Indicative simplified baseline and monitoring methodologies
for selected small-scale CDM project activity categories

## TYPE II - ENERGY EFFICIENCY IMPROVEMENT PROJECTS

Project participants shall take into account the general guidance to the methodologies, information on additionality, abbreviations and general guidance on leakage provided at http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html.

## *II.K. Industrial process optimisation for energy efficiency and electricity generation*

### Technology/measure

1. This methodology comprises technologies and measures to improve energy efficiency of a sub-process within an existing industrial, mining, or mineral production facility where the saved energy is utilised for the increased generation of electricity that displaces electricity from another source[1].

2. A sub-process is defined as a discrete set of operations where inputs (energy and raw material or intermediate products) are received and intermediate or end-products are produced. All of the inputs and outputs from the sub-process (both energy and materials) are quantifiable[2].

3. The methodology is applicable under the following conditions:

   (a) It is possible to measure and record all energy forms (e.g., electrical and thermal) and other inputs and outputs (e.g., raw material feedstock, products and by-products) that enter and exit the sub-process;

   (b) The sub-process in which the project activity takes place must have a homogeneous output, and its production level shall not exceed by more than 10% the average pre-project level (determined as an average of three years or all historical data, but not less than one year, prior to the operational start date of the project);

   (c) The units of production output are defined in a manner consistent with existing procedures at the project facility;

   (d) The key indicator for composition of the feedstock(s) to the sub-process does not change by more than ±10% from the pre-project level. This is determined as an average of three years or all historical data, but not less than one year, prior to the operational start date of the project. The selection of key indicator shall be in a manner consistent with existing procedures at the project facility. For instance, in the aluminium digestion process, the key indicator for composition of the ore feedstock is the Total Available Alumina (TAA). If the composition of the feedstock changes beyond ±10% during a specific period, emission reductions cannot be claimed during this specific period;

[1] An example of an energy efficiency improvement in a sub-process is the implementation of double digestion process replacing single digestion process at a bauxite refinery process within an aluminium production facility.

[2] An example of a sub-process is the "digestion process" within an aluminium production facility in which aluminium ore undergoes steam treatment to extract alumina.

(e) Where the ratio of energy consumption to production output is planned to remain the same or decrease[3] for the sub-process in which the project activity takes place;

(f) The impact of the efficiency measures implemented in the project activity resulting in an incremental electricity generation is clearly distinguished from changes in energy use due to other variables not influenced by the project activity (signal to noise ratio).

4. Only emission reductions due to increased electricity generation will be credited by this methodology**.** For calculating emission reductions from energy efficiency measures, project participants may choose to apply one of the approved Type II small scale CDM methodologies, or submit a new one.

5. The aggregate energy savings of a single project may not exceed the equivalent of 60 $GWh_e$ per year. The savings shall correspond to an increase in net electricity generated from the sub-process. A total saving of 60 $GWh_e$ per year is equivalent to a maximal saving of 180 $GWh_{th}$ per year in fuel input.

**Project Boundary**

6. The project boundary is defined as the identified sub-process and energy production equipment within the sub-process of the production facility.

**Baseline**

7. In the absence of the project activity, the existing sub-process would continue to consume energy at historical average specific levels, with proportional production and energy outputs, until the time at which the industrial or mining and mineral production facility would be likely to be replaced, modified, or retrofitted in the absence of the project activity. From that point of time onwards, the baseline scenario selected is no longer accurate and no further emission reductions are assumed to occur.

8. The requirements concerning demonstration of the remaining lifetime of the replaced equipment shall be as per the procedures described in the General Guidance for SSC methodologies. If the remaining lifetime of the affected systems increases due to the project activity, the crediting period shall be limited to the estimated remaining lifetime, i.e., the time when the affected systems would have been replaced in the absence of the project activity.

9. In order to estimate the point in time when the existing equipment would need to be replaced in the absence of the project activity, project participants may follow the procedures described in the General Guidance for SSC methodologies.

10. Baseline emissions are the sum of emissions resulting from:

(a) Electricity generation from the baseline source that is replaced by incremental electricity generation by the sub-process; and

[3] In the case that this assumption does not hold true during the project activity, emissions from any specific increase in energy consumption will be considered as project emissions.

(b) The manufacture of products during year *y* of the project activity. The baseline emissions corresponding to manufacture of products will be equal or less than the project emission component, as illustrated in paragraph 20 below.

$$BE_y = (EG_{increlec,y} * EF_{increlec,y}) + (SER_{BL} * P_y) \quad \textbf{(1)}$$

Where:

$BE_y$ Baseline emissions in year *y* ($tCO_2$)

$EG_{increlec,y}$ Net incremental electricity generation attributable to efficiency measures within the sub-process (GJ)

$EF_{increlec,y}$ Emission factor for electricity displaced due to incremental electricity generation by the project activity in year *y* ($tCO_2$/GJ)

$SER_{BL}$ Baseline specific emissions ratio ($tCO_2$ per units of production)

$P_y$ Annual production output from the sub-process in the year *y* of the project activity. This is determined *ex post* by monitoring the production output of the sub-process.

11. The net incremental electricity generation, $EG_{increlec,\,y}$, is the difference between the generation within the sub-process in year *y* of the project activity, and the historical generation within the sub-process) and shall be calculated as follows:

$$EG_{increlec,y} = EG_{PJ,y} - EG_{H,y} \quad \textbf{(2)}$$

Where:

$EG_{PJ,y}$ Net electricity generated within the sub-process in year *y* of the project activity (GJ)

$EG_{Hy}$ Net electricity generated within the sub-process, determined as an average of three years or all historical data, but not less than one year, prior to the implementation of the project activity (GJ)

12. The baseline emission factor, $EF_{increlec,y}$, shall be calculated as the weighted average of all relevant electricity sources (i.e., captive or cogeneration electricity generation and grid electricity imports), as per the procedure described in the recent versions of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption".

13. To ensure that the energy and GHG emissions input to the sub-process, per unit production, remain appropriately accounted for, the Specific Emission Ratio (SER) is determined based on historical plant data. The SER is the sum of $CO_2$ emissions per units of production.

14. $SER_{BL}$ is determined as the average $CO_2$ emissions per unit of production of the sub-process, and is determined based on the average of historical data comprising three years, where available, but not less than one year prior to the operational start date of the project. This value includes each energy input *i* to the project boundary, e.g., thermal or electrical energy, which are considered according to the specific Energy Consumption Ratios (ECR). The ECR is the ratio of energy consumption per unit of production of the sub-process. $ECR_{BL,i}$ is determined for each energy form *i* consumed by the sub-process (i.e., thermal or electrical energy).

$$SER_{BL} = \sum_i ECR_{BL,i} * EF_{BL,i} \qquad \textbf{(3)}$$

Where:

| | |
|---|---|
| $SER_{BL}$ | Specific emissions ratio of the sub-process prior to project implementation ($tCO_2$ per units of production) |
| $ECR_{BL,i}$ | Specific energy consumption ratio: Input energy form *i* consumed per unit of production from the identified sub-process (GJ per units of production) |
| $EF_{BL,i}$ | Baseline emission factor for the $i^{th}$ energy form ($tCO_2$/GJ) |

15. For steam consumption, the baseline emission factor shall be calculated as follows:

$$EF_{BL,steam} = EF_{BL,FF} / \eta_{BL,boiler} \qquad \textbf{(4)}$$

Where:

| | |
|---|---|
| $EF_{BL,steam}$ | Steam emission factor ($tCO_2$/GJ) |
| $EF_{BL,FF}$ | Baseline emission factor of fossil fuel used by steam boilers for the baseline sub-process. In the case where more than one fossil fuel(s) are used by boilers, the lowest emission factor among the identified fuels shall be used for conservativeness ($tCO_2$/GJ) |
| $\eta_{BL,boiler}$ | Weighted average boiler efficiency used to generate steam for the baseline sub-process (%) |

16. The emission factor for each fossil fuel type shall be determined based on measurements or use accurate and reliable local or national data. In the case where country or project specific data are not available or difficult to obtain, IPCC default values shall be used.

17. For determination of boiler efficiency, use either of the following:

(a) The monitored performance of the existing unit;

(b) Manufacturer's information on the efficiency;

(c) Default efficiency value from the most recent version of AM0058.

**Project activity emissions**

18. Project emissions may occur in cases where the specific emissions ratio increases as a result of the project activity.

19. Project emissions during year *y* are determined based on the specific emissions ratio multiplied by the production in year *y*:

$$PE_y = SER_{PJ,y} * P_y \qquad \textbf{(5)}$$

Where:

$SER_{PJ,y}$ Specific emissions ratio per unit of production ($tCO_2$ per units of production) of the project sub-process in year *y*

20. The Specific Emission Ratio of the project in year *y*, $SER_{PJ,y}$, is determined as the sum, for each energy form consumed within the project boundary (e.g., thermal or electrical) multiplied by its respective emission factor in year *y*. As a conservative measure, $SER_{PJ,y}$ is defined as the higher emission ratio of baseline and project scenarios:

$$SER_{PJ,y} = \max\left\{SER_{BL}, \sum_{i}\left(ECR_{PJ,i,y} * EF_{PJ,i,y}\right)\right\} \quad \textbf{(6)}$$

Where:

$ECR_{PJ,i,y}$ Specific energy consumption ratio for the $i^{th}$ energy form in year *y* (GJ per unit production)

$EF_{PJ,i,y}$ Emission factor for $i^{th}$ energy form ($tCO_2$/GJ)

21. For steam consumption, the project emission factor shall be calculated, applying a method comparable to the method described in paragraph 15 above, as follows:

$$EF_{PJ,steam,y} = EF_{PJ,FF,y} / \eta_{PJ,boiler,y} \quad \textbf{(7)}$$

Where:

$EF_{PJ,steam,y}$ Project steam emission factor ($tCO_2$/GJ)

$EF_{PJ,FF,y}$ Weighted average emission factor for fossil fuel(s) used by boilers supplying steam to the project activity ($tCO_2$/GJ)

$\eta_{PJ,boiler,y}$ Weighted average boiler efficiency used to generate steam for the project activity in year *y* (%)

22. For electricity consumption, the project emission factor shall be calculated as the weighted average of all relevant electricity sources (i.e., captive or cogeneration electricity generation and grid electricity import), as per the procedure described in the recent versions of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption".

**Leakage**

23. If the energy efficient equipment is transferred from another activity, leakage from that source is to be considered.

24. Any changes in energy quality or quantity (beyond the historical range of variation) which is leaving the project boundary and could lead to an increase of emissions outside the project boundary must be accounted for as leakage emissions. For example, a change in the temperature of condensate returned to the boiler(s) may result in increased fossil fuel consumption at the boiler(s).

25. In the case of a reduction in condensate return temperature or quantity, leakage emissions may be determined as follows.

$$LE_y = \left( \frac{QC_{BL}}{P_{BL}} hc_{BL} - \frac{QC_{PJ}}{P_y} hc_{PJ} \right) * P_y * EF_{PJ,steam,y} \tag{8}$$

Where:

| | |
|---|---|
| $QC_{BL}$ | Quantity of condensate returned to the boiler(s) by the sub-process in the baseline scenario (tonne) |
| $QC_{PJ,y}$ | Quantity of condensate returned to the boiler(s) by the sub-process in the project scenario in year *y* (tonne) |
| $hc_{BL}$ | Enthalpy of condensate returned to the boiler(s) by the sub-process in the baseline (GJ/tonne) |
| $hc_{PJ,y}$ | Enthalpy of condensate returned to the boiler(s) by the sub-process in the in the project scenario in year y(GJ/tonne) |
| $P_{BL}$ | Annual production from the sub-process, determined as an average of three years or all historical data, but not less than one year, prior to the implementation the project activity (units) |
| $EF_{PJ,steam,y}$ | Emission factor of steam generation in year *y* of the project activity ($tCO_2/GJ$). This shall be estimated using the approach described in the baseline section above |

26. In the case of a reduction in steam export temperature or quantity, leakage emissions may be determined as follows.

$$LE_y = \left( \frac{QS_{BL}}{P_{BL}} hs_{BL} - \frac{QS_{PJ}}{P_y} hs_{PJ} \right) * P_y * EF_{PJ,steam,y} \tag{9}$$

Where:

| | |
|---|---|
| $QS_{BL}$ | Quantity of steam exported by the sub-process in the baseline scenario (tonne) |
| $QS_{PJ}$ | Quantity of steam exported by the sub-process in the project scenario (tonne) |
| $hs_{BL}$ | Enthalpy of steam exported by the sub-process in the baseline (GJ/tonne) |
| $hs_{PJ}$ | Enthalpy of steam exported by the sub-process in the project scenario (GJ/tonne) |

**Monitoring**

27. The production outputs crossing the project boundary are monitored (i.e., units, tonnes, $m^3$, etc.), including both products and by-products (waste products with no application can be excluded). These product values are to be monitored on a daily or batch-wise basis as appropriate and aggregated at least monthly. The production outputs are measured in a manner consistent with existing procedures at the project facility (i.e., number or mass or volume of units).

28. The composition of principal raw material input(s) to the sub-process must be monitored and not vary beyond ± 10% of historical amounts. The composition is to be monitored monthly and aggregated at least annually. For example, in the case of the "digestion" sub-process of an aluminium production facility, the key indicator on feedstock composition is the total available alumina (TAA).

29. All forms of energy crossing the project boundary are to be monitored. All energy forms are to be monitored on an hourly, daily, or batch-wise basis as appropriate and aggregated at least monthly. Specifically, the energy monitoring shall include:

(a) Measuring the amount of electricity generated by the project activity (monitored continuously and aggregated at least monthly);

(b) Monitoring steam energy (enthalpy) consumed by the project activity by measuring the mass flow, temperature, and pressure of steam consumed (monitored continuously or as per standard onsite practice and aggregated at least monthly);

(c) Measuring the other energy inputs to and outputs from the sub-process, the latter with respect to energy delivered by the sub-process to other consumers and/or sub-processes(monitored continuously or as per standard onsite practice and aggregated at least monthly);

(d) Monitoring the fossil fuel(s) type used to generate steam supplying to the sub-process (monitored monthly and aggregated at least yearly).

30. Monitoring the efficiency of the steam generators supplying steam to the sub-process. This is to be monitored annually for each boiler supplying steam to the project activity.

### Project activity under a programme of activities

31. Further guidance on leakage would be required[4] to adapt this methodology for application to project activities under a programme of activities.

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**History of the document**

| Version | Date | Nature of revision(s) |
|---|---|---|
| 01 | EB xx, Annex #<br>28 May 2009 | To be considered at EB xx. |

[4] A request for revision may be proposed in accordance with the procedures.