



Reducing poverty  
through sustainable industrial growth

40 YEARS OF SERVICE TO MANKIND



## **Energy Efficiency Projects in CDM : Issues Paper**

**Prepared for Seminar on Energy Efficiency Projects in CDM and JI, organized by UNIDO in cooperation with CTI and UK Trade and Investment, Vienna, Austria, March 19-20, 2007**

*Prepared by Anne Arquit Niederberger, Policy Solutions ([policy@optonline.net](mailto:policy@optonline.net))*

### **Introduction**

UNIDO, in cooperation with the Climate Technology Initiative (CTI) and UK Trade and Investment, will hold a seminar on "Energy Efficiency Projects in CDM and JI" in Vienna, Austria, on 19 and 20 March, 2007. The objective of the seminar is to provide a forum for business and industry to advance their understanding of the methodological issues surrounding energy efficiency projects/programmes under the flexibility mechanisms of the Kyoto Protocol, namely the Clean Development Mechanism (CDM) and Joint Implementation (JI).

This paper is prepared to facilitate discussion and knowledge sharing among experts. It is structured around a set of nine theses, which can be explored during the workshop panel and discussion sessions.

## Thesis 1

### **End-use energy efficiency is crucial for climate mitigation and Parties expect the CDM to promote it**

It has become abundantly clear that the current trend in greenhouse gas emissions is unsustainable (the IEA (2006) anticipates more than a doubling of energy-related CO<sub>2</sub> emissions from 1990 to 2030 under its Reference Scenario). Equally troubling is that most of the emissions growth over the next decades is expected to take place in the developing world.

Recent energy scenarios (e.g., IEA, IPCC, WBCSD) converge in demonstrating that demand-side energy efficiency will have to carry most of the weight in climate mitigation in the next decades, if we are to limit emissions sufficiently to stabilize atmospheric concentrations. In the latest IEA Alternative Policy Scenario, which assumes the use of existing technologies, implemented only through additional policies currently planned or under discussion in each country, end-use efficiency accounts for 65% of energy-related CO<sub>2</sub> abatement in 2030 (IEA, 2006). This means that if we do not succeed in overcoming market failures and breaking down barriers to introducing energy efficient technologies and practices in industry and transforming global markets for high-efficiency equipment, products and services, the price of climate mitigation will be much higher.

Investment in end-use energy efficiency is not only crucial from the perspective of climate protection; it can make an important contribution to economic and social development in all countries (Arquit Niederberger et al., 2007). 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). For developing countries facing the challenge of providing adequate energy services to growing populations and economies, investments in energy efficiency improvements have the added benefit of creating jobs and being much quicker and cheaper to implement than building new supply capacity (Spalding Fecher and Roy, 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 improved overall productivity / process efficiency;
- Avoidance of pollutant and greenhouse gas emissions that are damaging to humans, infrastructure and ecosystems.

However, significant, well-documented barriers to investment in high-efficiency equipment and practices are widespread, even in the most advanced economies, and these can be particularly pronounced in the developing country context: knowledge of energy-saving potential in industry and other sectors 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; retrofits may incur additional planning expense, can require factories to be shut down and may not function flawlessly from the outset; a strong policy, regulatory and enforcement regime and incentives to make energy conservation efforts profitable are lacking.

The challenge of ensuring that billions of energy end-users, mostly in poor countries, make additional up-front investments in energy efficient technologies is daunting (despite the attractiveness of such investments on a least lifecycle cost basis), but there is a range of regulations, market mechanisms and other policies and measures to promote the necessary market transformation. The Kyoto Protocol's flexibility mechanisms, the Clean Development Mechanism (CDM) and Joint Implementation (JI), can address primarily financial barriers. A number of countries – for example, China – have made energy efficiency a CDM priority.

Yet the CDM has only managed to catalyze approximately two dozen demand-side efficiency projects across all sectors, which collectively will reduce greenhouse gas emissions by about 300 kt CO<sub>2</sub>e per year (of the order of 3 Mt CO<sub>2</sub>e cumulatively through 2015). This is an insignificant amount, compared with the vast potential for cost-effective energy efficiency improvement. With energy efficiency currently at the top of the political agenda around the globe, there is a desire to make the carbon markets work for energy efficiency, recognizing that CDM/JI are only one part of the necessary market transformation process.

## Thesis 2

### **The Kyoto Mechanisms have largely failed to stimulate industrial end-use efficiency**

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 (Arquit Niederberger & Spalding-Fecher, 2006; Hayashi & Michaelowa, 2007). Among the 563 CDM projects approved up to 22 March 2007<sup>1</sup>, captive industrial cogeneration projects (i.e., power plants built to generate electricity primarily for the facility's own use) and use of waste heat or gas to deliver heat/power (which are sometimes classified as energy efficiency projects) are well-represented, but only five large-scale<sup>2</sup> and six small-scale projects – out of a total number of 277 and 286, respectively – are aimed at improving the efficiency of energy end-use (this is referred to as “Sectoral Scope 3”, energy demand<sup>3</sup>).

The approved energy efficiency projects in the industrial sector are listed in Table 1. These 19 projects – representing only 3% of the total number of registered CDM projects – are estimated to reduce greenhouse gas emissions by < 300 kt CO<sub>2</sub>e per year, a miniscule share of global energy efficiency potential. This is reflected by their limited geographical distribution (all but two projects in India), range of applied technologies and tendency to be small-scale.

**Table 1. Registered Industrial End-Use Efficiency Projects**

Project ID	Title	Host Party	Sector	Methodology
------------	-------	------------	--------	-------------

<sup>1</sup> <http://cdm.unfccc.int/Projects/projsearch.html>

<sup>2</sup> Simplified modalities and procedures have been adopted for small-scale project activities. For an energy efficiency project or program to qualify as small-scale, it must result in less than 60 GWh of energy savings annually. All other activities are classified as large-scale. For more on small-scale CDM, refer to Thesis 4.

<sup>3</sup> Annex 1 lists the Sectoral Scopes defined under the CDM.

Full-Size CDM Projects				
CDM0123	Energy efficiency through installation of modified CO <sub>2</sub> removal system in Ammonia Plant	India	Chemicals	AM0018
CDM0261	Energy efficiency through steam optimization projects at RIL, Hazira	India	Petrochemicals	AM0018
CDM0340	Reduction in steam consumption in stripper reboilers through process modifications	India	Petrochemicals	AM0018
CDM0677	Optimization of steam consumption by applying retrofit measures in blow heat recovery system	India	Paper	AM0018
CDM0679	Optimization of steam consumption at the evaporator	India	Paper	AM0018
Small-Scale CDM Projects				
CDM0255	Demand-side energy efficiency programme in the 'Humidification Towers' of Jaya Shree Textiles	India	Textiles	AMS-II.C
CDM0262	Energy efficiency projects - Steam system upgradation at the manufacturing unit of Birla Tyres	India	Petrochemicals	AMS-II.D.
CDM0445	Demand side energy conservation & reduction measures at IPCL – Gandhar Complex	India	Petrochemicals	AMS-II.D.
CDM0568	GHG Emission Reductions through Energy Efficiency Improvements	India	Cement	AMS-II.D.
CDM0582	India - Vertical Shaft Brick Kiln Cluster Project	India	Building materials	AMS-II.D.
CDM0701	Energy efficiency project in the Ramla Cement Plant in Israel through instalment of new grinding technology	India	Cement	AMS-II.D.
CDM0745	Demand side energy conservation and reduction measures at ITC Tribeni Unit	India	Paper	AMS-II.D.
CDM0757	Factory energy-efficiency improvement project in Malaysia (MAPREC, PRDM, PSCDDM, PAVCJM, PCM)	Malaysia	Manufacturing	AMS-II.D. (bundle)
CDM0759	Factory energy-efficiency improvement project in Malaysia (PHAAM, PCOM (PJ), PCOM (SA), PEDMA, MEDEM)	Malaysia	Manufacturing	AMS-II.D. (bundle)
CDM0777	Energy Efficiency Improvement in Electric Arc Furnace at Indian Seamless Metal Tube Limited (ISMT), Jejuri, Maharashtra	India	Iron & steel	AMS-II.D.
CDM0806	Demand side energy efficiency programmes for specific technologies at ITC Bhadrachalam pulp and paper making facility in India	India	Paper	AMS-II.D.
CDM0850	Installation of Plate Type Heat Exchanger for preheating combustion air of primary reformer and reducing heat loss to atmosphere through flue gases at Indo Gulf Fertilisers (A Unit of Aditya Birla Group), Jagdishpur	India	Chemicals	AMS-II.D.
CDM0858	Grasim Cement: Energy efficiency by up-gradation of clinker cooler in cement manufacturing	India	Cement	AMS-II.D.
CDM0932	Energy Efficiency Measures At Paper Production Plant	India	Paper	AMS-II.D.

(Source: <http://cdm.unfccc.int/Projects/projsearch.html>, categories: Energy Demand, Manufacturing Industries – end-use energy efficiency)

The pipeline for energy efficiency projects, however, is expanding rapidly. The UNEP Risoe 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 (see previous section);
- validated by a Designated Operational Entity (DOE) and requested registration by the CDM Executive Board;
- submitted to a DOE for validation.

In the most recent compilation from 15 March 2007 (URC, 2007), energy efficiency projects<sup>4</sup> represent roughly 12% (196) of the total of 1571 projects in the CDM project pipeline (at least submitted to a DOE for validation). In terms of cumulative CERs that would be delivered by the projects in the pipeline, however, the share of energy efficiency projects is only 7% (about 120 Mt CO<sub>2e</sub>). The majority of these proposed projects are hosted by Indian entities and over 80% (162 projects) are in the industrial sector.

Over half of the projects in the pipeline attributed to the industrial energy efficiency category involve recovery and use of waste heat/gas, and the vast majority of these use the consolidated methodology ACM0004. Just over one-third of the industrial energy efficiency projects are small-scale (<60 GWh of savings per year).<sup>5</sup> It is clear that the CDM is only making a very small contribution to promotion of energy efficiency, despite significant potential for improvement in developing countries worldwide.

### Thesis 3

#### **A lack of viable, broadly-applicable approved methodologies is a barrier to energy efficiency CDM**

One of the barriers that energy efficiency projects face under the CDM is a lack of suitable approved baseline and monitoring methodologies for large-scale projects. The approval of CDM methodologies generally takes a "case law" approach: Once a methodology has been approved by the CDM Executive Board, it is valid for use by any project developer to prepare new CDM Project Design Documents for official CDM project registration. It is therefore important to get a critical mass of methodologies approved rapidly that can serve as a basis for energy demand CDM project development across key sectors and applications.

Table 2 provides an overview of CDM Executive Board decisions on proposed new methodologies for industrial energy efficiency projects. Only three full-scale methodologies for demand-side industrial energy efficiency (Sectoral Scope 3) have made the cut<sup>6</sup>:

- AM0017 (steam system efficiency at refineries)
- AM0018 (steam system optimization)
- AM0038 (energy efficiency of electric arc furnaces)

**Table 2. Overview of CDM Methodology Approval and Rejection for Demand-Side Energy Efficiency Projects/Programs applicable to Industry**

Methodology Type	Approved	Rejected	Under Consideration
Consolidated	none	n/a	n/a
Large-Scale	<ul style="list-style-type: none"> <li>• AM0017 (steam system efficiency at refineries)</li> </ul>	<ul style="list-style-type: none"> <li>• NM0086 (petrochemical industry)</li> </ul>	<ul style="list-style-type: none"> <li>• NM0197 (replacement of electrical equipment with</li> </ul>

<sup>4</sup> Note that this figure is much lower when the selection is limited to projects that use Sectoral Scope 3 (demand-side efficiency) methodologies. The classification used in the UNEP-URC compilation includes both supply and end-use efficiency under the groupings "EE Supply side", "Energy distribution", "EE Service", "EE Industry", "EE Households", and "Transport".

<sup>5</sup> For a more detailed pipeline analysis, refer to Hayashi and Michaelowa (2007).

<sup>6</sup> The designation of Sectoral Scope is taken from the UNFCCC web site for approved projects and from the information provided by the developer of the rejected and "B"-case (revisions required) methodologies. Note that there is some inconsistency in these designations, but for full-scale methodologies, cogeneration and waste heat/gas utilization methodologies are generally excluded from this category. AM0038 has been included here, even though it is in Sectoral Scope 4 (Manufacturing Industries), due to the nature of the methodology.

	<ul style="list-style-type: none"> <li>• AM0018 (steam system optimization)</li> <li>• AM0038 (energy efficiency of electric arc furnaces)</li> </ul>	<ul style="list-style-type: none"> <li>• NM0092-rev (smelter upgrade)</li> <li>• NM0099 / NM0101 / NM0137 / NM0154 (cement)</li> <li>• NM0100 (unitary equipment replacement)</li> <li>• NM0118-rev (brewery optimization)</li> <li>• NM0119 (process energy integration)</li> <li>• NM0169 (efficient utilization of energy in the form of fuel, power and steam)</li> <li>• NM0182 (advanced SCADA control systems &amp; energy management)</li> </ul>	<ul style="list-style-type: none"> <li>• variable load</li> <li>• NM0195 (steam turbine replacement)</li> </ul>
Small-Scale	<ul style="list-style-type: none"> <li>• AMSII-C (specific technologies)</li> <li>• AMSII-D (industrial facilities)</li> <li>• AMSII-E (buildings)</li> </ul>	n/a	n/a

Source: <http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html> and <http://cdm.unfccc.int/methodologies/PAmethodologies/publicview.html>

Unfortunately, it is difficult to distill the key ingredients shared by these approved methodologies (beyond their focus on the discretionary retrofit market and application of a baseline approach that determines the emissions baseline from existing actual or historical emissions). There is a lack of top-down guidance, consistency and predictability that discourages methodology development. Over all, the energy efficiency category has suffered the highest rejection rate by the Executive Board (Hayashi & Michaelowa, 2007).

To be sure, 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, which appears to have discouraged the development of new methodologies (in the last four new methodology submission rounds combined, only two Sectoral Scope 3 methodologies were proposed).

The CDM Executive Board has given a number of common reasons for the rejection of new methodologies for energy efficiency projects. These can be summarized<sup>7</sup> as a failure to:

- Select an appropriate project scope or specify how methodology can be applied in different sectors
- Provide a procedure to select baseline scenario (even though retrofit projects often apply the historical emissions approach to setting the baseline)
- 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
- 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

<sup>7</sup> Refer to Arquit Niederberger and Spalding-Fecher (2006) for details.

- Distinguish between energy efficiency markets (i.e., discretionary retrofit; planned replacement (“lost opportunity”)); new equipment markets)
- Give full consideration to the potential for leakage
- Provide adequate guidance on developing a monitoring plan
- Provide level of methodological specificity sufficient to allow DOE to verify reductions

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 that do not exceed the small-scale energy saving limit; 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; account for rebound effects; demonstrate that efficiency gains are significant relative to uncertainty (signal-to-noise ratio).

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 Executive Board), 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-22 destruction projects).

There has been little incentive for developers to invest in methodologies for energy efficiency (Sectoral Scope 3), not the least because private investors expect higher returns from non-CO<sub>2</sub> 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 large inconsistency in the decision-making process, particularly with gross-to-net adjustments (refer to Thesis 6 for an in-depth discussion).

As a result of the challenges faced by energy efficiency methodologies, widely applicable methodologies for sectors, program types and technologies with large greenhouse gas emissions from energy end-use, such as energy-intensive industry or industrial motors<sup>8</sup> are lacking. Two proposed new industrial energy efficiency methodologies have received preliminary recommendations from the CDM Meth Panel and are currently under revision (see Table 2). If NM0197 is ultimately approved, it could open the door for industrial energy efficiency improvements to at least those electric motor systems that are easily monitored.

A gaping hole in the coverage of the approved industrial energy efficiency methodologies for full-size projects is that all of the methodologies approved to date only apply to the retrofit market (and apply the baseline approach that relies on “existing actual or historical emissions”). Given the double-digit growth rates in many industrial sectors, particularly in emerging economies, the lack of methodologies applicable to new installations means that we are missing an important opportunity to leverage CDM to ensure adoption of state-of-the-art energy management practices and systems that will have a significant operating lifetime.

---

<sup>8</sup> Electric motor systems are responsible for 70% of industrial electricity demand and have an average cost-effective efficiency improvement potential of 25-30% (SEEEM, 2006).

Another observation is that even though a methodology might ultimately have received EB approval, it is not necessarily viable in practice. AM0018 is the only one of the approved industrial Sectoral Scope 3 methodologies that has actually led to projects being registered (5 projects, with two more currently requesting registration).

#### **Thesis 4**

### **Most industrial efficiency projects could be conducted under the new 60 GWh limit for small-scale CDM (SSC)**

The CDM Executive Board has provided a suite of small-scale CDM (SSC) energy efficiency methodologies (that apply to “Type II project activities”; Table 2 lists the SSC methodologies relevant to the industry sector). To qualify as a Type II small-scale project, a CDM activity must result in less than 60 GWh of energy savings annually. In addition to being eligible to apply pre-approved, simplified methodologies, SSC project activities can follow simplified modalities and procedures – which include a simplified PDD and provisions for environmental impact analysis, as well as lower registration fees and other special arrangements – with a view to reducing the transaction costs associated with preparing and implementing CDM projects.

While a large number of small-scale projects have been registered in other project categories, industrial energy demand projects account for only 13 registered small-scale CDM projects (less than 5% of the total), all but one of which use methodology AMS II-D (see Table 2).

The decision by the Parties to the Kyoto Protocol in November 2006 to raise the limit for small-scale energy efficiency activities from 15 GWh to 60 GWh has a significant impact on the scope of industrial energy efficiency activities that fall under the SSC rules and, hence, the transaction costs for industrial energy efficiency CDM projects. In the industry sector, an individual factory might have an electricity consumption of the order of between 1 and 100 GWh annually. This means that three large factories (or 300 small factories) could be bundled together in a single small-scale project or program to improve the efficiency of energy use by 20%.

Taking the example of industrial electric motor systems (Arquit Niederberger & Brunner, in press), the 60 GWh electricity savings can come from a combination of efficiency measures that might affect the coefficient of performance of the motor, operating conditions (e.g., hours per year) or the load split across the range of motor size. A motor system of any size (between 1 kW and 20 MW) running 3000 hours per year and delivering 30% efficiency gains would qualify as a small-scale CDM project (equivalent of < 60 GWh energy savings).

The resulting total load of motors to be improved is between 2000 and 6000 kWe. The load can then be attributed to individual motor systems within the same project boundary. Given the distribution of motor size, CDM projects will likely target the most common standard motor sizes between 5 kW and 500 kW. A CDM motor project that resulted in 30% efficiency gains for 100 large (500 kW) or 10 000 smaller pieces of equipment (5 kW) operating 4000 hours annually would still qualify under the SSC rules (Arquit Niederberger & Brunner, in press). This calculation illustrates the significance of the new SSC limits for motor and other industrial system efficiency initiatives under the CDM.

Given the relatively small scale of the vast majority of motor systems, even under the SSC rules, transaction costs associated with PDD preparation and determining project emissions remain a key consideration in CDM project viability. Fortunately, the small-scale methodologies allow for energy efficiency programs to be implemented under a single Project Design Document (PDD):

- under AMS II.D., a single PDD is applicable to "any energy efficiency and fuel switching measure implemented at a single industrial facility";
- AMS II.E. only requires a single PDD applicable to "any energy efficiency and fuel switching measure implemented at a single building...or group of similar buildings" and
- AMS II.C. allows "programs that encourage the adoption of energy-efficient equipment...at many sites" to be submitted under a single PDD.

## Thesis 5

### **Barriers to SSC industrial energy efficiency projects/programs remain**

Given that SSC methodologies applicable to the industry sector have been approved, why aren't we seeing more projects being developed, with the exception of India (which is the only country with registered industrial energy efficiency projects)? There are a number of possible explanations, for example:

- Lack of awareness of energy efficiency opportunities in host country industrial sector
- Unfamiliarity with CDM and scope for SSC CDM
- Challenge of structuring deals, so that the CDM revenue stream can help address the important up-front capital (and sunk) cost barriers
- Simplified methodologies put the burden of documentation and PDD preparation on the individual enterprise, without much guidance, and demands human resources that might not be readily available, particularly in SMEs
- CER income may not cover the true transaction, business interruption and sunk costs involved, and is often less than the cost savings from reduced energy demand, which can be substantial (Arquit Niederberger & Brunner, in press); there is a sense that CDM is "not worth the effort".

In addition to addressing methodological issues, awareness-raising is a key challenge. Relevant institutions (e.g., UNIDO, World Bank, UNDP, GEF, in partnership with local industry associations) should establish programs to assist industry in taking advantage of the CDM, preferably piggy-backing onto existing programs to provide energy audits, training and other market transformation activities. There is also a need for funds (e.g., dedicated energy efficiency lending facilities, revolving funds or ESCO structures) and programmatic approaches to ease the administrative burden on individual enterprises and make funds available to cover up-front capital costs. The energy efficiency financing facilities established by the IFC in several countries could be a model.

Finally, the potential to leverage CDM funds in support of energy efficiency incentive programs, typically run by governments and utilities, remains to be explored. There is a pervasive lack of awareness of the Kyoto Mechanisms among agencies responsible for energy efficiency, utility regulation and demand-side management in many countries and little cross-fertilization between the energy efficiency expert community and the climate change / CDM world<sup>9</sup>.

---

<sup>9</sup> This issue is also raised in Thesis 7 and Thesis 8.

## Thesis 6

### The nature of dispersed energy efficiency projects / programs raises particular methodological challenges

Energy efficiency projects/programs have many characteristics that differentiate them from those in other sectoral scopes. At a fundamental level, energy savings from energy efficiency projects cannot be measured as they can for energy supply projects, such as renewable energy projects. The savings are equal to baseline energy consumption less the consumption associated with the new project, with the understanding that baseline consumption is a hypothetical value that cannot be directly measured. It is essential to acknowledge this fact and to recognize that that energy savings and greenhouse gas mitigation impacts of energy efficiency projects therefore represent “negotiated” values, as baselines must be stated, inferred, calculated, or simulated. The UNIDO workshop can explore how to deal with the following unique methodological challenges that have been encountered by end-use efficiency efforts:

#### Non-financial barriers, additionality and CDM

To qualify for CDM registration, a project/program of activities must demonstrate additionality, that is, it must reduce anthropogenic emissions of greenhouse gases by sources below those that would have occurred in the absence of the registered CDM project activity. In considering project additionality, the three major energy efficiency markets should 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<sup>10</sup> (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.

**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

For discretionary retrofits, baseline approach 48a<sup>11</sup> is the obvious choice, since these projects are 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.

<sup>10</sup> The small-scale methodologies are applicable to all three efficiency markets.

<sup>11</sup> The baseline approaches defined in sub-paragraphs 48 (a) to (c) of the CDM modalities and procedures are: existing actual or historical emissions, as applicable (48a); emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment (48b); the average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 per cent of their category (48c).

The planned replacement and new installations efficiency markets pose other issues for additionality assessment, since these generally involve new investment decisions<sup>12</sup>. 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. Under its "Save Energy Now" program, energy assessments of 200 industrial facilities in the United States in 2006 uncovered 52 trillion Btu in annual natural gas savings potential<sup>13</sup> (equivalent to 3.3 million tons CO<sub>2</sub> per year) – over 80% of which represented activities with payback periods of less than two years (40% with payback periods of less than 9 months). Decisions taken by the CDM Executive Board and Meth Panel do not reflect this reality; even though investment analysis is not mandated by the approved additionality tool, application of both the barrier and investment analysis has been recommended to those trying to devise new energy efficiency methodologies (Hayashi & Michaelowa, 2007).

Furthermore, both the additionality tool and the combined tool to identify the baseline scenario and demonstrate additionality<sup>14</sup> 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 do not include the major barriers facing energy efficiency projects. It would be helpful to highlight examples of typical barriers to energy efficiency projects/programs, such as those mentioned above, as well as for the CDM Executive Board to provide tools and guidance on documentation requirements to demonstrate barriers. It should not be necessary for each project developer to provide individual documentation of prevalent barriers to demand-side efficiency, when these have been well documented by energy efficiency experts and reliable institutions, such as the International Energy Agency and governments.

As defined, the combined tool explicitly is not applicable "where one or more baseline alternatives are not available options to project participants", which is generally the case under energy efficiency programs. According to the tool, a program to disseminate or encourage the use of energy efficient appliances by multiple end-users could not use the combined tool, because a credible and plausible alternative to the project activity could be that the end-users (i.e. third parties) continue to use existing appliances and/or start using more efficient appliances – which are not available options to the project participants. Existing protocols to quantify energy savings from end-use efficiency improvements typically distinguish between gross energy (emission) savings at the site level (i.e., the difference between the baseline and project emissions) and net savings that actually occur at the electricity generating unit. Factors commonly considered in determining net savings include increased savings due to lower T&D losses, decreased savings due to non-additional free riders, increased savings due to spillover effects, and secondary effects (e.g., leakage, rebound effect, activity shifting)<sup>15</sup>. It would be highly recommended to try to address these issues systematically and comparably – rather than at the point of baseline definition. A number of these factors have caused problems in methodology approval and are discussed in detail below. Clear guidance on what needs to be taken into account to determine net energy savings and emission reductions and the methods to do so should be provided.

Quantification protocols also provide for baseline adjustments for changes in independent variables – both routine adjustments such as for weather in the case of space heating/cooling

<sup>12</sup> This is not always the case, for example, when replacement equipment has been purchased in advance.

<sup>13</sup> See <http://www.eere.energy.gov/industry/saveenergynow/partners/results.cfm>

<sup>14</sup> Tools available at <http://cdm.unfccc.int/methodologies/PAMethodologies/approved.html>

<sup>15</sup> Steve Schiller, personal communication (March 2007).

projects or for changes in the level of industrial production, which can be monitored and should therefore be included in monitoring plans, and non-routine adjustments such as a change in product line. The latter are typically addressed only as they occur. Adopting this terminology and these practices could add a great deal of transparency to the whole CDM methodology process and make it consistent with existing energy efficiency programs, especially those that might also link to carbon markets, such as white certificate schemes. Issues related to baseline adjustment have also been the cause of methodology rejection and are described below.

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).

### **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 based on fuel use data and CO<sub>2</sub> emission factors, determining emissions 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 (independent variables) that would affect the energy demand of the system and require baseline adjustment. 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 Meth Panel rejected the 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). Clear guidance on when and how routine and non-routine baseline adjustments are required is needed, and such issues should be treated independently of baseline selection.

Monitoring costs can be a significant barrier to dispersed CDM projects in energy efficiency. One approach that has received mixed reviews from the Meth Panel is the use of system simulation models, which has been widely applied to complex building and industrial process efficiency programs outside of the CDM. If a set of such tools for key applications could be pre-approved by the Meth Panel, this would be very helpful. Many such tools are in use to assist with estimating energy saving potential and could be adapted for CDM use.

### **Autonomous efficiency improvements**

In numerous cases, proposed new baseline and monitoring methodologies for energy efficiency activities have been rejected for their failure to account for autonomous efficiency improvement trends in the baseline (i.e., rate of historical improvement in energy efficiency of equipment that is attributed to technological innovation not driven by energy efficiency policies/programs). Even more importantly, this issue has 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 (although no guidance on how to do so has been provided). 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.

Since the CDM is project-based, it can be argued that autonomous efficiency improvement need not be taken into account. In the case of 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. It is misguided 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.

The 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.

In any case, it is nearly impossible to determine with any degree of rigor what the rate of historical improvement in energy efficiency of equipment is that can be attributed to technological innovation not driven by energy efficiency policies/programs, or even how to define it in a way that is relevant at the project level. Such a complex analytical exercise certainly exceeds the capabilities of individual project developers. If there have been any major technology jumps, provisions for reassessing the baseline under methodologies that select a renewable crediting period should take this into account and would be adequate. We should always bear in mind the order of magnitude that we are talking about and consider whether addressing an issue such as "autonomous improvement" will enhance rigor or increase uncertainty.

### **Gross-to-net adjustments: Free riders/spillover effects & secondary effects**

Under the CDM methodology approval process, concerns have also been raised about “free riders”. The concept of “free riders” and “free drivers” (spillover effects) 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 & 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). As indicated above, free riders / spillovers, secondary effects (e.g., leakage, rebound effects) and electrical transmission and distribution losses are not a project-level baseline issue, but represent factors that are generally taken into account at the level of the program when making gross-to-net adjustments.

Free rider/spillover effects are notoriously difficult to quantify, with wildly different estimates from different experts using different approaches (Geller & Attali, 2005; Gillingham, Newell & Palmer, 2004). Methods of determining free rider and spillover effects 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 based on 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 Meth Panel scrutiny, but it is too early to say whether they will be accepted by the CDM Executive Board and whether they will be viable in practice. One methodology tried to use a survey/self-declaration, but this approach was rejected (NM0157).

It is also possible to design energy efficiency promotion programs so as to minimize potential free riders (and maximize positive spillovers). 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.

There are numerous examples of existing energy efficiency programs that recommend only minimal or no evaluation of free rider and spillover issues, due to the general desirability of energy efficiency improvements, the tendency for both effects to occur (and therefore cancel each other out), a lack of agreement on appropriate methodologies, and the difficulty and expense of such assessments. Other programs have assigned default gross-to-net conversion factors to be used for different types of energy saving measures<sup>16</sup>.

Similarly, most efficiency program evaluation protocols do not recommend inclusion of secondary effects in evaluation analyses, since these tend to be negligible for energy efficiency

---

<sup>16</sup> See, for example, the *User's guide to the Conservation Verification Protocols* (Washington DC: US Environmental Protection Agency, April 1996).

projects. In any case, gross-to-net adjustments should not be considered at the level of the project baseline and require a consistent, top-down approach applied to all eligible end-use energy projects.

### **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 installations 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 Executive Board: 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 baseline scenario selection tool (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 baseline scenario selection tool 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, 2006b). 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 than what would normally be considered for energy supply projects, the draft baseline scenario selection tool (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 installations efficiency market – another approach is needed. The alternatives offered in subparagraphs 48b and 48c of the CDM modalities and procedures are difficult to apply to energy efficiency projects, which may explain the lack of approved methodologies for the planned replacement and new installations 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, however, there is great economic potential for energy efficiency improvement, but other barriers prevent the uptake of efficient technologies. The fact that there remains vast potential for fossil fuel and electricity end-use efficiency improvement in the industrial sector of OECD countries with payback periods of less than two years demonstrates the prevalence and persistence of these barriers, even when technology standards are in place and net cost savings on a life-cycle basis are substantial. Applying the draft baseline scenario selection tool 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 per cent 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 the 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 installations 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. New efforts to develop standards to certify the energy performance of industrial plants could assist with benchmarking and should flow directly into the CDM methodological toolbox.

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”.

### **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 – and ensure that any technological fixes result in sustained savings. In the case of industrial electric motor systems, the difference is striking. Based on Motor Challenge programs 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 (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 approach (AM0017), 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 energy savings would be possible by taking a systems approach (and also addressing the new equipment market, where it is much easier to consider complete systems). Furthermore, taking a systems approach – particularly when implemented in the context of a comprehensive energy management system – promises greater permanence of energy savings and greenhouse gas emission reductions than one-time equipment replacement (McKane, 2007).

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 Executive Board 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. We will discuss several new proposals for motor methodologies at the UNIDO Seminar.

## **Thesis 7**

### **Energy efficiency experts should play a much greater role in the CDM**

Linked to the previous thesis, it is crucial to build on the large body of existing knowledge on international protocols/best practice that has been built since the 1973 oil crisis. This requires engaging government regulators and industry energy efficiency experts (incl. utilities, ESCOs, technology providers, end-users) with experience in the implementation and evaluation of public and private energy efficiency regulatory, incentive, contracting, training, and audit programs. Ideally, a “community of practice” on energy efficiency CDM would be built.

There is an urgent need for top-down guidance on key energy efficiency design issues, including:

- Emission reduction quantification methodologies: Most energy efficiency programs/protocols offer a menu of approved options that can be selected by the project proponents, typically including (i) use of default abatement factors ("deemed savings" approach), (ii) calculated (engineering) methods for discrete equipment/systems, sometimes in conjunction default efficiencies and other parameters, (iii) before/after metering/modeling, typically applied to more complex systems, such as buildings and (iv) sometimes, reliance on energy monitoring plans audited by third parties (this is the approach followed under JI Track 2).
- Baseline adjustment requirements/techniques for routine and non-routine factors
- Decisions on whether it is necessary and, if so, how to treat "gross-to-net" energy saving issues (including leakage, rebound effects, free riders, spillovers)
- Definition of related default abatement factors, efficiencies and other parameters to enhance transparency, consistency and certainty.

Such issues are not new to CDM, and regulators have made decisions in the context of existing regulatory programs about how to handle them. This experience could be synthesized to come up with common methodologies, tools and default factors for Sectoral Scope 3 CDM. The previous practice under the CDM – with the exception of small-scale and sink-related methodologies – has been to derive guidance and tools based on bottom-up submissions. However, since there are so few approved Sectoral Scope 3 methodologies to draw from, and the approval process has been inconsistent, a top-down approach that draws on methodologies for demand efficiency projects already available outside of the CDM world is urgently needed.

A great deal of work has been done internationally, by national governments, energy agencies, utilities and other private actors, and by NGOs to devise measurement and verification protocols for energy efficiency activities, and these have been used in a range of regulatory programs, including cap and trade programs (see Table 4 for some examples, including programs in Canada, Italy, UK, USA). All of these stakeholders need to be brought together in a rapid process to propose good practice monitoring and verification approaches for key sectors and technologies under the CDM.

Table 4. Ongoing Monitoring, Evaluation, Reporting, Verification and Certification (MERVC) Activities for Energy Efficiency

Convening Organization(s)	Title of Initiative	Objective	Focus	Key Deliverables
<b>STANDARDS / GUIDANCE</b>				
ASHRAE	Guideline 14-2002	Provide guidelines for reliably measuring the energy and demand savings due to building energy management projects (using pre-retrofit/post-retrofit data)	Energy demand reductions in residential, commercial and industrial buildings	Guideline 14-2002 "Measurement of Energy and Demand Savings"
Efficiency Valuation Organization	International Performance Measurement & Verification Protocol	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 & verification protocols	IPMVP Volume I provides general guidance for energy efficiency M&V for buildings and industry. Volume III addresses new construction
International Energy Agency	IEA Demand-Side Management Program	To develop, test, and promote an evaluation guidebook for governmental and non-governmental Energy Efficiency Programmes and also for (utility) DSM programmes targeted towards energy end-users and focussed on GHG reductions to meet Kyoto's targets	Guidance on evaluation of DSM programs	Evaluation Guidebook on DSM and EE Programs related to Kyoto targets
International Standards Organization	ISO 14064-2 International Standard for Greenhouse Gas Accounting*	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
EU SAVE	Specific Actions for Vigorous Energy Efficiency Program	To disseminate evaluation theory and thus indirectly help reduce the overall CO2 emissions and improve energy efficiency	Demand-side management programs and the energy service provider industry	European Ex-Post Evaluation Guidebook for DSM and EE Service Programmes
WRI/WBCSD	GHG Protocol for Project Accounting	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	CO2 Accounting and Reporting Standard for the Cement Industry	To provide a harmonized methodology for calculating CO2 emissions, with a view to reporting	Emission inventories & reporting for the cement sector	Cement CO2 Protocol
<b>REGULATORY PROGRAMS / PROTOCOLS</b>				
California Climate Action Registry	CCAR Emission Reduction Protocols	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)

Italy	Tradable Energy Efficiency (White Certificate) Scheme	Provide guidelines for demand-side efficiency project eligibility and quantification	Interventions or projects to reduce consumption of primary energy via reducing final electricity or gas consumption or other measures.	Linee guida per la preparazione, esecuzione e valutazione dei progetti di cui all' articolo 5, comma 1, dei decreti ministeriali 24 aprile 2001 e per la definizione dei criteri e delle modalità per il rilascio dei titoli di efficienza energetica
Japan METI	Future CDM Project	Development of CDM methodologies in previously underrepresented areas	Methodologies for: (i) energy efficiency and (ii) transportation sector CDM	Methodologies submitted to CDM EB for approval
NSW / ACT (Australia)	NSW Greenhouse Gas Abatement Scheme (also applies to parallel ACT scheme)	Rules for creation and methods for calculation of NSW Greenhouse Abatement Certificates	Greenhouse gas emission reductions from various activities, including increased efficiency of electricity consumption and reduction in electricity consumption where there is no negative effect on production or service levels	Greenhouse Gas Benchmark Rule (Demand Side Abatement) No. 3 of 2003
Ontario Provincial Government	Ontario SO <sub>2</sub> and NO <sub>x</sub> Trading Program	Emission Reduction Credit creation, recording and transfer rules, rules for renewable energy projects and conservation projects, and rules for the operation of the Ontario Emissions Trading Registry	Project-based direct SO <sub>2</sub> /NO <sub>x</sub> reductions or displacement of coal-fired grid electricity by EE/RE projects	Ontario Emissions Trading Code (detailed rules, including Standard Method for "Emission Reductions from Energy Conservation through Process Efficiencies" and for "Displacement of Electricity from Conservation Projects")
UK	Energy Efficiency Commitment 2005 – 2008	Provide guidance on quantifying energy efficiency improvement and best practice guidelines for each type of action under EEC2	Utility DSM programs to improve energy efficiency in domestic properties (insulation, lighting, heating and appliances, Combined Heat and Power, fuel switching)	Energy Efficiency Commitment 2005-2008: Technical Guidance Manual Issue 1 (stipulated values / calculation spreadsheet)
US EPA	National Energy Efficiency Action Plan	Create a Model Guide to provide basic process and technical guidance on evaluation issues and requirements, which can be used by individual jurisdictions to establish their own evaluation requirements	Energy savings & avoided emissions associated with energy efficiency programs implemented by states, cities, utilities, private companies, etc.	Model Energy Efficiency Program Evaluation Guide
US EPA	NO <sub>x</sub> SIP Call Guidance on EE/RE Set-Aside	Guidance to NO <sub>x</sub> SIP Call stakeholders	EE projects and programs that reduce electricity generation	Guide on evaluation, measurement and verification of electricity savings for determining emission reductions from EE/RE actions

<p>US States</p>	<p>Regional Greenhouse Gas Initiative (RGGI) CO2 Budget Trading Program</p>	<p>Model rule for participating States to use in establishing their State CO2 Budget Trading Program, which is designed to stabilize and then reduce anthropogenic emissions of CO2 in an economically efficient manner</p>	<p>Five broad offset categories, including reduction or avoidance of CO2 emissions from natural gas, oil, or propane enduse combustion due to enduse energy efficiency in buildings</p>	<p>Regional Greenhouse Gas Initiative Model Rule, including rules on CO2 offset allowances</p>
------------------	---	---	---	--

## Thesis 8

### **Modalities for CDM Programs of Activities should reflect the nature of programs that target energy efficiency**

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 programme 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.

For the industry sector, this could mean, for example, that companies participate in voluntary programs, such as rebate or tax credit programs or challenge programs that motivate enterprises to voluntarily adopt and implement energy management standards or energy intensity targets.

A typical approach that has been used to quantify the energy savings from financial incentive programs is to specify these *ex ante*, based on a hypothetical comparison between the energy efficient technology and a technology baseline (e.g., a legally mandated energy performance standard). This approach has been used in the United States, for example, to promote high-efficiency motors (NEMA Premium), with the benchmark assumed to be the Energy Policy Act minimum standard for the given motor size, assuming hours of operation that reflect industry sector practice. The Database for Energy Efficient Resources (DEER) – compiled by the California Public Utilities Commission and the California Energy Commission, with support and input from utilities and other interested stakeholders – provides estimates of the energy-savings potential for selected energy-efficient technologies and measures in residential and nonresidential applications (<http://eega.cpuc.ca.gov/deer>). The database contains information on typical measures – those commonly installed in the marketplace – and data on the costs and benefits of more energy-efficient measures.

Other countries, including Italy (Pavan, 2006), the United Kingdom (Defra, 2007) and a range of US States (Nadel, 2006) are using deemed values in the context of utility efficiency requirements and/or white certificate programs. Australian governments (New South Wales (NSW, 2003) and Australian Capital Territory) offer a similar default abatement factor method, as well as default efficiency improvement values that can be used to calculate emission reductions for a discrete equipment, process, or system. All of these programs include industrial motors among the equipment that can use stipulated values. It is conceivable to envision CDM-supported programs to provide incentives for utilities to implement demand-side management programs. A decision by the Parties to the Kyoto Protocol to allow the use of stipulated abatement factors or default efficiency values could pave the way for many types of energy efficiency CDM projects.

Voluntary challenge programs are typically comprehensive, treating a sector or enterprise as a black box and relying on self-reporting at the level of the enterprise, based on guidelines. More attention needs to be devoted to appropriate methodologies for such programs, which are also being established increasingly in developing countries. The 1000-enterprise program in China is an example. An increasing number of countries (including China, Denmark, Ireland, Sweden, and the USA) are developing energy management standards for industrial energy management

systems, and the USA is also developing standardized assessment protocols for major industrial systems (incl. pumping, compressed air, steam, process heating), which can support quantification of energy savings and plant certification programs (McKane, 2007). Such methodological tools could be used in the CDM context to address complex industrial systems, where the greatest potential for sustained energy savings and greenhouse gas emission reductions lies.

Other types of highly-effective demand-side efficiency programs for which appropriate methodologies have yet to be approved include programs that facilitate compliance with mandatory or voluntary standards or codes. NM0159-rev was unfortunately rejected, mainly because the Meth Panel and Executive Board did not accept that emission reductions can be attributed to the implementation of an efficiency testing, consumer labelling and quality assurance program, based on the case of air conditioners in Ghana. A review of this decision by an energy efficiency "community of practice" (Thesis 7) could determine whether the proposed methodology reflects measurement and quantification good practice, or whether there is any practical alternative approach that would better address the concerns of the CDM bodies. If not, either the Executive Board itself or the Parties to the Kyoto Protocol might want to overturn the original decision. Governments around the world are using taxpayer money to implement standard/code and label programs and have documented their effectiveness; best practices adopted for such assessments should be adequate under the CDM.

## **Thesis 9**

### **Rigor must be balanced against results**

Uncertainty is inherent to energy efficiency projects under CDM/JI. A key question that needs to be answered by policymakers is the acceptable level of rigor that should apply to end-use energy efficiency projects and how to achieve it. Rigor is a term used to encompass the issues of uncertainty and error for monitoring & verification activities and is defined as the level of expected reliability of energy, and thus emission, reductions (EPA, forthcoming). The responsible CDM bodies are requiring great effort to address non-routine baseline adjustments up-front, as well as gross-to-net adjustments, without providing top-down guidance. It is not at all clear that this approach is making results more accurate and precise, given the lack of guidance and the limited capacity of individual project developers to address such complex issues.

Yet one thing is certain: Methodologies for end-use energy efficiency projects and programs are having a very difficult time receiving approval, preventing meaningful volumes of greenhouse gas reductions being generated from end-use efficiency projects/programs under the CDM.

If this is not the intent of the Parties to the Protocol, then appropriate means to ensure an acceptable level of rigor – that can maintain the environmental integrity of the Kyoto Protocol overall, while encouraging energy efficiency – must be defined top down. In doing so, we should start from current good practice, as reflected in existing regulations and protocols that govern requirements to monitor energy efficiency activities, and be realistic about the level of accuracy that can be achieved and still be viable. Utility DSM programs, incentive programs for energy efficient products, equipment and services and white certificate schemes all must quantify emissions reductions. The programs in place in OECD and other countries, and the methodologies that they employ (such as those listed in Table 4), should be the starting point. These protocols provide useful top-down guidance on difficult issues that have often been treated unsystematically and inconsistently under the CDM, such as baseline selection, routine and non-routine baseline adjustment for independent variables and gross-to-net adjustments (incl. free riders, spillovers, leakage, rebound effects).

In this discussion, it is important to keep in mind that allowances to Annex I Parties and compliance with commitments are based on national greenhouse gas inventories. These inventories are improving, but still contain significant room for error. Nonetheless JI employs much less cumbersome procedures than the CDM. For Track 1 JI, there is no third-party scrutiny at all, since Parties involved in the transaction have emission caps, which is assumed to guarantee a zero-sum outcome for the climate system. Track 2 JI is similar conceptually to CDM, as it must be applied when the host Party does not meet the eligibility requirements for Track 1, including having a national system for tracking greenhouse gas emissions and a national registry to track transaction that comply with guidelines. In other words, if the inventory or tracking systems are not rigorous/in place and therefore cannot guarantee a zero-sum outcome for the climate system from JI transactions (which is analagous to the situation under the CDM), then the Track 2 verification procedure must be followed.

JI verification merely requires determination by an independent entity of whether a project and the ensuing reductions of anthropogenic emissions by sources or enhancements of anthropogenic removals by sinks meet the relevant requirements (i.e., approved by the Parties involved; additional; appropriate baseline and monitoring plan; documentation on environmental impacts, and, if impacts are considered significant, environmental impact assessment undertaken in accordance with procedures as required by the host Party). This determination is based on a Project Design Document that outlines how the baseline is determined and the emissions reductions calculated. While CDM methodologies can be used, there is no requirement to use specific methodologies approved *ex ante*. Determinations are final and projects are automatically approved after 45 days, unless a review is requested. This basic procedure is similar to that adopted under a number of other regulatory programs listed in Table 4.

Adopting pragmatic, good practice procedures for Sectoral Scope 3 and related end-use efficiency CDM activities – similar to those applied under Track 2 JI and other existing regulatory programs around the world – might mean that some CERs are issued for business-as-usual activities, thus meaning that the overall emission mitigation achieved on a global basis is slightly less than projected. But it is doubtful whether the current practice offers greater rigor and certainty, and, with rapidly growing emissions in developing countries and an ongoing process to continuously strengthen Parties' emission reduction obligations over time, less complexity with respect to gross-to-net adjustments might be justified to spur the massive investment in energy efficiency that is needed urgently in developing countries. Investments in outdated equipment are being made every day and will dictate high energy demand for decades. This seems an unnecessary price to pay to fool ourselves into thinking that we can guarantee certainty in quantifying energy efficiency project impacts under the CDM.

After all, barriers to energy efficiency investment are real and prevalent, even in OECD countries.

## ANNEX 1 CDM Sectoral Scopes

This list of sectoral scopes is based on the list of sectors and sources contained in Annex A of the Kyoto Protocol. For some of these scopes, there is partial overlap.

Designation	Sectoral Scope
<b>Industrial Sectors</b>	
1	Energy industries (renewable - / non-renewable sources)
2	Energy distribution
3	Energy demand
4	Manufacturing industries
5	Chemical industry
6	Construction
7	Transport
8	Mining/Mineral production
9	Metal production
<b>Sources</b>	
10	Fugitive emissions from fuels (solid, oil and gas)
11	Fugitive emissions from production and consumption of halocarbons and sulphur hexafluoride
12	Solvents use
13	Waste handling and disposal
14	Afforestation and reforestation
15	Agriculture

## REFERENCES

- Arquit Niederberger, A., and C. Brunner (in press) Promotion of high-efficiency electric motor systems under the Clean Development Mechanism, *Proc. of EEMODS 2007 (Beijing, China, 10-13 June 2007)*.
- Arquit Niederberger, A., C. Brunner, K. Jiang, Y. Chen (2007) Energy efficiency in China: The business case for mining an untapped resource, *Greener Management International*.
- Arquit Niederberger, A., and R. Spalding-Fecher (2006) Demand-side energy efficiency promotion under the Clean Development Mechanism: lessons learned and future prospects. *Energy for Sustainable Development X(4)*, 45-58.
- Benkhart, B. (2006) *NEMA Premium motor transformation programmes in the United States*. Presentation at the IEA Industrial Electric Motor Systems Workshop, 15-16 May 2006, Paris.
- Defra (UK Department for Environment, Food and Rural Affairs) (2007) *Energy, cost and carbon saving calculations for the draft EEC 2008-11 Illustrative Mix: Energy Efficiency Commitment 2008-11* (London: UK Department for Environment, Food and Rural Affairs).
- EPA (US Environmental Protection Agency) (forthcoming) *Creating an Energy Efficiency and Renewable Energy Set-Aside in the NOx Budget Trading Program: Evaluation, Measurement and Verification of Electricity Savings for Determining Emission Reductions from Energy Efficiency and Renewable Energy Actions* (Washington: US Environmental Protection Agency).
- Geller, H., and S. Attali (2005) *The Experience with Energy Efficiency Policies and Programmes in IEA Countries: Learning from the Critics*. IEA Information Paper (Paris: International Energy Agency).
- Gillingham, K., Newell, R.G., and K. Palmer (2004) *Retrospective Examination of Demand-Side Energy Efficiency Policies* (Washington, DC: Resources for the Future).
- Hayashi, D., and A. Michaelowa (2007) *Lessons from submission and approval process of large-scale energy efficiency CDM methodologies*. Paper prepared for the UNIDO/CTI/UK Investment and Trade Seminar on Energy Efficiency Projects in CDM and JI, 19-20 March 2007, Vienna.
- IEA (International Energy Agency) (2006) *World Energy Outlook 2006* (Paris: Organisation for Economic Co-operation & Development/International Energy Agency).
- McKane, A. (2007) *Industrial Energy Management: Issues Paper*. Paper prepared for UNIDO Expert Group Meeting on Using Energy Management Standards to Stimulate Persistent Application of Energy Efficiency in Industry, 21-22 March 2007, Vienna.
- Nadel, S. (2006) *Energy efficiency resource standards: experience and recommendations*. ACEEE Report E063 (Washington: American Council for an Energy Efficient Economy).
- NSW (New South Wales) (2003) *Greenhouse Gas Benchmark Rule (Demand Side Abatement)*, No. 3 of 2003
- Pavan, M. (2006) *New trends in energy regulation: the integration of command and control approaches, tariff regulation and artificial markets for demand-side resources*. Proceedings of the 29th International Conference of the International Association for Energy Economics (IAEE), 7-10 June 2006.
- Sathaye, G. (2006) A Comment: Determining additionality for bundled energy efficiency projects. Submitted to UNFCCC website in response to call for public inputs on additionality. Accessed 27 March 2006.

SAVE (European Commission Specific Actions for Vigorous Energy Efficiency Program) (2001) *European Ex-Post Evaluation Guidebook for DSM and EE Service Programmes* (Brussels: European Commission).

SEEEM (Standards for Energy Efficiency of Electric Motor Systems) (2006) *Market Transformation to Promote Efficient Motor Systems* (Zurich: SEEEM).

Spalding-Fecher, R., and J. Roy, et al. (2004) Potential for energy efficiency: Developing nations *Encyclopedia of Energy* 5, 117-133.

URC (UN Environment Program Risoe Centre on Energy, Climate and Sustainable Development) (2006) *CDM Pipeline Overview* (<http://cd4cdm.org/Publications/CDMpipeline.xls>)