Draft baseline and monitoring methodology AM00XX

"Energy efficiency improvement projects: boiler rehabilitation or replacement in industrial and district heating sectors"

I. SOURCE AND APPLICABILITY

Source

This methodology is based on the project activity "Energy efficiency improvements carried out by an Energy Service Company (ESCO) in Ulaanbaatar, Mongolia to replace old boilers with new ones (the Project) ", whose baseline and monitoring methodology and project design document were prepared by Clean Energy Finance Committee, Mitsubishi UFJ Securities (MUS).

For more information regarding the proposal and its consideration by the Executive Board please refer to case NM0144-rev: "Energy efficiency improvements carried out by an Energy Services Company (ESCO) through boiler rehabilitation or replacement" on
http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

This methodology also refers to the latest version of the "Tool for the demonstration and assessment of additionality".[1]

Selected approach from paragraph 48 of the CDM modalities and procedures

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

Applicability

For the purposes of this methodology the project participant is herein defined as the owner of the boilers during the project activity period. The "owner of the boilers" may be the owner of all the sites or part of the sites where the boilers are to be installed or a third party that owns all the project boilers during the project activity period.

The methodology is applicable to project activities that results in thermal energy efficiency improvement of boilers, at multiple locations, through rehabilitation or replacement of the boilers implemented by the project participant. In case the project participant is a third party, a contractual agreement with project activity sites where the boiler(s) efficiency improvement activity are implemented will be entered into.

The following conditions apply to the methodology:

- The project activity is to rehabilitate boilers and/or the replacement of boilers with some remaining lifetime;
- The owner of the boilers implements all the rehabilitation/installation of the boilers included in the project boundary;

[1] Please refer to: < http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>

- The geographical extent of the project boundary can be clearly established;
- The project activity is limited to rehabilitation/installation of the boilers to improve efficiency and no fuel switching is undertaken within the project boundary;
- There are no enforced regulations on minimum efficiency ratings that are applicable to boiler(s) within the project boundary. The project participants shall confirm this through documented evidence, e.g. building code documents, etc. These documents shall be submitted to the DOE at the time of validation;
- The installed capacity of each baseline and respective boiler shall be determined using a performance test, which is to be conducted in accordance with well-recognized international standards, e.g. ASME PTC 4-19982;
- Only one type of fuel is used by each of the boiler included in the project boundary.

II. BASELINE METHODOLOGY

Project boundary

All project activity sites where the boilers are rehabilitated / replaced during the implementation of the project activity[3] are included in the project boundary. The geographical extent of the project boundary (e.g. town, city, etc.) shall be clearly stated in the CDM project design document (PDD). The officially accepted map (encompassing the region) shall be used to demarcate the project boundary of the project activity.

Only CO_2 is included in the project boundary for estimating the baseline and project emissions.

Table 1: Summary of gases and sources included in the project boundary and justification / explanation where gases and sources are not included.

	Source	Gas	Included?	Justification / Explanation
Baseline	Fossil fuel consumption in the boilers	CO_2	Yes	Main GHG gas emitted.
		CH_4	No	Conservative. Excluded for simplification, as the amount is expected to be very small.
		N_2O	No	Negligible.
Project Activity	Boiler fossil fuel consumption	CO_2	Yes	Main GHG gas emitted.
		CH_4	No	Negligible. Excluded for simplification, as the amount is expected to be very small.
		N_2O	No	Negligible.

[2] American Society of Mechanical Engineers Performance Test Codes for Steam Generators: ASME PTC 4 – 1998; Fired Steam Generators.
[3] The sites may be plants, factories and buildings where thermal energy is generated for internal use or for sale to surrounding customers.

Procedure for estimating lifetime of the Boiler(s)

The following approaches shall be taken into account to estimate the remaining lifetime of the boilers, i.e. the time when the existing boiler(s), replaced by the project activity, would need to be replaced in the absence of the project activity:

a) The typical average technical lifetime of the type of equipment may be determined taking into account common practices in the sector and country (e.g. based on industry surveys, statistics, technical literature, etc.);
b) The practices of the responsible company regarding replacement schedules may be evaluated and documented (e.g. based on historical replacement records for similar equipment);

The time to replacement of the existing equipment in the absence of the project activity should be chosen in a conservative manner, i.e., the earliest point in time should be chosen in cases where only a time frame can be estimated.

Procedure for the selection of the most plausible baseline scenario

The following steps shall be used to identify the baseline scenario:

Step 1. Identification of alternative scenarios to the proposed CDM project activity consistent with current laws and regulations.

Project participants shall identify all realistic and credible alternatives to the project activity that are consistent with current laws and regulations.

Alternatives include, but are not limited to, the following scenarios:

- Continuation of use of the existing boilers;
- Replacement/rehabilitation of boilers by the project participant, as defined in this methodology, to increase the efficiency and reduce fossil fuel consumption (i.e, implementation of the proposed project activity without the CDM).

In case the project participant is third party, the following scenario shall be assessed as well:

- Replacement/rehabilitation of boilers by the owners of the sites where the boilers are operated, i.e., the proposed project activity is implemented by the owners of project activity sites without the CDM benefit.

Step 2: Identify the most likely baseline scenario

The project participant shall examine each of the above candidates in order to identify the most likely baseline scenario using the Steps 2 and 3 of the latest version of the "*Tool for the demonstration and assessment of additionality*".

If project activity site(s)install a project-boiler(s) with higher capacity than the baseline-boiler(s) capacity, then for such project activity sites the most likely alternative scenario will be examined individually.

The following barriers, among others, may be considered while conducting a barrier analysis (step 3 of the "Tool for the demonstration and assessment of additionality"):

- Access to capital, needed to replace/rehabilitate boiler(s), by the owners of the project facility site;
- Access to capital by the third party to implement the proposed project activity is either constrained or expected returns are unacceptably low;
- Lack of technical expertise among the owner of the project facility site to install/operate the new boiler that may result in additional costs due to necessity to hire consultants.

Project participants shall use Step 4 of the latest version of the "*Tool for the demonstration and assessment of additionality*" to confirm that rehabilitation/replacement of boilers to improve efficiency is not a common practice in the country where the project activity is being implemented.

This baseline methodology is only applicable if the baseline scenario is "continuation of use of the existing boilers".

Additionality

Additionality shall be demonstrated using the latest approved version of the *"Tool for the demonstration and assessment of additionality"*. Guidance on its use as provided below shall be used.

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

Project participants shall consider all the evaluated alternatives while identifying the baseline scenario.

If alternative scenario 1 (i.e., continuation of use of the existing boilers) is not in compliance with mandatory laws and regulations then the proposed project activity is not additional.

Step 2: Investment analysis

The investment analysis is mandatory only if the project activity is to be implemented by a third party, as financial analysis is required to confirm the additionality of the project activity. Otherwise its use is optional.

The benchmark analysis shall be used to compare the various alternatives. The benchmark used for analysis shall represent standard returns on investment in the market, considering the specific risk of the project type, but not linked to the subjective profitability expectations or risk profile of a particular project developer. The benchmark can be derived from government bond rates, increased by a suitable risk premium to reflect private investment and/or the project type, as substantiated by an independent (financial) expert. In this particular methodology two kinds of risk premiums are added to this bond rate to arrive at a suitable benchmark value for the project activity. The first kind is the risk of private projects in general as opposed to public ones. The second kind of risk is that associated with the country and technology.

The project Internal Rate of Return (IRR) shall be estimated, as explained in the "*Tool for the demonstration and assessment of additionality",* and compared with the benchmark to assess the additionality.[4] For each alternative scenario the project IRR shall be estimated for each of the top 10

[4] Project IRR is used because there could be many different potential project developers (ESCOs).

project activity sites or the top 10% of the project activity sites, whichever has the highest number. To select this group first order the project activities site in decreasing order of the installed boiler capacity (kW_{th}) and choose project activity sites representing the top 80% of the project activity site. Then among these project activity sites order the project activity sites by the thermal efficiency improvements achieved by implementing the project activity and choose 10% or top 10 of the project activity sites. The highest IRR of all project activity sites examined shall be compared with the benchmark rate.[5]

In the case that the project involves 10 or less boilers, all boilers shall be subject to IRR analysis.

For all project activity sites where the project-boiler(s) installed is(are) of higher capacity than the one in the baseline-boiler(s), an IRR analysis shall be conducted.

Income based on thermal energy generation/salesmust be included in the IRR analysis. In case of third party this applies only if this income is received by the third party. This could be the case when the total capacity is increased due to the project. Initial expenses are equivalent to the projected cash outlay used to purchase the new boiler and other equipment required to rehabilitate/replace boilers at the selected project activity sites. The operating and maintenance costs for the project participant are equivalent to all projected expenses associated with operating the project boiler.

As a minimum, for each boiler, the IRR will be calculated based on the following data, and supporting documentation/information made available:

- Initial investment for the boiler;
- Total income;
- Total operating and maintenance costs;
- Project life.

Step 2 is mandatory for this methodology if the project activity is to be implemented by a third party.

Step 3 can be applied by the project participants to supplement step 2.

Step 3: Barrier analysis (optional)

Establish a complete list of barriers that would prevent alternative scenarios to occur in the absence of the CDM, using the guidance in Step 3 of the latest version of the "*Tool for the demonstration and assessment of additionality*". The following text supplements the list of possible barriers that could be demonstrated to prevent implementation of one or more of the alternative scenarios.

Investment barrier:

- The third party or the owners of the individual project activity site are unable to access foreign equity capital and debt in absence of CDM revenues.

[5] It is assumed that all the project activity sites not included in the group will have a lower IRR than the IRR of the project activity site which has the lower IRR among the project activity site included in the group.

Technology barrier:

- This barrier shall be considered only if the technology used is the same across all the project activity sites.

Prevailing practice barrier:

- This shall be considered only if the proposed project is first of its kind and uses state-of-the-art boiler technology, which has not been used before in the host country.

Step 4: Common practice analysis

Due to the large number of boilers within certain areas, it may not be feasible/viable to check the status of every boiler individually. In this case and if in place, local legislation regarding boiler replacement (e.g for safety policies) may be used to provide information regarding the maximum lifetime permitted for boilers. Then, such information shall be compared to the typical boiler replacement schedule in the region (using actual archived replacement schedule data /information).

The common practice assessment shall determine whether or not existing boilers should be replaced during the project activity period and when. The Control group for the common practice analysis shall be defined as plants, factories and/or buildings where thermal energy is generated for internal use or for sale to surrounding customers, excluding the projects implemented under the CDM, in the region where the project is located. The region of the control group is defined as the geographic area around the project activity that has similar legal compliance requirements as for the project activity. The thermal energy production capacity of the plants, factories and/or buildings included in the control group should represent at least 20% of the total thermal energy output of these sites in the region and should include at least 10 plants, factories and/or buildings. If the legal compliance for all provinces in the country is similar, the thermal energy production capacity of the plants, factories and/or buildings included in the control group should represent at least 20% of the total thermal energy output of these sites in the country and should include at least 10 plants, factories and/or buildings. The common practice analysis shall be undertaken using documented information on the prevailing thermal energy generation technologies in use by plants, factories and/or buildings where thermal energy is generated for internal use or for sale to surrounding customers in the region or in the country where the project is located. If such information is not readily available, a survey of these plants, factories and/or buildings shall be conducted to obtain information on thermal generation technologies. The common practice threshold shall be applied to the control group selected prior to the start of the project and at each renewal of the crediting period.

If more than 33%[6] of the control group uses improved boilers that are similar to the project activity, then the project is not additional. The designated operational entity shall verify the documented evidence for the purpose of common practice evaluation.

[6] This threshold is referenced from Everett M. Rogers, 2003, Diffusion of Innovations, Fifth Edition, Simon & Schuster Inc. This value is subject to further guidance from the CDM-EB and sets no precedent.

Baseline emissions

The following steps shall be used to estimate the baseline emissions:

Step 1 – Determine the thermal efficiency of each baseline boiler

The baseline thermal efficiency for each boiler included in the project boundary shall be determined using the following formula:

$$\eta_{BL,m,i} = \frac{EG_{BL,his,i}}{FC_{BL,his,i}} \quad \textbf{(1)}$$

Where:

$\eta_{BL,m,,i}$	=	Average baseline thermal efficiency of boiler 'i'.
$EG_{BL,his,i}$	=	Average historic thermal energy output from the baseline boiler 'i' (MJ/yr).
$FC_{BL,his,i}$	=	Average historic fossil fuel consumption from the baseline boiler 'i' (MJ/yr).

Where possible, the above calculation shall be based on historical data for the project activity site for the most recent 3 years before the implementation of the project activity. The average thermal output and fuel consumption value for the 3 years will be used in the equation. This data shall be reported in the CDM-PDD.

Total thermal output for each baseline boiler will be determined from actual measured baseline data for steam flow, pressure and temperature, using acceptable standard methods as outlined in ASME PTC 4-1998[7] or BS845[8] or other recognized national or international standard. The measurement procedure for thermal output shall be in accordance with guidance provided in the monitoring methodology. An overall uncertainty coefficient will be determined for thermal efficiency as directed in the national or international standard chosen and the efficiency adjusted upwards to compensate as per equation below.

$$\eta_{BL,i} = \eta_{BL,m,i} * u_i \quad \textbf{(1a)}$$

Where:

$\eta_{BL,i}$	=	Average baseline thermal efficiency of boiler 'i'.
$\eta_{BL,m,i}$	=	Average baseline thermal efficiency of boiler 'i' as measured using data for thermal output and fuel use as per the measurement procedures.
u_i	=	Conservativeness factor, chosen from the table 2 below, associated with the estimated uncertainty of the thermal efficiency measurement.

In the case that actual baseline data for a boiler at the project activity site is not available, the following data can be used (from highest to lowest priority):

1) Actual measurements of thermal efficiency and adjusted for conservativeness (project participants shall select (and justify) the appropriate conservativeness factor from the table 2 below). Methods

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

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

from recognized international standards shall be used to determine thermal efficiency, and uncertainty estimated (as directed in the standard). This uncertainty level shall be used to select the appropriate conservatives factor from the table. For example, an uncertainty of 40 % would mean that the project participant must multiply the baseline thermal efficiency by 1.12.

2) A conservative thermal efficiency based on other boilers in the region which are similar to that of the boiler on the project activity site (in terms of age, technology, capacity, etc.). This shall be justified using data and/or published reports. The uncertainty level in this case will be assumed to be greater than 100% unless based on assessment of the above data/information an independent expert justifies a lower level of uncertainty. The DOE is to check the credentials of the independent expert at the time of validation and also verify that there is no conflict of interest. NOTE: *This option is only valid for small boilers according to the definition provided by USEPA (output capacity below 29 MW). Large boilers are not allowed to use this option*.

Table 2. Conservativeness factors[9]

Estimated uncertainty range (%)	Assigned uncertainty band (%)	Conservativeness factor where higher values are more conservative
Less than or equal to 10	7	1.02
Greater than 10 and less than or equal to 30	20	1.06
Greater than 30 and less than or equal to 50	40	1.12
Greater than 50 and less than or equal to 100	75	1.21
Greater than 100	150	1.37

Step 2 – Calculate fossil fuel input for each baseline boiler (MJ/yr) that would have been needed in the absence of the project activity

The fossil fuel input for each boiler, included in the project boundary, in the baseline is determined using the below formula:

$$FC_{BLe,i,y} = \left(\frac{EG_{PJ,i,y}}{\eta_{BL,i}}\right) * CF_{i,y} \qquad \textbf{(2)}$$

Where:

$FC_{BLe,i,y}$ = Calculated input of fossil fuel to baseline boiler 'i' in year 'y' (MJ/yr)
$EG_{PJ,i,y}$ = Thermal energy output of project boiler 'i' in year 'y' (MJ/yr)
$CF_{i,y}$ = Activity capping factor for boiler 'i' in year 'y'.

The estimation of baseline fuel that would have been used is capped for case(s) where the thermal output of the boiler in a particular project activity site is higher than that of the boiler capacity in the baseline, as follows:

$$CF_{i,y} = \frac{EG_{BL,i}}{EG_{PJ,i,y}} \qquad \textbf{(3)}$$

[9] Annex III (pg. 24) of the following document (FCCC/SBSTA/2003/10/Add.2) Technical guidance on methodologies provides detailed guidance on the table of conservativeness factors: http://unfccc.int/resource/docs/2003/sbsta/10a02.pdf

The maximum value of CF can be 1.

The total thermal output of the project boiler is monitored *ex post* as stipulated in the monitoring methodology. An overall uncertainty coefficient will be determined for thermal output as directed in the international standard chosen in step 1 and the value adjusted upwards to compensate for uncertainty by multiplying the measured thermal output with a conservativeness factor. The conservativeness factor shall be chosen from the values provided in table 2 above.

$$EG_{PJ,i,y} = EG_{PJ,i,m,y} * utc_i$$

Where:

$EG_{Pj,I,m,y}$ = measured thermal output of the project boiler 'i' in year 'y' as per procedure provided in the monitoring methodology

utc_i = conservative factor corresponding to uncertainty in thermal output measurement of project boiler 'i' (MJ)

For the purpose of *ex-ante* emission reduction calculation in the CDM-PDD, an estimated value for thermal output based on data from the manufacturer of the project boiler should be used.

Step 3 – Calculate baseline emissions from combustion of fossil fuel in each baseline boiler (tCO2/yr)

Baseline emissions from the combustion of fossil fuel for each boiler in the baseline is determined using the below formula:

$$BE_{i,y} = FC_{BL,i,y} \cdot EF_{C,FF,i} \cdot OXID_{FF,i} \cdot 44/12 \quad \textbf{(4)}$$

Where:

$BE_{i,y}$ = Baseline emissions for fossil fuel combustion at boiler 'i' in year 'y' (tCO_2/yr)

$FC_{BL,i,y}$ = Input of fossil fuel to baseline boiler 'i' in year 'y'(MJ/yr)

$EF_{C,FF,i}$ = Emission factor for the fossil fuel used in the boiler 'i' (tC/MJ).

$OXID_{FF,i}$ = Oxidation factor for the fossil fuel used in the boiler 'i' (fraction).

44/12 = Conversion factor: carbon equivalent to CO_2 eq (ratio: molecular weight of CO_2 / molecular weight of carbon)

Step 4 – Calculated total baseline emissions from all baseline boilers (tCO2/yr)

Total baseline emissions from all baseline boilers are determined using the below formula:

$$BE_y = \sum_{i=1}^{n} BE_{i,y} \quad \textbf{(5)}$$

Where:

BE_y = Baseline emissions during the year 'y' (tCO_2/yr)

n = Number of boilers within the project boundary

Project Emissions

Project emissions are calculated as follows:

$$PE_{i,y} = FC_{PJ,i,y} \cdot NCV_i * EF_{C,FF,i} \cdot OXID_{FF,i} \cdot 44/12 \quad \textbf{(6)}$$

$PE_{i,y}$ = Emissions from fossil combustion at project boiler 'i' in year 'y' (tCO_2/yr).
$FC_{PJ,i,y}$ = Fossil fuel consumption at project boiler 'i' in year 'y' (mass of volume units/yr).
$EF_{C,FF,i}$ = Emission factor for the fossil fuel used in the project boiler 'i' (tC/MJ).
NCV_i = Net calorific boiler of fossil fuel used in the project boiler 'i' (MJ/mass or volume units)
$OXID_{FF,i}$ = Oxidation factor for the fossil fuel used in the project boiler 'i' (fraction).

Total emissions from all project boilers are determined using the below formula:

$$PE_y = \sum_{i=1}^{n} PE_{i,y} \quad \textbf{(7)}$$

Where:
PE_y = Project emissions during the year 'y' (tCO_2/yr).

Project emissions shall be determined *ex post* using monitored data for consumption of fossil fuel. Uncertainty is deemed low since strict quality control and quality assurance procedures are in place.

For the purpose of completing emission reduction calculations in the CDM-PDD, an estimated value for consumption of fossil fuels should be used, based on data from the manufacturer of the project boiler.

Leakage

No significant leakage is expected for this type of project activity, thus leakage can be ignored.

Emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad \textbf{(8)}$$

Where:
ER_y = Emission reductions during the year y (tCO_2/yr)
BE_y = Baseline emissions during the year y (tCO_2/yr)
PE_y = Project emissions during the year y (tCO_2/yr)

Changes required for methodology implementation in 2^{nd} and 3^{rd} crediting periods

This methodology is applicable for only one crediting period of up to ten years.

Data and parameters not monitored

The following data and parameters are included in this methodology but do not need to be monitored during the crediting period:

Data / Parameter:	**-**
Data unit:	kW_{th}
Description:	Installed capacity of baseline boiler(s)
Source of data:	Actual (direct) measurements
Measurement procedures (if any):	Determined on the basis of a standard performance test which is conducted in accordance to relevant international standards.
Any comment:	Used to confirm an applicability condition and second option for thermal output

Data / parameter:	$EG_{BL,i}$
Data unit:	MJ/yr
Description:	Average historic thermal energy output from the baseline boiler i.
Source of data:	Actual measurements
Measurement procedures (if any):	Heat generation is determined as the difference of the enthalpy of the steam or hot water generated by the energy production facility(s) minus the enthalpy of the feed-water, the boiler blow-down and any condensate return. The respective enthalpies should be determined based on the mass (or volume) flows, the temperature and, the pressure. Steam tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature and pressure. Recognised international standards such as BS845 or ASME PTC 4-1998 should be used. Overall uncertainty should also be determined as directed in the international standard.
Any comment:	Average determined from the most recent 3 years data.

Data / parameter:	$FC_{BL,his,i}$
Data unit:	MJ/yr
Description:	Average historic fossil fuel consumption from the baseline boiler i.
Source of data:	Actual measurements
Measurement procedures (if any):	Wherever possible, all data is to be cross-checked with fuel purchase receipts. In most cases fuel data is recorded in mass or volume units. To convert it into energy content actual measured or local data for net calorific values (NCV) of fossil fuels is to be used. If measured or local data of NCV is not available, regional data should be used, and in its absence IPCC defaults can be used from the latest version of the IPCC Guidelines for National Greenhouse Gas Inventories.
Any comment:	Average determined from the most recent 3 years data. *if possible?*

Data / parameter:	$\eta_{BL,m,i}$
Data unit:	-
Description:	Baseline (average) thermal efficiency of boiler i
Source of data:	Actual (direct) measurements
Measurement procedures (if any):	Measurements shall be taken using recognised standards. The direct method (dividing the net thermal energy generation by the energy content of fuel fired during a representative time period) should be used where possible in preference to the indirect method (determination of fuel supply or thermal energy generation and estimation of the losses). Document measurement procedures and results and manufacturer's information transparently in the CDM-PDD. Overall uncertainty should also be determined as directed in the international standard
Any comment:	This option for baseline thermal efficiency of boilers is only to be used in the absence of three years worth of historic data. Methods from recognized international standards shall be used to determine thermal efficiency, and uncertainty estimated (as directed in the standard)

III. MONITORING METHODOLOGY

Monitoring procedures

The following data will be collected by the project participant for each boiler listed in the CDM- PDD[10].

This methodology requires the monitoring of the following items to confirm applicability conditions:

- The actual installed capacity (kW_{th}) of project boiler(s) at each project activity site.

This methodology requires the monitoring of the following items to complete project activity emission calculations:

- The date at which activity commences at each site after boiler rehabilitation/installation;
- Amount of fossil fuel(s) consumed in each boiler (mass or volume/year);
- Net Calorific Value (NCV) of fossil fuel(s) used (MJ/mass or volume);
- Emission factor of the fossil fuel(s) (tC/MJ);
- Oxidation factor of fossil fuels.

This methodology requires the monitoring of the following items to complete baseline emission calculations:

- Total thermal output of the project boiler (MJ/yr) (enthalpies should be determined based on the mass (or volume) flows, the temperature and, the pressure.

Describe and specify in the CDM-PDD all monitoring procedures, including the type of measurement instrumentation used, the responsibilities for monitoring and QA/QC procedures that will be applied.

[10] All data shall be archived for a minimum of 2 years after the end of the crediting period.

Where the methodology provides different options (e.g. use of default values or on-site measurements), specify which option will be used. All meters and instruments should be calibrated regularly as per industry standards.

Data and parameters monitored

Data / Parameter:	**-**
Data unit:	kW_{th}
Description:	Installed capacity of project boiler(s).
Source of data:	Actual (direct) measurements.
Measurement procedures (if any):	Determined on the basis of a standard performance test which is conducted in accordance to relevant international standards.
Monitoring frequency:	Yearly
QA/QC procedures:	Standard performance test which is conducted according to applicable international standards. Double check using official receipts or other information from the new boiler manufacturer. Boiler inspections shall be conducted yearly according to best international practices.
Any comment:	Used to confirm the applicability condition.

Data / Parameter:	**-**
Data unit:	Date
Description:	Date of activity start
Source of data:	Recorded by project participant
Measurement procedures (if any):	Recorded as the day the newly installed / newly rehabilitated starts producing thermal energy.
Monitoring frequency:	Monthly
QA/QC procedures:	Double checked against relevant documentation
Any comment:	Data gathered monthly to establish starting date for each site

Data / Parameter:	$EG_{PJ,i,y}$ $EG_{PJ,i,m,y}$
Data unit:	MJ/yr
Description:	Thermal energy output of project boiler 'i' in year 'y'.
Source of data:	Measurements
Measurement procedures (if any):	Heat generation is determined as the difference of the enthalpy of the steam or hot water generated by the energy production facility(s) minus the enthalpy of the feed-water, the boiler blow-down and any condensate return. The respective enthalpies should be determined based on the mass (or volume) flows, the temperature and, in case of superheated steam, the pressure. Steam tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature and pressure. Recognised international standards such as BS845 or ASME PTC 4-1998, should be used.
Monitoring frequency:	Continuously, aggregated yearly
QA/QC procedures:	Flow meters should be subject to a regular maintenance and testing regime in accordance to appropriate national/international standards. Overall uncertainty should also be determined as directed in the international

	standard and the value adjusted using the conservativeness tables if necessary to estimate the thermal output to be used for estimating baseline fuel consumption.
Any comment:	-

Data / Parameter:	$FC_{PJ,i,y}$
Data unit:	MJ units/yr
Description:	Fossil fuel consumption at project boiler 'i' in year 'y'.
Source of data:	Measurements
Measurement procedures (if any):	In the case of natural gas and oil-based fuels, monitoring shall be conducted with an (industrially recognised) standard flow meter and calibration conducted according to relevant international standards. Data will be complied monthly and local data used for density if converting the units to tonnes. Coal, lignite and other solid fuels shall be recorded at the time of delivery and data aggregated monthly.
Monitoring frequency:	Recorded monthly, aggregated yearly.
QA/QC procedures:	Fossil fuel data double checked against receipt of purchase. The highest value of the two must be used. Flow meters should be subject to a regular maintenance and testing regime in accordance to appropriate /international standards.
Any comment:	-

Data / Parameter:	NCV
Data unit:	MJ/mass or volume units
Description:	Net Calorific Value of fossil fuel(s) used in the boiler.
Source of data:	Actual measured or local data is to be used. If not available, regional data should be used and, in its absence, IPCC defaults can be used from the most recent version of IPCC Guidelines for National Greenhouse Gas Inventories.
Measurement procedures (if any):	Measurements taken according to best international practices.
Monitoring frequency:	Yearly
QA/QC procedures:	If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements. Double-checked against IPCC defaults (for consistency) if data is local or regional.
Any comment:	-

Data / Parameter:	$EF_{C,FF,i}$
Data unit:	tC/MJ
Description:	Emission factor for the fossil fuel used in the boiler
Source of data:	Actual measured or local data is to be used. If not available, regional data should be used and, in its absence, IPCC defaults can be used from the most recent version of IPCC Guidelines for National Greenhouse Gas Inventories.
Measurement procedures (if any):	Measurements taken according to best international practices.
Monitoring frequency:	Yearly
QA/QC procedures:	If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements. Double-checked against IPCC defaults (for consistency) if data is local or regional.
Any comment:	-

Data / Parameter:	$OXID_{FF,i}$
Data unit:	Fraction
Description:	Oxidation factor for the fossil fuel used in the boiler.
Source of data:	Actual measured or local data is to be used. If not available, regional data should be used and, in its absence, IPCC defaults can be used from the most recent version of IPCC Guidelines for National Greenhouse Gas Inventories.
Measurement procedures (if any):	Measurements taken according to best international practices.
Monitoring frequency:	Yearly
QA/QC procedures:	If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements. Double-checked against IPCC defaults (for consistency) if data is local or regional.
Any comment:	-

Data / Parameter:	N
Data unit:	-
Description:	Number of boilers within the project boundary
Source of data:	
Measurement procedures (if any):	
Monitoring frequency:	
QA/QC procedures:	
Any comment:	-

References and any other information

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

American Society of Mechanical Engineers Performance Test Codes for Steam Generators: ASME PTC 4 – 1998; Fired Steam Generators