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:

Baseline methodology for project activities involving energy efficiency, self-generation, cogeneration, and/or fuel switching measures at an industrial facility

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

The UNFCCC CDM web site appears not to provide a list of categories of project activities, from which one might choose that applicable for this proposed new methodology.

If one were to use the "Sectoral Scope" classification as applied to Designated Operational Entities, possible categories might be: (3) Energy demand or, due to the project activity is developed at an industrial facility, (4) Manufacturing industry or (5) Chemical industry.

A more specific category of project activity might be "industrial energy efficiency, self-generation, cogeneration, and fuel switching."

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

This methodology would apply to the case where the project activity involves any one or any combination of the following activities at the industrial site:

- Changes in the energy efficiency of any equipment (fuel and electricity savings)
- Installation of electricity self-generation equipment or changes in electricity self-generation equipment
- Installation of electricity cogeneration equipment or changes in electricity cogeneration equipment
- Fuel switching for equipment

These activities can generate improvements in the production process —giving rise to a better energy efficiency leading to fuel and electricity savings—, fuel usage, and management of electricity demand. The improvements can be achieved, for example, through equipment replacement or adaptations, development and incorporation of more advanced technologies, partial redesign of some processes, better use of process heat (which can be used for additional energy generation), etc.

A.4. What are the potential strengths and weaknesses of this proposed new methodology?

The potential strengths of the proposed new methodology include the following:

- It is applicable to a number of types of project activities
- It is straightforward to apply
- It is adequate both for simple processes as well as for complex processes involving variables that are difficult to predict

The only potential weakness of this proposed methodology is the difficulty in the identification of adequate process variables that act as control variables for the project in the case of complex multi-product facilities, and the establishment of their relation with fuel consumption and/or energy purchases or sales in the baseline scenario.

SECTION B. Overall summary description:

The methodology considers emissions from fuel consumption by equipment at the industrial site (boilers, furnaces, etc.), both in the baseline and the project scenarios.

Energy purchased (electricity or steam) results in emissions from energy generation outside the industrial facility, and energy sold from the industrial facility reduces such emissions. Assuming that the mitigation measure contemplates energy savings, increasing electricity self-generation or cogeneration at the industrial site, and/or sale of energy, emissions from energy generation outside the industrial facility would decrease as a result of project activity. Thus such emissions are part of baseline emissions and include both *net* energy purchases in the baseline scenario and *net* energy sales in the project scenario.

In such a way, electricity purchased from the grid and/or an isolated private plant results in emissions elsewhere in the power grid and/or in the private plant, and electricity sold from the industrial facility to the interconnected grid reduces such emissions in the power grid. In the same way, steam purchased results in emissions outside the industrial facility, and steam sold reduces such emissions, in relation to emissions released as a consequence of fuel consumed for steam production.

This new methodology incorporates the following procedures and methodologies:

- Tools for the demonstration and assessment of additionality (Annex 1 to EB 16 Report).
- Approved consolidated baseline methodology ACM0002 “Consolidated baseline methodology for grid-connected electricity generation from renewable sources.”

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:

☒ **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 C.1 above is considered the most appropriate:

Baseline emissions will be determined in a dynamic or *quasi*-dynamic way, based on monitored actual data. Thus, the proposed methodology fits with the first option “Existing actual or historical emissions.”

Moreover, the project activity may involve a combination of quite project-specific measures and technologies so that no single set of technologies can be used as a package reference, as required in the second option. For the same reason, the project is likely to be unique and cannot be readily identified with “similar” project activities elsewhere.

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):

The basic assumptions of the baseline methodology are:[1]

- The project activity may involve a series of measures that change energy consumption patterns of the industrial facility.
- These changes can lead to fuel and electricity savings, use of process heat to self-generate electricity, cogeneration to cover process heat and electricity demand, fuel switching of the industrial facility, etc.
- We assume that thermal energy associated to fuel consumption and electrical energy is decoupled.
- For fuel consumption, when circumstances permit a one-to-one identification of energy fluxes and consumption patterns, we match heat output in the project scenario in order to determine the fuel consumption in the baseline scenario required to provide the same amount of heat output (dynamic baseline). Otherwise, a process control variable shall be identified to establish a relation —within an applicability range— between this variable and fuel consumption, fixing the value that fuel consumption would have had in the baseline scenario for a given value of the control variable in the project scenario, whatever it is into the applicability range (*quasi*-dynamic baseline).
- For electricity (and similarly for outside steam) we consider net electricity purchase from the grid or individual power plants in the baseline scenario and net electricity sale through the grid in the project scenario, referred as emissions in the baseline scenario. For the estimation of net electricity purchase in the baseline scenario, a process control variable shall be identified to establish a relation —within an applicability range— between this variable and net electricity purchase, fixing the value that net electricity purchase would have had in the baseline scenario for a given value of the control variable in the project scenario, whatever it is into the applicability range (*quasi*-dynamic baseline).[2]

[1] To better understanding this section we recommend the entire reading of this proposed new baseline methodology.

[2] If directly working with the sum of net electricity purchase in the baseline scenario plus net electricity sale in the project scenario instead of dealing with each term separately results to be more convenient, due to the sum can be directly obtained from monitoring data, then it is not necessary to use the *quasi*-dynamic baseline.

The equipment involved in the project activity might be only a part of total equipment of the industrial facility. Since all equipment is typically inter-related in a complex and large process, it is consistent to consider total input and output of the facility. On the contrary, if only the equipment involved in the project activity were monitored, there exists the risk that a part of the emissions reduced by the project are emitted anyway due to operation of equipment not controlled following project implementation. Therefore, while guaranteeing that the applicability range is not exceeded (*i.e.* actual or foreseen maximum value of the control variable —*e.g.* production capacity— is not modified beyond what is stated in the PDD, following project implementation), emission reductions associated with equipment not included in the project activity, as originally proposed in the PDD, can be accredited by project participants, if they are part of minor improvements of some equipment, also helped by CER revenue (obviously it cannot include energy-intensive equipment).

The first step in determining the baseline scenario is to analyse all options available to project participants. These include the business-as-usual case —considering sectoral policies and circumstances to determine whether this case corresponds to the continuation or not of the current operation of the industrial facility—, the project scenario, and any other scenarios that might be applicable. In general, due to the complexity of the processes involved and the probably low similarities of the project operating conditions with other industrial facilities, alternative scenarios are mostly project specific and should be analysed under a case-by-case approach. For example, since the project involves energy efficiency, self-generation, cogeneration, and fuel switching, some of the available possibilities include:

- Continuing with the current fuel consumption patterns and maintaining all equipment currently in use. Existing energy-intensive equipment is expected to have a lifetime exceeding that of the crediting period.
- Making any combination of the above-mentioned measures (e.g. switching fuels without replacing any equipment, energy savings plus replacing, adding or modifying equipment used to generate energy at the industrial facility, and so on).

The choice of the baseline scenario is determined after considering the additionality test described in Section D.3. Choice of baseline and project alternatives would be affected by legal requirements, economic and financial considerations, and barriers that may favour one or other alternative. In Step 1 of the additionality test, different alternative scenarios shall be considered. The rest of the Steps will allow one the possibility to select the most likely scenario as the baseline one. In this way, the same steps used to prove additionality shall be used to determine the baseline scenario.

Once the baseline scenario is selected (whatever it is), baseline emissions are those corresponding to existing actual or historical emissions by sources in the baseline scenario and are consistently calculated according to the processes involved. General considerations were given in Section B above.

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

The proposed methodology is based on a number of already approved methodologies and tools for the demonstration and assessment of additionality:

- AM0008 “Industrial fuel switching from coal and petroleum fuels to natural gas without extension of capacity and lifetime of the facility”
- AM0014 “Natural gas-based package cogeneration”
- ACM0002 “Consolidated baseline methodology for grid-connected electricity generation from renewable sources”

- Tools for the demonstration and assessment of additionality

The proposed methodology would generalize the approved methodology AM0008 by enlarging the range of mitigation options rather than only considering fuel switching and relaxing some stringent conditions which were related to additionality issues. These options could involve cogeneration and self-generation, and the impact of such generation on an interconnected power system is similar to that from CDM projects involving renewable electricity generation connected to the grid. The calculation tools of the approved consolidated methodology ACM0002 would thus be applicable even though the project does not involve renewable energy. Indeed, this methodology was recommended to be used as part of AM0014, which involves cogeneration of electricity at an industrial facility using a non-renewable fuel.

In addition, the proposed methodology provides a new approach for estimating GHG emissions that would occur in the absence of the project activity, which could be used for energy efficiency, self-generation, cogeneration, and fuel switching project activities.

The proposed methodology also widens the additionality tests incorporated into AM0004 and AM0014, by recommending the use of the Tools for the demonstration and assessment of additionality.

One of the key criteria used in developing the baseline methodology is the following: Total input and output of the industrial facility is considered in order to ensure a thorough accounting of the emissions resulting from the project activity, avoiding that emissions reduced in one part of the process could be issued in other part of the production process.

We believe that the proposed methodology would be applicable to several types of mitigation options involving the production of heat and electricity at an industrial facility while remaining simple to use.

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 methodology proposed here recommends the use of the Tools for the demonstration and assessment of additionality (Annex 1 to the Report of the 16th meeting of the CDM Executive Board, Oct. 2004).

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

The type of activity involves equipment changes at an industrial facility. Such changes generally must meet legal requirements, including environmental impact assessment. If the proposed project activity is required by laws or regulations, the project might not be additional. Similarly if there were special incentives to promote project activities similar to the one proposed here, again the activity would not be additional. All these issues are taken into consideration in the Tools for the demonstration and assessment of additionality mentioned in Section D.3. As a part of that determination, the project proponents are required to:

- Analyse legal requirements and obligations with respect to the project activity.
- Analyse national incentives to promote similar project activities.
- Analyse sectoral policies that can, directly or indirectly, drive the development of similar project activities.

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

The project boundary encompasses the physical, geographical site of the industrial facility. Schematically, Figure 1 shows the project boundary, indicating energy flows into the boundary and the GHG emissions. We consider all fuels used both in the baseline scenario and in the project case. This indicates that the project boundary is applicable both for the baseline analysis as well as for monitoring of emissions following project implementation, and emission reductions.

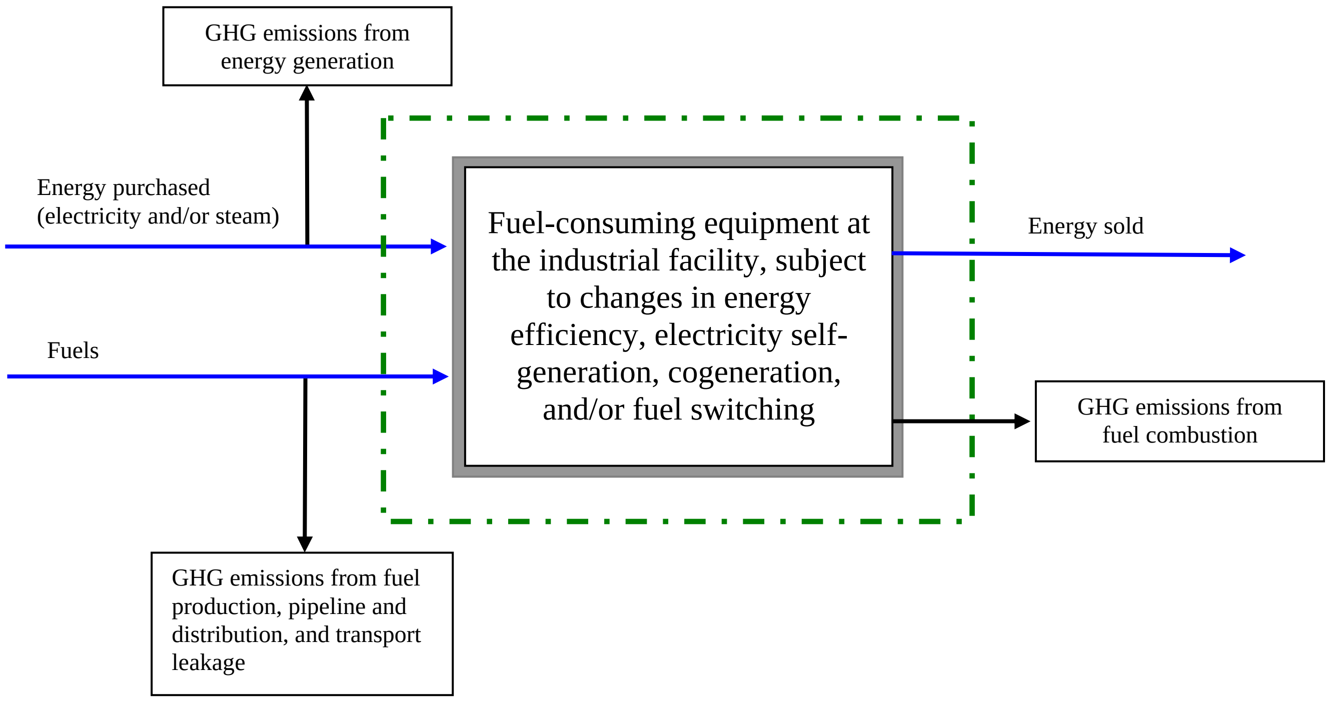

Fig. 1. Project boundary

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):

The candidates to baseline scenario, which are potentially eligible to use this methodology, are all of scenarios mentioned above in section D.1, which include:

- Continuing with the current fuel consumption patterns in the existing facility to produce heat and electricity without any substantial investment in equipment to increase the electric power output of the facility and/or change the energy consumption of equipment. Existing energy-intensive equipment is expected to have a lifetime exceeding that of the crediting period.
- Anyone or any combination of fuel switching, energy efficiency, self-generation, and cogeneration measures at the industrial site, that results in increased emissions of GHG than the emissions from the proposed project activity.

Baseline emissions BE (tCO_2e/year) are given by:

$$BE = \Sigma_j BFC_j \times [CEF_j + MEF_j \times GWP(CH_4) + NEF_j \times GWP(N_2O)] +$$

$$+ \Sigma_j \, (NBEP_j + NPES_j) \times EFel_j + \Sigma_j \, (NBSP_j + NPSS_j) \times EFst_j$$

where:

BFC_j	Consumption of fuel *j* used in the baseline scenario, measured in energy units (*e.g.* GJ)
CEF_j	Carbon dioxide emission factor per unit energy of fuel *j* (*e.g.* tCO_2/GJ)
MEF_j	Methane emission factor per unit energy of fuel *j* (*e.g.* tCH_4/GJ)
GWP (CH_4)	Global warming potential of CH_4 set as 21 tCO_2e/tCH_4 for the 1st commitment period
NEF_j	Nitrous oxide emission factor per unit of energy of fuel *j* (*e.g.* tN_2O/GJ)
GWP (N_2O)	Global warming potential of N_2O set as 310 tCO_2e/tN_2O for the 1st commitment period
$NBEP_j$	Net electricity purchased (electricity purchased less electricity sold) in the baseline. Include net electricity purchased from the grid and/or a private plant (*e.g.* MWh). Each seller/buyer of electricity is denoted by *j.*
$NPES_j$	Net electricity sold (electricity sold less electricity purchased) in the project scenario. Include net electricity sold to the grid (*e.g.* MWh). Each buyer/seller of electricity is denoted by *j*.
$EFel_j$	Baseline emission factor from electricity generation, including electricity generation by the grid and/or a private plant (*e.g.* tCO_2/MWh). Each source of electricity is denoted by *j*.
$NBSP_j$	Net steam purchased (steam purchased less steam sold) in the baseline. Include net steam energy purchased (*e.g.* GJ/year). Each seller/buyer of steam is denoted by *j*.
$NPSS_j$	Net steam sold (steam sold less steam purchased) in the project scenario. Include net steam energy sold (*e.g.* GJ/year). Each buyer/seller of steam is denoted by *j*.
$EFst_j$	Baseline emission factor from steam generation (*e.g.* $kgCO_2e$/GJ steam). Each source of steam is denoted by *j*.

Baseline emissions include the emissions from fuels burnt at the industrial facility in the baseline scenario. Electricity purchased to meet a part or all of the demand at the facility would cause emissions elsewhere in the power grid and/or in the private plant. Such emissions are also included in baseline emissions. If, following project implementation, electricity were sold from the industrial facility through the power grid, the emissions would be offset elsewhere in the grid. In the absence of such electricity supply in the baseline scenario, there would be additional emissions in electricity generation, which are also included in baseline emissions. In the same way, steam purchased results in emissions outside the industrial facility. Such emissions are included in baseline emissions. If, following project implementation, steam were sold from the industrial facility, the emissions would be offset in the plant where steam came from. Such emissions are also included in baseline emissions.

Note that we consider *net* energy (electricity and steam) purchased in the baseline scenario and *net* energy (electricity and steam) sold in the project scenario, as explained in the definitions of *NBEP* and *NPES*, and *NBSP* and *NPSS*. This equation allows for any of these quantities to be negative. To avoid confusion these emissions are included in the baseline emissions equation only. In the typical project, all terms are expected to be positive or zero.

Baseline emissions associated with fuel consumption

In order to estimate baseline emissions from fuel combustion, the proposed methodology provides the following two options:

Option 1

In this case, the procedure is essentially identical to the baseline for industrial fuel switching projects of AM0008.

This option can be used for projects that involve fuel switching, self-generation, and/or cogeneration without changes in energy efficiency, and when the baseline scenario consists of continuing with the fuel or fuels currently being used at the facility and maintaining all energy-intensive equipment currently in use.

The *ex-ante* baseline emissions related to fuel consumption are determined using values of fuel consumption based on trends in consumption prior to project implementation, *e.g.* assuming a fixed growth rate.

The *ex-post* baseline emissions related to fuel consumption can be determined in a dynamic manner from monitored project data in such a way that the heat output of the industrial facility is maintained constant. In other words, baseline emissions related to fuel consumption would correspond to the consumption of fuels used in the baseline scenario in order to provide the same amount of heat as is actually measured in the project scenario. The procedure for determining the dynamic baseline is given below.

The following constraint relation applies:

$$\Sigma_i BFC_{n,i} \times \eta_{n,i} = \Sigma_i PFC_{n,i} \times \eta_{n,i}$$

for each process element (or equipment) n which uses the fuel i in either the baseline or the project scenario. Here $BFC_{n,i}$ and $PFC_{n,i}$ stand for baseline and project fuel consumption of process (or equipment) n for use of fuel i, respectively. $\eta_{n,i}$ is the efficiency of process (or equipment) n for use of fuel i, measured either in unit of output per unit of thermal energy (*e.g.*, tonnes of steam output/Joule) or ratio of the output thermal energy to the input energy (*i.e.* percentage). To the extent possible, $\eta_{n,i}$ should be representative of actual operating conditions, such as typical load factor. In this sense a direct measurement of heat output vs. fuel input provides a more reliable indicator than an efficiency measurement based on flue gas analysis, which usually correspond to full-load conditions, and moreover does not take into account jacket losses from boilers and furnaces.

For equipment and fuel combinations that are used in the baseline but not in the project scenario, it will not be possible to monitor the efficiency of the equipment, as it would apply to the baseline scenario. In such cases, and in any other data limitations, conservative values should be assumed, *i.e.* assumptions that would tend to reduce baseline emissions and increase project emissions. Thus conservative assumptions for efficiency estimates imply high values for the baseline and low for the project scenarios.

The methodology proposed here is applicable to industrial facilities that may be producing electricity as well as thermal energy. The constraint relation expressed above matches heat output in the project scenario in order to determine the fuel consumption in the baseline scenario required to provide the same amount of heat output.

Our basic assumption of equalizing thermal energy rather than some combination of thermal and electrical energy, *i.e.* that the industrial production scales with heat demand, is clearly a simplification based on the consideration that the magnitude of the heat demand is likely to be much higher than the magnitude of the electricity generated in the facility. For specific projects, other scaling arrangements may be presented for determining the dynamic baseline. However, since industrial output is likely to scale

equally with heat and electricity demand, so that this assumption is unlikely to introduce a significant error in estimating fuel consumption.

A more serious problem arises when there are multiple fuels and multiple processes or equipment involved in providing heat and electricity to the industrial facility. A single constraint equation such as given above cannot be used to determine *BFC* for each equipment and fuel, since many combinations of equipment and fuels could provide the same amount of heat output. Here, additional constraints need to be introduced and justified for specific projects. Such constraints could include:

- Equipment and processes that only operate on certain fuels
- Certain equipment are preferred over others because of fuel efficiency
- Certain fuels are preferred because of price, etc.

A good starting point for such determination is the actual equipment and fuel use patterns in recent years prior to project implementation. The dynamic baseline is intended to be a minor adjustment to this established pattern, and fuel consumption patterns in the dynamic scenario should not differ significantly from previous patterns.

If establishing a dynamic baseline proves to be very difficult, or the baseline determination difficult to justify, a constant baseline may be used instead, as a conservative alternative.

In any case, the constraint relation and other assumptions will help determine consumption of different fuels in the baseline (BFC_i).

Option 2

This option can be used for projects that involve any one or any combination of energy efficiency, self-generation, cogeneration, and fuel switching measures, and when the baseline scenario can be any of the scenarios mentioned above in section D.1.

The *ex-ante* baseline emissions related to fuel consumption are determined using values of fuel consumption based on:

- Trends in consumption prior to project implementation, if the baseline scenario consist of continuing with current fuel consumption patterns (same energy content) at the facility and maintaining all equipment currently in use;
- Estimations from studies and/or simulations, if anyone or any combination of energy efficiency, self-generation, cogeneration, and fuel switching measures, different from the project activity, would be executed in the absence of the project activity.

The *ex-post* baseline emissions related to fuel consumption can be determined in a *quasi*-dynamic manner from project monitoring data and relations between fuel consumption in the baseline and adequate process variables that act as control variables. The procedure for determining the *quasi*-dynamic baseline is given below.

The first step for determining the *quasi*-dynamic baseline is the identification of process variables (*e.g.* total production of the plant, quantity of an specific raw material consumed at the plant, etc.) that act as control variables for the project, and that will be monitored during the crediting period.

The second step involves the establishment, for each process or equipment, or combinations of processes or equipment, of an adequate relation between fuel consumption in the baseline scenario and the control variables identified. Preferably, these relations would be uniquely defined (bijective function), meaning that there is a one-to-one correspondence between fuel consumption and the control variable.

These relations are based on:

- Trends in consumption prior to project implementation, if the baseline scenario consists of continuing with the current fuel consumption patterns and maintaining all energy-intensive equipment currently in use;
- Estimations from studies and/or simulations, if anyone or any combination of energy efficiency, self-generation, cogeneration, and fuel switching measures, different from the project activity, would be executed in the absence of the project activity.

These relations will be established *ex-ante* and considered unalterable during the crediting period. As a consequence, any estimation of fuel consumption in the baseline scenario that is used to establish these relations needs an adequate justification able to be verified by a DOE.

Following project implementation, the *ex-post* baseline fuel consumption will be determined through the relations established *ex-ante,* based on measurements of the control variables in the monitoring process. In other words, baseline fuel consumption is the quantity of fuel that would be consumed by each process or equipment, or combinations of processes or equipment in the baseline scenario, when the control variables have the values measured in the project scenario.

This procedure is illustrated below.

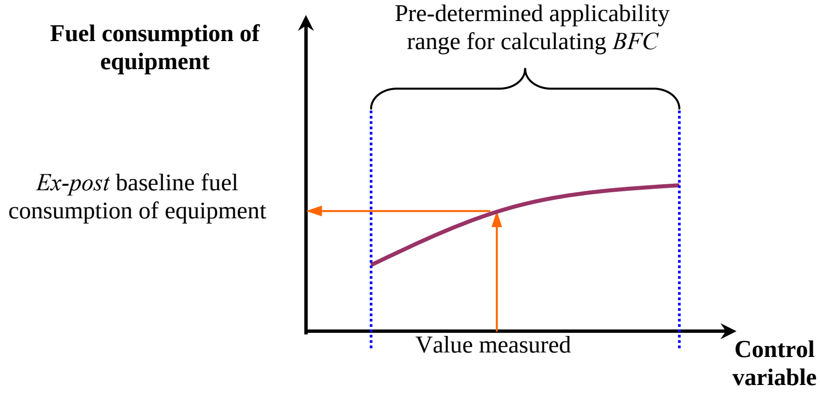

Fig. 2. Determination of fuel consumption in the baseline scenario

The procedure gives the possibility of grouping the equipment and the fuels as needed. Each relation may involve one piece of equipment o combinations of equipment, and one or more fuels.

This procedure is applicable to a number of types of project activities. The only restriction is that following project implementation the values of the control variables should not exceed the range previously determined (*e.g.* related to the current or foreseen maximum production capacity of the industrial facility).

Baseline emissions associated with purchase/sale of energy (electricity or steam)

The emissions associated with energy generation outside the industrial facility depend on the sum of the *net energy purchased* in the baseline scenario and the *net energy sold* in the project scenario, and the emission factor for energy generation.

Net energy purchase in the baseline scenario

The *ex-ante* baseline emissions related to *net* energy purchase are determined using values of steam and electricity purchases/sales based on:

- Trends in consumption prior to project implementation, if the baseline scenario consists of continuing with the current fuel consumption patterns and maintaining all energy-intensive equipment currently in use;
- Estimations from studies and/or simulations, if anyone or any combination of energy efficiency, self-generation, cogeneration, and fuel switching measures, different from the project activity, would be executed in the absence of the project activity.

The *ex-post* baseline emissions related to *net* energy purchases can be determined in a *quasi*-dynamic manner from project monitoring data and relations between steam and electricity purchases/sales in the baseline and adequate process variables that act as control variables. These relations will be established *ex-ante* and considered unalterable during the crediting period. The procedure is the same that is described in Option 2 above for estimation of *ex-post* baseline emissions related to fuel consumption.

Net energy sale in the project scenario

The *ex-ante* baseline emissions related to *net* energy sale are determined using values of steam and electricity purchases/sales based on estimations from studies and/or simulations for the project scenario, and the *ex-post* baseline emissions related to *net* energy sold can be determined from project monitoring data.

Emission factor for energy generation outside the industrial facility

If the project activity involves purchase/sell of electricity from/to the grid, the Methodology Panel and CDM Executive Board have already proposed a consolidated methodology for determining the emission factor. We recommend to incorporate this approved consolidated baseline methodology, denominated ACM0002, as a component of the proposed new methodology. ACM0002 offers some alternative pathways for determining the emission factor, and each specific PDD should adopt an own specific procedure, according to its circumstances.

Note that ACM0002 is actually designated "Consolidated baseline methodology for grid-connected electricity generation from renewable sources." When the project involves electricity generation from renewable sources, project emissions for electricity generation are negligible, and the baseline emissions are emissions avoided elsewhere in the power grid. The new methodology being proposed here is related to electricity generation at an industrial facility using fuels, which need not be renewable. However, the emissions from these fuels are being estimated and counted as part of project emissions due to fuel consumption at the facility, and thus, as far as the baseline is concerned, ACM0002 should be perfectly applicable. Indeed, another approved methodology, "Natural gas-based package cogeneration," was accepted as AM0014 under the condition that the consolidated methodology for grid-connected electricity generation from renewable sources be used.

AM0014 offers an alternative procedure for estimating the emission factor, namely the "Simplified Methodology for Small-scale CDM Project Activities," which would be applicable in case electricity displaced is less than 15 MW equivalent.

Thus, when the project activity involves purchase/sell of electricity from/to the grid, this proposed new methodology recommends the use of either ACM0002 or the simplified methodology for small-scale projects, as appropriate.

On the other hand, if the proposed project activity involves purchase/sell of steam and/or purchase of electricity from an isolated private plant, emission factors of the plants providers of steam and/or electricity should be used.

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):

The project activity may involve replacing some or all fossil fuels currently being used by other lower carbon fuels for providing heat and electricity at the industrial facility. The project activity may also include fuel and electricity savings, increased electricity generation at the facility, and sales of energy. Either of these components would reduce GHG emissions compared to the baseline.

The project emissions E (tCO_2e/year) are given by:

$$E = \Sigma_i\, FC_i \times [CEF_i + MEF_i \times GWP\,(CH_4) + NEF_i \times GWP\,(N_2O)]$$

where:

FC_i	Consumption of fuel *i* used in the project scenario, measured in energy units (*e.g.* GJ)
CEF_i	Carbon dioxide emission factor per unit energy of combusted fuel *i* (*e.g.* tCO_2e/GJ)
MEF_i	Methane emission factor per unit energy of combusted fuel *i* (*e.g.* tCH_4/GJ)
$GWP\ (CH_4)$	Global warming potential of CH_4 set as 21 tCO_2e/tCH_4 for the 1st commitment period
NEF_i	Nitrous oxide emission factor per unit energy of combusted fuel *i* (*e.g.* tN_2O/GJ)
$GWP\ (N_2O)$	Global warming potential of N_2O set as 310 tCO_2e/tN_2O for the 1st commitment period

Project emissions correspond to the emissions from fuels burnt at the industrial facility. These fuels may produce both heat and electricity. If any electricity and/or steam were exported from the facility, this would offset emissions from energy generation outside the industrial facility. Such emissions are thus counted in baseline emissions, as well as emissions associated with net energy purchases in the baseline scenario. Additional details on emissions associated with energy generation outside the project facility, including the methodology to be used in order to estimate such emissions, were presented in Section D.6.

The *ex-ante* project emissions are determined using values of fuel consumption based on estimations from studies and/or simulations for the project scenario, and the *ex-post* project emissions can be determined from monitoring data of the project.

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

This section is similar to that in AM0008.

Emissions from fuel production, pipeline and distribution, and CO_2 emissions from fuel transportation are considered as leakage. Emissions from fuel production/transportation is counted only if the fuel is produced/transported in a non-Annex I country.

Typical fuels might be natural gas, diesel, heavy fuel oil, bunker fuel, coal, etc., the former more likely in the project scenario and that latter more likely in the baseline. Fugitive methane emissions are associated with natural gas production and pipeline leakage. Fugitive methane emissions are also associated with coal mining. In case that the effect of these methane emissions could not be neglected, it should be included here.

The leakage LE is given by

$$LE = \Sigma_j\ (FC_j - BFC_j) \times FE_j\ (CH_4) \times GWP\ (CH_4) + \Sigma_j\ PTF_j \times EF_j - \Sigma_j\ BTF_j \times EF_j$$

where $FE_j\ (CH_4)$ is the IPCC default methane emission factor of fuel j associated with fugitive emissions.

The second and third terms in the above formula refer to emissions from fuel transportation in the project and baseline scenarios, respectively, shown as a product of the energy content of the fuels consumed in transporting fuels to the facility and the corresponding CO_2 emission factor for the fuels consumed by the different transportation modes (such as marine, railroad or truck). In view of the relatively small magnitude of CO_2 emissions from fuel transportation to typical industrial facilities, IPCC emission factors can be used.

The quantity of fuels consumed in transporting fuels to the facility (PTE_j or BTE_j in energy units) can be obtained in a facility-specific way. It can be calculated as the product of the specific energy consumption of the transport mode (quantity of fuel consumed per unit of fuel transported in the round trip) and the quantity of fuel transported (fuel consumed at the industrial facility). The specific energy consumption of the transport mode is determined *ex-ante* from historical data or estimations, and it is considered fixed during the crediting period. This simplification is valid since the relatively small magnitude of CO_2 emissions from fuel transportation to typical industrial facilities.

Thus to estimate the leakage before and after project implementation it is necessary to calculate the *ex-ante* and *ex-post* consumption of fuel *i* at the industrial facility used in the baseline and project scenario (BFC_j and PFC_j), which can be determined as explained in Sections D.6 and D.7, respectively.

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):

The emission reductions ER (tCO_2e/year) by the project activity are given by:

$$ER = BE - E - LE$$

Total emission reductions should be estimated *ex-ante* and determined *ex-post* as explained in Sections D.6, D.7, and D.8 above. The estimation of total emission reductions shall be reported in the PDD submitted for validation.

SECTION E. Data sources and assumptions:

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

The parameters are listed together with data sources in Section E.3, below.

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:

Calculation depends on the values of the following parameters, whose sources are given below:

Table 1: parameters

Symbol	Definition	Data source (in order or preference) and justification
CEF_i	Carbon dioxide emission factor per unit energy of fuel *i* (*e.g.* tCO_2/GJ)	1. National inventory of GHG emissions, prepared as part of the National Communications to the UNFCCC or other official documents. This is the most important emission factor and thus needs to be based on the most reliable and specific data source as possible. 2. On-site measurements of carbon content and calorific value of fuels. This would be recommended for fuels where there is significant variation in properties and/or when the fuel is not widely commercialised. 3. IPCC default emission factors. This is the last choice, and should be used only where data from other sources are not available.
MEF_i	Methane emission factor per unit energy of fuel *i* (*e.g.* tCH_4/GJ)	IPCC default values. Methane emissions from fuel combustion are likely to be insignificant so that standard values should suffice to provide an adequate estimate.
NEF_i	Nitrous oxide emission factor per unit of energy of fuel *i* (*e.g.* tN_2O/GJ)	IPCC default values. Nitrous oxide emissions from fuel combustion are likely to be insignificant so that standard values should suffice to provide an adequate estimate.
$EFel_i$	Baseline emission factor from energy generation, including electricity generation by the grid and/or a private plant (*e.g.* tCO_2/MWh). Each energy source is denoted by *i*.	If the project activity involves purchase/sale of electricity from/to the grid, emission factor is determined using either: ▪ ACM0002 “Consolidated methodology for grid-connected renewable electricity generation from renewable sources.” ▪ Simplified methodology for small-scale CDM project activities (for electricity generation less than 15 MW equivalent).
$EFst_i$	Baseline emission factor from steam generation (*e.g.* $kgCO_2e$/tonne steam). Each energy source is denoted by *i*.	If the project activity involves purchase/sale of steam, emission factors of the fuels consumed to produce steam at the plant providers shall be used.

Emissions from grid-connected electricity generation require data that are specified in ACM0002, and depend on the specific methodological option chosen among several alternatives proposed therein.

Leakage calculations are likely to be small compared to other components of baseline and project emissions; so that IPCC default values may be chosen for these estimates.

Dynamic baseline calculation

The dynamic baseline calculation is used to calculate baseline emissions related to fuel consumption when Option 1 is chosen.

In order to estimate baseline emissions *ex-ante*, the dynamic baseline calculation requires an assumption on the fuel consumption growth rate. This is based preferably on fuel consumption data for the three years prior to project implementation.

Dynamic baseline calculation also requires data on the fuel efficiency of each combination of equipment and fuel that produce heat. A preferred source of efficiency data would be based on direct measurements of heat output and fuel input. When it is not possible, efficiency measurements may be based on stack gas analysis (measurements of temperature and oxygen or CO_2 concentration).

Quasi-dynamic baseline calculation

The *quasi*-dynamic baseline calculation is used to calculate baseline emissions related to energy purchase/sale, and also baseline emissions related to fuel consumption (when Option 2 is applicable).

In order to estimate baseline emissions *ex-ante*, the *quasi*-dynamic baseline calculation requires estimating the values of the control variables that would occur in the absence of the project. This is based preferably on:

- Data of the three years prior to project implementation, if the baseline scenario consist of continuing with the current fuel consumption patterns and maintaining all equipment currently in use;
- Studies and/or simulations, if anyone or any combination of energy efficiency, self-generation, cogeneration, and fuel switching measures, different from the project activity, would be executed in the absence of the project.

As mentioned above, the *quasi*-dynamic baseline calculation involves the establishment, for each process or equipment, or combinations of processes or equipment, of an adequate relation between fuel consumption in the baseline scenario and the control variable.

This relation will be established *ex-ante* and considered unalterable during the crediting period. As a consequence, any estimation of fuel consumption and energy purchase/sale in the baseline scenario, that is used to establish the relation, needs an adequate justification.

When fuel consumption and/or energy purchase/sale remain approximately constant prior to project implementation, and it is also estimated that they would be constant in the absence of the project, this methodology includes the possibility of considering them as fixed values for the baseline scenario.

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

When historical values of fuel consumption and energy purchase/sale are used to determine baseline emissions, data are required for at least three years prior to project implementation.

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

Fuel consumption, energy purchase/sale, control variables, and equipment efficiency data correspond to the industrial facility.

Parameters needed to determine the emission factor for grid-connected electricity generation depend on the wholesale electricity manager and power plants connected to the grid in question.

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

Dynamic baseline calculation

One important component of emissions depends on fuel consumption at the industrial facility prior to and following project implementation, and the CO_2 emission factors of the fuels involved. Fuel consumption following project implementation is controlled by the procedures established in the monitoring methodology, while fuel consumption prior to project implementation is just straightforwardly calculated from equations given above. CO_2 emission factors are estimated from official data, fixed as IPCC default

values or from measurements under the control of project participants with quality procedures described in the monitoring plan.

Other parameters are much less important. For instance equipment efficiency values are used to make a minor correction of baseline emissions required for determining the dynamic baseline.

***Quasi*-dynamic baseline calculation**

If the baseline scenario consist of continuing with the fuel or fuels currently being used at the facility and maintaining all equipment currently in use, fuel consumption, energy purchase/sale, and control variables data used to determine the relations defined above, are measured prior to project implementation. Since data can be spread out a statistical analysis is needed. A function will be determined and standard deviation shall be calculated in order to see the confidence interval from which values are set. If a large number of cases is collected (for example, daily values during the last three years), we can assume that the historical series is sufficiently dense as to consider the function obtained is an accurate approximation of what would have been occurred in the absence of the project activity. Note that in the long term, those values that are greater than the ones predicted by the function are compensated by those that are lower.

If data used to determine the relations are estimated based on studies and/or simulations, all assumptions made shall be duly justified, since the established relations are considered unalterable during the crediting period.

Fuel consumption, energy purchase/sale, and control variables following project implementation will be accurately measured, according to measurement procedures established in the monitoring plan.

One, potentially large, source of emissions and emission reductions is associated with grid-connected power generation. The methodology proposed here for dealing with these emissions is the approved consolidated methodology ACM0002. This ACM0002 includes multiple options for determining the emission factor for grid-connected electricity. The result is likely to be sensitive to the option chosen.

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

All equations that make up the determination of baseline emissions are straightforward and transparent. Wherever data limitations might exist, this methodology proposes alternative procedures and, in case of doubt, how to make conservative assumptions.