project developers, the guidelines will also reduce the time and effort to prepare a new methodology, as well as the time required to validate projects using approved methodologies.

4.2.4. Additionality and baseline tools

The CDM EB has developed generic tools for testing additionality and for identifying an appropriate baseline scenario. These pre-approved tools can be incorporated into any new methodology proposal, reducing uncertainty for methodology developers. The additionality tool (AT) has been used by a large majority of the methodology submissions since it was released. It is currently under revision, following a request from the parties to the Kyoto Protocol for the CDM EB to consider new proposals and improvements to the additionality tool.

The baseline scenario selection tool (BSST) was released as a draft by the Methodology Panel in February 2006. It offers a pre-approved procedure that methodology developers can incorporate into proposed new methodologies to select an appropriate baseline scenario, which was lacking in many early methodology submissions. The BSST has similar tests to the additionality tool, including barrier analysis, investment analysis and common practice assessment. Following a call for public inputs by the EB, the Methodology Panel has prepared recommendations on how to revise and potentially merge these two tools, doing which may or may not prove helpful in the development of new methodologies for energy efficiency programs/projects. The most recent EB meeting did not reach final agreement on how to combine and/or modify the tools, so this work is ongoing in the Methodology Panel.

Several submissions on the current draft BSST point out that it may not be appropriate across all sectors, and for Sectoral Scope 3 may pose some particular problems. The rationale followed by the BSST is to identify the most attractive investment alternative from among those alternative scenarios that are not prevented by a barrier [World Bank, 2006a]. As a result, the BSST requires plausible and credible alternatives to the project activity scenario other than continuation of the current situation to be evaluated, even though Baseline Approaches 48a and 48c pre-define what the baseline scenario is. As pointed out above, Approach 48a is the most appropriate for discretionary retrofit projects and defines the baseline as "actual or historical emissions", but the tool requires inclusion of alternatives, including "common practices in the relevant sector", which is a completely different concept. With a discretionary retrofit, the decision is between continuing the status quo or a new, discretionary investment (which is the CDM project activity), not between two alternative investment decisions.

Thus the BSST requirement that proposed new methodologies provide a procedure to select the baseline scenario – for which many energy efficiency proposals addressing the discretionary retrofit market by applying Baseline Approach 48a have been criticized – may be inconsistent with the baseline approaches in the CDM modalities and procedures. Proposed New Methodology 150 ("Lighting retrofit for residential use"), which received a "B" recommendation from the Methodology Panel, will be a test on this important issue. Following the same rationale as ACM0002 for renewable power generation, NM0150 states that only a single baseline scenario is considered (i.e., that lighting would have been supplied by the types of lighting appliances currently used and by replacement of the lighting appliances in use before the project activity with new lighting appliances).

The BSST requirement for alternative scenarios is also inconsistent with Approach 48c. Approach 48c precisely pre-defines the baseline scenario as the 5-year average of the top 20 % of similar projects. Whereas this benchmarking concept may be consistent with the BSST concept of common practice in the relevant sector, it does not leave room for alternative scenarios, due to its prescriptive nature, and is therefore incompatible with the BSST.

4.2.5. Development of other "methodological tools"

The Methodology Panel also agreed in February 2006 to begin to develop a catalog of methodological components, which project participants could draw upon when developing new methodologies. The first Methodological Tool, approved at the 26th meeting of the EB in September 2006, provides a methodology to determine methane emissions avoided from dumping waste at a solid waste disposal site. Other tools will also be stand-alone documents that cover a particular type of emissions (e.g., emission from the combustion of fossil fuels) and identify the necessary data sources, equations, quality control procedures, etc., to quantify that emission source. Project proponents developing a new methodology could then simply refer to several of these pre-approved modules to address at least a portion of the emissions covered by the methodology.

Because the source material for these modules is approved methodologies, more methodology proposals with good approaches to energy efficiency are needed so that modules to cover Sectoral Scope 3 can be developed. Alternatively, the CDM EB could take a more top-down approach, as suggested in the recommendations below.

4.2.6. Monitoring methodology guidelines

The CDM EB has identified the need for more detailed guidance and standards on monitoring methodologies, including issues such as sampling, calibration, and standards. The guidelines are under development by the Methodology Panel. They are intended to make it easier for project proponents to identify what must be included in a new methodology. It is unclear whether this guidance will address explicitly the unique nature of end-use energy efficiency programs and the very different monitoring challenges that they face.

4.3. Recommendations

4.3.1. CDM EB and Methodology Panel

It would be important for the CDM EB to institutionalize and provide resources for a *continuous quality assurance and learning process for decision-making on CDM methodologies* that would include independent analysis of the relevant decisions that have been taken by the CDM Executive Board/Methodology Panel, with a view to:

- identifying key issues raised;
- deriving lessons learned;
- evaluating whether issues have been handled consistently; and
- making recommendations on how to improve the process.

This is particularly urgent for Sectoral Scope 3 (energy demand), which is currently underrepresented, but should be part of a continuous, comprehensive quality management system for CDM operations.

Energy efficiency projects/programs have many characteristics that differentiate them from those in other sectoral scopes, not least the fact that many opportunities will be implemented as programs of activities, rather than discrete project activities. It might be advisable, therefore, for the CDM EB to either create a dedicated energy efficiency working group (analogous to the working group for small-scale projects and for afforestation/reforestation projects) or to have a call for public inputs and instruct the Methodology Panel to commission analysis and formulate recommendations on how to address some of the unique energy efficiency issues, just as it has done to address additionality, baseline scenario selection or small-scale project issues. The scope under either approach should include:

- periodic review of EB decisions and Methodology Panel recommendations on proposals for new baseline and monitoring methodologies for Sectoral Scope 3 CDM project activities and programs of activities with respect to the four bullet points outlined above;
- guidance on (and perhaps development of methodology modules to address) methodological issues common to energy efficiency projects, for example:
  - applicability of baseline approaches to different efficiency markets;
  - estimating baseline emissions and developing monitoring plans for energy efficiency programs of activities;
  - determination of whether a project represents a discretionary retrofit or a planned replacement;
  - criteria/approaches for establishing appropriate benchmarks (e.g., technology/sectoral/geographical scope, relation to best practice or top x % of sample, benchmarking period and level);
  - techniques for determining operating parameters for dispersed equipment/systems (e.g., hours of operation, load factors, equipment lifetime);
  - treatment of exogenous factors affecting energy end-use;
  - clarification of whether (and, if so, how) autonomous efficiency improvements and "free riders" need to be taken into account when applying the different baseline approaches in the relevant efficiency markets; and
  - demonstrating transparency and conservativeness; and
- assessment of the applicability and implications of all new guidance or tools (such as the draft BSST) to Sectoral Scope 3 CDM project activities and related recommendations to the CDM EB and/or Methodology Panel to ensure consistency. As shown in the previous section, it is unclear whether the new initiatives of the CDM EB will address the unique methodological challenges facing energy efficiency projects appropriately.

Whatever institutional arrangements are agreed to undertake this important work, the CDM EB should ensure that the process draws on existing international protocols/best practice and involves experts with experience in the implementation and evaluation of public and private energy efficiency programs, audit programs and energy efficiency regulatory programs. Ideally, a "community of practice" on energy efficiency CDM would be built.

4.3.2. Industry/CDM developers

Even carefully prepared proposals have been rejected. Thus there is also a need for developers to do the following.

- Draw on (1) monitoring and evaluation protocols and best practice, (2) existing CDM guidance, and (3) lessons learned from detailed Methodology Panel decisions for similar projects to gain insights into promising approaches.
- Collaborate on methodologies for key sectors (e.g., cement, iron and steel, pulp and paper) and technologies. The cement sector GHG protocol [WBCSD, 2005] provides an excellent starting-point for preparing methodologies in the cement sector and has even been recommended by desk reviewers.
- Rely on approved tools, where available and applicable.
- Provide data to justify key assumptions.
- Provide input to the CDM EB and Methodology Panel when public comments are invited.
- Develop generic methodological approaches for each efficiency market:
  - discretionary retrofit (primarily Baseline Approach 48a);
  - planned replacement (any of 48a-c could be appropriate, depending on the situation); and
  - new facility (perhaps 48b or c).

For the planned replacement and new installations markets, in particular, some kind of benchmarking approach could be explored.

4.3.3. Governments and multilateral institutions

Due to the "case law" approach to full-scale methodologies, as opposed to small-scale methodologies (which have been prepared by the Small-Scale Working Group and approved by the CDM EB), the onus of developing methodologies has fallen on individual project developers. As a result, the sectoral scope of approved methodologies reflects the market niches of larger developers (e.g., landfill methane and renewable power) and/or the investment criteria of buyers, in particular, low-risk, large-volume and low-cost CERs (which drove HFC-23 destruction projects).

There has been little incentive for developers to invest in methodologies for energy efficiency (Sectoral Scope 3), not least because private investors expect higher returns from non-CO_2 greenhouse gas projects, but also because of the lack of guidance on how end-use efficiency methodologies must be designed to receive approval, which creates great uncertainty. There is no common understanding of what constitutes a good or best practice energy efficiency CDM methodology, and almost no one is willing to pay for this. As mentioned above, an energy efficiency working group or less formalized work commissioned by the CDM EB could take on this challenge.

Alternatively, the World Bank, the International Energy Agency (IEA) and the United Nations Development Programme (UNDP), for example, with support from governments and in partnership with other relevant institutions could create a practitioner/expert forum to derive international best practice with respect to:

- monitoring and verification of CDM projects, drawing on existing protocols (e.g., IPMVP, GHG Protocol for Project Accounting, ISO-14064); and
- common elements in the design of CDM baseline methodologies for end-use energy efficiency projects.

Such a broad-based, international forum could provide important context for the evaluation of individual CDM methodology proposals by the CDM Methodology Panel and EB.

5. Conclusions

Promotion of energy efficiency can make a major contribution to sustainable development and climate change mitigation, yet the CDM has only managed to catalyze eight demand-side energy efficiency projects, which collectively will reduce greenhouse gas emissions by 140 kt CO_2e per year. This is an insignificant amount, compared with the vast potential for cost-effective energy efficiency improvement. In its Third Assessment Report, the Intergovernmental Panel on Climate Change (IPCC) estimated that it would be possible to reduce global greenhouse gas emissions to below 2000 levels by 2010-20 (equivalent to a global emission reduction of 1.9 to 2.6 Gt CO_2e per year in 2010 and 3.6 to 5.0 Gt CO_2e per year in 2020) using demonstrated technologies [IPCC, 1996]. Half of the potential reductions would result in direct benefits (energy saved) exceeding direct costs (net capital, operating, and maintenance costs).

If the CDM is to play a greater role in market transformation and broader dissemination of efficient technologies and practices, approved methodologies covering a much broader share of the discretionary retrofit, planned replacement and new installation efficiency markets are urgently needed. These must be credible, yet practicable from a transaction cost perspective at prevailing market prices for CERs of below Euro 8/tCO_2e.

Given the fact that energy efficiency programs differ from the more successful types of CDM projects in many ways – and present unique challenges from a methodological point of view – more attention should be given to energy efficiency methodology development. The CDM EB should create an energy efficiency working group or other mechanism to provide further clarity and guidance on these issues rapidly, and governments and international organizations should support methodology development efforts (individual private actors have little incentive to do so), in particular for technologies and end-uses with the greatest cost-effective reduction potential. ■

Acknowledgements

The authors would like to thank Conrad U. Brunner, A+B International (Sustainable Energy Advisors), and Gautam Dutt, Technical Editor of this journal, for their suggestions on improving the paper.

Notes

1. Note that this figure is much lower – only 2 % – when the selection is limited to projects that use Sectoral Scope 3 methodologies. The classification used in the UNEP-URC compilation includes waste gas/heat recovery/utilization, cogeneration, and some Sectoral Scope 4 (Manufacturing Industries) projects under the energy efficiency sector classifications "EE Service", "EE Industry", "EE Households".
2. Any proposal for new methodology must be accompanied by a draft project design document (PDD) for a specific project applying the proposed methodology.
3. This figure does not include the five approved Indian projects in Sectoral Scope 4 that use AMS-II.D, which can include both energy efficiency and fuel-switching measures in industry.
4. Actually, 40 full-scale methodologies have been approved, but seven were subsequently withdrawn by the EB because their scopes are covered by another approved methodology or an approved consolidated methodology. In addition, since the consolidated methodologies are all based on more than one submission, there have actually been more than 40 successful submissions for baseline methodologies.
5. This is not always the case, for example, when replacement equipment has been purchased in advance.
6. Voluntary Motor Challenge programs were launched by the US Department of Energy in 1995 and by the European Commission in 2003 to provide enterprises with technical assistance, tools and recognition to promote efficient motor systems.

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