METHODOLOGY

BM IN02.001

Energy efficiency and fuel switching measures for industrial facilities

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Sectoral scope(s): Industries

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1. Introduction

1. This methodology is adopted and refers to the latest approved version of the UNFCCC Clean Development Mechanism Methodology AMS-II.D (as valid from 04 October 2013).

2. It shall be the responsibility of the non-obligated entity and Accredited Carbon Verification Agency (ACVA) to note of any subsequent changes or revisions in the above-mentioned methodology while developing projects and performing validation and/or verification activity respectively.

3. The following table describes the key elements of the methodology:

Table 1. Methodology key elements

Typical project(s)	Introduction of energy efficiency measures such as efficient motors, pumps, boilers etc. for specific industrial or mining and mineral production processes (such as steel furnaces, paper drying, tobacco curing, etc.) through new installation or retrofit/replacements
Type of GHG emissions mitigation action	Fuel/electricity savings through increase in energy efficiency

2. Definitions

4. For the purpose of this methodology, the following definitions apply:

(a) **Energy Carrying Medium (ECM)** - the medium carrying the energy in the form of heat or pressure. Examples of ECM include gas, air, water and steam;

(b) **Existing facilities** - existing facilities are those that have been in operation for at least three years immediately prior to the start date of the project activity.[1]

3. Scope & Applicability

3.1. Scope

5. This methodology comprises any energy efficiency improvement measures implemented at a single or several industrial or mining and mineral production facilities. The project activities may involve:

Process energy efficiency improvement(s) affecting either a single production step/element process[2] (e.g. furnace, kiln) or a series of production steps/element processes (e.g. industrial process involving many machines) that transform(s) raw

[1] The definition of start date is applicable as defined in the “Detailed Procedure for Offset Mechanism”.

[2] An element process is a process, with associated equipment, in which an energy source (e.g. fuel, electricity, steam) is used for production purposes to convert raw materials into intermediate or finished product using thermal energy.

materials (e.g. feedstocks) and other inputs into either intermediate forms or final finished outputs (e.g. molten metal, tiles, steel ingots);

Energy efficiency improvement in energy conversion equipment (e.g. boiler, motor) that supplies energy (thermal/electrical/mechanical) within a facility.

6. Fuel switching may also result in energy efficiency improvements. Fuel switching measures that are an integral part of energy efficiency measures may be part of a project activity included in this project category (e.g. switching from steam or compressed air to electricity).

7. Project activities involving fuel switching and energy efficiency improvements may use the applicable methodology “BM IN02.001: Energy efficiency and fuel switching measures for industrial facilities” provided that the emissions reductions associated with each project are conservatively determined and that interactive effects between the efficiency and fuel switching actions are accounted for such that no double counting of emission reductions occurs. The approach shall be sufficiently explained in the PDD.[3]

8. Retrofit/replacement as well as new construction (Greenfield) projects are included under this methodology.

3.2. Applicability

9. This category is applicable to project activities where it is possible to directly measure and record the energy use of the project activity within the project boundary (e.g. electricity and/or fossil fuel consumption and/or the energy contained in the energy carrying medium (ECM) such as steam, hot water, compressed air, etc.) and the quantities of such ECMs utilized in the project boundary. The ‘direct measurement’ in the case of thermal energies (fossil fuel, steam/heat consumption) does not have to involve the metering of energy itself but corresponding parameters such as quantity of fossil fuel consumed, temperature/pressure and quantity amount of steam. The energy flow then can be determined using acceptable engineering methods outlined in recognized national or international standards in an accurate or conservative manner for example ASME PTC 4-1998[4] or BS845[5] can be used to determine thermal energy output of a baseline boiler from actual measured baseline data for steam flow, pressure and temperature.

10. This category is applicable to project activities where the impact of the measures implemented (improvements in energy efficiency) by the project activity can be clearly accounted for and documented as well as distinguished from changes in energy use due to other independent variables not influenced by the project activity (signal to noise ratio). Examples of other variables include upstream/downstream process factors, feedstock and

[3] As an example to avoid double counting would be that the efficiency savings are calculated ‘first’ and savings are based on emissions of project low carbon fuels. The fuel switch savings are then calculated ‘second’ and savings are based on energy consumption after efficiency project. For example, the efficiency emission reductions are based on going from 100 units of consumed energy to 90 with low carbon fossil fuel and the fuel switch emission reductions are based on 90 units of consumed energy going from high carbon to low carbon fossil fuel.

[4] American Society of Mechanical Engineers Performance Test Codes for Steam Generators: ASMEPTC 4 – 1998; Fired Steam Generators.

[5] British Standard Methods for Assessing the Thermal Performance of Boilers for Steam, Hot Water and High Temperature Heat Transfer Fluids.

product characteristics, and environmental parameters (e.g. ambient temperature, humidity) associated with the baseline or project activity that may influence the energy savings from the project activity.

11. In the case where the independent variables mentioned above may have an impact on emissions reduction greater than approximately five per cent of the total annual emission reduction, then (a) the project boundary shall be extended to cover all such processes that influence the energy savings from project activity; and (b) such independent variables shall be monitored and taken into account in the emissions reduction calculations. Documentation of an assessment of all variables that may be reasonably expected to potentially affect emission reductions calculations shall be included in the project design document.

12. The output (e.g. steam/heat) and product(s) (e.g. ceramic insulators, tiles, steel ingots, aluminium cookware) produced in the industrial facility throughout the crediting period shall be equivalent to the product(s) produced in the baseline.

13. For the purposes of this methodology, equivalent products are defined as output or products having the same use, the same general physical properties, and which function in a similar manner. Product(s) produced in the industrial facility throughout the crediting period shall provide the same, or a better, level of service and be of the same level of quality, or better than the product(s) produced in the baseline. When national or international product standards apply to the product(s), product quality shall be as defined in such standards, otherwise the relevant industrial norms are to be followed.

14. In cases where product output (e.g. hot/fused metal) cannot be measured, the input material (i.e. feedstock) quantities used in the element process can be used as a proxy for determining baseline/project emissions. However, in such cases that input materials are used as a proxy for product output, potential differences in product output characteristics/quality shall be accounted for in the calculation procedures. The calculation procedures shall be sufficiently explained in the PDD (e.g. assumptions, justifications, etc.)

15. The type of input materials used in the project shall be homogeneous and similar to the input material that was used in the baseline and any deviation during the crediting period of input material type, composition, or amount used per unit of product output shall be within the range that does not cause a change in energy consumption per unit of output beyond ±10 per cent of the baseline characteristics and values

16. The project activity that aims to achieve energy savings through improved maintenance practices, for example through cleaning of filters, repairing valves, correcting system leaks, and using new equipment lubricants, are not covered under this methodology.

17. If the energy-efficient equipment contains refrigerants, then the refrigerant used in the project case shall have no ozone depleting potential (ODP). While this methodology does not provide any credits for reductions in emissions associated with refrigerant reductions or changes, the calculation of project emissions shall include any incremental increases in GHG emissions, as compared to the baseline, associated with refrigerants used in the project equipment.

3.3. Entry into force

18. The date of adoption of this document shall be effective from 27 March 2025.

3.4. Applicability of sectoral scopes

19. For validation and verification of ICM projects and by a designated ACVA using this methodology, application of sectoral scope "*02: Industries"* is mandatory.

3.5. Applicability of approved adopted tools

20. This methodology also refers to the latest approved versions of the following tools, methodologies and standards:

(a) "BM-T-001: Combined tool to identify the baseline scenario and demonstrate additionality" (hereinafter referred to as BM-T-001);

(b) "BM-T-002: Tool to calculate project or leakage CO2 emissions from fossil fuel combustion (hereinafter referred to as BM-T-002);

(c) "BM-T-003: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (hereinafter referred to as BM-T-003);

(d) "BM-T-006: Tool to determine baseline efficiency of thermal and electricity systems (hereinafter referred to as BM-T-006);

4. Methodology: Baseline Component

4.1. Project boundary

21. The project boundary is the physical, geographical site of the industrial or mining and mineral production facility(ies), including all processes and equipment that are affected by the project activity. The material (feedstock) and/or energy input to and output from the project boundary shall be transparently defined in the PDD. For example if the ECM is used or generated by the project activity, the facilities which produce or consume the ECM should be included in the project boundary.

4.2. Additionality

22. The additionality for the project activity shall be determined in accordance with BM-T-001.

4.3. Baseline scenario

23. In the case of replacement, modification or retrofit measures, the baseline consists of the energy consumption (or energy consumption per unit of production) that would have occurred in the absence of the project activity for the existing facility or sub-system that is replaced, modified or retrofitted. In the case of project activities involving several facilities, the baseline needs to be established separately for each facility. In the case of project activities involving multiple energy efficiency measures at individual facilities, the interaction between the measures should be taken into consideration when establishing the baseline.

24. For new facilities and project activities involving capacity additions the energy baseline consists of: (a) the industrial or mining and mineral production facility(ies) that would have

been built in the absence of the project activity and/or (b) the particular process that would have been built with the facility in the absence of the project activity. The most plausible baseline scenario for the project activity shall be evaluated based on one of the following:

(a) Related and relevant requirements in the “Detailed Procedure for Offset Mechanism under CCTS”;

(b) Reference plant approach as described below:

(i) The Reference plant (technology and fuel type) shall be based on common practice for similar project systems/equipment and fuel sources in the same sector and in the same country or region as the project. The identification of the reference plant shall exclude plants implemented as ICM project activities. In cases where no such plant exists within the region, the economically most attractive technology and fuel type should be identified among those which provide the same service (i.e. thermal energy, manufacturing product) comparable with the proposed ICM project activity, technologically available and in compliance with relevant regulations. The non-obligated entity may exclude scenarios that are not in compliance with legal and regulatory requirements;

(ii) A clear description of each available technology and fuel type, such as efficiency and technical lifetime, shall be provided in the ICM-PDD. The efficiency of the technology should be selected in a conservative manner (i.e. where several technologies could be used and are similarly economically attractive, the most efficient technology should be defined as the baseline scenario). In addition, the least carbon intensive fuel type should be chosen in case of multiple fuels being possible choices;

(iii) If one or more scenarios are excluded, an appropriate explanation and documentation to support the exclusion of such scenario shall be provided.

4.4. Baseline emissions calculations

25. For project activities implemented in existing facilities, baseline determination shall be based on relevant operational data for existing system/equipment (assuming that the continuation of current practice is demonstrated to be the baseline scenario) for the immediately prior three years to the start date of the project activity (or the start date of validation with due justification). The data under abnormal operations shall be excluded with due justifications. Abnormal operations shall refer to the periods of shutdown due to repairs, routine maintenance, or specific testing. These shall be defined by the non-obligated entity in the PDD. For project activities with estimated annual average energy savings less than or equal to 600 MWh, a minimum of one year’s worth of data are sufficient.

26. For existing facilities having no historical data/information (i.e. less than three years or in the case of micro-scale less than one year) on baseline parameters or for new construction/capacity addition, the baseline parameters shall be determined using baseline measurement campaign or based on manufacturers specifications or based on the actual performance data of baseline plants that are in operation in the country/region as described below:

(a) A baseline measurement campaign shall be carried out (before or in parallel with the project implementation) on the baseline equipment/system, to establish the performance characteristics of the baseline scenario due to all the identified parameters (independent variables) that will have an effect on the performance of the equipment. The baseline measurement campaign would be conducted for a period of time sufficient to capture the range of the independent variables expected to be, or actually, encountered during the crediting period. The non-obligated entity may also follow the relevant provisions of BM-T-006, where applicable;

(b) Conservative baseline parameters based on performance data provided by two or more manufacturers for the baseline equipment (scenario) that would have been implemented in the absence of the ICM project activity (e.g., the lowest specific energy consumption (kWh/ton) full load performance value provided by two or more manufacturers);

(c) The weighted average performance data based on the most recent available data of baseline existing plants producing the same/similar output as the project facilities in the appropriate geographical region (i.e. host country as default).

27. For project activities involving retrofit/replacement/modification the emissions reductions accrue only up to the estimated remaining lifetime of the baseline equipment (i.e. the time when the affected baseline system/equipment would have been replaced in the absence of the project activity). From that point of time onwards, the baseline scenario is assumed to correspond to the project activity, and baseline emissions (BE) are assumed to equal project emissions (PE) and no emission reductions are assumed to occur.

$$EC_{BL} = EC_{HY} \text{ until } DATE_{BaselineRetrofit}$$

$$EC_{BL} = EC_{PJ,\,y} \text{ on/after } DATE_{BaselineRetrofit}$$

28. The following options shall be used to calculate baseline emissions using baseline data obtained from paragraph 25 or 26 above as applicable:

Option 1: Constant load device(s);

Option 2: Variable load device(s);

Option 3: Production efficiency/specific energy consumption (for partial or entire production process).

BE_y = Baseline emissions during year *y* of the project activity (t CO_2e/year)

EC_i = The amount of electricity consumption by baseline device *i* or process*i*(MWh)

$EF_{E,i}$ = Emission factor of the electricity consumption by baseline device type *I* or process *i* (t CO_2e/MWh). For captive plant(s), it is calculated in accordance with the “Tool to calculate project or leakage CO_2 emissions from electricity consumption"

i = Device *i* or process *i* which consume electricity with constant load in baseline scenario

n = Number of device or processes which consumes electricity in baseline scenario

$FC_{j,k}$ = The volume of the baseline fossil fuel type k consumed by baseline device *j* (Nm3 or tonnes)

NCV_k = The net calorific value of the baseline fossil fuel type *k* (TJ/Nm3 or TJ/tonnes)

$EF_{FF,k}$ = Emission factor of the baseline fossil fuel type *k* (t CO_2e/TJ)

j = Device *j* which consumes fossil fuel in baseline

k = Baseline fossil fuel type *k*

m = Number of devices which consumes fossil fuel in baseline

p = Number of types of the fossil fuel

ECM_l = Flow rate of energy carrying medium (*ECM*) consumed by baseline devices (tonne). For those *ECM* produced by a facility which is included in the project boundary, ECM_i equals zero, if the fossil fuel energy consumption to produce ECM_i has already been taken into account to estimate baseline emissions

$H_{in,l}$ = Enthalpy of the inflow energy carrying medium to the equipment (TJ/tonne)

$H_{out,l}$ = Enthalpy of the outflow energy carrying medium to the equipment (TJ/tonne). If the *ECM* is compressed air the units may be TJ/m^3

$EF_{ECM,l}$ = Emission factor of the *ECM* for equipment *L* or process *L*, t CO_2/TJ

$$\frac{3L,FF}{3L}$$ Equation (1)

Where:

$EF_{BL,FF}$ = Emission factor of baseline fossil fuel that is used to generate *ECM*. It is obtained from reliable local or national data if available; alternatively, IPCC default emission factors can be used (t CO_2/TJ)

BL = Efficiency of baseline -device generating *ECM* as determined using the procedure described in the section below

l = Device or process which consumes *ECM* in baseline scenario

q = Number of devices or processes consuming *ECM* in baseline scenario

$Q_{ref,BL}$ = Average annual quantity of refrigerant used in the baseline to replace the refrigerant that has leaked (tonnes/year). Only applies to projects that replace equipment containing ODP refrigerants. Values from Chapter 7: Emissions of Fluorinated Substitutes for Ozone Depleting Substances, Volume 3, Industrial Processes and Product Use, 2006 IPCC Guidelines for National Greenhouse Gas Inventories may be used

$GWP_{ref,BL}$ = Global Warming Potential of the baseline refrigerant (t CO_2e/t refrigerant), as obtained from the latest IPCC Assessment Report.

29. For all of the options the baseline shall be defined in a way that CCCs cannot be earned for decreases in activity levels outside the project activity or due to force majeure.

4.4.1. Option 1: Constant load device(s)

30. The constant load condition shall be demonstrated by monitoring or using the historical records of energy consumption data for at least one-year period prior to the project implementation. The data recording interval is at least daily (i.e. a minimum of 365 data points). Data are considered to demonstrate a constant rate of energy consumption if 90 per cent of the energy consumption values are within ±10 per cent of the annual mean.

31. The baseline emissions ex ante are calculated as follows:

$$BE_y = \sum_{i=1}^{n} EC_i \times EF_{E,i} + \sum_{j=1}^{m}\sum_{k=1}^{p} FC_{j,k} \times NCV_k \times EF_{FF,k} + \sum_{l=1}^{q} [ECM_l \times (H_{in,l} - H_{out,l})] \times EF_{ECM,l} + Q_{ref,BL} \times GWP_{ref,BL}$$ Equation (2)

Where:

32. See example 1 to illustrate project applying option 1 in the appendix of this document.

33. Efficiency of the baseline equipment shall be determined by using one of the following:

Highest measured operational efficiency over the full range of operating conditions of a unit with similar specifications, using baseline fuel. The efficiency tests shall be conducted following the guidance provided in relevant national/international standards;

Highest of the efficiency values provided by two or more manufacturers for units with similar specifications, using the baseline fuel;

The default values where applicable using option E of BM-T-006.

4.4.2. Option 2: Variable load device(s)

34. This option applies to baseline equipment (scenario) for which the rate of energy consumption varies in response to independent variable(s) such as and quantity, type, and/or quality of final finished output. A mathematical function is developed, using regression techniques, to determine baseline energy consumption as a function of the relevant independent variable(s). The independent variables are measured during the crediting period and used in the regression function to predict baseline energy consumption throughout the crediting period.

35. Baseline emission calculation will apply the same equation (1) used for constant load devices, however, the EC_i, FC_j and ECM_l will be functions of relevant independent variable(s) associated with device *i, j* and *l*. The relationship between the E_i, FF_j, ECM_l and the independent variable(s) are established by regression analysis.

$$EC_i = f(P_i, X_1, X_2, \ldots X_n) + \varepsilon 1$$

$$FC_j = g(P_j, Y_1, Y_2, \ldots Y_n) + \varepsilon 2$$

$$ECM_l = h(P_l, Z_1, Z_2, \ldots Z_n) + \varepsilon 3$$

36. The data for the analysis used to develop the mathematical function must cover a period of 12 continuous months or at least a period of time sufficient to cover the full range of actual and expected operating conditions and independent variables. The data measurement interval will depend on the application but is typically 0.25 to 1.0 hour in length.

37. In order to utilize the regression model to determine emission reductions, the t-test associated with relevant independent variables that have a physical influence on energy use has to be at least 1.645 for a 90 per cent confidence. The regression model must be documented with a complete report indicating at least who completed the regression analyses, when it was completed, key assumptions, how the independent variables were selected and basis for including these variables and rejecting others, the regression results, the survey instrument(s), final sample results, and predicted baseline energy consumption with respect to key variables.

38. See example 2 to illustrate project applying option 2 in the appendix of this document.

4.4.3. Option 3: Production efficiency/specific energy consumption (for partial or entire production process)

39. The energy efficiency measures under this option aim to cover overall efficiency improvement of partial or entire production process. The non-obligated entity may establish the average specific energy consumption (production efficiency) for the partial or entire production process included in the project boundary instead of establishing the baseline emissions for each of the devices and/or processes involved.

40. This option is only applicable if it can be conservatively shown that baseline energy use and emissions are only a function of finished product production rates (e.g. number of finished products produced per year or batch) and that the baseline energy use and emissions per unit of production does not vary from an average value by more than +/-10 per cent.

41. The baseline is calculated by using energy consumption per unit of output (specific energy consumption/production efficiency) in the baseline multiplied by the output in project year *y* multiplied by the emission factor for the energy displaced.

42. The baseline emissions are calculated as follows:

$$BE_y = \sum_i \frac{SEC_i \times P_{PJ,i,y}}{(1 - l_y)} \times EF_{CO_2,y} + Q_{ref,BL} \times GWP_{ref,BL}$$ Equation (2)

Where:

SEC_i	=	Specific energy consumption per unit production output in the baseline (MWh/unit/year) for equipment group *i* as calculated using paragraph 44 below. A group is a collection of devices sharing similar sizes, functions, schedules, outputs or loads
$P_{PJ,i,y}$	=	Total quantity of output (e.g. flow rate of a pump, mass flow rate of beverage produced, number of tiles, tonnes of clinker) in project year y for equipment in group *i* in units of weight or volume, kg or m3. In the event that project output in year *y* is greater than the average historical output[6] and the demonstration of the baseline for the incremental capacity is not undertaken, the value of the output in year *y* is capped at the value of the historical average output level. For example, if $P'_{PJ,i,y}$ is the total amount of product produced by the project element process in year *y* (uncapped), then $P'_{PJ,i,y} = P_{PJ,i,y}$ for $P_{PJ,i,y}$ <PHy , and $P_{PJ,i,y} = P_{Hy}$ for $P_{PJ,i,y} > P_{Hy}$. In the case where production output of element process cannot be measured, the quantity of input material (feedstock) used in the element process can be used as a proxy
l_y	=	Applies only in the case of grid electricity savings. Average annual technical grid losses (transmission and distribution) during year *y* for the grid serving the locations where the devices are installed, expressed as a fraction. This value shall not include non-technical losses such as commercial losses (e.g. theft). The average annual technical grid losses shall be determined using recent, accurate and reliable data available for the host country. This value can be determined from recent data published either by a national utility or an official governmental body. The reliability of the data used (e.g. appropriateness, accuracy/uncertainty, especially exclusion of non-technical grid losses) shall be established and documented by the non-obligated entity . A default value of 0.1 shall be used for average annual technical grid losses, if no recent data are available or the data cannot be regarded accurate and reliable

43. For project activities that involve replacing, modifying or retrofitting systems in existing facilities, the average specific energy consumption can be calculated ex ante as follows:

Equation (3)

$$SEC_{BL} = \left(\sum EC_{BL,i,j} + \sum_{i,j} FC_{BL,i,j} \times NCV_{CO_2,j} \right) \div P_{Hy}$$

[6] A maximum of ±10 per cent variation is permitted.

Where:

$EC_{BL,i,j}$	=	Average annual baseline electricity consumption value in the process *I* (MWh)
$FC_{BL,i,j}$	=	Average annual baseline fossil fuel consumption value for fuel type *j* combusted in the process *i*, using volume or weight units[7]
$NCV_{CO_2,j}$	=	Average net calorific value of fuel type *j* combusted, MWh per unit volume or mass unit
P_{Hy}	=	Average annual quantity of output in baseline in units of weight or volume, kg or m^3

44. For new facilities and project activities involving capacity additions, annual specific energy consumption of baseline equipment (scenario) can be determined using one of the options below (in preferential order):

The lowest *SEC* full load performance value provided by two or more manufacturers;

The weighted average SEC values of baseline existing plants producing the same/similar output as the project facilities in the appropriate geographical region (i.e. host country as default).

45. See example 3 to illustrate project applying option 3 in the appendix of this document.

4.5. Project emissions

46. Project emissions are equal to:

The emissions associated with consumption of fossil fuel, electricity and *ECM* within the project boundary by the project systems;

The emissions associated with any refrigerants used in new project cooling equipment (e.g. electrical compression chillers).

47. Project emissions in year *y* is calculated as follows:

$$PE_y = PE_{El,y} + PE_{FF,y} + PE_{ECm,y} + PE_{ref,y} \qquad \text{Equation (4)}$$

Where:

PE_y	=	Project emissions in year *y* (t CO_2e)
$PE_{El,y}$	=	Project emissions due to electricity consumption and shall be estimated following the latest version of BM-T-003
$PE_{FF,y}$	=	Project emissions due to fossil fuel and shall be estimated following the latest version of “BM-T-002
$PE_{ECm,y}$	=	Project emissions due to consumption of ECM in year *y* (t CO_2e/y) as determined using paragraph 47/equation 5 below

7 Volume or weight units will be used depending on which best defines the fuel consumption requirements of the brick making process(es).

$PE_{ref,y}$ = Project emissions from physical leakage of refrigerant from the project equipment in year y (t CO_2e/y) as determined using paragraph 50/equation 6 below

48. $PE_{ECM,y}$ is calculated as follows:

Equation (5)

$$PE_{ECM,y} = \sum_{i=1}^{n} \left[ECM_{PJ,i,y} \times \left(H_{in,i,y} - H_{out,i,y}\right)\right] \times EF_{ECM,i}$$

Where:

$ECM_{PJ,i,y}$ = Flow rate of energy carrying medium (ECM) consumed by project device *i* (tonne)

ECM_i equals zero, if the fossil fuel energy consumption to produce *ECM_i* has already been taken into account to estimate project emissions as $PE_{FF,y}$.

$H_{in,i,y}$ = Enthalpy of the inflow energy carrying medium to the equipment *i* in year *y* (TJ/tonne)

$H_{out,i,y}$ = Enthalpy of the outflow energy carrying medium to the equipment *i* in year *y* (TJ/tonne)

$EF_{ECM,i}$ = Emission factor of the *ECM* for equipment *i* or process *i*, t CO_2/TJ

$$EF_{ECM,l} = \frac{EF_{PJ,FF}}{PJ}$$

Where:

$EF_{PJ,FF}$ = Emission factor of project fossil fuel that is used to generate *ECM*. It is obtained from reliable local or national data if available; alternatively, IPCC default emission factors can be used (t CO_2/MWh)

PJ = Efficiency of project equipment generating *ECM*. The project proponent may follow the relevant provisions from BM-T-006 to determine efficiency of project equipment as applicable

i = Equipment or process *i* which consumes *ECM* in project scenario

n = Number of equipment or processes consuming *ECM* in project scenario

49. Project emissions from physical leakage of refrigerants should be accounted for, along with any other greenhouse gas leakages that may occur due to the implementation of the project activity. All greenhouse gases as defined per the latest IPCC Assessment Reports shall be considered.

50. $PE_{ref,y}$ is calculated as follows:

$$PE_{ref,y} = \left(Q_{ref,PJ,y}\right) \times GWP_{ref,PJ}$$ Equation (6)

Where:

$PE_{ref,y}$	=	Project emissions from physical leakage of refrigerant from the project equipment in year *y* (t CO_2e/y)
$Q_{ref,PJ,y}$	=	Average annual quantity of refrigerant used in year *y* to replace refrigerant that has leaked in year *y* (tonnes/year). Values from Chapter 7: Emissions of Fluorinated Substitutes for Ozone Depleting Substances, Volume 3, Industrial Processes and Product Use, 2006 IPCC Guidelines for National Greenhouse Gas Inventories may be used
$GWP_{ref,PJ}$	=	Global Warming Potential of the refrigerant that is used in the project equipment (t CO_2e/t refrigerant)

4.6. Leakage

51. If the energy efficiency technology is equipment transferred from another activity, such that emissions increase in the other facility on account of a new equipment and the use of energy/fuel, leakage is to be considered.

4.7. Emission reduction

52. The emission reduction achieved by the project activity shall be determined as the difference between the baseline emissions and the project emissions and leakage.

$$ER_y = \left(BE_y - PE_y\right) - LE_y$$ Equation (7)

Where:

ER_y	=	Emission reductions in year *y* (t CO_2e)
LE_y	=	Leakage emissions in year *y* (t CO_2e)

5. Methodology: Monitoring Component

5.1. Parameters those are required at Validation (ex-ante)

53. Documenting of the technical specification of the equipment/systems displaced or equipment/systems that would otherwise have been built.

5.2. Parameters that are monitored (ex post)

54. The applicable requirements specified in the “Detailed Procedure for Offset Mechanism under CCTS ” (e.g. calibration requirements, sampling requirements) are also an integral part of the monitoring guidelines specified below and therefore shall be referred by the non-obligated entity.

55. For projects using option 1 and 2 with constant/variable load characteristics, the monitoring shall consist of metering the energy use of the project system/equipment installed.

56. For projects using option 2 where regression function is applied, the independent variables shall be monitored during the crediting period that are and used in the regression function to determine baseline energy consumption in the crediting period.

57. For projects using option 3 the monitoring shall consist of metering the energy use of element process and annual average production output. In case the output parameter cannot be measured, the quantity of input material (feedstock) used in the element process can be used as a proxy if the conditions indicated in paragraph 11 and 12 are met.

58. For projects using any of the options:

Those external variables that have an impact on emissions reduction greater than (five per cent of total annual emission reduction) shall be monitored and comply with the applicability condition (see paragraph 7 and 8);

Where applicable, *ECM* (its flow and energy density) shall be monitored continuously;

The energy consumption of each element process (included in the project boundary) need not be monitored separately if the performance data (input/output) is determined based on the overall production process covering series of element processes;

In the case of project activities involving several facilities, the monitoring procedure as described above shall apply for each facility.

Appendix 1. Examples of projects applying various options of the methodology

1. Example 1: Project using Option 1

1. An industrial pumping system is used to circulate process fluid with constant volume. Hours of operation vary seasonally and annually depending on production rate. The measure is to replace existing pump motors with premium efficiency units. Monitoring data collected monthly over a one-year period of the rate of energy consumption (kW) demonstrates a constant load condition; 90 per cent of records are ±10 per cent of their mean. Short-term monitoring is conducted for the period of one month and the data are used to establish the baseline demand (kW). Operating hours of the efficient motors are recorded during the crediting period and multiplied by the baseline demand to determine baseline energy use (kWh).

2. Example 2: Project using Option 2

2. A project involves a food processing facility where process cooling in the baseline is provided by distributed chilling units. The project will replace existing chillers with chilled water supplied from a new and efficient central chiller plant. The non-obligated entity will build a baseline model using regression analysis to predict annual kWh use. For this simple example all the distributed units are the same size and are sued for the exact same purpose in the exact same way and thus a single regression model can represent all units. The independent variables driving kWh use are types and amount of food processed. The equation below is the general form of the regression equation determining kWh demand for each unit:

$$kWh_i = \sum_k (b + x_1 \times t + x_2 \times q)_k \qquad \text{Equation (1)}$$

Where:

k	=	The k^{th} hour of the cooling season
b	=	Regression coefficient
x_1,x_2	=	Regression coefficients
t	=	Type of food *i* processed
q	=	Quantity of food *i* processed

3. Hourly cooling load data and energy (kWh) use for a sample distributed chiller unit were collected for 12 months. The collection period captured temperatures under peak design conditions and the lower end of the expected cooling range. Daily average kWh use per cooling load per unit was regressed against daily average production and types of production. Daily averages were used instead of hourly values because the resulting model gave a better fit to the data. Using the coefficients and types and quantity of food processed by the regression analysis during the credit period, baseline kWh use is calculated.

3. Example 3: Project using Option 3

4. A project is replacement of an inefficient cooling system within a plastics extrusion plant where chilled water is used to cool the extrusions. The cooling load and energy consumption (kWh) for the cooling equipment is established to be essentially constant by showing that the per unit production cooling energy consumption in the baseline period (e.g. kilogram of extruded plastic) does not vary more than ±10 per cent from the average per unit process cooling energy consumption during the pre-project monitoring period and it is also expected that the relatively constant cooling load will not change throughout the crediting period. In addition, the quality (physical/chemical properties) of feed stocks (i.e. plastic pellets) used in the baseline and in the project cases would not change and is based on national standards. The plant maintains accurate energy consumption records and production records including kilograms of pellets used per day. The recent three years of pellet throughput per day data and electricity consumption data for cooling were collected. The total kWh consumed over the three years is divided by the total number of kilograms of pellets used over the same period. The result is the SEC (cooling kWh/plastic kg) for the process, which is used to estimate baseline emissions (using equation (2)).

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Revision/Changes in the Document

Version	*Date*	*Description*
1.0	27 March 2025	Initial Adoption