Hamburgisches
WeltWirtschafts
Institut

Lessons from submission and approval process of large-scale energy efficiency CDM methodologies

Daisuke Hayashi, Axel Michaelowa

HWWI Research
Paper 4-11
by the
HWWI Research Programme
International Climate Policy

Hamburg Institute of International Economics (HWWI) | 2007
ISSN 1861-504X

Daisuke Hayashi
Hamburg Institute of International Economics (HWWI)
Neuer Jungfernstieg 21 | 20354 Hamburg | Germany
Tel +49 (0)40 34 05 76 - 67 | Fax +49 (0)40 34 05 76 - 76
hayashi@hwwi.org | www.hwwi.org

Axel Michaelowa
University of Zürich
Mühlegasse 21 | 8001 Zürich | Switzerland
axel.michaelowa@pw.unizh.ch

HWWI Research Paper
Hamburg Institute of International Economics (HWWI)
Neuer Jungfernstieg 21 | 20354 Hamburg | Germany
Tel +49 (0)40 34 05 76 - 0 | Fax +49 (0)40 34 05 76 - 76
info@hwwi.org | www.hwwi.org
ISSN 1861-504X

Lessons from submission and approval process of large-scale energy efficiency CDM methodologies

Daisuke Hayashi, Axel Michaelowa

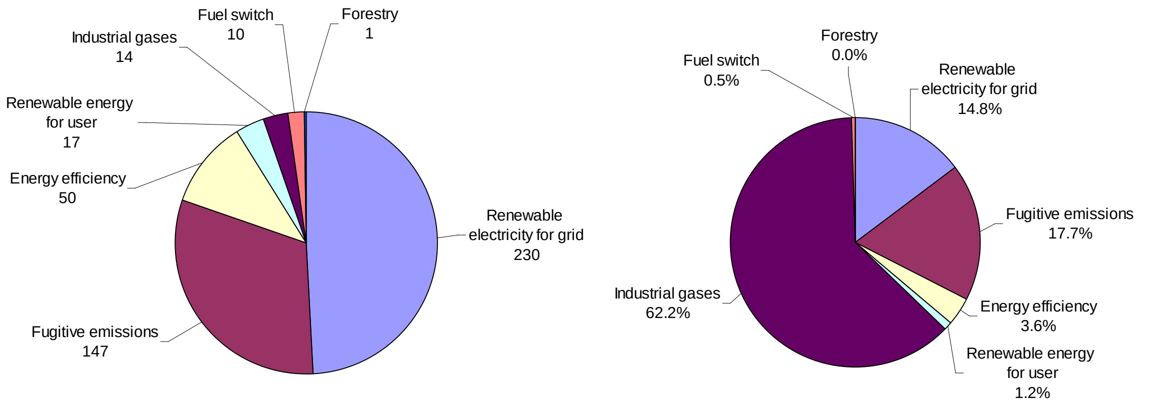
Abstract: The Clean Development Mechanism (CDM) so far has failed to mobilize a substantial amount of energy efficiency projects; less than 4% of credits come from this category. This is due to the fact that only few methodologies for setting of baselines and monitoring project emissions have been approved by the CDM Executive Board (EB). While energy efficiency methodologies have the highest share of methodology submissions, they also suffer from the highest rejection rate. Just 25% of energy efficiency methodology submissions have been approved or consolidated. The applicability of those methodologies is typically narrow and the requirements for monitoring are heavy. Industrial efficiency improvements (e.g. waste heat recovery) are covered relatively well, whereas there are glaring gaps with regards to electricity generation and transmission as well as transport. Demand-side management in households and commercial buildings so far has not been covered either. The EB has not been willing to accept empirical models and performance benchmarks as a basis for baseline emission determination. We see some inconsistencies in decision-making of the Methodology Panel (MP)/ EB particularly with respect to the underlying baseline approach, treatment of rebound effects and endogenous energy efficiency improvement, and additionality assessment of programmatic CDM. A key challenge for energy efficiency projects is determination of additionality; attempts to focus on the barrier analysis only have been rejected by the MP/ EB. A new challenge comes up in the context of programmatic CDM which could give a boost to demand-side activities if the rules are less cumbersome than those for single projects. Here, the application of the additionality test again becomes crucial.

Key words: Clean Development Mechanism, Energy efficiency improvement, Baseline and monitoring methodology, Additionality

Acknowledgement: This paper was prepared for the “Future CDM” project, funded by Ministry of Economy, Trade, and Industry (METI), Japan.

1. Introduction

The CDM has failed so far to live up to its potential for materializing the vast opportunities of energy efficiency improvement in non-Annex I countries. As of December 2006, 469 projects have been registered by the EB, only 50 of which are energy efficiency projects. Dwarfed by projects which reduce industrial gas emissions, e.g. HFC-23 and N_2O, the share of CER generation till 2012 from registered energy efficiency projects is only 3.6%, or 25 $MtCO_2eq$.



Number of registered projects, 469 CERs till 2012 from registered projects, 697 $MtCO_2eq$

Figure 1. Number of and CERs till 2012 from registered projects by project type (December 2006)
Source: UNFCCC (2006a) and authors' calculation

Energy efficiency CDM projects have faced several major challenges, notably regarding baseline and monitoring methodology development and additionality assessment. Project developers have so far focused on methodologies that do not generate problems with additionality assessment, have low costs of data collection, and restrict applicability of the methodology to a very specific project type and host country. Consequently, methodologies for complex project types with several emissions streams, several locations, indirect effects and a wide project boundary have not been submitted. Energy efficiency methodologies, especially demand-side ones, typically fall into such a complex category. This has lead to the highest rejection rate of energy efficiency methodologies among all types of methodologies submitted to the EB. Moreover, technologies which generate revenues through product(s) that can be sold on the market, including energy efficient technologies by saving energy, have had problems in demonstrating additionality (see Michaelowa and Hayashi 2006).

This paper analyzes the submission and approval process of energy efficiency methodologies and gives recommendations regarding future methodology development and additionality assessment of energy efficiency projects.

2. Overview of small-scale energy efficiency methodologies

There are currently 21 small-scale (SSC) methodologies approved by the EB, of which six are applicable to energy efficiency projects:

1. AMS-II.A.: Supply side energy efficiency improvements for transmission and distribution;
2. AMS-II.B.: Supply side energy efficiency improvements – generation;
3. AMS-II.C.: Demand-side programmes for specific technologies;
4. AMS-II.D.: Energy efficiency and fuel switching measures for industrial facilities;
5. AMS-II.E.: Energy efficiency and fuel switching measures for buildings; and
6. AMS-II.F.: Energy efficiency and fuel switching measures for agricultural facilities and activities.

No new SSC energy efficiency methodologies have been approved since the last analysis in August 2005 (see Müller-Pelzer and Michaelowa 2005).[1] While they have repeatedly been revised, the revisions only reflect changes in the methods to calculate the electricity grid emission factor and definition of thresholds for SSC projects. Therefore, the following analysis will focus on the submission and approval process of large-scale energy efficiency methodologies.

3. Overview of large-scale energy efficiency methodologies

This chapter gives an overview of large-scale energy efficiency methodologies, first, in form of a summary and then in a detailed evaluation to give a thorough picture of these methodologies.

3.1. Evaluation status of large-scale methodologies

As of December 2006, 202 large-scale New Methodologies (NMs) had been submitted to the EB. After evaluation of these submitted methodologies, the EB has made available 38 Approved Methodologies (AMs) and 10 Approved Consolidated Methodologies (ACMs). Figure 2 shows a wide variety of submitted methodology types. However, most of them are designed for a specific technology/ measure or a host country. As discussed above, only a few widely applicable methodologies have been approved so far.

Importantly, the energy efficiency category has received the largest number of methodology submissions (81) as well as the highest rejection rate by the EB (48%). Despite the continuous efforts of the methodology developers, the rejection rate has not been reduced significantly over time. Because application of AMs or ACMs is mandatory to submit CDM projects to the EB, the lack of suitable methodologies has been a major hurdle for energy efficiency projects. The next section will focus on large-scale methodologies for energy efficiency projects and give an overview of their submission and approval status.

[1] Refer to Müller-Pelzer and Michaelowa (2005) for lessons from approved SSC methodologies.

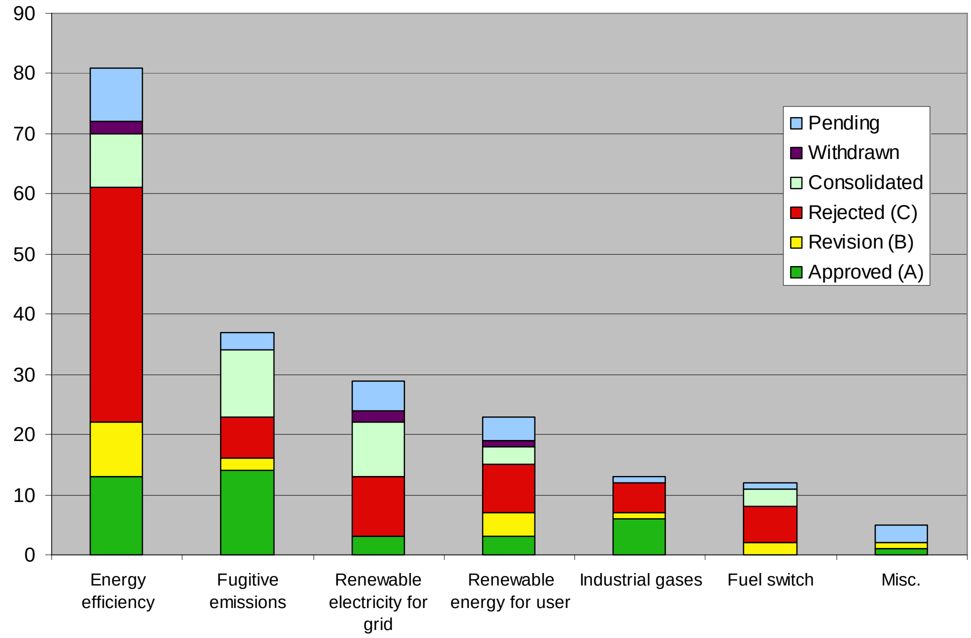


Figure 2. Status of large-scale methodology evaluation (December 2006)
Source: UNFCCC (2006b) and authors' calculation

3.2. Evaluation status of large-scale energy efficiency methodologies

As of December 2006, the following 81 methodologies had been submitted for energy efficiency project activities (including 16 resubmissions upon C ratings). In Table 1, these methodologies are categorized into seven types according to the six SSC energy efficiency methodology categories with an addition of "energy efficiency and fuel switching measures for transport."[2]

Out of the 81 energy efficiency methodologies submitted, 13 have been approved as AMs (A ratings), 9 consolidated to ACMs, 39 rejected (C ratings), 2 withdrawn, and 18 are still in process. The last category includes 9 methodologies which the EB has not made final decisions on (pending) and 9 methodologies where the project participants have received B ratings.

[2] Transport methodologies are commonly much broader than "energy efficiency and fuel switching." However, the category is set as specified for convenience.

Table 1. Status of large-scale energy efficiency methodology evaluation (December 2006)

Methodology	**Status**	**Type**[a]
NM0003: Construction of new methanol production plant (called: M 5000)	C	4
NM0017-rev: Steam efficiency improvements by replacing steam traps and reusing hot-water condensate	A (AM0017)	4
NM0018-rev: MGM baseline methodology for natural gas based package cogeneration	A (AM0014)	2
NM0031-rev2: OSIL baseline methodology for electricity generation projects from utilization of waste heat from waste gases	Consolidated (ACM0004)	4
NM0033: Baseline methodology for cement kiln replacement	Withdrawn	4
NM0037-rev: IGFL baseline methodology for steam optimisation system	A (AM0018)	4
NM0042-rev: Water pumping efficiency improvement	A (AM0020)	4
NM0044: Power factor improvements	C	4
NM0045-rev2: BCL methodology for GHG emission reduction in cement industry	Consolidated (ACM0005)	4
NM0046: Simplified project-level least cost and scenario analysis for the rehabilitation of district heating systems	C	1
NM0047-rev: Baseline methodology for project activities that substitute Ordinary Portland Cement (OPC) with blended cement/ fossil fuels with alternative fuels in cement kilns	Consolidated (ACM0005)	4
NM0049: Combined margin methodology applied to electricity grid (BOF gas waste heat recovery)	C	4
NM0052: Public transport sector energy efficiency and modal change baseline	C	7
NM0058: Heat supply baseline in China for district heating based on surplus heat from power production	C	1
NM0059: Methodology for energy co-generation from steel making gas recovery	C	4
NM0064: Methodology for electronic energy consumption reduction in steel making process	C	4
NM0070: Open cycle to combined cycle gas turbine conversion connected to an economically dispatched, centrally controlled grid	Consolidated (ACM0007)	2
NM0071-rev: Avoiding flaring of waste gases from steel manufacturing operations and its utilization for substituting GHG intensive fuel in power generating units and/ or generating power to supply to grid	C	4[3]
NM0072: Energy efficiency through mandatory national-level appliance standards	Withdrawn	3
NM0074: Baseline methodology for technological improvements in industry	C	4
NM0077: Fuel switching and changes in self-generation and/ or cogeneration at an industrial facility	C	4
NM0078-rev: Conversion from single-cycle to combined-cycle power generation	Consolidated (ACM0007)	2
NM0079-rev: Baseline methodology for greenhouse gas reductions through waste heat recovery and utilisation for power generation at cement plants	A (AM0024)	4
NM0080-rev: Baseline methodology for grid connected electricity generation plants using non-renewable and less GHG intensive fuel	A (AM0029)	2
NM0086: Baseline methodology for project activities involving energy efficiency, self-generation, cogeneration, and/ or fuel switching measures at an industrial facility	C	4
NM0087: Baseline methodology for electricity generation using waste heat recovery in sponge iron plants	Consolidated (ACM0004)	4
NM0088: Baseline methodology for electricity production from waste energy recovery in an industrial or manufacturing process	Consolidated (ACM0004)	4

[3] Resubmission of NM0049.

NM0089: CECL methodology for power generation for captive use, which is grid connected, using non-renewable and less GHG intensive fuels	C	2
NM0092-rev: Baseline methodology for energy efficiency on electricity and fossil fuel consumption through technological improvements in the metal production industry through smelting	C	4
NM0095: Methodology for increase of additive percentage in PPC blended cement	Consolidated (ACM0005)	4
NM0096: Energy efficiency improvements in district heating production and distribution	C	1[4]
NM0097: Improvement in recovery of waste biomass from process streams and use of that biomass in energy generation	C	4
NM0099: Energy efficiency improvement in process and manufacturing industries	C	4
NM0100: Activities for the promotion of electricity efficiency, through the replacement of unitary equipment, by parties that are not the energy consumers	C	3
NM0101: Grasim baseline methodology for the energy efficiency improvement in the heat conversion and heat transfer equipment system	C	4
NM0103: Baseline methodology for district heating rehabilitation, possibly reducing use of in house devices	C	1[5]
NM0105-rev: Baseline methodology for bus rapid transit projects	A (AM0031)	7[6]
NM0106: Baseline methodology for optimization of clinker use in the cement industry through investment in grinding technology	Consolidated (ACM0005)	4[7]
NM0107-rev: Baseline methodology for waste gas-based cogeneration system for power and steam generation	A (AM0032)	2 and 4
NM0112-rev: Increased electricity generation from existing hydropower stations through decision support system optimization	C	2
NM0113: Gas powered combined cycle cogeneration replacing coal based steam generation and grid electricity	C	2 and 4
NM0114: Improved efficiency of electrical power system generation through advanced SCADA control systems and related Energy Management Protocol	C	2
NM0116: Reduction in the use of OPC for concrete mix preparation	C	4
NM0118-rev: Introduction of integrated demand-side energy saving system for existing beer brewing system	C	4
NM0119: Baseline methodology for energy integration project activities involving energy efficiency, self-generation, and/ or cogeneration measures at an industrial facility	C	4[8]
NM0120: Demand-side electricity management for food retailers, supermarkets, hypermarkets, shopping centers and other similar commercial activities	C	5
NM0122: Cogeneration at an industrial facility	C	4[9]
NM0123-rev: Methodology for use of non-carbonated calcium sources in the raw mix for cement processing	A (AM33)	4
NM0128: Baseline methodology for modal shifting in industry for product/ feedstocks	C	7
NM0136: Reduction of technical losses in electricity distribution systems	C	1
NM0137: Energy efficiency improvements in cement industry	C	4[10]
NM0138-rev: Fuel switching from coal and/ or petroleum fuels to natural gas and cogeneration at an industrial facility	C	4

[4] Resubmission of NM0058.
[5] Resubmission of NM0046.
[6] Resubmission of NM0052.
[7] Resubmission of NM0074.
[8] Resubmission of NM0086.
[9] Resubmission of NM0077.
[10] Resubmission of NM0099.

NM0141-rev: New cogeneration facilities supplying electricity and/ or steam to multiple customers	B	2
NM0144-rev: Energy efficiency improvements carried out by an Energy Service Company (ESCO) through boiler rehabilitation or replacement	A (AM0044)	4 and 5
NM0146: Baseline methodology for improved electrical energy efficiency of an existing submerged electric arc furnace used for the production of silicomanganese	A (AM0038)	4
NM0150-rev: Lighting retrofit for residential use	B	3
NM0153: Baseline methodology for grid connected electricity generation plants using Natural Gas (NG) / Liquefied Natural Gas (LNG) fuels	A (AM0029)	2
NM0154: Grasim baseline methodology for the energy efficiency improvement in the heat conversion and heat transfer equipment system	B	4[11]
NM0155-rev: Baseline methodology for waste gas and/or heat utilization	B	4
NM0157-rev: Methodology for DSM program switching from incandescent lamps to CFLs	B	3
NM0158: GHG emissions reductions in urban transportation projects that affect specific routes or bus corridors or fleets of buses including where fuel usage is changed	C	7
NM0159-rev: Activities to increase market penetration of energy efficient appliances	B	3[12]
NM0160: Cogeneration at an industrial facility	B	4[13]
NM0161: Baseline methodology for gas powered cogeneration for an industrial facility	B	4[14]
NM0163: Baseline methodology for project activities using alternative materials in clinker manufacturing to reduce GHG emissions in a cement kiln	A (AM0040)	4
NM0169: Baseline methodology for reducing GHG emission by efficient utilization of energy in the form of fuel, power and steam	C	4
NM0171: Energy efficiency improvement through oil/ water emulsion technology incorporated into an oil-fired thermal and/ or electricity power production facility	Pending	2
NM0177: Utilization of coke oven gas for cogeneration	C	4
NM0179: Waste gas and/ or waste heat utilization for ‘process steam’ generation or ‘process steam and power’ generation in an industrial facility	Pending	4
NM0181: Introduction of a new primary district heating system	B	1[15]
NM0182: Improved efficiency of electrical power system generation through advanced SCADA control systems and related Energy Management Protocol Software (EMS)	C	2[16]
NM0183: Baseline methodology for the GHG avoidance project through environment friendly technology in refinery/ petrochemical process	C	4
NM0184: Improved heat rates and capacity enhancement of power plant through retrofit of equipment(s) such as retrofit of existing gas turbine for inlet air cooling	C	2
NM0186: Increased electricity generation from existing hydropower stations through Decision Support System optimization	Pending	2[17]
NM0190: Baseline methodology for heavy fuel-oil trigeneration	C	4
NM0192: Baseline and monitoring methodology for the recovery and utilization of waste gas in refinery facilities	Pending	4
NM0195: Methodology for efficiency improvement in electricity generation by steam turbine replacement in a production facility where process steam is required for production	Pending	2

[11] Resubmission of NM0101.
[12] Resubmission of NM0072.
[13] Resubmission of NM0122.
[14] Resubmission of NM0113.
[15] Resubmission of NM0096.
[16] Resubmission of NM0114.
[17] Resubmission of NM0112.

NM0197: Power saving through accelerated replacement of electrical equipment with variable load under a program of activities	Pending	3
NM0199: GHG emission reductions through reduced energy consumption of the furnace due to enhanced heat content of the raw material(s) input(s) to the furnace	Pending	4
NM0201: Modal shift for the transport of bulk goods within a two node network	Pending	7[18]
NM0202: Power plant rehabilitation and/ or energy efficiency improvement combined with an optional change in fuel mix	Pending	2

[a] Methodology type definitions

1. Supply side energy efficiency improvements for transmission and distribution
2. Supply side energy efficiency improvements - generation
3. Demand-side programmes for specific technologies
4. Energy efficiency and fuel switching measures for industrial facilities
5. Energy efficiency and fuel switching measures for buildings
6. Energy efficiency and fuel switching measures for agricultural facilities and activities
7. Energy efficiency and fuel switching measures for transport

Source: UNFCCC (2006b) and authors' categorization

The number of energy efficiency methodologies by evaluation status is summarized in Table 3. Around three quarters of the energy efficiency methodologies have been submitted in category 4 (energy efficiency and fuel switching measures for industrial facilities) and 2 (supply side energy efficiency improvements - generation). The category 4 is the only category where the submissions have been relatively successful. However, again, applicability of AMs/ACMs of this category is usually limited to a specific technology. Attempts to achieve wider applicability incorporating multiple technologies or measurements have been unsuccessful so far (e.g. NM0099, NM0119, NM0137). Category 2 takes the second position. The AMs/ACMs of the category also follow the trend of narrower applicability so far. An exception is AM0029, which is applicable to new installation of natural-gas power plant(s) and has been applied by as many as 14 projects since its approval in May 2006.

Methodology submissions to other categories have been limited. The category 3 (demand-side programmes for specific technologies) has received only six submissions all applied to energy efficient equipments for buildings, e.g. efficient light bulbs and room air conditioners. Although a programmatic approach is essential for this kind of projects (and the first methodology for this category, NM0072, was submitted long back in November 2004), a clear guidance on the definition of "a programme of activities under the CDM" had not been given by the EB until its 28th meeting in December 2006 (see UNFCCC 2006c). This has lead to great confusion among stakeholders and tardy development of demand-side energy efficiency methodologies. The category 7 (energy efficiency and fuel switching measures for transport) has also lagged behind due to a complex nature of transport projects. Although AM0031 has become available in July 2007, its applicability is very specific to the project attached to the methodology (BRT Bogotá, Colombia: TransMilenio Phase II to IV). Consequently, AM0031 has not been applied to any other projects so far.

[18] Resubmission of NM0128.

Table 3. Number of large-scale energy efficiency methodologies by evaluation status (December 2006)

Methodology type	Submitted	AM	ACM
1: Supply side energy efficiency improvements for transmission and distribution	6	-	-
2: Supply side energy efficiency improvements – generation	16	2.5	1
3: Demand-side programmes for specific technologies	6	-	-
4: Energy efficiency and fuel switching measures for industrial facilities	46.5	8	2
5: Energy efficiency and fuel switching measures for buildings	1.5	0.5	-
6: Energy efficiency and fuel switching measures for agricultural facilities and activities	0	-	-
7: Energy efficiency and fuel switching measures for transport	5	1	-
Sum	81	12	3

Note: "2 and 4" or "4 and 5" is allocated to methodology type 2, 4, and 5 respectively with 0.5 points. NM0107, NM0113, and AM0032 are of the former category. NM0144 and AM0044 are of the latter.
Source: UNFCCC (2006b) and authors' categorization

4. Analysis of submission and approval process of large-scale energy efficiency methodologies

Based on the analysis of the submission and approval process of large-scale energy efficiency methodologies, this chapter will discuss lessons learned from the experience focusing on i) applicability, ii) baseline approach, iii) baseline scenario selection and additionality assessment, and iv) emission reductions calculation. The analysis will mainly focus on lessons specific to energy efficiency methodologies, based on the submission and approval process from August 2005 to December 2006. For more generic methodological issues (e.g. transparency, conservativeness, formatting, and other basic methodological rules) or earlier lessons specific to energy efficiency methodologies, refer to Müller-Pelzer and Michaelowa (2005). In addition, preliminary analysis will be given to methodologies for energy efficiency CDM programmes, which have recently gained great momentum.

4.1. Applicability

As discussed above, applicability of energy efficiency methodologies has typically been limited to a specific technology or measurement. Such a bottom-up approach, based on engineering analysis of each relevant component, allows for accurate calculation of emission reductions and has been preferred by the MP/ EB. Again, a drawback of this approach is that a methodology tends to have technology-/measurement-specific applicability by nature. Although a majority of energy efficiency methodologies are based on the bottom-up approach, several attempts to achieve wider applicability have also been observed. These can be categorized into i) empirical model approach and ii) performance parameter approach.

Examples of the empirical model approach are NM0119 and NM0122. Both of them employ an empirical model (as opposed to the bottom-up engineering approach as a "theoretical" model) to estimate the baseline emissions. For example, NM0119 applies regression analysis assuming that there is a relationship between the fuel use in the baseline scenario and the production of an industrial facility. Such an approach can “skip” each production component but is likely to face difficulty in attributing emission reductions to the project activity. Although the approach is attractive in terms of simplicity and wider applicability (because it does not require process-specific analysis; e.g. NM0119 is applicable to any energy efficiency improvement measurements in industrial facilities that produce only one product), the MP/ EB have taken unfavourable decisions on such an approach mainly due to inappropriate causality between emission reductions and the project activity.

Another approach for wider applicability is based on performance parameters. An example of performance parameters is specific electrical/ thermal energy consumption measured as final electricity/ thermal energy consumption divided by quantity of production (NM0120 for building electrical efficiency, NM0099 and NM0137 for cement plant efficiency). Such performance parameters are typically estimated based on historical performance data (e.g. three years for NM0120 and one year for NM0137). Endogenous energy efficiency improvement in the baseline scenario is not considered at all in NM0120. NM0137 takes into consideration such effects by choosing a baseline scenario with an endogenous efficiency improvement rate based on a historical trend (although guidance to justify the historical improvement trend is vague). These attempts have failed mainly because of improper treatment of causality between emission reductions and the project activities. For example, although NM0099 and NM0137 are designed for project activities reducing emissions through energy efficiency measures, the proposed methodologies also account for emission reductions that result from activities other than efficiency measures, such as changes in a clinker factor or product/ fuel mix. In addition, the lack of proper treatment of endogenous energy efficiency improvements is another critical issue of these methodologies.

These experiences give an insight into development of widely applicable energy efficiency methodologies. Facility-level-bundling (or complex type methodologies), which bundles multiple processes at a facility into one methodology, is essential to achieve wider applicability. However, it is important to note that such an approach is likely to fail unless it is built on bottom-up engineering model, not an empirical one, and endogenous energy efficiency improvement is properly taken into account.

4.2. Baseline approach

A majority of the energy efficiency methodologies has aimed at retrofit or replacement activities of existing equipment(s). Consequently, most of the methodologies are based on the baseline approach 48.a (historical emissions). The share of the approach 48.b (emissions of an economically attractive course of action, taking into account barriers to investment) is much lower due to the lack of methodologies designed for activities for new installations. The approach 48.c (emissions of the top 20% of similar project activities undertaken in the previous five years) has hardly been applied successfully mainly due to difficulties in data collection (from potential competitors) and definition of “a similar circumstance” (e.g. NM0003, NM0116).

Table 4. Number and share of baseline approaches applied to large-scale energy efficiency methodologies (December 2006)

	NM		AM/ACM	
48.a	61	75.3%	10	66.7%
48.b	19	23.5%	5	33.3%
48.c	1	1.2%	0	0.0%
Sum	81	100.0%	15	100.0%

Note: "48.a or 48.b" is allocated to 48.a and 48.b respectively with 0.5 points. ACM0004 and ACM0007 are of this category.
Source: UNFCCC (2006b) and authors' calculation

Wrong choice of the baseline approach has been one of the reasons for rejection of methodology submissions (see Müller-Pelzer and Michaelowa 2005). In most cases, the use of 48.a has been supported by the MP/ EB for retrofit or replacement projects, while 48.b for new installation projects. However, the MP/ EB have occasionally taken different stances on the baseline approach choice. For example, NM0136 is considered as a methodology for discretionary retrofit energy efficiency projects. Against its choice of the baseline approach 48.a, the MP recommended 48.b stating "48.a is more appropriate to projects that derive no financial benefits other than the carbon income." If such reasoning is always applied, all the energy efficiency projects have to be based on 48.b, which is not necessarily reasonable. Another example is NM0159 which is based on 48.a. The MP also recommended 48.a even though NM0159 is only applicable to end-of-life replacement. At the end of technical lifetime of equipments, the equipment purchase decision is usually widely open and 48.b suits better to such a situation than 48.a does.

UNFCCC (2006d) states that "project participants proposing new baseline methodologies shall ensure consistency between the determination of additionality of a project activity and the determination of a baseline scenario" and "ensure consistency between baseline scenario derived by this procedure and the procedure and formulae used to calculate the baseline emissions." As per these guidelines, project participants shall ensure consistency among i) baseline scenario selection, ii) calculation of the baseline emissions, and iii) demonstration of additionality. Because the baseline approach, in principle, serves as a basis for calculation of the baseline emissions, it is considered to determine how the above three procedures should be carried out. Therefore, to avoid further confusion, it is important to reconsider what kind of baseline approach should be applied in the context of energy efficiency CDM projects.

Niederberger and Spalding-Fecher (2006) proposed distinction among three energy efficiency markets: i) discretionary retrofit, ii) planned replacement, and iii) new installations markets. Discretionary retrofit market is defined as decisions to prematurely replace existing technology with high-efficiency equipment for the primary purpose of improving energy efficiency. Planned replacement market concerns decisions to replace existing technology at the end of its useful lifetime (e.g., failure, replacement schedule) with high-efficiency equipment. New installations market is for decisions to select high-efficiency equipment over other alternatives at a time of new installations.

Different baseline approaches are required for the three different energy efficiency markets. First of all, 48.a is recommended for discretionary retrofit since such a project is replacing existing, functioning equipment before the end of its technical lifetime. As for the planned replacement, 48.b is generally the most suitable baseline approach since it generally involves new investment decisions. However, if replacement equipment has already been purchased, 48.a may become more appropriate since not employing the already purchased equipment would represent a sunk cost. Lastly, 48.b is the first choice for new installations since the equipment purchase decision is widely open and there is no historical data for such projects by nature (see Niederberger and Spalding-Fecher 2006). Applicability of 48.c is difficult to assess because the experience is scarce so far. It would lend itself mainly to the market for new installations where one could look at the market for comparable new technologies. But it could also be applicable for a situation where one looks at a retrofit/ replacement activity if there is a common characteristic of a retrofit/ replacement (e.g. "normally technology x is replaced after 10 years with technology y") and data for the retrofitted/ replaced technology are available. As long as necessary data is available and the choice does not lead to less conservative calculation of the baseline emissions than 48.a or 48.b does (i.e. cherry picking of the baseline approach to reap more CERs is most likely rejected by the MP/ EB), 48.c can also play a role. It is important to note that 48.c can readily address a rebound effect issue (see below for detailed discussion) where historical data is not available. Emissions from an increased output level due to energy efficiency improvement must be taken into account in calculation of the baseline emissions. The problem with 48.b-based new installation energy efficiency projects is that they tend to set an output level of the baseline scenario equal to the one of the project activity since such project do not have historical output data (i.e. no consideration of rebound effects). 48.c could solve this problem by taking an output level of "similar" project activities although such approach has never been applied successfully so far. A summary of baseline approach choice for the three different energy efficiency markets is given in Table 5.

Table 5. Suitable baseline approach for different energy efficiency project types

Energy efficiency project type	Suitable baseline approach
Discretionary retrofit	48.a is preferable. 48.c is also applicable if necessary data is available and the choice does not lead to less conservative calculation of the baseline emissions than 48.a does.
Planned replacement	48.b is preferable (a possible exception is a case where replacement equipment has already been purchased. In such a case, 48.a might be more preferable). 48.c is also applicable if necessary data is available and the choice does not lead to less conservative calculation of the baseline emissions than 48.b does.
New installations	48.b is preferable. 48.c is also applicable if necessary data is available and the choice does not lead to less conservative calculation of the baseline emissions than 48.b does.

Source: Adopted from Niederberger and Spalding-Fecher (2006)

4.3. Baseline scenario selection and additionality assessment

Energy efficiency projects are often economically/ financially viable even without CER revenues. Due to the limited contribution of CER revenues to the overall project finance, such projects have faced difficulty with demonstrating additionality. As a consequence, project participants have attempted to exclude the investment analysis from baseline scenario selection and additionality assessment. The examples are NM0119, NM0122, and NM0136 which are all based on the baseline approach 48.a and suggested application of the barrier analysis only. All of these attempts have not been supported by the MP/ EB. A partial use of the additionality tool (i.e. predominantly exclusion of the investment analysis in the context of energy efficiency projects) has triggered second thoughts of the MP/ EB and become one of the major reasons for methodology rejections. Although it is not mandated by the additionality tool, application of both the barrier and investment analysis has been the first priority recommendation by the MP/ EB.

Compared to the investment analysis, the barrier analysis tends to be more qualitative and subjective, hence prone to more gaming. In the case where barriers exist to all the alternatives, demonstrating the barriers to the alternative chosen as the result are clearly "less likely" to prevent this alternative than the barriers affecting the other alternatives is considered invalid (e.g. the MP recommendation on NM0136). In case of an inconclusive result of the barrier analysis, methodologies have to provide a way to come up with a single result e.g. either by the investment analysis or the choice of a scenario with the lowest emissions (e.g. NM0141). However, it should be noted that a combination of the barrier and investment analysis can be conclusive, but energy efficiency projects are likely to face difficulty in passing the investment analysis. Also, the barrier analysis complemented by the choice of a scenario with the lowest emissions can be conclusive, but the result is likely to be the project activity itself if the option is not screened out by the barrier analysis.

In order to systemize the baseline scenario selection and additionality assessment process, the combined tool to identify the baseline scenario and demonstrate additionality (the combined tool) has established a flow chart to select the most plausible baseline scenario and demonstrate additionality (see UNFCCC 2006e). It basically sets two options in case the barrier analysis is not conclusive. First, if the remaining alternatives include the project undertaken without the CDM, project participants should apply the investment analysis to single out an alternative. Second, if the remaining alternatives do not include the project undertaken without the CDM, project participants can either apply the investment analysis or choose the baseline scenario alternative with the least emissions. Here again, the barrier analysis plays a key role especially in the context of energy efficiency projects, where the investment analysis is likely to end up with unfavourable results for the project activities.

Niederberger and Spalding-Fecher (2006) argues that major barriers to energy efficiency projects can be that capital investment decisions are generally not made on the basis of what is cost effective, but rather on the basis of which investment bear the least risk and will give the greatest/ most rapid return on investment. Also, those who purchase energy-using capital equipment or appliances are often not the ones who pay energy bills. Therefore, their main concern is a low equipment purchase price, not operating costs such as energy bills.

In order to incorporate the barriers mentioned above and overcome the additionality challenge that energy efficiency projects have been facing with, additionality assessment has to be streamlined by defining one-step criteria and simple barrier analysis as far as possible. Also, the investment analysis has to take into account the risk premium which projects in developing countries face with. Possible options could be additionality assessment based on i) a list of "first of its kind" technologies, ii) an internal rate of return below the lending rate of commercial banks for the maximum loan duration available for private debtors at the date of PDD submission, and iii) a payback period commonly used as cut-off for projects in the associated economic sector in the host country. For more details, refer to Michaelowa (2005).

Another upcoming problem is additionality assessment of projects which employ a facility-level-bundling approach. Such an approach typically incorporates multiple processes at a facility into one methodology (e.g. NM0099, NM0122, NM0137). Therefore, additionality assessment can be applied either at a facility level or each production process level. Although the experience with this kind of approach is scarce, a general lesson can be drawn from the methodology submission and approval process so far. The MP/ EB have been very cautious in establishment of causality between the emission reductions and project activity (e.g. the MP recommendation on NM0137 and NM0159). Also, the EB guidance on programmatic CDM clearly states that a programme of activities must demonstrate that the emission reductions for each project activity under the programme are uniquely attributable to the programme (see UNFCCC 2006c. For further discussion, see Section 4.5.3.). If the EB is consistent, it would mean that each component of a bundle of activities at an industrial facility would have to show additionality, which is likely to be difficult.

4.4. Emission reductions calculation

There are three major methodological challenges which energy efficiency methodologies have continuously been faced with: i) remaining technical lifetime of existing equipments, ii) output increase by the project activity, and iii) endogenous energy efficiency improvement in the baseline scenario.

4.4.1. Remaining technical lifetime of existing equipments

The EB, at its eighth meeting, gave guidance on the treatment of existing and newly built facilities, stating that "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 out or lifetime of the existing facility (see UNFCCC 2003)." The 22nd meeting of the EB gave further guidance on treatment of the technical lifetime of plants and equipment (see UNFCCC 2005a). However, despite the EB guidance, many energy efficiency methodologies have failed to take into account the issue properly (e.g. NM0118, NM0119, NM0141, NM0169, NM0171).

A solution could be to either i) limit the applicability to the case where the retrofit undertaken does not increase the technical lifetime of existing equipments (e.g. NM0163, NM0171, AM0040, ACM0009), or ii) determine the remaining technical lifetime of existing equipments without any retrofit and issue CERs only as long as the this technical lifetime would not be reached by the facility (e.g. NM0144, the MP recommendation on NM0184). In the latter approach, the methodology has to clearly describe the procedure to estimate the technical lifetime of existing equipments (for detailed guidance, see UNFCCC 2005a).

4.4.2. Output increase by the project activity

There are two types of output increase caused by the project activities: i) capacity expansion by the project activity and ii) rebound effects due to the increased energy efficiency level. In either case, as discussed above, 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 of the existing facility. For any increase of output of the facility which is due to the project activity, a different baseline shall apply (see UNFCCC 2003).

Capacity expansion

Two approaches have been applied so far to address emissions from output increase by capacity expansion due to the project activity: i) to limit the applicability to the case where the retrofit undertaken does not expand the capacity of existing equipments (e.g. NM0163, NM0171, AM0040, ACM0009), or ii) not to claim for CERs for emission reductions associated with project activity output above the maximum capacity of existing equipments.

The former is very similar to the first approach addressing the remaining technical lifetime issue discussed above. An example of the latter can be found in AM0044. It applies a capping factor (i.e. "average historic thermal energy output from the baseline boiler" divided by "thermal energy output by the project boilers") so that project participants do not claim for CERs for reduction of emissions from fuel consumption associated with any thermal energy output above the maximum capacity of the baseline boilers.

Rebound effects

The MP/ EB have occasionally given recommendations to consider emissions from the increased output level caused by energy efficiency improvement by the project activity (i.e. rebound effects). However, clear and consistent methodological guidance is lacking and decisions by the MP/ EB have been extremely inconsistent. Although some large-scale energy efficiency methodologies have been rejected because they did not take into account rebound effects (e.g. NM0096, NM0103), SSC energy efficiency methodologies do not consider rebound effects and project with serious rebound effects (e.g. Kuyasa low-cost urban housing energy upgrade project) has been registered. In addition, a few large-scale energy efficiency AMs also lack of appropriate treatment of this issue (e.g. AM0020, AM0029).

The issue poses another debatable question: rebound effects and suppressed demand. In the case of many developing countries, any rebound effect resulting from energy efficiency projects is often linked to situations of suppressed demand due to insufficient supply (see Figueres and Bosi 2006). There is a view that meeting suppressed demand through an energy efficiency project activity should not be penalized because the CDM is to promote sustainable development in developing countries (see James 2005). To avoid further confusion, more clarification/ consistency is needed on treatment of rebound effects by the MP/ EB.

4.4.3. Endogenous energy efficiency improvement in the baseline scenario

Over time, baseline emission might be reduced by a certain percentage due to modernisation, better maintenance and new equipment installations, etc. In most cases, the MP/ EB have recommended to take into account such endogenous energy efficiency improvement in the baseline emission calculation (e.g. the MP recommendations on NM0120 and NM0136). However, again, the MP/ EB decisions have sometimes been inconsistent. For example, NM0042 was approved as AM0020 even though it did not consider any endogenous energy efficiency improvement.

Possible approaches to tackle this issue are application of i) a default factor for endogenous energy efficiency improvement, ii) benchmarking (e.g. based on 48.c or other criteria), and iii) a project and baseline sample group approach. The first approach was employed by NM0137, which applied a default factor for endogenous energy efficiency improvement based on regressions analysis on a historical energy efficiency improvement rate. However, the methodology was rejected because of the lack of guidance as to the time periods over which a trend in performance must exist in order to justify its reflection in the baseline. Also, in case of a deteriorating energy efficiency trend, the MP rejected the application of historical (deteriorating) trend and recommended the use of a constant baseline emission level based on data for the year prior to project start (see the MP recommendation on NM0137).

The second approach is benchmarking. If ex-post monitoring is applied, 48.c inherently addresses this issue because it calculates the baseline emissions as the average emission of similar project activities undertaken in the previous five years, in similar circumstances, and whose performance is among the top 20% of their category (but no example of successful application so far). Another example of benchmarking is ACM0005, which sets the benchmark of a clinker to cement ratio (c/c ratio) for baseline emission calculation as the lowest value among the following three options: i) the production-weighted-average of the five highest c/c ratio for the relevant cement type in the region, ii) the production-weighted-average c/c ratio in the top 20% (in terms of share of additives) of the total production of the blended cement type in the region, and iii) the c/c ratio of the relevant cement type produced in the proposed project activity plant before the implementation of the CDM project activity, if applicable.

The third approach is a project and baseline sample group approach, or (quasi-) random experimentation. This is applied in NM0150 and it basically accounts for “continuation of the current practice + endogenous energy efficiency improvement” by setting a control group, which receives no intervention by the project activity, and an intervention group, which is given the project intervention (see Rossi et al. 2004 or Cook and Campbell 1979 for further details of (quasi-)random experimentation methods). Although the approach, based on statistical sampling, is relatively complicated, it can address the issue in the most rigorous manner among the three approaches.

4.5. Programmatic approach

The EB has issued guidance on programmatic CDM in December 2006 (see UNFCCC 2006c). Due to the nature of many activities in energy efficiency improvement where small technologies (e.g. lighting equipment, electric motors) are distributed and installed in large numbers, the programmatic approach could become crucial for the role of energy efficiency projects under the CDM.

4.5.1. Evolution of programmatic CDM

Programmatic CDM is not a new phenomenon. As mentioned above, the first methodology of this category, NM0072, was submitted long back in November 2004. The methodology, which addresses a mandatory energy efficiency standard for room air conditioners in Ghana, opened a long-standing discussion on whether local/regional/national policy or standard can be considered as a CDM project activity. The 1st session of the Conference of the Parties serving as the Meeting of the Kyoto Protocol (COP/MOP1) in December 2005 decided that "a local/regional/national policy or standard cannot be considered as a CDM project activity, but that project activities under a programme of activities can be registered as a single CDM project activity (see UNFCCC 2005b)."

Since the COP/MOP1 decision, programmatic CDM has gained greater momentum, driven by the expectation that the approach could mobilize more CDM projects with higher sustainable development benefits such as energy efficiency and renewable energy projects. The MP/ EB have worked on guidance related to the registration of project activities under a programme of activities as a single CDM project activity and recently finalized its work. Among the several existing methodologies for programmatic CDM activities, this section gives an overview of NM0150 and NM0157, both of which were developed for energy efficiency improvement of light bulbs.

NM0150 is designed for distribution of compact fluorescent lamps (CFLs) by donation or sales at reduced price (not via a retailer). As mentioned above, the methodology employs a project and baseline sample group approach, or a random experimentation method, which is based on a random sampling of households for both sample groups. The baseline sample group, or the control group, is given compensation for not participating in the programme. On the other hand, the project sample group, or the intervention group, is distributed CFLs to replace less energy efficient lighting appliances in use. Additionality assessment is to be conducted on the CFL distributor level (i.e. on the programme level). The selected major issues raised by the MP are i) lack of appropriate description of the method to establish the control group, ii) risk of manipulation in the control group (e.g. by giving incentives not to use CFLs through the crediting period), and iii) potential leakage (e.g. through export of CFLs to Annex I countries, re-use of incandescent lamps, and residential and/ or non-residential free-riders). The additionality assessment only on the programme level was not criticized by the MP.

NM0157 is designed for distribution of CFLs through the general retail channel. As opposed to the random experimentation approach employed by NM0150, the methodology calculates emission reductions based on a technology penetration approach. The approach compares penetration rates with and without the proposed CDM activity. Those penetration rates are monitored ex-post by using the "unbiased" questionnaire to the customers of the CFLs, which is aimed to identify the customer's purpose of purchase.[19] In order to exclude free-riders, a swapping method, i.e. to introduce new CFLs by swapping usable incandescent lamps, as well as confirmation

[19] "Unbiased" implies that the subsidy for answering the questionnaire is to be provided whatever the answer is.

of usability of the incandescent lamps (less efficient light bulbs used in the baseline scenario) by the unbiased questionnaire is applied. Additionality assessment is to be conducted both i) on the individual participant level and ii) on the programme level. The selected major issues raised by the MP are i) lack of full description of the "unbiased survey," ii) doubtful additionality assessment both on the individual participant level (because of the lack of check on reliability of the survey answers) and on the programme level (it is not appropriate to automatically assume additionality of the programme based on the fact that the subsidy is provided by the CER revenue; this kind of programme could benefit from non-CDM-based subsidies), and iii) potential leakage through the same channels pointed out in the MP recommendation on NM0150.

From these two examples, some general lessons can be drawn. Firstly, programmatic CDM may require relatively complex and sophisticated emission reduction calculation methods (e.g. random experimentation or technology penetration rate approaches). It is important to ensure that the intermediary (i.e. programme coordinator) has enough capacity to carry out such complicated methods (otherwise, the programme will face problems at a time of verification). Secondly, additionality assessment (to exclude free-rider effects) needs careful consideration. It is not very clear yet on which level additionality assessment must be conducted: on the programme level, on the individual participant level, or both?

4.5.2. Emission reductions calculation

In calculation of emission reductions of a programme, two elements play a crucial role: i) free riders and ii) spill over. Taking a CFL distribution programme as an example, free riders, who would have installed CFLs anyway, act to decrease the gross energy savings of the programme. On the contrary, spill over acts to increase the gross energy savings of the programme by accounting for the influence the programme has had on the market. Such influence is a combination of the following three types of spill over:

1. Within project spill over: Participants purchased CFLs through the programme;
2. Outside project spill over: Participants purchased additional CFLs through other outlets;
3. Non-participant spill over: Non-participants were induced to purchase CFLs because of suggestions from participants, greater availability in the marketplace, etc.

The effect of free riders and spill over is aggregated to the net-to-gross ratio (NTG), which represents the share of the programme's gross energy savings that can be properly attributed to the programme's influence (see Skumatz and Howlett 2006). The NTG is mathematically expressed as follows:

$$NTG = (1-FR) \times (1+SO)$$

where:
FR is the share of free riders (fraction); and
SO is the share of spill over (fraction).

Even if programmes employ the same technology, the NTG can vary significantly depending on the programme designs. For example, a nationwide study of CFL programmes in the U.S. shows variations of i) free rider estimates ranging from 1-50%, ii) spill over estimates from 8-32%, and iii) the NTG from 80-91% (see Skumatz and Howlett 2006). This example shows the importance of well-established programme evaluation methods to properly calculate emission reductions by the programme. In the CDM context, only the free rider effect has attracted much attention so far, apparently because underestimation of actual emission reductions in non-Annex I countries would positively contributes to the environmental integrity of the Kyoto Protocol. However, if project participants do not want to unnecessarily give away their emission reductions (which is normally the case), they have to contemplate proper estimation of spill over as well.

Importantly, methodologies for estimation of free riders and spill over are usually complicated and likely to involve high transaction costs. Such methodologies include comparison of programme participants and non-participants by a (quasi-)random experimentation method (e.g. NM0150). Another approach could be to determine trends in autonomous market penetration of high-efficiency equipment targeted by the CDM programme (e.g. NM0157). However, considering the fact that the MP/ EB have hardly supported simple extrapolation of historical trends so far, such an approach needs careful consideration. It may be questionable to assume that past trends are a good indication of future trends (see Niederberger and Spalding-Fecher 2006).

4.5.3. Additionality assessment

Additionality can principally be assessed at two levels in the context of a programme: i) on the level of an intermediary who organizes the programme and ii) on the level of the actors who actually install/ use the efficient technology. The problem is that investment analysis tends to apply on the intermediary level, whereas the activity level is usually characterized by mainly non-monetary barriers (e.g. lack of trust in the new technology, lack of information, lack of servicing in case of failure).

The EB is still making up its mind whether additionality has to be assessed on both levels. The guidance states that the programme of activities (PoA: on the programme level) shall ensure that additionality is unambiguously defined for each CDM program activity (CPA; on the individual participant level) within the PoA (see UNFCCC 2006c). However, it lacks of clear guidance on the desegregation level of a CPA; must each light bulb replaced by a PoA be considered as an individual CPA? In addition, the guidance does not explicitly state the need of additionality assessment on the programme level.

The MP/ EB decisions on this issue have been inconsistent. First of all, as discussed above, the EB guidance on programmatic CDM clearly requires additionality assessment on the individual participant level, but not explicitly states the need of additionality assessment on the programme level. Secondly, in the case of NM0150 which conducts additionality assessment only on the programme level, the MP did not raise any issues on which level additionality assessment should be carrier out. Thirdly, however, the MP recommendation on NM0198, which relates to a project type similar to demand-side energy efficiency (distribution of efficiency increasing technology to farmers), asks for additionality assessment on the two levels: i) on the choice of the individual farmer on a particular fertilizing technique and ii) on the choice of the distributor to carry out the inoculant rebate/ subsidy program. This suggests that the two-tiered additionality assessment would be required for programmatic CDM. Clearer and more consistent guidance on additionality assessment of programmatic CDM is essential to fully realize its potential.

Experience with evaluation of demand-side management programmes in the U.S. has shown that it is extremely difficult and expensive to assess additionality on the actor level. Thus, Trexler et al. (2006) and Sathaye (2006) have proposed aggregated additionality assessment, which discounts emission reductions of the programme by the percentage of ex-ante estimated non-additional activities in the programme. The problem with that suggestion is that both non-additional and additional activities would receive the same amount of CERs; the non-additional ones would thus crowd out the additional ones. A solution might be to allow aggregated additionality assessment if the programme intermediary can show that he has measures in place to deter non-additional activities.

5. Conclusions

Energy efficiency methodologies have so far been the stepchildren of the CDM. They have been assessed very critically by the MP/ EB and their success rate has been very limited. Those that managed to come through suffer from narrow applicability criteria and cover only a part of potentially interesting project types. Although facility-level-bundling could be a way to achieve wider applicability, such an approach is likely to follow a difficult track as far as the existing methodology submission and approval process tells. The approach of “20% best comparable technology” which was originally thought to be applicable to energy efficiency project so far is almost not used due to heavy data collection and difficulty in setting “similar” circumstances. Moreover, practices used in demand-side management programmes such as empirical modelling or benchmarking have not been accepted. The MP/ EB are still grappling with key concepts such as rebound effects and endogenous energy efficiency improvement. It remains to be seen whether the rules on programmatic CDM will be set in a way that reduces the barriers for the implementation of energy efficiency projects under the CDM.

References

Cook T.D., Campbell D.T. Quasi-experimentation: Design & analysis issues for field settings. Chicago: Rand McNally College Publishing Company, 1979.

Niederberger A.A., Spalding-Fecher R. Demand-side energy efficiency promotion under the Clean Development Mechanism: Lessons learned and future prospects. Energy for Sustainable Development 2006;X(4):51-64.

Michaelowa A. CDM: Current status and possibilities for reform, HWWI Research Paper No.3. Hamburg: HWWI, 2005.

Michaelowa A., Hayashi D. How institutional innovations in climate policy impact on mitigation technology choice in developing countries – the case of the CDM. Presented at the workshop "Market, Institutions, and Innovation-related Services." Hamburg: Universität Hamburg, 2006. See also: http://www.cgg.uni-hamburg.de/english/contributions.html

Müller-Pelzer F., Michaelowa A. Lessons from the submission and approval process of energy efficiency CDM baseline and monitoring methodologies, HWWI Research Paper No.1. Hamburg: HWWI, 2005.

James K. Methodological issues arising across different types of energy efficiency projects. Presented at "Expert workshop on CDM methodologies and technical issues associated with power generation and power saving project activities." Montreal: World Bank, 2005. See also: http://carbonfinance.org/docs/Kevin_James_Quality_Tonnes_Presentation_Montreal_ee_Dec_05.ppt

Rossi P.H., Lipsey M.W., Freeman H.E. Evaluation: A systematic approach (seventh edition). Thousand Oaks, CA: SAGE Publications, 2004.

Sathaye J. Energy efficiency project activities observations about CDM: Policies and programs. Presented at "The 12th session of the Conference of the Parties to the Climate Change Convention (COP12)." Nairobi: UNFCCC, 2006.

Skumatz L.A., Howlett O. Findings and "gaps" in CFL evaluation research: Review of the existing literature. Superior, CO: Skumatz Economic Research Associates (SERA), 2006. See also: http://mail.mtprog.com/CD_Layout/Day_2_22.06.06/1115-1300/ID109_Skumatz3_final.pdf

Trexler M.C., Broekhoff, D.J., Kosloff, L.H. A statistically driven approach to offset-based GHG additionality determinations: What can we learn. Sustainable Development Law and Policy 2006;VI(2):30-40.

UNFCCC. EB08 meeting report Annex 1: Clarifications on issues relating to baseline and monitoring methodologies. Bonn: UNFCCC, 2003. See also: http://cdm.unfccc.int/EB/008/repan1.pdf

UNFCCC. EB22 meeting report Annex2: Guidance regarding methodological issues. Bonn: UNFCCC, 2005a. See also: http://cdm.unfccc.int/EB/022/eb22_repan2.pdf

UNFCCC. FCCC/KP/CMP/2005/L.7: Report of the EB of the CDM and election of members of the EB. Montreal: UNFCCC, 2005b. See also: http://unfccc.int/resource/docs/2005/cmp1/eng/l07.pdf

UNFCCC. CDM project activities registered. Bonn: UNFCCC, 2006a. See also: http://cdm.unfccc.int/Projects/registered.html

UNFCCC. CDM baseline and monitoring methodologies. Bonn: UNFCCC, 2006b. See also: http://cdm.unfccc.int/methodologies

UNFCCC. EB28 meeting report Annex 15: Guidance on the registration of project activities under a programme of activities as a single CDM project activity (version 01). Bonn: UNFCCC, 2006c. See also: http://cdm.unfccc.int/EB/028/eb28_repan15.pdf

UNFCCC. Guidelines for completing the Project Design Document (CDM-PDD), and the proposed New Baseline and Monitoring Methodologies (CDM-NM) (version 06). Bonn: UNFCCC, 2006d. See also: http://cdm.unfccc.int/EB/025/eb25_repan16.pdf

UNFCCC. EB27 meeting report Annex 9: Combined tool to identify the baseline scenario and demonstrate additionality. Bonn: UNFCCC; 2006e. See also: http://cdm.unfccc.int/EB/027/eb27_repan09.pdf

HWWI Research Papers
by the HWWI Research Programme "International Climate Policy"

10. Efficient DNA operation: Lessons from different DNA settings in non-Annex-B countries
Daisuke Hayashi, Axel Michaelowa
Hamburg, January 2006

9. CDM afforestation and reforestation baseline methodologies: An analysis of the submission and approval process
Axel Michaelowa, V. R. S. Rawat
Hamburg, January 2006

8. Greenhouse gas benefits of fighting obesity
Axel Michaelowa, Björn Dransfeld
Hamburg, November 2006

7. On the impact of renewable energy support schemes on power prices
Sven Bode
Hamburg, September 2006

6. CO_2 emission reduction potential of large-scale energy efficiency measures in heavy industry in China, India, Brazil, Indonesia and South Africa
Daisuke Hayashi, Matthias Krey
Hamburg, November 2005

5. CO_2 emission reduction potential of large-scale energy efficiency measures in power generation from fossil fuels in China, India, Brazil, Indonesia and South Africa
Benn J. Boehme, Matthias Krey
Hamburg, November 2005

4. CDM potential of SPV pumps in India
Pallav Purohit, Axel Michaelowa
Hamburg, November 2005

3. CDM: current status and possibilities for reform
Axel Michaelowa
Hamburg, November 2005

2. Climate or development: Is ODA diverted from its original purpose?
Axel Michaelowa, Katharina Michaelowa
Hamburg, November 2005

1. Lessons from the submission and approval process of energy-efficiency CDM baseline and monitoring methodologies
Felicia Müller-Pelzer, Axel Michaelowa
Hamburg, September 2005

The **Hamburg Institute of International Economics (HWWI)** is an independent economic research institute, based on a non-profit public-private partnership, which was founded in 2005. The University of Hamburg and the Hamburg Chamber of Commerce are shareholders in the Institute .

The HWWI's main goals are to:
- Promote economic sciences in research and teaching;
- Conduct high-quality economic research;
- Transfer and disseminate economic knowledge to policy makers, stakeholders and the general public.

The HWWI carries out interdisciplinary research activities in the context of the following research programmes: Economic Trends and Hamburg, International Trade and Development, Migration Research and International Climate Policy.

Hamburg Institute of International Economics (HWWI)

Neuer Jungfernstieg 21 | 20354 Hamburg | Germany
Phone +49 (0)40 34 05 76 - 0 | Fax +49 (0)40 34 05 76 - 76
info@hwwi.org | www.hwwi.org