CLEAN DEVELOPMENT MECHANISM

PROPOSED NEW METHODOLOGY: MONITORING (CDM-NMM)
Version 01 - in effect as of: 1 July 2004

CONTENTS

SECTION A. Identification of methodology

A.1. Title of the proposed methodology:

Monitoring methodology for energy integration project activities involving energy efficiency, self-generation, and/or cogeneration 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 does not provide a list of categories of project activities, from which one might choose the ones 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, since 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 integration involving energy efficiency, self-generation, and/or cogeneration."

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

This methodology is applicable under all of the following conditions:

1. The project activity involves an energy integration aimed primarily at energy efficiency in industrial facilities that produce only one product, where different mitigation options can be included:
   - Changes in the energy efficiency of any equipment (fuel and electricity savings),
   - Addition of electricity self-generation equipment or changes in electricity self-generation equipment,
   - Addition of electricity cogeneration equipment or changes in electricity cogeneration equipment.

   Energy integration refers to a set of interrelated technological options that generates improvements in fuel usage, in the management of electricity, and in the overall production process, giving rise to a better energy efficiency leading to fuel and/or electricity savings (i.e. to take advantage of surplus energy from a part of a process to be used in other part). 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.

2. The production processes at industrial facilities involve variables that are difficult to predict and where an individual monitoring of equipment turns out to be impractical. In such processes are those in which the operation and energy use conditions change frequently in an unscheduled way, making it almost impossible to determine a one-to-one correlation between energy fluxes and consumption patterns. An example of such processes is a petrochemical facility where steam can be provided by

different sources, such as boilers, exothermal reactions, waste heat, etc., depending on operating conditions.

For such production processes, the baseline is determined from data representing different operation and energy use conditions. In this methodology, the baseline fuel consumption is determined by correlating fuel consumption with production (output) of the industrial facility. In the same way, baseline electricity purchase/sale is determined by correlating electricity purchase/sale with industrial output. Accordingly, it is required that equipment giving rise to an eventual interdependence between fuel consumption and electricity purchase/sale can be identified, and their effects separated, in such a way that fuel consumption and electricity purchase/sale are independent variables, removing the constraints among them, if any.[1] Otherwise this methodology is not applicable.

This includes, for example, the case of existing equipment consuming steam from boilers (burning fuels) for producing electricity (e.g. using a turbo-steam generator) that is converted to mechanical energy by other equipment. It is required that the operating modality of this equipment (on/off) is not affected by the project activity, in order to assume that this operating modality is the same for both, the baseline and project scenarios.[2]

Once correlations are established, baseline fuel consumption and electricity purchase/sale are obtained from these correlations, based on production recorded following project implementation (*quasi*-dynamic baseline).

3. Project activities where the continuation of current practice is not prevented by any circumstance.

This methodology shall be used in conjunction with the accompanying monitoring methodology submitted together with this proposal.

This methodology is thus limited to emissions related to fuel consumption at the industrial facility and to emissions related to electricity generation outside the industrial facility. The emissions related to electricity generation may be produced either from isolated power plants serving the facility or from power plants belonging to the grid where the facility is connected. It does not include GHG not related to the sources mentioned above.

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:

[1] When monitoring data allow one to determine the electricity component of baseline emissions in a straightforward manner the sophisticated statistical curve method can be avoided. This happens, for example, when the current practice does not involve on-site electricity generation, which is added by the project activity. In that case, avoided power-grid CO_2 emissions are directly obtained as the amount of electricity generated by the new generation equipment (see Section B.2.4).

[2] This situation might occur when electricity and fuel prices are competing, thus influencing company's decision regarding the operation mode of the turbo-steam generator at the industrial facility. In this case the relations are split in two families of curves, depending on whether the turbo-steam generator is used or not during a given day, week, or month. The parameter that should be monitored in this case is the whether the turbo-steam generator is operating or not (see Section B.2.4).

- It is applicable to several types of project activities
- It is straightforward to apply and relies on relatively simple metering
- It is built on approved methodologies

Variables resulting from the proposed methodology are simple to be monitored. Thus, no weaknesses are identified in this methodology.

SECTION B. Proposed new monitoring methodology

B.1. Brief description of the new methodology:

The type of project activity described by this methodology involves emissions from fuel consumption by equipment at the industrial site (boilers, furnaces, cogeneration equipment, etc.), both in the baseline and project scenarios. Baseline emissions are determined from direct measurements of relevant variables (production and fuel consumption at the industrial facility) following project implementation and using historical curves correlating fuel consumption to production at the industrial facility. Project emissions are determined from direct measurements of fuel consumption following project implementation.

This type of project activity also involves emissions from electricity generation outside the industrial site. These emissions are considered as baseline emissions. They are determined from direct measurements of relevant variables (production and electricity purchased/sold by the industrial facility) following project implementation and using historical curves correlating electricity purchase/sale to production at the industrial facility.

B.2. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario:

B.2.1. Data to be collected or used in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1	*Quantity of fuel j consumed during the day, week, or month i, at the industrial facility in the project* QF_{ij}	*Industrial facility*	*Unit of mass or volume (e.g.: m^3, tonnes)*	*m*	*Daily, weekly or monthly*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It corresponds to each fuel j used at the industrial facility in the project scenario. Before calculation of project emissions, it shall be converted to energy units by multiplying by the correspondent Lower Heating Value.*
2	*Project emissions E*	*Industrial facility*	tCO_2e	*c*	*Daily, weekly or monthly*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It will be calculated using data 1, as explained in Section B.2.2.*

B.2.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

The project activity may include fuel and electricity savings, increased electricity generation at the facility, and sale of energy. Either of these components would reduce GHG emissions compared to the baseline.

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

$$E = \Sigma_i \{\Sigma_j PFC_{ij} \times [CEF_j + MEF_j \times GWP(CH_4) + NEF_j \times GWP(N_2O)]\}$$

where:

PFC_{ij}	Consumption of fuel *j* used in the project scenario corresponding to the monitoring day, week, or month *i*, expressed in energy units (*e.g.* GJ), and based on lower heating values of each fuel[3]
CEF_j	Carbon dioxide emission factor per unit energy of combusted fuel *j* (*e.g.* tCO_2e/GJ)
MEF_j	Methane emission factor per unit energy of combusted 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 energy of combusted 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

Project emissions correspond to emissions from fuels burnt at the industrial facility. If electricity were exported from the facility, this would offset emissions from energy generation outside the industrial facility. Such emissions were already counted in baseline emissions, as well as emissions associated with *net* electricity purchase prior to project implementation. Additional details on emissions associated with electricity generation outside the project facility, including the methodology to be used in order to estimate such emissions, are presented below in Section B.2.4.

Following project implementation, fuel consumption at the industrial facility shall be monitored, and the measured values will be used for the *ex-post* calculation of project emissions.

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[3] The criterion to decide whether daily, weekly, or monthly data are those to be used is explained in Section B.2.4, because it depends on data availability to construct correlation curves used for determining baseline emissions (see footnote 4).

B.2.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of greenhouse gases (GHG) within the project boundary and how such data will be collected and archived:								
ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1	*Quantity of fuel j consumed during the day, week, or month i, at the industrial facility in the project* Q_{Fij}	*Industrial facility*	*Unit of mass or volume (e.g.: m^3, tonnes)*	*m*	*Daily, weekly or monthly*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It corresponds to each fuel j used at the industrial facility in the project scenario.*
3	*Production of the industrial facility during the day, week, or month i* P_i	*Industrial facility*	*Unit of mass or volume (e.g.: m^3, tonnes)*	*m*	*Daily, weekly or monthly*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It is used to calculate ex-post baseline emissions related to energy purchase/sale, and related to fuel consumption.*
4	*Proportion of each fuel j used in the project scenario during the day, week, or month i* $\%_{ij}$	*Industrial facility*		*c*	*Daily, weekly or monthly*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It will be calculated using data 1, as explained in Section B.2.4. Before calculation of the proportions, the quantities of fuel consumed in the project shall be converted to energy units by multiplying by the correspondent Lower Heating Value.*

5	*Quantity of fuels consumed during the day, week, or month i, at industrial facility in the baseline* BFC_{ij}	*Industrial facility*	*Unit of energy (e.g.: MMBtu, GJ)*	*c*	*Daily, weekly or monthly*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It will be calculated using data 3 and 4 as explained in Section B.2.4.*
6	*Net electricity purchased prior to project implementation consumed during the day, week, or month i* $NEPp_{ik}$	*Industrial facility*	*MWh*	*c*	*Daily, weekly or monthly*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It will be calculated using data 3 as explained in Section B.2.4.*
7	*Net electricity sold following project implementation during the day, week, or month i* $NESf_{ik}$	*Industrial facility*	*MWh*	*m*	*Daily, weekly or monthly*	*100%*	*Paper (field record) Electronic (spreadsheet)*	
8	*Emission Factor from the isolated power plant* $EFel_{ip}$	*Isolated power plant*	tCO_2/MWh	*c*	*Annually*	*100%*	*Paper (field record) Electronic (spreadsheet)*	
9 ACM0002	*Amount of each fossil fuel consumed by each power source / plant of the grid* $F_{i,y}$	*Power producers, dispatch centers or latest local statistics*	*Unit of mass or volume (e.g.:* m^3*, tonnes)*	*m*	*Annually*	*100%*	*Electronic*	*It corresponds to Simple OM, Simple Adjusted OM, Dispatch Data OM, Average OM, BM of the ACM0002.*

10 ACM0002	*CO_2 emission coefficient of each fuel type i $COEF_i$*	*Plant or country specific values to calculate COEF are preferred to IPCC default values.*	*tCO_2 /mass or volume unit*	*m*	*Annually*	*100%*	*Electronic*	*It corresponds to Simple OM, Simple Adjusted OM, Dispatch Data OM, Average OM, BM of the ACM0002.*
11 ACM0002	*Electricity imports to the project electricity system*	*Latest local statistics. If local statistics are not available, IEA statistics are used to determine imports.*	*kWh*	*c*	*Annually*	*100%*	*Electronic*	*It corresponds to Simple OM, Simple Adjusted OM, Dispatch Data OM, Average OM, BM of the ACM0002.*
12 ACM0002	*CO_2 emission coefficient of fuels used in connected electricity systems (if imports occur) $COEFi_{,j\ y\ IMPORTS}$*	*Latest local statistics. If local statistics are not available, IPCC default values are used to calculate.*	*tCO_2 /mass or volume unit*	*c*	*Annually*	*100%*	*Electronic*	*It corresponds to Simple OM, Simple Adjusted OM, Dispatch Data OM, Average OM, BM of the ACM0002.*

13 ACM0002	*Identification of power source / plant of the grid for the OM*	*Industrial facility*		*e*	*Annually*	*100% of set of plants*	*Electronic*	*It corresponds to Simple OM, Simple Adjusted OM, Dispatch Data OM, Average OM of the ACM0002.* *Identification of plants (j, k, or n) to calculate Operating Margin emission factors*
14 ACM0002	*Electricity generation of each power source / plant j, k or n of the grid* $GEN_{j/k/n,,y}$	*Power producers, dispatch centers or latest local statistics*	*MWh/a*	*m*	*Annually*	*100%*	*Electronic*	*It corresponds to Simple OM, Simple Adjusted OM, Dispatch Data OM, Average OM, BM of the ACM0002.*
15 ACM0002	*Fraction of time during which lowcost/ must-run sources are on the margin* λ_y	*Industrial facility*		*c*	*Annually*	*100%*	*Electronic*	*It corresponds to Simple Adjusted OM of the ACM0002.* *Factor accounting for number of hours per year during which lowcost/ must-run sources are on the margin*
16 ACM0002	*The merit order in which power plants are dispatched by documented evidence*			*m*	*Annually*	*100%*	*Paper for original documents, else electronic*	*It corresponds to Dispatch Data OM of the ACM0002.* *Required to stack the plants in the dispatch data analysis.*
17 ACM0002	*Operating Margin emission factor of the grid* $EFOM,_y$	*Industrial facility*	tCO_2/MWh	*c*	*Annually*	*100%*	*Electronic*	*It corresponds to Simple OM, Simple Adjusted OM, Dispatch Data OM, Average OM of the ACM0002.* *Calculated as indicated in the relevant OM baseline method of ACM0002.*
18 ACM0002	*Identification of power source / plant of the grid for the BM*	*Industrial facility*		*e*	*Annually*	*100% of set of plants*	*Electronic*	*It corresponds to BM of the ACM0002.* *Identification of plants (m) to calculate Build Margin emission factors*

19 ACM0002	*Build Margin emission factor of the grid* $EFBM_{,y}$	*Industrial facility*	tCO_2/MWh	*c*	*Annually*	*100%*	*Electronic*	*Calculated as [∑i Fi,y*COEFi] / [∑m GENm,y] over recently built power plants defined in the baseline methodology ACM0002.*
20 ACM0002	*Emission factor of the grid* $EFel_g$	*Industrial facility*	tCO_2/MWh	*c*	*Annually*	*100%*	*Electronic*	*It corresponds to Simple OM, Simple Adjusted OM, Dispatch Data OM, Average OM of the ACM0002.* *Calculated as a weighted sum of the OM and BM emission factors, as indicated in the ACM0002.*
21	*Mode of operation of "fuel to electricity" equipment*	*Industrial facility*		*e*	*Daily*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*Mode of operation (on/off) of equipment giving rise to an eventual interdependence between fuel consumption and electricity purchase/sale.*
22	*Baseline emissions BE*	*Industrial facility*	tCO_2e	*c*	*Daily, weekly or monthly*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It will be calculated using data 5 to 8, 20, and 21 as explained in Section B.2.4.*

B.2.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

Baseline emissions in a given year, *BE* (tCO_2e/year), are given by:

$$BE = \Sigma_i \{\Sigma_j BFC_{ij} \times [CEF_j + MEF_j \times GWP(CH_4) + NEF_j \times GWP(N_2O)] +$$
$$+ \Sigma_k (NEPp_{ik} + NESf_{ik}) \times EFel_k\}$$

where the sum over *i* extends to all the days, weeks, or months[4] in a given year, the sum over *j* extends to all the fuels and the sum over *k* extends to all the electricity sources, and:

BFC_{ij}	Consumption of fuel *j* used in the baseline scenario corresponding to the monitoring day, week, or month *i*, expressed in energy units (*e.g.* GJ), and based on lower heating values of fuel *j*
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 1^{st} commitment period[5]
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 1^{st} commitment period
$NEPp_{ik}$	*Net* electricity purchased prior to project implementation corresponding to the monitoring day, week, or month *i*: $NEPp_{ik} = EPp_{ik} – ESp_{ik}$ (electricity purchase less electricity sale)

[4] These days, weeks, or months are those corresponding to the daily, weekly, or monthly monitoring of relevant variables. The daily, weekly, or monthly production values recorded "dynamically" following project implementation in the day, week, or month *i* are the production values used into the "static" baseline curve to determine baseline fuel consumption and *net* electricity purchase. The selection among days, weeks, or months depends on data availability and the size of the sample appropriate to apply a consistent statistical method to construct the static baseline curve that fits the historical data.

[5] IPCC, Second Assessment Report, "1995 IPCC GWP values" adopted by COP3, Decision 2/CP.3, FCCC/CP/1997/7/Add.1. Article 5.3 of the Kyoto Protocol establishes: "The global warming potentials used to calculate the carbon dioxide equivalence of anthropogenic emissions by sources and removals by sinks of greenhouse gases listed in Annex A shall be those accepted by the Intergovernmental Panel on Climate Change and agreed upon by the Conference of the Parties at its third session. Based on the work of, *inter alia*, the Intergovernmental Panel on Climate Change and advice provided by the Subsidiary Body for Scientific and Technological Advice, the Conference of the Parties serving as the meeting of the Parties to this Protocol shall regularly review and, as appropriate, revise the global warming potential of each such greenhouse gas, taking fully into account any relevant decisions by the Conference of the Parties. Any revision to a global warming potential shall apply only to commitments under Article 3 in respect of any commitment period adopted subsequent to that revision." These GWP for methane and nitrous oxide shall be thus adjusted following relevant COP/MOP decisions.

Include *net* electricity purchase from the grid and/or isolated power plants (*e.g.* MWh). Each seller/buyer of electricity is denoted by *k*.

$NESf_{ik}$ *Net* electricity sold following project implementation during the day, week, or month *i*:

$NESf_{ik} = ESf_{ik} - EPf_{ik}$

(electricity sale less electricity purchase)

Include *net* electricity sale to the grid (*e.g.* MWh). Each buyer/seller of electricity is denoted by *k*.

$EFel_k$ Baseline emission factor from electricity generation, including electricity generation by the grid and/or an isolated power plant (*e.g.* tCO_2/MWh). Each source of electricity is denoted by *k*. This emission factor is calculated using ACM0002.

Baseline emissions include emissions from fuels burnt at the industrial facility in the baseline scenario. Baseline emissions also consider emissions from electricity generation outside the industrial site.

Prior to project implementation, 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 an isolated power plant. Such emissions should be included as baseline emissions. In the same way, if electricity were sold from the industrial facility through the power grid, there would be emissions offset elsewhere in the grid. Such emissions should be discounted from baseline emissions. Typically, electricity purchase is higher than electricity sale prior to project implementation; in consequence, the subtraction between both types of contributions is considered as *net* electricity purchase, as explained in the definitions of *NEPp*.

If, following project implementation, electricity were purchased, it would cause emissions elsewhere in the power grid and/or in an isolated power plant. If electricity were sold by the industrial facility to the power system, the emissions would be offset elsewhere in the grid. Typically, electricity sale is higher than electricity purchase following project implementation; in consequence, the subtraction between both contributions is considered as *net* electricity sale, as explained in the definitions of *NESf*.

To avoid confusion *NESf* is added in the equation corresponding to baseline emissions instead of discounting it from project emissions[6].

Baseline emissions associated with fuel consumption

Ex-post baseline emissions (i.e. baseline emissions calculated from monitoring data following project implementation) 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 production of the industrial facility. The procedure for determining the *quasi*-dynamic baseline is given below.

[6] Avoided emissions associated with the sale of electricity following project implementation are considered as baseline emissions instead of discounting them in the project scenario, since they are emissions that would have otherwise been generated in the baseline scenario. (It is similar to what happen with a renewable electricity generation project connected to a grid, since in that case baseline emissions are those avoided by the presence of the project that otherwise would have released —a little fraction of grid emissions— and not the emissions of the entire grid without the project.)

The *quasi*-dynamic baseline involves the establishment of accurate relations that correlate fuel consumption in the baseline scenario and production of the industrial facility. Preferably, these relations would be uniquely defined (bijective function), meaning that there is a one-to-one correspondence between fuel consumption and production. These relations are based on trends in fuel consumption and production levels under the current practice.

These relations are fixed by using daily, weekly, or monthly data of the three years immediately prior to implementation of the project and will not be altered during the entire crediting period.

The relations shall cover the range of total production values of the industrial facility that is expected during the crediting period based on historical data. However, if the range is exceeded during the project, this methodology allows the extrapolation of the curves obtained *ex-ante* without exceeding the maximum production capacity of the existing facility. Extrapolation is valid because the relations are based on a great amount of data that represent different operation conditions and production levels. Thus the statistic method allows one to determine and extrapolate representative curves.

The *ex-post* baseline fuel consumption will be determined through the relations established from historical data, based on monitored production during the life of the project. In other words, baseline fuel consumption is the quantity of fuel (in energy units) that would have been consumed in the absence of the project activity for the production level measured during project implementation.

This procedure is illustrated in Fig. 1 below.

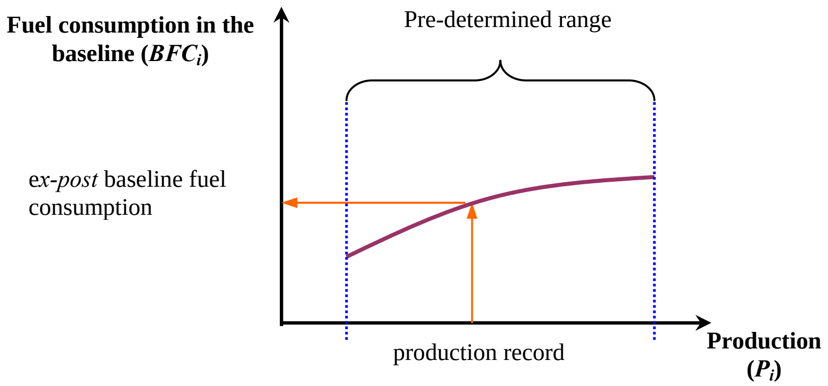

Fig. 1. Determination of fuel consumption in the baseline scenario from historical correlation

In order to calculate daily, weekly or monthly *ex-post* baseline consumption of each fuel *j* (BFC_{ij}), the type and proportion of each one of the fuels consumed in the project are considered to be the same in the baseline scenario.

Thus, *ex-post* consumption of fuel *j* used in the baseline scenario is given by:

$$BFC_{ij} = BFC_i \times \%_{ij}$$

where:

BFC_{ij} Consumption of fuel *j* used in the baseline scenario, corresponding to the monitoring

day, week, or month *i*, expressed in energy units (*e.g.* GJ), and based on lower heating value of each fuel. It is considered the same type of fuel as the one consumed in the project.

BFC_i Fuel consumption in the baseline scenario, corresponding to the monitoring day, week, or month *i*, expressed in energy units (*e.g.* GJ), and based on lower heating value of each fuel. It is obtained from the relation established prior to project implementation.

$\%_{ij}$ Proportion of each fuel *j* used in the baseline scenario, corresponding to the monitoring day, week, or month *i*. It is considered the same proportion as the one used in the project. In consequence, it is calculated, based on monitored fuel consumption during the day, week, or month *i*, as follow:

$$\%_{ij} = PFC_{ij} / (\Sigma_j\ PFC_{ij})$$

where PFC_{ij} is the consumption of fuel *j* used in the project scenario corresponding to the monitoring day, week, or month *i*, expressed in energy units (*e.g.* GJ), and based on lower heating values of each fuel.

This methodology considers that, in the baseline scenario, the same kind and proportion of fuels that are consumed following project implementation would be consumed. In consequence, fuel switching is not covered by the current methodology.

Baseline emissions associated with purchase/sale of electricity

The emissions associated with electricity generation outside the industrial facility depend on the sum of the *net* electricity purchase prior to project implementation and the *net* electricity sale following project implementation, and the emission factor for electricity generation.

Net electricity purchase prior to project implementation

Ex-post baseline emissions related to *net* electricity purchase can be determined in a *quasi*-dynamic manner from project monitoring data and relations between electricity purchase/sale in the baseline and production of the industrial facility. Preferably, these relations would be uniquely defined (bijective function), meaning that there is a one-to-one correspondence between electricity purchase/sale and production. These relations are based on trends in electricity purchase and sale and production levels under the current practice.

These relations are fixed by using daily, weekly, or monthly data of the three years immediately prior to implementation of the project and will not be altered during the entire crediting period.

The relations shall cover the range of total production values of the industrial facility that is expected during the crediting period based on historical data. However, if the range is exceeded during the project, this methodology allows the extrapolation of the curves obtained *ex-ante* without exceeding the maximum production capacity of the existing facility. Extrapolation is valid because the relations are based on a great amount of data that represent different operation conditions and production levels. Thus the statistic method allows one to determine and extrapolate representative curves.

The *ex-post* baseline electricity purchase and sale will be determined through the relations established from historical data, based on monitored production during the life of the project. In other words, baseline electricity purchase and sale is the quantity of electricity that would have been purchased and/or sold in the absence of the project activity for the production level measured during project implementation. The

procedure is the same that is described above for estimation of *ex-post* baseline emissions related to fuel consumption. A graph similar to the one shown in Figure 1 will be used to correlate electricity purchase/sale to production.

Net electricity sale following project implementation

Ex-post baseline emissions related to *net* electricity sale following project implementation can be determined from project monitoring data.

As mentioned above, if working directly with the sum of *net* electricity purchase prior to project implementation plus *net* electricity sale following project implementation results to be more convenient than dealing with each term separately and the sum can be directly obtained from monitoring data, then it is not necessary to use the *quasi*-dynamic baseline.

This happens, for example, when the current practice does not involve electricity generation, which is added by the project activity. In that case, avoided power-grid CO_2 emissions are directly obtained as the amount of electricity generated by the new generation equipment, since the difference between electricity purchase in the baseline and project scenario plus the electricity sale in the project (if any) is the quantity of electricity generated by the new turbo-generator in the project (EG_i). It means:

$$NEPp_i + NESf_i = (EPp_i - ESp_i) + (ESf_i - EPf_i) = (EPp_i - EPf_i) + ESf_i = EG_i$$

Emission factor for electricity generation outside the industrial facility

If the project activity involves purchase/sale of electricity from/to the grid, the Methodology Panel and CDM Executive Board have already proposed a consolidated methodology for determining the emission factor. This approved consolidated baseline methodology, identified as ACM0002, is adopted as an appropriate basis to calculate emission reductions from avoided electricity generation. ACM0002 offers some alternative pathways for determining the emission factor, and each specific PDD should adopt a specific procedure, according to its circumstances and criteria stated in ACM0002.

ACM0002 deals with grid-connected electricity generation from renewable sources. When the project activity involves electricity generation from renewable sources, project emissions for electricity generation are mostly negligible, and the baseline emissions are emissions avoided elsewhere in the power grid. The new methodology proposed here is related to electricity generation at an industrial facility using fuels, which are not necessarily renewable. However, emissions released from burning these fuels are counted as part of project emissions due to fuel consumption at the facility. Therefore, ACM0002 is appropriate for calculating avoided emissions related to electricity generation in this methodology. Indeed, another approved methodology, “Natural gas-based package cogeneration,” was accepted as AM0014 under the condition that ACM0002 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 or equal to 15 MW equivalent.

Thus, following the criterion proposed in AM0014, when the project activity involves purchase/sale of electricity from/to the grid, this proposed new methodology recommends the use of either ACM0002 or the simplified methodology for small-scale projects, if electricity displaced is less than or equal to 15 MW equivalent.

On the other hand, if the proposed project activity involves purchase/sale of electricity from an isolated power plant, it is necessary to consider whether the industrial facility and the other nearby industrial facilities supplied by this isolated power plant are connected to the grid. If the facilities are not connected to the grid, the power plant emission factor must be used to obtain avoided CO_2 emissions. If the facilities are connected to the grid, it is highly probable that they are purchasing electricity from the isolated power plant due to its lower price, so that the reduction of electricity demand from this plant by the industrial facility indirectly has an influence on the purchase of electricity by the other facilities, resulting in emission reductions in the power grid.

If there were equipment that produces electricity from burning fuels in the baseline, a basic hypothesis of this methodology (fuel and electricity are not causally related) would not be met. In that case, this methodology could even be applied if this equipment is not changed by the project activity and it is possible to guarantee that its operation is not modified by the project activity. Moreover, in order to decide what are fuel consumption and electricity purchase/sale that would have occurred in the absence of the project activity, the operation mode of this equipment must be clearly identified. A concrete case of this behavior corresponds to a turbo-steam generator that can be used in a day depending on the comparison between fuel and electricity prices. In that case there are two possibilities: to use or not this equipment on that day. Therefore, two different curves shall be obtained for the relation between fuel consumption and production level and other two curves for the relation between electricity purchase and production level. For a given production the higher the fuel consumption is the lower electricity purchased will be, and vice-versa.

To account for baseline emissions in this eventual case the following procedure shall be executed:

i) Monitor daily[7], following project implementation, the use of the turbo-steam generator.

ii) Intersect the curve that corresponds to the mode of operation applied on that day (on/off) following project implementation, as much as for fuel consumption vs. production as electricity purchase vs. production.

[7] Under this case, a daily monitoring is required by this methodology. Exceptions shall be transparently justified.

B.3. Option 2: Direct monitoring of emission reductions from the project activity:

B.3.1. Data to be collected or used in order to monitor emissions from the project activity, and how this data will be archived:								
ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

N/A

B.3.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

N/A

B.4. Treatment of leakage in the monitoring plan:

B.4.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity:

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1	*Quantity of fuel j consumed during the day, week, or month i, at the industrial facility in the project* Q_{Fij}	*Industrial facility*	*Unit of mass or volume (e.g.: m^3, tonnes)*	*m*	*Daily, weekly or monthly*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It corresponds to fuels transported to the industrial facility in the project scenario, as well as fuels that have fugitive methane emissions associated. Before calculation of leakage, the quantity of fuels that have fugitive methane emissions associated shall be converted to energy units by multiplying by the correspondent Lower Heating Value.*
5	*Quantity of fuels consumed during the day, week, or month i, at industrial facility in the baseline* BFC_{ij}	*Industrial facility*	*Unit of energy (e.g.: MMBtu, GJ)*	*c*	*Daily, weekly or monthly*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It corresponds to fuels transported to the industrial facility in the baseline scenario, as well as fuels that have fugitive methane emissions associated. Before calculation of leakage, the quantity of fuels that transported to the industrial facility shall be converted to mass or volume units by dividing by the correspondent Lower Heating Value.*
23	*Leakage LE*	*Industrial facility*	tCO_2e	*c*	*Monthly*	*100%*	*Paper (field record) Electronic (spreadsheet)*	*It will be calculated using data 1 and 5 as explained in Section B.4.2.*

B.4.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

The methodology addresses leakage from upstream fuel production and delivery. Emissions from fuel production, pipeline and distribution, and CO_2 emissions from fuel transportation are considered as leakage. Emissions from fuel production/transportation are 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. 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:

$$LE = \Sigma_i \{\Sigma_j (PFC_{ij} - BFC_{ij}) \times FE_j (CH_4) \times GWP (CH_4) + \Sigma_j PTF_{ij} \times EF_j - \Sigma_j BTF_{ij} \times EF_j\}$$

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

The second and third terms within the first summatory in the above formulae 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_{ij} or BTE_{ij} in energy units, and based on lower heating value of each fuel) 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 corresponding to the monitoring day, week, or month i).

The quantity of fuel consumed is expressed in energy units and based on its lower heating value. The quantity of fuel transported is expressed in units of mass or volume.

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 because of 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 determine *ex-ante* and *ex-post* consumption of fuel j at the industrial facility used in the baseline and project scenarios, which can be determined as explained in Section B.2.

B.5. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

The emission reductions ER (tCO_2e/year) generated 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 *ex-ante* estimation of total emission reductions shall be reported in the PDD submitted for validation.

B.6. Assumptions used in elaborating the new methodology:

The basic assumptions of the monitoring methodology are:

- The project activity may involve a series of measures that change energy consumption patterns of the industrial facility. These changes lead to fuel and electricity savings, e.g. by using process heat to generate electricity on-site and/or implementing cogeneration to cover process heat and electricity demand of the industrial facility, etc.
- There are data available on fuel and electricity usage for the prior three years at the facility.
- Baseline fuel usage and electricity purchase/sale can be accurately correlated to production of the industrial facility.
- Total input and output at the industrial facility is considered in order to ensure a thorough accounting of the emissions resulting from the project activity. This feature ensures that emission reductions in one part of the industrial facility that might be counter-balanced by emission increases somewhere else in the facility will be accounted for properly.
- Information is available to calculate grid or isolated power plant electricity emission factors.
- The use of combined margin (as outlined in ACM0002) is an appropriate basis to calculate emission reductions from avoided grid electricity generation.
- The modification of industrial processes does not affect emissions of GHG in other ways.

The monitoring methodology and its application is compatible with the baseline methodology and the development of the baseline scenario for this type of projects.

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, 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. Thus, once the project activity has been decided, no energy-intensive equipment would be replaced during the crediting period.

As mentioned above, the *quasi*-dynamic baseline involves the establishment of accurate relations that correlate fuel consumption and production at the industrial facility and electricity purchase/sale and production at the industrial facility. These relations are fixed by using daily, weekly, or monthly data of

the three years immediately prior to implementation of the project and will not be altered during the entire crediting period.

GHG emissions are dominated by CO_2 emissions from fuel combustion and electricity generation outside the industrial facility. Variations due to changes in the industrial process are smoothed since the established relations are determined from a robust set of values representing several operational conditions.

Following project implementation, *ex-post* baseline fuel consumption and electricity purchase and sale will be determined through the relations established prior to project implementation, based on records of production in the monitoring process. As a consequence, it is assumed that the daily, weekly, or monthly production level of the industrial facility is the same in both, the baseline and project scenarios.

This methodology considers that, in the baseline scenario, the same kind and proportion of fuels that are consumed following project implementation would be consumed.

CO_2 emissions from fuel combustion are determined from emission factors and lower heating values of each fuel, which are known with a high level of accuracy. There are large uncertainties in the emission factors of methane and nitrous oxide in combustion. Project or country specific values are unlikely to be available, and even IPCC sources show gaps in estimates. However, in terms of CO_2 equivalent, the emissions of methane and nitrous oxide in combustion make up a very small part of total GHG emissions, so that these uncertainties are not important.

For emissions associated with grid-connected power generation, the methodology proposed here for dealing with these emissions is the approved consolidated methodology ACM0002. ACM0002 includes multiple options for determining the emission factor for grid-connected electricity. The result is likely to be sensitive to the option chosen, but the chosen option will be subject to review by a DOE and others for appropriateness.

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.

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

Leakage calculations are likely to be small compared to other components of baseline and project emissions and country specific values are unlikely to be available, so that these uncertainties are not important and IPCC default values may be chosen for these estimates. However, in the calculation of emissions from fuel transportation, the specific energy consumption of the transportation mode is determined prior to project implementation 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.

The assumptions regarding heating values and emission factors of fuels are unchanged throughout the project. These factors should be country specific. However, where data from other sources are not available, IPCC default emission factors may be used. In any case, these factors should be listed in the PDD.

B.7. Please indicate whether quality control (QC) and quality assurance (QA) procedures are being undertaken for the items monitored:		
Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1. QF_{ij}	*Low*	*The industrial facility shall have a series of internal procedures that ensures data have low uncertainties during monitoring process. These procedures are specific for each industrial facility and shall be explained in the PDD. However, in general terms it shall be considered that fuel consumption is measured by fuel meters, level gauge, weighing balance or any other method in the industrial facility to the best accuracy possible (either manually or through DCS). The accuracy of the meter readings will be cheeked against fuel purchase receipts and inventory data.*
3. P_i	*Low*	*The industrial facility shall have a series of internal procedures that ensures data have low uncertainties during monitoring process. These procedures are specific for each industrial facility and shall be explained in the PDD. However, in general terms it shall be considered that production is measured by automatic or manual weighing balance or by flow meter in the industrial facility to the best accuracy possible (either manually or through DCS). The accuracy of the meter readings will be cheeked against sale records and inventory data.*
7. NES_{fik}	*Low*	*The industrial facility shall have a series of internal procedures that ensures data have low uncertainties during monitoring process. These procedures are specific for each industrial facility and shall be explained in the PDD. However, in general terms it shall be considered that electricity purchase and electricity sale are measured by electricity recording meters in the industrial facility to the best accuracy possible (either manually or through DCS). The accuracy of the meter readings for electricity purchased will be cheeked against purchase receipts, and the accuracy of the meter readings for the electricity sold will be cheeked against sales record to the grid and other records are used to ensure the consistency.*

All variables related with calculation of emission factors of the grid using the methodology proposed in the ACM0002, are publicly available official data. Default data (for emission factors) and IEA statistics (for energy data) are used to check the local data.

Measurements in the levels of fuel consumption as well as electricity purchase and sale, in order to determine the decrease in energetic intake after the project implementation, shall be made by the correspondent departments of the industrial facility.

All of the measured instruments will be subject to maintenance and monthly calibration following appropriate industry standards.

To ensure the quality of the data, the measurements shall be double-checked against commercial documents.

B.8. Has the methodology been applied successfully elsewhere and, if so, in which circumstances?

There are several methodologies that are referred by this new proposal. However, the new proposed methodology has not been applied before.

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