CLEAN DEVELOPMENT MECHANISM
PROPOSED NEW METHODOLOGY: BASELINE (CDM-NMB)
Version 01 - in effect as of: 1 July 2004

CONTENTS

SECTION A. Identification of methodology

A.1. Proposed methodology title:
>> Energy Efficiency Through Mandatory National-Level Appliance Standards

A.2. List of category(ies) of project activity to which the methodology may apply:

Sectoral Scope 3: Energy Demand

A.3. Conditions under which the methodology is applicable to CDM project activities:

- In countries/regions where no mandatory energy efficiency standard for the proposed appliance exists; or
- In countries/regions where there is an existing standard for specific appliances but technology improvements allows for an increase in the standard; and
- In countries/regions where it can be demonstrated by the project developer that the standard is put in place as a result of the CDM credits.

A.4. What are the potential strengths and weaknesses of this proposed new methodology?
Strengths- Simple approach using proven quantification methods developed by the leading experts in Appliance standards.

Weaknesses- Relies on availability of data and/or scientific surveys that can be difficult and/or expensive to obtain. Both the baseline and the monitoring methodology may rely on statistical sampling as it may be impossible to monitor the performance of every appliance in the market.

Little precedence with approved methodologies: This is a relatively unique methodology that is not able to borrow heavily from already approved methodologies.

Long term activity: Developing a national level appliance standard has traditionally required a tremendous investment of time and resources. Project developers will need to work jointly with key government, industry and NGO groups to move projects forward. The project may require extensive sampling surveys of both the efficiency levels of proposed appliances and the typical hours of use by consumers. The project would also likely require extensive long-term discussions with stakeholders and policy makers to determine what the standard should be.

SECTION B. Overall summary description:

Appliances such as air conditioners, refrigerators, lighting, motors, and many others are growing in popularity throughout the developing world. As more consumers are able to make purchases of these energy-consuming appliances, national power grids and fuel suppliers are asked to provide more service often increasing CO2 emissions.

In very general terms, more efficient products may have a slightly higher initial purchase cost, but lower operating costs. Because the market place is imperfect and consumers are often unaware that they might be ‘paying more by paying less’ governments, particularly in the developed world, have enacted appliance standards to force manufacturers to provide consumers more efficient products, thus increasing the average efficiency of the pool of appliances in use. The standard benefits consumers by giving them appliances that will cost them less over the life of the product and it benefits society by helping to limit energy demand reducing the need for expensive additional power plants with the associated pollution.

The developing world as a whole has been much less able to take advantage of the benefits of energy efficiency standards for appliances. Since the developed world has appliance standards, the developing world is often the 'dumping grounds' for the most inefficient appliances that can no longer be sold in places like Europe or Japan. This is due in part to the high transaction costs of creating a mandatory appliance standard. Implementing a standard usually requires access to appliance testing labs to certify appliances, detailed analysis of the optimal standard to impose, and some degree of cooperation from the manufactures. Additionally, in most cases there are potential losers along with the potential winners who try to disrupt efforts. Implementing an appliance standard – as with any policy – is a political process and few countries in the developing world have been able to implement one.

The project developer will be responsible for the following steps

1. Defining the project boundary- the specific appliance or subset of appliance that will be covered by mandatory standards
2. Quantifying a baseline case scenario that determines what the energy consumption from the appliance would have been absent the mandatory efficiency standard (note: some efficiencies are generated in the market without a standard, so that has to be taken into account in the baseline)
3. Quantification of the resulting reductions in energy use because of the mandatory energy efficiency appliance standard
4. Determining, using the approach outlined by the Executive Board's additionality tool, that the project would not happen without CDM.

More specifically, the project developer defines a specific political unit (country, state , etc.) that does not currently have a mandatory standard for the appliance in question or has a standard that can be improved.

The baseline is determined by calculating the amount of energy which appliances would have consumed without the standard. Annual data on new appliance population and use is calculated. This data is then combined with the pre-standard average efficiency rating of the appliance adjusted by a business as usual annual efficiency improvement.

This is compared to the existing situation using the post standard average efficiency rating of the appliance. The resulting energy savings are then converted to CO2 savings using IPCC data for appliances that directly consume fuel or a combined margin approach that can most accurately depict the emission reduction impact of reducing the electricity consumption on the grid. Like with a renewable energy project, energy efficiency will allow existing generation plants to produce less electricity with the most expensive operational plants being the first to reduce output and fewer generation plants will have to be built in the future which would likely be of similar composition to the most recent plants built.

The project will use the Executive Board's proposed additionality tool to determine that the project would not have occurred without CDM. The tests including a review of potential alternatives, a financial or barriers additionality test, and a common practice test will make the case for why CDM is required to make this project happen.

SECTION C. Choice of and justification as to why one of the baseline approaches listed in paragraph 48 of CDM modalities and procedures is considered to be the most appropriate:

C.1. General baseline approach:

X? Existing actual or historical emissions, as applicable;

? Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment;

? 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.

C.2. Justification of why the approach chosen in 3.1 above is considered the most appropriate:

The energy consumption of the population of the given appliance before the standard will be compared to the total energy consumption of the population of the given appliance after the mandatory energy efficiency standard is put in place. Option two is inappropriate since standard will not advocate one particular technology, but instead will just mandate an increase in average energy efficiency within the population of the sales of that appliance. Option three is inappropriate since in many cases this will be the first project of its kind in a country with nothing to compare it to.

SECTION D. Explanation and justification of the proposed new baseline methodology:

D.1. Explanation of how the methodology determines the baseline scenario (that is, indicate the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases (GHG) that would occur in the absence of the proposed project activity):

Since the population and market penetration of the given appliance will likely change over course of the project, the baseline methodology will measure the efficiency of the appliance population in the baseline year, adjust it for normal efficiency improvements seen historically or in similar cases and then use the population of appliances and average hours of use in the project year to determine what would have happened if the standard was not implemented.

In most cases for most appliances, baseline efficiency increases gradually over time, so the methodology will take this into account by measuring historical improvements in efficiency where data is available or conservative interpretations of similar cases in other countries when local data is not available. This method is typically employed by the leading standards development groups around the world.

The baseline methodology requires data in six areas: 1) average existing efficiency in baseline year as measured in terms of energy input requirements (kw, kj, etc.); 2) average annual efficiency improvement over time in business as usual scenario 3) average hours of use in reporting year 4) number of new units in population in reporting year 5) average retirement age of appliance and 6) annual carbon emissions factor either documenting the carbon emissions factor for direct fuel used or outlining the combine margin carbon emissions factor of the grid. With this information, the project developer can determine the likely baseline case for emissions in each of the project years that can be compared to the actual circumstances using the actual average efficiency of the appliance post-standard implementation.

D.2. Criteria used in developing the proposed baseline methodology:

- Simplicity- Employs a straight forward approach using the best available data.
- Replicability- Can be used for a variety of appliances in a multiple countries.
- Precedence- This approach follows the norms of decades of work by academics, NGOs, governments and others in quantifying the impacts of appliance standards.

Note on Sampling: The data sets required to calculate the CO2 savings will likely come from several sources including government data sets, industry data sets, sales data, and statistically significant sampling surveys In many cases scientifically derived sampling data will be the only possible way to gather the

appropriate data. This method is standard practice within the field of appliance standards. Data sets gathered using appropriately-designed surveys have been proven to be reliable and accurate sources of data. The project developer, however, will need to show they have followed internationally-accepted sampling and statistical practices. The sampling plan will be shown to the DOE to illustrate how universally-accepted statistical methods were used. The following general guidelines should also be considered when utilizing sampling surveys:

- To ensure statistical significance, the sample size and target group should account for distribution of appliances based on:
    - median income of typical ownership, (surveys do not need to include large populations of people making a dollar a day because they are unlikely to have air conditioners),
    - regional availability of electricity/fuel, (non-electrified areas might not need to be included in survey's for major electric appliances),
    - other population factors population factors (size or population, rate of income growth, etc.).
- Use the conservative end of the margin of error to populate data fields (ie: if the survey of air conditioners usage points to average hours of operation of 4 hours per day with a margin of error of ±.25 hours, the project developer should use the 3.75 hours to populate the data field).

D.3. Explanation of how, through the methodology, it can be demonstrated that a project activity is additional and therefore not the baseline scenario (section B.3 of the CDM-PDD):

The project developer will utilized the Executive Board's final approved Additionality Tool to determine additionality. The text of a preliminary draft is included below.

Step 0. Preliminary screening of projects started
after 1 January 2000 and prior to 31 December 2005
The Marrakech Accords and COP 9 decisions provide guidance on the eligibility of proposed CDM project activities started before registration[1]. If the starting date of the project activity falls between 1 January 2000 and the date of the registration of a first CDM project activity and prior to 31 December 2005, evidence should be publicly provided that the incentive provided by the CDM was seriously considered in the decision to proceed with the project activity. This evidence shall be based on (preferably official) documentation clearly showing that the CDM incentive played a role at or before the moment of decision making. Without any such evidence, the authenticity of which can be verified by the DOE, the project is not additional. If the project participants can provide adequate evidence, the project activity shall proceed through the steps below.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations
(Note: In accordance with guidance by the Executive Board, consistency should be ensured between "baseline scenario" and "baseline emissions"[1])
Define realistic and credible alternatives[2] to the project activity(s) that can be (part of) the baseline scenario through the following sub-steps:

[1] Please refer to paragraph 2 of Annex 3 of report of the Executive Board at its ninth meeting, see: http://cdm.unfccc.int/EB/Meetings/009/eb09repa3.pdf.

[2] When referring to alternatives throughout this text it is meant alternative scenarios.

Sub-step 1a. Define alternatives to the project activity:
1. Identify realistic and credible alternative(s) available to the project participants that provide outputs or services comparable with the proposed CDM project activity[3]. These alternatives should include:

- The proposed project activity not undertaken as a CDM project activity;
- All other plausible and credible alternatives to the project that deliver similar outputs and services in a comparable service area; and,
- If relevant, continuation of the current situation (no project activity or other alternatives undertaken)

Sub-step 1b. Enforcement with applicable laws and regulations:
2. The alternative(s) should be in compliance with all applicable legal and regulatory requirements, even if these laws and regulations have objectives other than GHG reductions, e.g. to mitigate local air pollution.[4] (This sub-step does not consider national and local policies that do not have legally-binding status.).
3. If an alternative does not comply with all applicable regulations and legislation, then show, based on an examination of current practice in the country or region in which the law or regulation applies, that the non-complying element of the alternative is currently widespread. If it cannot be shown that the noncompliance is widespread, then eliminate the alternative from further consideration;
4. If the proposed project activity is the only alternative amongst the ones considered by the project participants that is in compliance with all regulations with which there is general compliance, then the proposed CDM project activity is not additional.

Proceed to Step 2 (Investment Analysis) or Step 3 (Barrier Analysis). (Project participants may also select to complete both Steps 2 and 3.)

Step 2. Investment Analysis
If this step is used, determine whether the proposed project activity is the economically or financially less attractive than other alternatives without the revenue from sale of CERs. To conduct the investment analysis, use the following sub-steps:
Sub-step 2a. Determine appropriate analysis method
1. Determine whether to apply simple cost analysis, investment comparison analysis or benchmark analysis (sub-step 2b). If the CDM project activity generates no financial or economic benefits other than CDM related income, then apply the simple cost analysis (Option I). Otherwise, if the plausible alternative(s) include(s) investments of comparable scale to the project activity, then use the investment comparison analysis (Option II). If the proposed project and plausible baseline alternative do not involve investments of comparable scale or timing, use the benchmark analysis (Option III).

Sub-step 2b – Option I. Apply simple cost analysis
2. Document the costs associated with the CDM project activity and demonstrate that the activity produces no or negligible revenues other than those related to registration as a CDM project.
.. ***If it is concluded that the proposed CDM project activity is not financially attractive then proceed to Step 4 (Common Practice Analysis).***

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

[3] For example, the outputs of a cogeneration project could include heat for on-site use, electricity for on-site use, and excess electricity for export to the grid. In the case of a proposed landfill gas capture project, the service provided by the projects includes operation of a capped landfill.

[4] For example, an alternative consisting of an open, uncapped landfill would be non-complying in a country where this scenario would imply violations of safety or environmental regulations pertaining to landfills.

3. Identify the financial indicator, such as IRR[5], NPV, cost benefit ratio, or unit cost of service (e.g., levelized cost of electricity production in $/kWh or levelized cost of delivered heat in $/GJ) most suitable for the project type and decision context.

Sub-step 2b – Option III. Apply benchmark analysis
4. Identify the financial indicator, such as IRR NPV, cost benefit ratio, or unit cost of service (e.g., levelized cost of electricity production in $/kWh or levelized cost of delivered heat in $/GJ) most suitable for the project type and decision context. Identify the relevant benchmark value, such as the required rate of return (RRR) on equity. The benchmark should represent standard returns in the market, considering the specific risk of the project type, but not linked to the subjective profitability expectation or risk profile of a particular project developer. Benchmarks can be derived from:

- Government bond rates, increased by a suitable risk premium to reflect private investment and/or the project type, as substantiated by an independent (financial) expert, or
- Estimates of the cost of financing and required return on capital (e.g. commercial lending rates and guarantees required for the country and the type of project concerned), based on bankers views and private equity investors/funds' required return on comparable projects.

Sub-step 2c. Calculation and comparison of financial indicators:
5. Calculate the suitable financial indicator for the proposed CDM project activity and, in the case of Option II above, for the other alternatives. Include all relevant costs (including, for example, the investment cost, the operations and maintenance costs), and revenues (excluding CER revenues, but including subsidies/fiscal incentives where appropriate), and, as appropriate, non-market cost and benefits in the case of public investors.
6. Present the investment analysis in transparent manner and provide all the relevant assumptions in the CDM-PDD, so that a reader can reproduce the analysis and obtain the same results. Clearly present critical techno-economic parameters and assumptions (such as capital costs, fuel prices, lifetimes, and discount rate or cost of capital). Justify and/or cite assumptions in a manner that can be validated by the DOE. In calculating the financial indicator, the project's risks can be included through the cash flow pattern, subject to project-specific expectations and assumptions. By applying conservative assumptions, one can incorporate the project risks8.
7. Assumptions and input data for the investment analysis should not differ across the project and its alternatives, unless differences can be well substantiated.
8. Present in the CDM-PDD submitted for validation a clear comparison of the financial indicator for the proposed CDM activity and

(a) the alternatives, if Option II (investment comparison analysis) is used. If one of the other alternatives has the best indicator (e.g. highest IRR), then the CDM project activity can not be considered as the most financially attractive. If all alternatives that are more financially attractive emit less than the proposed project activity then the project activity is not additional;
(b) the financial benchmark, if Option III (benchmark analysis) is used. If the CDM project activity has a lower indicator (e.g. lower IRR) than the benchmark, then the CDM project activity can not be considered as financially attractive.

Sub-step 2d. Sensitivity Analysis
9. Include a sensitivity analysis that shows whether the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions. The investment analysis

[5] IRRs can be calculated either as project IRRs or as equity IRRs. Project IRRs calculate a return based on project cash outflows and cash inflows only, irrespective the source of financing. Equity IRRs calculate a return to equity investors and therefore also consider amount and costs of available debt financing. The decision to proceed with an investment is based on returns to the investors, so an equity IRR will be more appropriate in many cases. However, there will also be cases where a project IRR may be appropriate.

provides a valid argument in favour of additionality only if it consistently supports (for a realistic range of assumptions) the conclusion that the project activity is unlikely to be the most financially attractive (as per step 2(c)7(a)) or is unlikely to be financially attractive (as per step 2(c)7(b)).

.. ***If after the sensitivity analysis it is concluded that the proposed CDM project activity is unlikely to be the most financially attractive (as per step 2 c 7 (a)) or is unlikely to be financially attractive (as per step 2 c 7 b), then proceed to Step 4 (Common Practice Analysis).***
.. ***Otherwise, unless barrier analysis below is undertaken and indicates that the proposed project activity faces barriers that do not prevent the baseline scenario(s) from occurring, the project is considered not additional.***

Step 3. Barrier Analysis
If this step is used, determine whether the proposed project activity faces barriers that:
(a) Prevent a wide spread implementation of this activity and thus preventing the baseline scenarios from occurring; and
(b) Do not prevent a wide spread implementation of at least one of the alternatives.
Use the following sub-steps:

Sub-step 3a. Identify barriers that would prevent a wide spread implementation of the proposed project activity:
1. Establish that there are barriers that would prevent the proposed project activity from being carried out if the project were not registered as a CDM activity. Such barriers may include, among others:

- -Investment barriers, other than the economic/financial barriers in Step 2 above, e.g.:
  - Real and/or perceived risks associated with the unfamiliar technology or process are too high to attract investment
  - Funding is not available for innovative projects.
- Technological barriers, e.g.:
  - Skilled and/or properly trained labour to operate and maintain the technology is not available, leading to equipment disrepair and malfunctioning.
- Barriers due to prevailing practice, e.g.:
  - Developers lack familiarity with state-of-the-art technologies and are reluctant to use them.
  - The project is the “first of a kind”.
- Other barriers, e.g.:
  - Management lacks experience using state-of-the-art technologies, so that the project receives low priority by management.

The identified barriers are sufficient grounds for additionality only if they would prevent potential project proponents from carrying out the proposed project activity were it not registered as a CDM activity.

2. Provide transparent and documented evidence, and offer conservative interpretations of this documented evidence, as to how it demonstrates the existence and significance of the identified barriers. Anecdotal evidence can be included, but alone is not sufficient proof of barriers.

Sub-step 3 b. Show that the identified barriers would not prevent a wide spread implementation of at least one of the alternatives (excepted the proposed project activity already considered in step 3a):

3. If the identified barriers also affect other alternatives, explain how they are affected less strongly than they affect the proposed CDM project activity. In other words, explain how the identified barriers are not preventing a wide spread implementation of at least one of the alternatives. Any alternative that would be prevented by the barriers identified in Sub-step 3a is not a viable alternative, and should be eliminated from consideration. At least one viable alternative shall be identified.

.. ***If both Sub-steps 3a – 3b are satisfied, proceed to Step 4(Common Practice Analysis)***
.. ***If one of the Sub-steps 3a – 3b is not satisfied, the project is not additional.***

Step 4. Common Practice Analysis
The above generic additionality tests shall be complemented with an analysis of the extent to which the proposed project type (e.g. technology or practice) has already diffused in the relevant sector and region. This test is a credibility check to complement the investment analysis (Step 2) or barrier analysis (Step 3). Identify and discuss the existing common practice through the following sub-steps:
Sub-step 4a. Analyse other activities similar to the proposed project:

1. Provide an analysis of any other activities implemented previously or currently underway that are similar to the proposed project activity. Projects are considered similar if they are in the same country and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc. Provide quantitative information where relevant.
Sub-step 4b. Discuss any similar options that are occurring:

2. If similar activities are widely observed and commonly carried out, it calls into question the claim that the proposed project activity is financially unattractive (as contended in Step 2) or faces barriers (as contended in Step 3). Therefore, if similar activities are identified above, then it is necessary to demonstrate why the existence of these activities does not contradict the claim that the proposed project activity is financially unattractive or subject to barriers. This can be done by comparing the proposed project to the other similar activities, and pointing out and explaining essential distinctions between them that explain why the similar activities enjoyed certain benefits that rendered it financially attractive (e.g., subsidies or other financial flows) or did not face the barriers to which the proposed project is subject.
3. Essential distinctions may include a serious change in circumstances under which the proposed CDM project will be implemented when compared to circumstances under which similar projects where carried out. For example, new barriers may have arisen, or promotional policies may have ended, leading to a situation in which the proposed CDM project would not be implemented without the incentive provided by the CDM. The change must be fundamental and verifiable.
.. ***If Sub-steps 4.a and 4.b are satisfied, please go to step 5.***
.. ***If Sub-steps 4.a and 4.b are not satisfied, the proposed CDM project activity is not additional.***

Step 5. Impact of CDM Registration
Explain how the approval and registration of the project as a CDM activity, and the attendant benefits and incentives derived from the project activity, will alleviate the economic and financial hurdles (Step 2) or other identified barriers (Step 3) and thus enable the project to be undertaken. The benefits and incentives can be of various types, such as:
- Anthropogenic greenhouse gas emission reductions;
- The financial benefit of the revenue obtained by selling the CO_2-equiv emissions reductions,
- Attracting new players who are not exposed to the same barriers, or can accept a lower IRR (for instance because they have access to cheaper capital),
- Attracting new players who bring the capacity to implement a new technology, and
- Reducing inflation /exchange rate risk affecting expected revenues and attractiveness for investors.

.. ***If Step 5 is satisfied, the proposed CDM project activity is not the baseline scenario.***
.. ***If Step 5 is not satisfied, the proposed CDM project activity is not additional.***

D.4. How national and/or sectoral policies and circumstances can been taken into account by the methodology:

In this case the national and/or sector policy will be a direct result of the CDM activity. As the EB outlined, CDM should support not hinder good national level policy making. The energy savings impact of this new policy that would not happen but for CDM is therefore the focus of the methodology. The project developer will need to demonstrate that the government policy was chiefly enabled by the desire to obtain CERs.

D.5. Project boundary (gases and sources included, physical delineation):

The project boundary in this case will include

- the definition of the appliance or the subset of a particular appliance that is covered by the mandatory appliance standard.(ie all refrigerators or all refrigerators above a certain volume, etc.)

- the geographic area covered by the law typically a country or state (regionally-based, mandatory standards will have to concurrent submissions outlining the baseline and impact in each individual country covered by the standard)

While the project developer may be required to monitor and develop a Carbon Emissions Factor for the source of the CO2 emissions avoided (usually the electricity grid for the affected geographic area), the energy sources will not be part of the project boundary since it is out of the control of the project developer.

D.6. Elaborate and justify formulae/algorithms used to determine the baseline scenario. Variables, fixed parameters and values have to be reported (e.g. fuel(s) used, fuel consumption rates):

First, to be conservative, the baseline must be readjusted each year to specifically account for the actual new population of given appliance and the mean operating days and operating hours. The baseline will determine what the emissions would have been in the given circumstances for that year with the lower efficiency level of the appliance population in the baseline scenario.

The efficiency of the new appliance population will be measured in the baseline year. In addition, where at least three years of local data is available, the historical annual improvement of the efficiency and the average retirement age of the appliance population will be determined. At least three year of data will provide enough data points to support a basic trend analysis.

If three years of data does not exist, the project developer can work with the DOE to develop a conservative substitution for this data set. 1) Data from other countries with similar circumstances can be analyzed and a conservative interpretation of that data will provide the historical annual efficiency improvement factor. The project developer will have to document for the DOE the appropriate nature of the comparison by outlining criteria for choosing the other countries (i.e. proximity, similar market penetration for that appliance, similar per capita income level, etc.). 2) If the first approach is not achievable, one additional approach can be to substitute conservatively interpreted the global trend data for that appliance cross-checked with local sample data. This will maintain a conservative calculation of the impact of standard, since global data for almost every appliance is likely to show faster adoption of more efficient models than a developing country. For both the first and second options, the project developer will be asked to use sampling to help cross-check the results.

Since the population and market penetration of the given appliance will likely change over course of the project, the baseline will measure the efficiency of the new appliance population in the baseline year, adjust it for normal efficiency improvements over time and then use the given circumstances in the project year to determine what would have happened if the standard was not implemented.

The data sets required to calculate the CO2 savings will likely come from several sources including government data sets, industry data sets, sales data, and statistically significant sampling surveys. In many

cases scientifically derived sampling data will be the only possible way to gather the appropriate data. This method is standard practice within the field of appliance standards and data sets gathered using appropriately designed surveys have been proven time and again to be reliable and accurate sources of data. The following general guidelines should be employed when utilizing sampling surveys:

- Sample Size –must represent statically significant portion of the population
- Use the conservative end of the margin of error to populate data fields (ie if the survey of air conditioners usage points to an average hours of operation of 4 hours per day with a margin of error of .25 hours, the project developer should use the 3.75 hours to populate the data field.)

TBE_x=

$$\left(\sum_{n=b+1}^{x-1} TANBE_n\right) + (TANBE_x * K)$$

where $x\text{-}b \leq ara_b$ and x-1?b

or

Where $x\text{-}b > ara_b$

TBE_x=

$$\left(\sum_{n=x-ara_b}^{x-1} TANBE_n\right) + (TANBE_x * K)$$

or

where x-1=b

$TAE_x = (TANBE_x * K)$

where

$TANBE_n = (AEI_b / (1+ (HAEIF_b * n\text{-}b)) * TNA_n * AU_x * EF_x$

Where
TBE= Total baseline emissions
TANBE=Total Annual New Baseline Emissions
x = year of calculated emissions reductions
b = baseline year
n = year
ara = average equipment retirement age
AEI= average appliance energy input (kW, joules, Btus, etc.)
HAEIF=historical annual efficiency improvement factor = average annual efficiency improvement of new population of appliances (percentage)
AU= average use= average operational hours per year= mean operating days/year*mean operating hours/operational day

TNA= total new appliances added to the population in given year
? = percentage of average yearly user hours utilized by equipment bought in that year (%)
EF=Carbon emissions factor (CO2/fuel or electricity- units must match AEI's- kWh, joules, Btus, etc.)

Emissions reductions from the new appliances purchased in the year x will be modified to only include actual hours use and the resulting savings. To determine actual hours of use, sales data will be gathered to determine what percentage of the average hours of use for that type of appliance that appliance was in service for. For example, if the average new refrigerator was purchased in June, only half (July-December or K=50%) of the annual emissions reductions will be counted. In cases where sales data is not available a default value of 50% will be used.

In cases where the energy input into the appliance is in the form of a direct fuel, the IPCC data will be used to determine the carbon content of that fuel. For example, the project developer will determine the carbon emission factor for hot water heaters running on natural gas, from IPCC data. In cases where electricity is used to operate the appliance, the following combined margin approach will be used to determine the EF. The EF will be calculated annual to account for any changes in electricity generation.

EF_x is the GHG emission factor of the grid as calculated below for a given year,

An emission factor (*EFy*) is calculated as a combined margin (*CM*), consisting of the combination of operating margin (*OM*) and build margin (*BM*) factors according to the following three steps. Calculations for this combined margin must be based on data from an official source (where available) and made publicly available.[6]

STEP 1. Calculate the Operating Margin emission factor(s) (*EFOM,y*) based on one of the four following methods:
(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch Data Analysis OM, or
(d) Average OM.

Each method is described below.

[6] Plant emission factors used for the calculation of operating and build margin emission factors should be obtained in the following priority:
(A) *acquired directly* from the dispatch center or power producers, if available; or (B) *calculated*, if data on fuel type, fuel emission factor, fuel input and power output can be obtained for each plant; if confidential data available from the relevant host Party authority are used the calculation carried out by the project participants shall be verified by the DOE and the CDM-PDD may only show the resultant carbon emission factor and the corresponding list of plants; (C) *calculated*, as above, but using estimates such as
• default IPCC values from the *IPCC 1996 Revised Guidelines* and the *IPCC Good Practice Guidance* for net calorific values and carbon emission factors for fuels instead of plant-specific values (note that the *IPCC Good Practice Guidance* includes some updates from the *IPCC 1996 Revised Guidelines*);
• technology provider's name plate power plant efficiency or the anticipated energy efficiency documented in official sources (instead of calculating it from fuel consumption and power output). This is likely to be a conservative estimate, because under actual operating conditions plants usually have lower efficiencies and higher emissions than name plate performance would imply;
• conservative estimates of power plant efficiencies, based on expert judgments on the basis of the plant's technology, size and commissioning date; or (D) *calculated*, for the simple OM and the average OM, using aggregated generation and fuel consumption data, in cases where more disaggregated data is not available.

Dispatch data analysis should be the first methodological choice. Where this option is not selected project participants shall justify why and may use the simple OM, the simple adjusted OM or the average emission rate method taking into account the provisions outlined hereafter.

The Simple OM method (a) can only be used where low-cost/must run resources[7] constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term normals for hydroelectricity production.

The average emission rate method (d) can only be used
• where low-cost/must run resources constitute more than 50% of total grid generation and detailed data to apply option (b) is not available, and
• where detailed data to apply option (c) above is unavailable.

(a) *Simple OM.* The Simple OM emission factor (*EFOM,simple,y*) is calculated as the generation-weighted average emissions per electricity unit (tCO2/MWh) of all generating sources serving the system, not including low-operating cost and must-run power plants:

$$EF_{OM,simple,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}}$$

where
Fi ,j, y is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y*; *j* refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports[8] to the grid, *COEFi,j y* is the CO2 emission coefficient of fuel *i* (tCO2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources j and the percent oxidation of the fuel in year(s) y, and *GENj,y* is the electricity (MWh) delivered to the grid by source *j*.

The CO2 emission coefficient *COEFi* is obtained as

$$COEF_i = NCV_i \cdot EF_{CO2,i} \cdot OXID_i$$

where:
NCVi is the net calorific value (energy content) per mass or volume unit of a fuel *i*, *OXIDi* is the oxidation factor of the fuel (see page 1.29 in the 1996 Revised IPCC Guidelines for default values), *EFCO2,i* is the CO2 emission factor per unit of energy of the fuel *i*. Where available, local values of *NCVi* and *EFCO2,i* should be used. If no such values are available, country-specific values (see e.g. IPCC Good Practice Guidance) are preferable to IPCC world-wide default values.

[7] Low operating cost and must run resources typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. If coal is obviously used as must-run, it should also be included in this list, i.e. excluded from the set of plants.

[8] As described above, an import from a connected electricity system should be considered as one power source *j*.

The Simple OM emission factor can be calculated using either of the two following data vintages for years(s) *y*:
• A 3-year average, based on the most recent statistics available at the time of PDD submission, or
• The year in which project generation occurs, if *EFOM,y* is updated based on ex post monitoring.

(b) *Simple Adjusted OM.* This emission factor (*EFOM,simple adjusted,y*) is a variation on the previous method, where the power sources (including imports) are separated in low-cost/must-run power sources (*k*) and other power sources (*j*):

$$EF_{OM,simple\ adjusted,y} = \left(1-\lambda_y\right) \cdot \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \cdot \frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_k GEN_{k,y}}$$

where *Fi,k,y*, *COEFi,k* and *GENk* are analogous to the variables described for the simple OM method above for plants *k*; the years(s) *y* can reflect either of the two vintages noted for simple OM above, and

$$\lambda_y\ (\%) = \frac{\text{Number of hours per year for which low - cost/must - run sources are on the margin}}{\text{8760 hours per year}}$$

where lambda should be calculated as follows (see figure below):

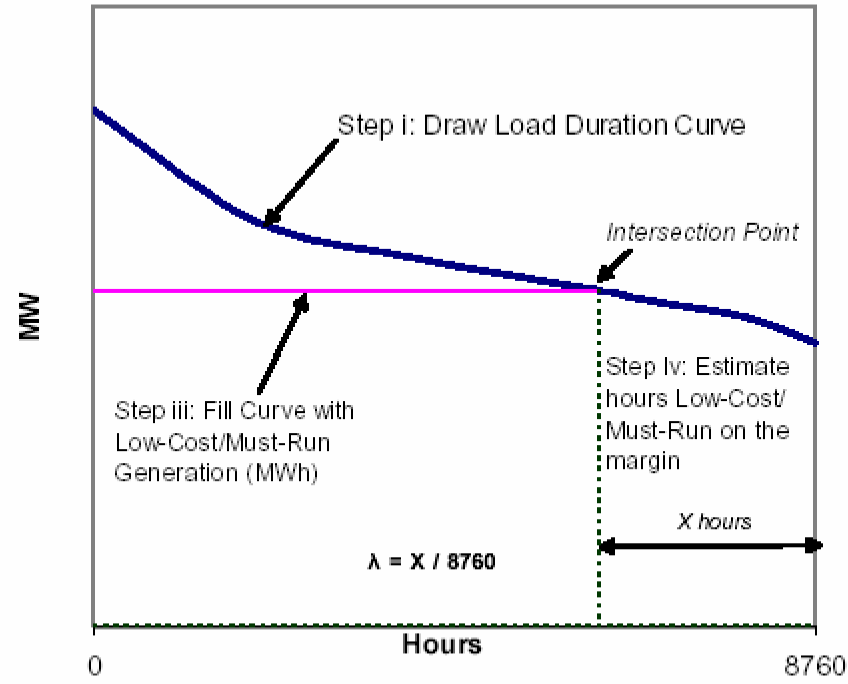
Step i) Plot a Load Duration Curve. Collect chronological load data (typically in MW) for each hour of a year, and sort load data from highest to lowest MW level. Plot MW against 8760 hours in the year, in descending order.

Step ii) Organize Data by Generating Sources. Collect data for, and calculate total annual generation (in MWh) from low-cost/must-run resources (i.e. ? *kGENk,y*).

Step iii) Fill Load Duration Curve. Plot a horizontal line across load duration curve such that the area under the curve (MW times hours) equals the total generation (in MWh) from low-cost/must-run resources (i.e. ? *kGENk,y*).

Step iv) Determine the .Number of hours per year for which low-cost/must-run sources are on the margin.. First, locate the intersection of the horizontal line plotted in step (iii) and the load duration curve plotted in step (i). The number of hours (out of the total of 8760 hours) to the right of the intersection is the number of hours for which low-cost/must-run sources are on the margin. If the lines do not intersect, then one may conclude that low-cost/must-run sources do not appear on the margin and ?*y* is equal to zero. Lambda (?*y*) is the calculated number of hours divided by 8760.

Figure 1: Illustration of Lambda Calculation for Simple Adjusted OM Method



Note: Step (ii) is not shown in the figure, it deals with organizing data by source.

(c) *Dispatch Data Analysis OM.* The Dispatch Data OM emission factor (*EFOM,Dispatch Data,y*) is summarized as follows:

$$EF_{OM,Dispatch\ Data,y} = \frac{E_{OM,y}}{EG_y}$$

where *EGy* is the generation of the project (in MWh) in year *y*, and *EOM.y* are the emissions (tCO2) associated with the operating margin calculated as

$$E_{OM,y} = \sum_h EG_h \cdot EF_{DD,h}$$

where *EGh* is the generation of the project (in MWh) in each hour *h* and *EFDD,h* is the hourly generation-weighted average emissions per electricity unit (tCO2/MWh) of the set of power plants (*n*) in the top 10% of grid system dispatch order during hour *h*:

$$EF_{DD,h} = \frac{\sum_{i,n} F_{i,n,h} \cdot COEF_{i,n}}{\sum_n GEN_{n,h}}$$

where *F*, *COEF* and *GEN* are analogous to the variables described for the simple OM method above, but calculated on an hourly basis for the set of plants (*n*) falling within the top 10% of the system dispatch. To determine the set of plants (*n*), obtain from a national dispatch center: a) the grid system dispatch order of operation for each power plant of the system; and b) the amount of power (MWh) that is dispatched from all plants in the system during each hour that the project activity is operating (*GENh*). At each hour *h*, stack each plant's generation (*GENh*) using the merit order. The set of plants (n) consists of those plants at the top of the stack (i.e., having the least merit), whose combined generation (? *GENh*) comprises 10% of total generation from all plants during that hour (including imports to the extent they are dispatched).

(d) *Average OM*. The average Operating Margin (OM) emission factor (*EFOM,average,y*) is calculated as the average emission rate of all power plants, using equation (1) above, but including low-operating cost and must-run power plants. Either of the two data vintages described for the simple OM (a) may be used.

STEP 2. Calculate the Build Margin emission factor (*EFBM,y*) as the generation-weighted average emission factor (tCO2/MWh) of a sample of power plants *m*, as follows:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$

where *Fi,m,y*, *COEFi,m* and *GENm,y* are analogous to the variables described for the simple OM method above for plants *m*.

Project participants shall choose between one of the following two options:

Option 1. Calculate the Build Margin emission factor *EFBM,y ex ante* based on the most recent information available on plants already built for sample group *m* at the time of PDD submission. The sample group *m* consists of either
• the five power plants that have been built most recently, or
• the power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently. Project participants should use from these two options that sample group that comprises the larger annual generation.

Option 2. For the first crediting period, the Build Margin emission factor *EFBM,y* must be updated annually *ex post* for the year in which actual project generation and associated emissions reductions occur. For subsequent crediting periods, *EFBM,y* should be calculated *ex-ante*, as described in option 1 above. The sample group *m* consists of either
• the five power plants that have been built most recently, or
• the power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently. Project participants should use from these two options that sample group that comprises the larger annual generation.

Power plant capacity additions registered as CDM project activities should be excluded from the sample group *m*.

STEP 3. Calculate the baseline emission factor *EFy* as the weighted average of the Operating Margin emission factor (*EFOM,y*) and the Build Margin emission factor (*EFBM,y*):

$$EF_y = w_{OM} \cdot EF_{OM,y} + w_{BM} \cdot EF_{BM,y}$$

where the weights *wOM* and *wBM*, by default, are 50% (i.e., *wOM* = *wBM* = 0.5), and *EFOM,y* and *EFBM,y* are calculated as described in Steps 1 and 2 above and are expressed in tCO2/MWh. Alternative weights can be used, as long as *wOM* + *wBM* = 1, and appropriate evidence justifying the alternative weights is presented. These justifying elements are to be assessed by the Executive Board.[9]

The weighted average applied by project participants should be fixed for a crediting period and may be revised at the renewal of the crediting period.

If the grid imports or exports electricity from/to other grids, the associated correction $EF_y \rightarrow EF_y + (EL_{iny})/(TGEN_y) * EF_{iny} - (EL_{outy})/(TGEN_y) * Ef_{outy}$ is needed unless such correction is demonstrated to be conservative or negligible, where El_{iny} (EF_{in}) and EL_{outy} (EF_{out}) are electricity coming in and going out of the grid (and their associate emission factors); and $TGEN_y$ is the electricity generated in the grid. The arrow means replacement of the EF_y by the right-hand-side of the above formula.

D.7. Elaborate and justify formulae/algorithms used to determine the emissions from the project activity. Variables, fixed parameters and values have to be reported (e.g. fuel(s) used, fuel consumption rates):

Since the energy involved for production and shipping of an energy efficient appliance is nominally the same as appliances that are less efficient, the project activity will not add any emissions.

D.8. Description of how the baseline methodology addresses any potential leakage of the project activity:

There should be no leakage from this project. If it took more energy to produce or deliver a more efficient appliance unit than a less-efficient model, there could be leakage. But the energy inputs into producing appliance units are virtually the same regardless of the efficiency of the models.

D.9. Elaborate and justify formulae/algorithms used to determine the emissions reductions from the project activity. Variables, fixed parameters and values have to be reported (e.g. fuel(s) used, fuel consumption rates):

Through the baseline calculations, the project developer has determined what the emissions would have been in year x assuming no standard were put in place to increase the efficiency of the appliance's population. Now the project developer simply subtracts this figure from the actual emissions calculated by multiplying the new appliance population's average efficiency by the total number of hours used. It is converted to carbon by multiplying it by the appropriate carbon emissions factor.

The new appliances purchased in given year x will operate for at least 50% of the average operating hours.

$TER_x = TBE_x - TAE_x$

[9] More analysis on other possible weightings may be necessary and this methodology could be revised based on this analysis. There might be a need to propose different weightings for different situations.

TAE_x=

$$\left(\sum_{n=b+1}^{x-1} TANE_n\right) + (TANE_x * K)$$

where $x\text{-}n \leq ara_n$ and x-1?b

or

Where $x\text{-}n > ara_n$

TAE_x=

$$\left(\sum_{n=x-ara_n+1}^{x-1} TANE_n\right) + (TANE_x * K)$$

or

where x-1=b

$TAE_x = (TANE_x * K)$

where

$TANE_n = AEI_n * TNA_n * AU_x * EF_x$

Where
TER =Total Emissions Reductions
TAE= Total Actual Emissions
TBE= Total Baseline Emissions
TANE=Total Annual New Emissions
x = year of calculated emissions reductions
b = baseline year
n = year
ara = average equipment retirement age
AEI= average appliance energy input (kW, joules, Btus, etc.)
AU= average use= average operational hours per year= mean operating days/year*mean operating hours/operational day
TNA= total new appliances in population in given year
? = percentage of average yearly user hours utilized by equipment bought in that year (%)
EF=Carbon emissions factor (CO2/fuel or electricity- units must match AEI's- kWh, joules, Btus, etc.)

The total emissions reductions per year x is the total calculated baseline emissions for year x minus the total of the actual emissions from year x. The actual emissions from year x are calculate by calculating the impact in year x of all the appliances purchased after the appliance standard has gone into affect. The impact of the appliance purchased in each year post standard is calculated by multiplying the average appliance energy input and number of units from the given year by the average use in year x (hrs/year) (avg.

# of days/year* average number of hours per day) and the carbon emissions factor for year x. The average retirement age of the given year's equipment is calculated to ensure that emissions reductions are not counted for that year's equipment that has reached their average retirement age.

Emissions reductions from the new appliances purchased in the year x will be modified to only include actual hours use and the resulting savings. To determine actual hours of use, sales data will be gathered to determine what percentage of the average hours of use for that type of appliance that appliance was in service for. For example, if the average new refrigerator was purchased in June, only half (July-December or K=50%) of the annual emissions reductions will be counted. In cases where sales data is not available a default value of 50% will be used.

In cases where the energy input into the appliance is in the form of a direct fuel, the IPCC data will be used to determine the carbon content of fuel. In cases where electricity is used to operate the appliance, the following combined margin approach will be used to determine the EF. The EF will be calculated annually to account for any changes in electricity generation. The combined margin approach is taken directly from ACM#2 and is laid out in section D6.

SECTION E. Data sources and assumptions:

E.1. Describe parameters and or assumptions (including emission factors and activity levels):

Sample data can accurately substitute for official data sources when they are not available. To address this uncertainty, the project developer will have to develop a thorough and scientific sampling plan. In addition, the project developer will conservatively interrupt the sampling data using the most conservative data point within the margin of statistical error.

It is assumed that the new appliances purchased in given year x will operate for at least 50% of the average operating hours. This will act as a default, but in some cases, the project developer or DOE can give clear indication why this number needs to be revised.

The same number of units of new appliances will be purchased annually in the baseline case and the post standard case. Some data indicated that the slightly higher entry price typical for more efficient appliances limits sales slightly. This would mean that the project results are actually undercounting the emissions reductions. To be conservative the project developer will assume the same sales figures for both baseline and post project.

E.2. List of data used indicating sources (e.g. official statistics, expert judgement, proprietary data, IPCC, commercial and scientific literature) and precise references and justify the appropriateness of the choice of such data:

- electricity emissions factor (calculated from best available official statistics, scientific studies, etc.)
- fuel emissions factor (from IPCC sources)
- total annual population of new appliance (from official government and industry statistics and/or scientifically derived sampling data)
- new appliance sales data by equipment model and efficiency (from official government and industry statistics and/or scientifically derived sampling data)
- Average energy input of new appliance population- may require additional data to determine such as average size/capacity/output and efficiency rate per unit of output to determine (from official government and industry statistics and/or scientifically derived sampling data)
- testing lab results for new equipment efficiency (from official government and industry statistics and/or scientifically derived sampling data)
- average retirement age of equipment (from official government and industry statistics and/or scientifically derived sampling data)

- mean user days (from official government and industry statistics and/or scientifically derived sampling data)
- mean user hours per day (from official government and industry statistics and/or scientifically derived sampling data)
- historical improvements in new appliance population efficiency (from official government and industry statistics and/or scientifically derived sampling data)

The data sets required to calculate the CO2 savings will likely come from several sources including government data sets, industry data sets, sales data, and statistically significant sampling surveys. Government and industry data when available will be transparent. In many cases, scientifically derived sampling data will be the only possible way to gather the appropriate data. This method is standard practice within the field of appliance standards and data sets gathered using appropriately designed surveys have been proven time and again to be reliable and accurate sources of data.

E.3. Vintage of data (e.g. relative to starting date of the project activity):

With the exception of the historical efficiency improvements data which will date back at least three years; all data will be kept annually from the baseline year until the project's conclusion.

E.4. Spatial level of data (local, regional, national):

National level data for all countries included in the appliance efficiency standard will be required. Dispatch data for the national level electricity grid will be gathered prior to validation and verification as appropriate.

SECTION F. Assessment of uncertainties (sensitivity to key factors and assumptions):

In many instances, the project developer will have to rely on scientifically derived sampling data. The project developer will have to convince the DOE that any data gathered using sampling has been gathered in a rigorous and conservative manner. Project developers may decide to employ reputable third party sampling firms to design and implement such studies to mitigate uncertainties surrounding the data derived in this manner.

SECTION G. Explanation of how the baseline methodology allows for the development of baselines in a transparent and conservative manner:

The baseline is built on the best available raw data either publicly available or gathered according to the accepted norms of sampling. The sampling plan and the results will be shared with the DOE. The baseline calculation is based on internationally accepted norms for calculating the impact of appliance standards. To be conservative, the baseline is adjusted annually to ensure only those non-business as usual emissions reductions are calculated. In addition, the methodology conservatively calls for the annual recalculation of the carbon emissions factor. In cases where the electricity sector undergoes dramatic change during the project period, this will more accurately reflect the true emissions reductions as a result of the project. (ie where power plants switch from coal to natural gas with the opening of a new pipeline)