**Draft approved baseline and monitoring methodology AM00XX**

**"Introduction of a new primary district heating system"**

## I. SOURCE AND APPLICABILITY

**Source**

This methodology is based on the proposed new methodology NM0181-rev "Houma District Heating project, Shanxi Province, P.R.C.", prepared by COWI A/S, Energy Department, Kongens Lyngby, Denmark.

This methodology also refers to the latest approved versions of the following:
- ACM0011 "Consolidated baseline methodology for fuel switching from coal and/or petroleum fuels to natural gas in existing power plants for electricity generation"
- AM0029 "Methodology for Grid Connected Electricity Generation Plants using Natural Gas"
- AM0044 "Energy efficiency improvement projects: boiler rehabilitation or replacement in industrial and district heating sector"
- "Combined tool to identify the baseline scenario and demonstrate additionality"
- "Tool for the demonstration and assessment of additionality"
- "Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion".

For more information regarding the proposed new methodology, approved methodologies and the tools as well as their consideration by the Executive Board please refer to http://cdm.unfccc.int/goto/MPappmeth.

**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**

The methodology is applicable to project activities that introduce a new primary district heating system to supply heat to residential and commercial consumers, where the heat comes predominantly from a cogeneration plant (CHP). The project may also involve introduction of new modern heat only boilers[1].

The methodology is applicable under the following conditions:
1. The geographical extent of the project boundary can be clearly established, in terms of location of existing and new buildings connected to the district heating system, identification of boilers and sub-stations and connected secondary heating networks as well as location and interconnections of cogeneration units at the power plant.
2. The power plant, from which heat is extracted for the district heating network, must operate in accordance with the following conditions:
   - The heat is extracted from a grid-connected fossil fuel fired power plant. The heat is extracted from a turbine, i.e. the heat is not generated in a backpressure type cogeneration plant.

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[1] For project activities dealing exclusively with boilers either by means of complete replacement or retrofit or fuel switch, project proponents may resort to the approved methodology AM0056. http://cdm.unfccc.int/goto/MPappmeth.

- Only one type of fuel is used (a maximum of 1% of auxiliary fuel may be used for start-up, etc.). The same type of fossil fuel is fired in the power plant in the baseline and project scenarios.
- The project activity does not lead to the increase in the technical lifetime of the power plant and does not result in any major integrated production changes at the power plant.
- There should be no diversion of heat or steam, which was extracted prior to the start of the project activity for other purposes such as industrial production[2], to the district heating network.

3. All fossil fuel fired heat-only boiler(s) must operate according to the following conditions:
    - The heat supplied to the district heating system is only used for heating of buildings and/or hot tap water supply in the residential and/or commercial sector, but not for production processes.
    - Only one type of fuel is used in each of the boilers included in the project boundary.

The methodology does not account for the following potential emission reductions, however project activities that include any of these components are still eligible to use the methodology:
- Emission reductions resulting from the supply of hot tap water through the district heating system.
- Emission reductions resulting from the inclusion in the district heating system those areas, were in the baseline scenario heating was provided on an individual basis, e.g. by coal-fired stoves, electric appliances or boilers in individual apartments.
- Emission reductions resulting from heat supply to new residential areas, in cases where within the primary district heating system more than 50% of the annual heat production originates from heat-only boilers and less than 50% of heat comes from the power plant.
- Emission reductions resulting from a decrease in the water losses or from demand-side measures  (e.g. insulation of buildings, use of thermostatic valves, behavioral changes due to billing practices).

In addition, the applicability conditions included in the tools referred to above apply.

## II.  BASELINE METHODOLOGY

**Project boundary**

The physical delineation of the project boundary includes:
- The site of the power plant, including the cogeneration unit(s) and all interrelated production units to account for emissions resulting from changes in power generation and consumption due to the project activity;
- The heat-only boilers that supply heat to the district heating system (e.g. such as peak load boilers);
- The district heating system, including pipes, sub-stations and buildings that are or will be connected to the district heating system.

All heat supplied to final consumers should be measured at each sub-station $i$ as part of the monitoring plan.  For this purpose, each secondary district-heating network that is supplied from a sub-station should have a unique identifier.  The quantity of heat supplied to each secondary district-heating network should be measured continuously.  Figure 1 below illustrates how the project boundary is defined and where the

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[2] In such cases, project participants should provide documented evidence of the power plant supply capacity and the confirmation of the financial conditions for the energy supply to industries being independent of the project activity.

points to measure heat supplied to buildings ($Q_{j,i}$) should be located as well as heat supply to the primary network by the CHP plant and heat only boilers.
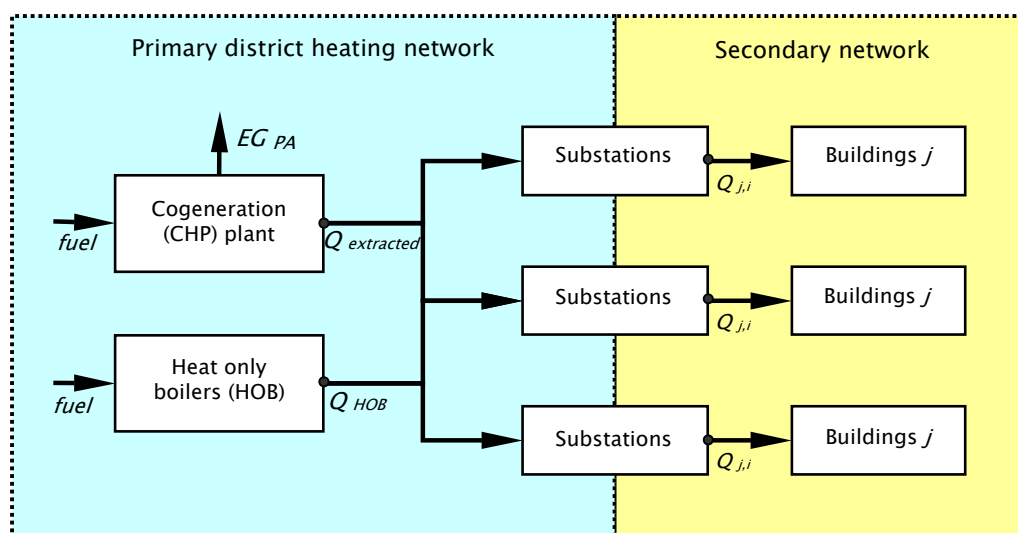


Figure 1

**Table 1: Emissions sources included in or excluded from the project boundary**

| | Source | Gas | Included? | Justification / Explanation |
|---|---|---|---|---|
| **Baseline** | Fossil fuel consumption for electricity production | $CO_2$ | Included | Major emission source. |
| | | $CH_4$ | Excluded | Excluded for simplification. This is conservative. |
| | | $N_2O$ | Excluded | Excluded for simplification. This is conservative. |
| | Fossil fuel consumption in boiler houses for heat supply | $CO_2$ | Included | Major emission source. |
| | | $CH_4$ | Excluded | Excluded for simplification. This is conservative. |
| | | $N_2O$ | Excluded | Excluded for simplification. This is conservative. |
| **Project Activity** | Fossil fuel consumption for generation of heat and electricity | $CO_2$ | Included | Major emission source. |
| | | $CH_4$ | Excluded | Minor emission source. Excluded for simplification. |
| | | $N_2O$ | Excluded | Minor emission source. Excluded for simplification. |
| | Fossil fuel consumption in heat-only boilers that supply heat to the district heating system | $CO_2$ | Included | Major emission source. |
| | | $CH_4$ | Excluded | Minor emission source. Excluded for simplification. |
| | | $N_2O$ | Excluded | Minor emission source. Excluded for simplification. |

**Identification of the baseline scenario and demonstration of additionality**

Project proponents shall determine the most plausible baseline scenario through the application of the steps prescribed by the latest approved version of the *"Combined tool to identify the baseline scenario and demonstrate additionality"*.

First of all, categories $j$ for buildings included in the project boundary should be defined on the basis of the following common attributes:

- Type of technology employed by the heating system(s), to which buildings in category $j$ would be connected in the baseline scenario;
- Fuel type used by the heating system(s), to which buildings in category $j$ would be connected in the baseline scenario;
- Type of buildings (i.e. existing or new).

For the purpose of the classification of types of buildings the following definitions apply:

- **Existing buildings**: buildings that were connected to the heating network (i.e. to an existing sub-station or a boiler house) before the start of the project activity. Recently constructed buildings (i.e. built after the start of the project activity either next to existing buildings or in place of a demolished building) that are connected to those sub-stations that, as a result of the project activity, replace old sub-stations or boiler houses should be treated as existing buildings.
- **New buildings**[3]: buildings that are constructed after the start of the implementation of the project activity and connected to new sub-stations that are built as a result of the project activity.
- **New sub-station**: refers to those sub-stations that are built in a location where no equipment for generation of heat existed before the start of the project activity. Sub-stations that were in place before the start of the implementation of the project activity or that replace existing boiler houses are to be considered **existing sub-stations**.

All identified categories $j$ should be described transparently in the CDM-PDD and the choice of categories should be justified by referring to relevant documentary evidence. This should be done on the basis of information obtained from both the responsible heat/urban planning authority and the schematic plan diagrams of the district heating system obtained at the district heating company. All buildings should be included in a filing system, and consistency of information from both sources should be crossed-check. The CDM-PDD should transparently document which buildings belong to which category $j$. Division of buildings to categories $j$ should be done as an outcome of the baseline identification procedure.

Project participants should determine the most plausible baseline scenarios separately for all buildings or sub-areas with similar characteristics as depicted above[4].

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[3] New buildings can only be included as part of the project activity if it can be demonstrated that more than 50% of the heat is supplied from the project power plant rather than from heat-only boilers (see applicability conditions).
[4] Once an accurate and clear classification of categories $j$ has been done on the basis of the baseline attributes, these categories $j$ shall be assigned to specific points of heat measurement $i$ corresponding to sub-stations introduced as result of the project activity.

**STEP 1. Identification of alternative scenarios**

*Step 1a. Define alternative scenarios to the proposed CDM project activity*

Identify all alternative scenarios that are available to the project participants and that provide outputs or services (i.e. heat supply) with comparable quality as the proposed CDM project activity i.e., all type of options that could provide heat with lower GHG intensity.  For the purpose of identifying relevant alternative scenarios, provide an overview of other technologies or practices used for generation of heat that have been implemented prior to the start of the project activity or are currently underway in the relevant geographical area.

The following baseline scenario alternatives for heat supply to buildings or sub-areas with similar caracteristics should be assessed:

1.  Introduction of a new integrated district heating system(s) connected by a new primary network:
    a)  The proposed project activity undertaken without being registered as a CDM project activity;
    b)  The introduction of a new district heating system, but with a different configuration for heat generation;
    c)  The replacement of the heat-only boilers in the existing network(s) by new heat-only boilers.
2.  Continued operation or rehabilitation of an existing disintegrated district heating network(s) (both existing and new buildings can be connected to an existing network) or establishment of a new disintegrated district heating network(s) (for new buildings) covering all buildings within the project boundary without the introduction of a primary heating network. Such disintegrated district heating network(s) employ the following technologies:
    a)  Coal fired boilers in boiler houses, supplying several buildings through a small heating network;
    b)  Natural gas fired boilers in boiler houses, supplying several buildings through a small heating network;
    c)  Oil fired boilers in boiler houses, supplying several buildings through a small heating network;
    d)  Small decentralized cogeneration plants;
    e)  Renewable energy sources, such as biomass or solar thermal collectors, connected to a small heating network.
3.  Continued use or introduction of individual heat supply solutions[5]:
    a)  Coal fired boilers for individual buildings;
    b)  Coal fired stoves for individual apartments;
    c)  Natural gas fired boilers for individual buildings;
    d)  Natural gas fired stoves for individual apartments;
    e)  Oil fired boilers for individual buildings;
    f)  Oil fired stoves for individual apartments;
    g)  Electricity (e.g. off-peak storage heating);
    h)  Individual heating devises using renewable energy sources, e.g. solar thermal collectors;
    i)  Individual heating devises using non-renewable biomass.

**Outcome of Step 1a:** List of identified realistic and credible alternative scenarios for all buildings or sub-areas.

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[5] All buildings or sub-areas, where the most likely baseline scenario is found within this category, should be excluded from the project activity.

*Step 1b. Consistency with applicable laws and regulations*

The alternatives shall be in compliance with all mandatory applicable legal and regulatory requirements, even if these laws and regulations have objectives other than GHG reductions, e.g. to mitigate local air pollution. (This sub-step does not consider national and local policies that do not have legally-binding status). If an alternative does not comply with all mandatory applicable legislation and regulations, then show that, based on an examination of current practice in the country or region in which the mandatory law or regulation applies, those applicable mandatory legal or regulatory requirements are systematically not enforced and that non-compliance with those requirements is widespread in the country. If this cannot be shown, then eliminate the alternative from further consideration.

**Outcome of Step 1b:** List of alternative scenarios to the project activity that are in compliance with mandatory legislation and regulations taking into account the enforcement in the region or country and EB decisions on national and/or sectoral policies and regulations.

*Step 2. Eliminate alternatives that face prohibitive barriers*

Scenarios that face prohibitive barriers should be eliminated by applying "Step 2 - Barrier analysis" of the latest approved version of the *"Combined tool to identify the baseline scenario and demonstrate additionality".*

→ If there is only one alternative scenario that is not prevented by any barrier, and if this alternative is not the proposed project activity undertaken without being registered as a CDM project activity, then this alternative scenario is identified as the baseline scenario.

→ If there are still several alternative scenarios remaining project participants may choose to either:
*Option 1:* go to step 3 (investment analysis[6]), or
*Option 2*: identify the alternative with the lowest emissions (i.e. the most conservative) as the baseline scenario.

*Step 3. Comparison of economic attractiveness of the remaining alternatives:*

Compare the economic attractiveness without revenues from CERs for alternatives that are remaining by applying "Step 3 - Investment analysis" of the latest approved version of the *"Combined tool to identify the baseline scenario and demonstrate additionality".*

− The economic investment analysis shall be based on the net present value (NPV) analysis, and explicitly state the following parameters:
− Investment requirements (including break-up into major equipment costs, required construction work, and installation);
− A discount rate appropriate to the country and sector (use government bond rates, increased by a suitable risk premium to reflect private investment in district heating projects, as substantiated by an independent (financial) expert);
− Efficiency of equipment, taking into account any differences between fuels;
− Current price and expected future price (variable costs) of each fuel. Estimates of the future prices have to be substantiated by a public and official publication from a governmental body or an intergovernmental institution. If such publications are not available, highlight the key logical assumptions and quantitative factors for determining the development of costs of each

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[6] If the investment analysis is carried out, then an investment comparison analysis of the alternatives should be chosen, using the levelized cost of provided heat (in USD/GJ) for each of the alternatives as the financial indicator.

fuel (e.g. international market price, transport costs, level of taxes/subsidies, local price). State clearly which assumptions and factors have significant uncertainty associated with them, and include these uncertainties in the sensitivity analysis in "Step 3 – investment analysis";
- − Operating costs for each fuel (especially, handling/treatment costs for coal);
- − Lifetime of the project, equal to the remaining lifetime of the existing electricity generation facility; and,
- − Other operation and maintenance costs, e.g. of slag and ash disposal, environmental pollution fees etc.

The net present value calculation should be done taking into account the residual value of the new equipment at the end of the lifetime of the project activity. Provide all the assumptions in the CDM-PDD.

**Outcome of step 3:** Ranking of the short list of alternative scenarios according to the NPV taking into account the results of the sensitivity analysis.
- → If the sensitivity analysis is not conclusive, identify the alternative with the lowest emissions (i.e. the most conservative).
- → If the sensitivity analysis is conclusive and confirms the result of the investment comparison analysis, then the most economically or financially attractive alternative scenario is considered as baseline scenario.

This methodology is only applicable if the identified most plausible baseline scenarios are as follows:
- • For existing buildings: continued operation or rehabilitation of an existing disintegrated district heating network(s) using fossil fuel fired boilers without the introduction of a primary heating network; and
- • For new buildings: connection of new buildings to an existing disintegrated district heating network(s) using fossil fuel fired boilers or establishment of a new disintegrated district heating network(s) using fossil fuel fired boilers without the introduction of a primary network.

**Additionality**

The following steps may be used to assess the additionality or project participants may use the latest *"Tool for the demonstration and assessment of additionality"* approved by the CDM Executive Board.

Step 1: Analysis of outcome of identification of baseline scenario procedure
1. If the proposed project activity is the only alternative amongst the ones considered by the project participants that is in compliance with all mandatory regulations, as identified by applying Step 1a of baseline scenario identification procedure described in section above, with which there is general compliance, then the proposed CDM project activity is not additional.
2. If a Barrier analysis is used to identify the baseline scenario, as described in previous section, then:
   a. If there is only one alternative scenario that is not prevented by any barrier, and if this alternative is the proposed project activity undertaken without being registered as a CDM project activity, then the project activity is not additional.
   b. If the proposed project activity undertaken without being registered as a CDM project activity is prevented by any barrier, then explain – using qualitative or quantitative arguments – how the registration of the CDM project activity will alleviate the barriers that prevent the proposed project activity from occurring in the absence of the CDM. If the CDM alleviates the identified barriers that prevent the proposed project activity from occurring, proceed to common practice analysis step, otherwise the project activity is not additional.

3. If an Investment analysis[7] step is used to identify the baseline scenario, and if the proposed project activity undertaken without being registered as a CDM project activity is not prevented by any barrier, then:
   a. If the sensitivity analysis confirms the result of the investment comparison analysis, and it cannot be ruled out that the most economically or financially attractive alternative scenario is the "proposed project activity undertaken without being registered as a CDM project activity", then the project activity is not additional.
   b. Else, proceed to common practice analysis step.

Step 2. Common practice analysis

Demonstrate that the project activity is not common practice in the relevant country by applying "Step 4 - Common practice analysis" of the latest version of the *"Tool for demonstration assessment and of additionality"* agreed by the CDM Executive Board.

**Baseline emissions**

The baseline emissions include emissions from fossil fuels fired for the production of heat and emissions from the generation of electricity:

$$BE_y = BE_{HG,y} + BE_{EL,y} \qquad \textbf{(1)}$$

Where:
$BE_y$      Baseline emissions during the year $y$, (tCO$_2$e)
$BE_{HG,y}$      Baseline emissions from the generation of heat during the year $y$, (tCO$_2$e)
$BE_{EL,y}$      Baseline emissions from the generation of electricity during the year $y$, (tCO$_2$e)

For the estimation of baseline emissions from the generation of heat the following stepwise approach should be applied:

***Step 1: Baseline emissions from heat generation***

Baseline emissions from heat generation are estimated as follows:

$$BE_{HG,y} = \sum_{j,i} Q_{j,i,y} \cdot EF_{BL,HG,j,i} \qquad \textbf{(2)}$$

Where:
$BE_{HG,y}$      Baseline emissions from the generation of heat during the year $y$, (tCO$_2$e)
$Q_{j,i,y}$      Quantity of heat supplied from sub-station $i$ to buildings in category $j$ in the year $y$, (GJ)
$EF_{BL,HG,j,i}$      CO$_2$ emission factor for heat generation for category $j$ connected to sub-station $i$ in the absence of the project activity (tCO$_2$/GJ)
$j$      All categories included in the project boundary
$i$      All sub-stations included in the project boundary

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[7] If the investment analysis is carried out, then an investment comparison analysis of the alternatives should be chosen, using the levelized cost of provided heat (in USD/GJ) for each of the alternatives as the financial indicator.

(a) For the cases where the category $j$ consists of existing buildings, as per the definition provided earlier in the procedure for the identification of the baseline scenario, the quantity of heat supplied to this category from sub-station $i$ should be estimated as follows:

$$Q_{j,i,y} = \left\{ Q_{inst\_cap,j,i}, Q_{measured,j,i,y} \right\} \tag{3}$$

Where:

$Q_{inst\_cap,j,i}$     Maximum quantity of heat that could have been supplied per year by existing boiler(s) at sub-station $i$ in the absence of the project activity, (GJ)

$Q_{measured,j,i,y}$     Measured quantity of heat supplied by the district heating system to existing buildings of category $j$ connected to sub-station $i$ in the year $y$. Monitored at point of measurement $i$ (i.e. sub-station level) in the project case, (GJ)

In order to determine the maximum quantity of heat $Q_{inst\_cap,j,i}$, project proponents should multiply a nameplate capacity value of the boiler corresponding to fuel $j$ by the number of operational hours per year (i.e. recommended default: 2400 hrs/year[8]):

$$Q_{inst\_cap,j,i} = CAP_{j,i} \cdot T \tag{3a}$$

Where:

$CAP_{j,i}$     Nameplate capacity of existing boiler(s) using fuel $j$ at sub-station $i$, (GJ/year)

$T$     Number of operational hours per year

(b) For the cases where category $j$ consists of new buildings, as per the definition provided earlier in the procedure for the identification of the baseline scenario, the quantity of heat supplied to this category should be estimated as follows:

If $Q_{extracted,y} < Q_{HOB,y}$, then $Q_{j,i,y} = 0$[9];

If $Q_{extracted,y} > Q_{HOB,y}$, then:

$$Q_{j,i,y} = \sum_{j,i} Q_{measured,j,i,y} \tag{4}$$

Where:

$Q_{extracted,y}$     Quantity of heat extracted from the cogeneration plant during the year $y$, (GJ)

$Q_{HOB,y}$     Quantity of heat extracted from heat-only boilers during the year $y$, (GJ)

$Q_{measured,j,i,y}$     Quantity of heat supplied by the district heating system to buildings of category $j$ connected to sub-station $i$. Monitored at point of measurement $i$ (i.e. sub-station level) in the project case, (GJ)

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[8] If a different value is suggested, project proponents shall provide evidence of the operational hours, taking into account seasonal changes.

[9] New buildings can only be included in the project activity, if it can be demonstrated that more than 50% of the heat is supplied by the project power plant rather than from heat only boilers (i.e. see applicability conditions).

*Step 2: CO₂ emission factor for heat supply in the baseline*

$CO_2$ emission factor for the heat generation in the baseline ($EF_{BL,HG,j,i}$) shall be identified for each category $j$ and each sub-station $i$.

The following factors may influence the $CO_2$ emission factor:

- The efficiency of the identified baseline technology ($\varepsilon_{HG,BLj,i}$);
- The fuel type identified as baseline fuel type and respectively the $CO_2$ emission factor of this fuel ($COEF_{BL,HG,j,i}$);

$EF_{BL,HG,,j,i}$ is determined as follows:

$$EF_{BL,HG,j,i} = \frac{COEF_{BL,HG,j,i}}{\varepsilon_{BL,HG,j,i}}$$
(5)

Where:

$EF_{BL,HGj,i}$     $CO_2$ emission factor for the heat generation system corresponding to substation $i$ for category $j$ in the absence of the project activity, (tCO₂/GJ)

$COEF_{BL,HGj,i}$     $CO_2$ emission factor of the fossil fuel used in the absence of the project activity in the heat generation system corresponding to substation $i$ (tCO₂/GJ).

$\varepsilon_{BL,HGj,i}$     Energy efficiency of the heat supply system $i$ that would be used in the absence of the project activity for buildings in category $j$.

*Sub-step 2b: Emission factor of fuel(s) used*

For all categories $j$, where the identified baseline scenario is the generation of heat in the existing boiler houses or the establishment of new disintegrated heating networks using fossil fuel fired boilers, project participants should determine $COEF_{BL,HG,j,i}$ corresponding to the fuel type identified in the selection of the baseline scenario.

For all categories $j$, where the identified baseline scenario is different from the generation of heat in the existing boiler houses or the establishment of new disintegrated heating networks using fossil fuel fired boilers, project participants should assume $COEF_{BL,HG,j,i} = 0$ tCO₂/GJ.[10]

For all categories $j$ of new buildings that are attached to a network that is predominantly supplied by heat from heat-only boilers (rather than from the power plant) project participants should assume $COEF_{BL,HG,j} = 0$ tCO2/GJ.

*Sub-step 2c: Efficiency of boilers used in the absence of the project activity*

The efficiency of the boilers that would have been used in the absence of the project activity in boiler houses ($\varepsilon_{BL,HG,j,i}$) should be determined for each category $j$ and each sub-station $i$ and be documented in the CDM-PDD. Once determined, $\varepsilon_{BL,HG,j,i}$ remains fixed for the duration of the crediting period.

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[10] This methodology only accounts for emission reductions, if in the absence of the project activity heat would have been generated by boilers installed in boiler houses.

To determine $\varepsilon_{BL,HG,j,i}$ project participants may use the following approaches:

- Conduct a representative number of sample measurements of $\varepsilon_{BL,HG,j,i}$ for similar boiler types (e.g. for new coal-fired boilers) at the project site prior to the implementation of the project activity or at other sites with comparable circumstances using the approach described in the latest approved version of AM0044 *"Energy efficiency improvement projects: boiler rehabilitation or replacement in industrial and district heating sectors"*.
- Use documented manufacturer's data on the boiler efficiency.
- Use the default values from Table 2 below[11].
- Determine $\varepsilon_{BL,HG,j,i}$ based on historical fuel consumption data.

Table 2.  Default baseline efficiency for different heat supply technologies

| Heat supply technology | Default efficiency |
|---|---|
| State-of-the-art boiler | 100% |
| New natural gas fired boiler (w/o condenser) | 92% |
| New oil fired boiler | 90% |
| Old natural gas fired boiler (w/o condenser) | 87% |
| New coal fired boiler | 85% |
| Old oil fired boiler | 85% |
| Old coal fired boiler | 80% |

For the purposes of this methodology, "old" boilers are boilers with an individual age of at least 15 years. Newer boilers are to be considered as "new" or "state-of-the-art".

Project participants should justify their choice of the baseline efficiency in the CDM-PDD for each of categories *j* and sub-stations *i* and demonstrate that conservative values are chosen.  In the cases of existing buildings this will correspond to the boiler that uses the cleanest fuel in the boiler house and that has been in operation at least once during the three-year period prior to the start of the implementation of the project activity.  For this purpose, project participants should provide information about the size, typical age, conditions as well as remaining lifetime of the baseline heat supply systems.

### Step 3.  Lifetime of existing heat only boiler(s)

In case, where the identified baseline scenario is the continued use of the existing boiler(s), project participants shall, consistent with the guidance by EB8 and EB22, determine whether the existing equipment would be replaced, retrofitted or modified during the project lifetime.  In order to determine the point in time by when the existing boiler(s) would be replaced in the absence of the project activity, project participants should estimate the typical technical lifetime of the boilers for each of categories *j* , taking into account the following:

- a) The typical average technical lifetime of equipment should be determined taking into account common practices in the sector and country (e.g. based on industry surveys, statistics, technical literature, etc.) or;
- 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).

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[11] References are contained in Appendix I.

The estimated typical technical lifetime of boilers for each identified category $j$ should be documented and justified in the CDM-PDD. Prior to the implementation of the project activity, project participants should determine the age of each boiler within each category $j$ that is replaced by the project district heating system, and the average age of the boilers per category $j$ should be calculated weighted by their annual heat generation (in GJ). From this, the average remaining lifetime of the boilers for each category $j$ is calculated as the difference between the typical technical lifetime in $j$ and the average age of boilers in category $j$.

The length of the crediting period of the project activity may not exceed the calculated average remaining lifetime of boilers in the category $j$ with the shortest average remaining lifetime of boilers.

**Baseline emissions from the power generation**

The ex-post calculation of baseline emissions from the power generation is based on the actual monitored electricity generated and supplied to the grid in the project activity and limited by the maximum historic annual amount of electricity generated over the three most recent years prior to the start of implementation of project activity:

$$BE_{EL,y} = \min\{EG_{max,hist}; EG_{PA,y}\} \cdot EF_{BL,EL} \qquad (6)$$

Where:

| | |
|---|---|
| $BE_{EL,y}$ | Baseline emissions from the generation of electricity during the year $y$, (tCO$_2$e) |
| $EF_{BL,EL}$ | Baseline emission factor for the electricity production, (tCO$_2$ / MWh) |
| $EG_{PA,y}$ | Monitored actual quantity of electricity supplied to the grid in the year $y$, (MWh) |
| $EG_{max,hist}$ | Maximum historic annual amount of electricity generated over the three most recent years prior to the start of the project activity, (MWh) |

$$EF_{BL,EL} = \frac{44}{12} \cdot \frac{3.6}{1000} \cdot \frac{EF_{FF,BL,EL}}{NCV_{FF,BL,EL} \cdot \eta_{BL,EL}} \qquad (7)$$

Where:

| | |
|---|---|
| $EF_{FF,BL,EL}$ | CO$_2$ emission factor for the fossil fuel fired in the power plant used prior to the start of the implementation of the project activity, (tC/mass or volume unit) |
| $NCV_{FF,BL,EL}$ | Net calorific value of fossil fuel fired in the power plant used prior to the start of the implementation of the project activity (TJ/mass or volume unit) |
| $\eta_{BL,EL}$ | Efficiency of the power plant used prior to the start of the implementation of the project activity |

Energy efficiency of the power plant (without heat extraction) prior to the start of the project activity ($\eta_{BL,EL}$) can be either measured according to the manufacturers' procedures to measure efficiency at the commissioning or the plant; or taken from the manufacturer's specification of efficiency at optimum load.

The values determined for $\eta_{BL,EL}$ should be documented in the CDM-PDD and shall in general remain fixed throughout the crediting period. However, if during the crediting period a technical measure is taken to improve efficiency of the project power plant and the efficiency increases by x%, then the efficiency of the baseline power plant $\eta_{BL,EL}$ should also be increased by the same x%.

**Project emissions**

Project emissions $PE_y$ comprise:

- $CO_2$ emissions from fossil fuel combustion associated with the production of heat and electricity in the CHP power plant; and
- $CO_2$ emissions from fossil fuel combustion in heat-only boilers.

These emissions are calculated using the latest approved version of the *"Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion",* where the process *j* corresponds to (a) combustion of fossil fuel at the co-generation plant and (b) combustion of fossil fuel at the heat-only boilers respectively. $PE_y$ will be estimated as $\sum_j PE_{FC,i,y}$ where $PE_{FC,j,y}$ is calculated as per the Tool.

**Leakage**

No calculation of leakage effect is required for project activities using the same fossil fuel type in the project activity and in the baseline scenario.

In cases, where the project activity results in a fuel switch from predominantly coal or oil to predominantly natural gas (e.g. from coal fired in the existing boilers to natural gas in the power plant), upstream emissions associated with the production, processing, transportation and distribution of fossil fuels may be significant and are considered as part of leakage emissions $LE_y$ to be estimated applying the approach of the latest approved version of AM0029.

**Emission Reductions**

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \tag{8}$$

Where:
| | |
|---|---|
| $ER_y$ | Emission reductions due to the project activity during the year $y$, (tCO$_2$e) |
| $BE_y$ | Baseline emissions during the year $y$, (tCO$_2$e) |
| $PE_y$ | Project emissions during the year $y$, (tCO$_2$e) |
| $LE_y$ | Leakage emissions in the year $y$, (tCO$_2$e) |

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

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

**Data and parameters not monitored**

The methodology includes certain parameters and variables that are determined at the beginning of the project activities ex-ante or through the first monitoring report and then remain fixed during the crediting period. However in some cases the option to monitor the same parameters has also been given, where this option is given the parameter is included in the monitoring section.

| Data/Parameter: | Average remaining lifetime of boilers for category $j$ |
|---|---|
| Data unit: | Years |
| Description: | Average lifetime of boilers |
| Source of data: | Documented boiler information |
| Measurement procedures (if any): | Lifetime of existing heat-only boiler(s). Comparing information about "year of construction" of all boilers for all categories $j$, with typical technical lifetime of the boilers for all categories $j$ (estimated taking into account the practices in the country and region). Evidence to be presented in the CDM-PDD. |
| Any comment: | |

| Data/Parameter: | $CAP_{,j,i}$ |
|---|---|
| Data unit: | GJ/year |
| Description: | Nameplate capacity of existing boiler(s) in category $j$ at sub-station $i$ |
| Source of data: | Manufacture's specifications |
| Measurement procedures (if any): | |
| Any comment: | |

| Data/Parameter: | $EG_{max,hist}$ |
|---|---|
| Data unit: | MWh |
| Description: | Maximum annual amount of electricity generated by the power plant used prior to the start of the project activity during the last 3 years before project implementation. |
| Source of data: | Historic production data of last 3 years |
| Measurement procedures (if any): | |
| Any comment: | |

| Data/Parameter: | $COEF_{BL,HG,j,i}$ |
|---|---|
| Data unit: | ton $CO_2$ / GJ fuel |
| Description: | $CO_2$ emission factor of the baseline fuel(s) of the heat production in the categories of $j$. |
| Source of data: | The following data sources may be used if the relevant conditions apply; <table><thead><tr><th>Data sources</th><th>Condition for using the data sources</th></tr></thead><tbody><tr><td>a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source.</td></tr><tr><td>b) Measurements by the project participants</td><td>if a) is not available</td></tr><tr><td>c) Regional or national default values</td><td>if a) is not available<br>These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances).</td></tr><tr><td>d) IPCC default values at the upper limit of the uncertainty at the 95% confidence interval as provided in table 1.4 of Chapter 1 of vol. 2 (Energy) of 2006 IPCC Guidelines on National GHG Inventories</td><td>If a) is not available</td></tr></tbody></table> |
| Measurement procedures (if any): | Once during the first year of the project<br>For a) and b) measurements should be undertaken in line with national or international fuel standards. |
| Any comment: | For a): If the fuel supplier does provide the NCV value and the $CO_2$ emission factor on the invoice and these two values are based on measurements for this specific fuel, this $CO_2$ factor should be used. If another source for the $CO_2$ emission factor is used or no $CO_2$ emission factor is provided, options b), c) or d) should be used. |

| Data/Parameter: | $\varepsilon_{BL,HG,j,i}$ |
|---|---|
| Data unit: | % |
| Description: | Efficiency of the heat supply system that would have been used in the absence of the project activity for category $j$ and sub-station $i$ |
| Source of data: | Conduct a representative number of sample measurements of $\varepsilon_{BL,HG,j,i}$ for categories of similar boiler types (e.g. for new coal-fired boilers) at the project site prior to the implementation of the project activity or at other sites with comparable circumstances. |
| Measurement procedures (if any): | *Sample measurement*<br>Use recognized standards for the measurement of the boiler efficiency, such as the "*British Standard Methods for Assessing the thermal performance of boilers for steam, hot water and high temperature heat transfer fluids*" (BS845). Where possible, use preferably the direct method (dividing the net heat generation by the energy content of the fuels fired during a representative time period), as it is better able to reflect average efficiencies during a representative time period compared to the indirect method (determination of fuel supply or heat generation and |

| | |
|---|---|
| | estimation of the losses). Document measurement procedures and results and manufacturer's information transparently in the CDM-PDD. |
| Any comment: | Alternatively, project proponents may use manufacturer data or default values as presented in Sub-step 2c: Efficiency of boilers used in the absence of the project activity |

| Data/Parameter: | $EF_{FF,BL,EL}$ |
|---|---|
| Data unit: | tC / mass or volume unit |
| Description: | $CO_2$ emission factor for the fossil fuel fired in the power plant used prior to the start of the implementation of the project activity |
| Source of data: | The following data sources may be used if the relevant conditions apply:<br><br><table><tr><td>Data source</td><td>Conditions for using the data source</td></tr><tr><td>a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source.</td></tr><tr><td>b) Measurements by the project participants</td><td>If a) is not available</td></tr><tr><td>c) Regional or national default values</td><td>If a) is not available<br>These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances).</td></tr><tr><td>d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If a) is not available</td></tr></table> |
| Measurement procedures (if any): | For a) and b): Measurements should be undertaken in line with national or international fuel standards.<br>For a): If the fuel supplier does provide the NCV value and the $CO_2$ emission factor on the invoice and these two values are based on measurements for this specific fuel, this $CO_2$ factor should be used. If another source for the $CO_2$ emission factor is used or no $CO_2$ emission factor is provided, options b), c) or d) should be used. |
| Any comment: | Fixed as part of first monitoring period |

| Data/Parameter: | $NCV_{FF,BL,EL}$ |
|---|---|
| Data unit: | TJ/mass or volume unit |
| Description: | Net calorific value of fossil fuel fired in the power plant used prior to the start of the implementation of the project activity |
| Source of data: | Preferably invoices from fuel supplier or use accurate and reliable local or national data where available. |
| Measurement procedures (if any): | Use mass or volume meters. |
| Any comment: | Where such local or national data are not available, IPCC default emission factors (country-specific, if available) may be used if they are deemed to reasonably represent local circumstances |

| Data/Parameter: | Subscript $j$ |
|---|---|
| Data unit: | |
| Description: | Categories grouped by (i) type of buildings (new/existing), (ii) type of technology used and (iii) fuel type used in the absence of the project activity. For each category $j$, all connected buildings should be clearly identified. |
| Source of data: | The responsible heat or urban planning authority and the maps or schematic-plan diagrams of the district heating system obtained at the district heating company. |
| Measurement procedures (if any): | N/A |
| Any comment: | Data shall be stored in a database/excel sheet and checked during first monitoring report. |

| Data/Parameter: | Subscript $i$ |
|---|---|
| Data unit: | |
| Description: | Sub-station |
| Source of data: | The responsible heat or urban planning authority and the maps or schematic-plan diagrams of the district heating system obtained at the district heating company. |
| Measurement procedures (if any): | |
| Any comment: | Data shall be stored in a database/excel sheet and checked during first monitoring report. |

| Data/Parameter: | $\eta_{BL,EL}$ |
|---|---|
| Data unit: | % |
| Description: | Efficiency of the power plant used prior to the start of the implementation of the project activity |
| Source of data: | |
| Measurement procedures (if any): | Can be either measured according to the manufacturers' procedures to measure efficiency at the commissioning or the plant; or taken from the manufacturer's specification of efficiency at optimum load. |
| Any comment: | Shall in general remain fixed throughout the crediting period. However, if during the crediting period a technical measure is taken to improve efficiency of the project power plant and the efficiency increases by x%, then the efficiency of the baseline power plant $\eta_{BL,EL}$ should also be increased by the same x%. |

## III.  MONITORING METHODOLOGY

## Monitoring procedures

Monitoring in this methodology includes the monitoring of parameters used for calculation of both baseline emissions and project emissions.

All heat supplied to final consumers should be measured at each sub-station $i$ as part of the monitoring plan.  For each secondary district heating network connected to a sub-station $i$, the quantity of heat supplied should be measured continuously.  If points of heat measurement are changed (e.g. due to a change in the heating network) or added during the crediting period (e.g. due to the construction of new buildings within the project boundary), this should be documented transparently in the CDM-PDD and the monitoring reports.

Note that meters should be installed in a manner that ensures that only the quantity of heat supplied for room heating purposes is metered and additional quantities of heat supplied for hot tap water demand within the project boundary.

All monitored data should be recorded in an electronic database (e.g. Excel sheets) with specifications of the points of measurement, the variable name and description, the corresponding value and unit as well as the time of measurement, the period for which the measurement is valid and the persons who are responsible for making the measurements and carrying out the records.  An extract of the complete database shall be included in each monitoring report.

*Data to be monitored for determination of the baseline emissions:*
- The quantity of heat supplied by the district heating system during each year for each point of heat measurement $i$:  For that purpose meters should be installed at all points of heat measurement $i$. The corresponding heat delivery has to be measured continuously and recorded at least annually. The meter readings should be documented in the above-mentioned database.  The meter readings have to be crosschecked against the meter readings of the heat extracted from the power plant as well as against fuel consumption and heat invoices to ensure that the heat records are plausible and reliable.  Moreover, the corresponding meters have to be subject to regular maintenance and calibration in order to ensure measurements with a low degree of uncertainty.
- Amount of electricity generated in project activity

*Data to be monitored for determination of the project emissions:*
- For parameters to be monitored for the calculation of project emissions please refer to the latest approved version of the *"Tool to calculate project or leakage CO$_2$ emissions from fossil fuel combustion"*

**Data and parameters monitored**

| Parameter: | Status of the district heating system and capacity |
|---|---|
| Data unit: | Number of substations and corresponding MWheat |
| Description: | Dates of commissioning and status of rated capacity of boilers |
| Source of data: | The responsible heat or urban planning authority and the maps or schematic-plan diagrams of the district heating system obtained at the district heating company. |
| Measurement procedures (if any): | Maps or schematic-plan diagrams of the district heating system should be updated on the basis of information from boiler supplier, manufacturers specification or catalogue references and SCADA systems. |
| Monitoring frequency: | Recorded at start of the project and whenever the newly installed substations start producing thermal energy. |
| QA/QC procedures: | Data gathered monthly to establish starting date for each substation and monthly status of the scope of the district heating system |
| Any comment: | |

| Parameter: | $Q_{extracted,y}$ |
|---|---|
| Data unit: | GJ |
| Description: | Quantity of heat extracted from the cogeneration plant during the year $y$ |
| Source of data: | Heat meter at supply side of heat exchanger |
| Measurement procedures (if any): | Hourly measurement of in- and outdoor temperatures and water flow in m³ |
| Monitoring frequency: | Hourly measurements, registered for the project at least on an annual basis |
| QA/QC procedures: | The meter readings should be crosschecked against the meter readings of the point of heat supply as well as against heat invoices to district heating company to ensure that the heat records are plausible and reliable. Moreover, the corresponding meters have to be subject to regular maintenance in order to ensure measurements with a low degree of uncertainty. Data to be stored electronically (database) |
| Any comment: | |

| Parameter: | $Q_{HOB,y}$ |
|---|---|
| Data unit: | GJ |
| Description: | Quantity of heat extracted from any heat only/peak load boilers during the year $y$ |
| Source of data: | Heat meter at supply side of any heat only boiler or peak load boiler |
| Measurement procedures (if any): | Hourly measurement of in- and outdoor temperatures and water flow in m³ |
| Monitoring frequency: | Hourly measurements, registered for the project at least on an annual basis |
| QA/QC procedures: | The meter readings should be cross-checked against the meter readings of the point of heat supply as well as against heat invoices to district heating company to ensure that the heat records are plausible and reliable. Moreover, the corresponding meters have to be subject to regular maintenance in order to ensure measurements with a low degree of uncertainty. Data to be stored electronically (database) |
| Any comment: | |

| Parameter: | $Q_{measured,j,i,y}$ |
|---|---|
| Data unit: | GJ |
| Description: | Quantity of heat supplied from sub-station $i$ to category $j$ buildings |
| Source of data: | On site measurements of heat meter at sub station |
| Measurement procedures (if any): | Hourly measurement of in- and outdoor temperatures and water flow in $m^3$ |
| Monitoring frequency: | Hourly measurements, registered for the project at least on an annual basis |
| QA/QC procedures: | The meter readings should be cross-checked against the meter readings of the heat extracted from the power plant as well as against heat invoices to ensure that the heat records are plausible and reliable. Moreover, the corresponding meters have to be subject to regular maintenance in order to ensure measurements with a low degree of uncertainty. Data to be stored electronically (database). |
| Any comment: | |

| Parameter: | $EG_{PA,y}$ |
|---|---|
| Data unit: | MWh |
| Description: | Actual quantity of electricity supplied to the grid in the year y |
| Source of data: | Electricity meter |
| Measurement procedures (if any): | |
| Monitoring frequency: | Continuous |
| QA/QC procedures: | |
| Any comment: | |

| Data / parameter: | $PE_{FC,j,y}$ |
|---|---|
| Data unit: | $tCO_{2e}$ |
| Description: | Project emissions from fossil fuel combustion in process $j$ during the year $y$ . |
| Source of data: | Calculated as per the "Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion". |
| Measurement procedures (if any): | As per the "Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion" |
| Monitoring frequency: | As per the "Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion" |
| QA/QC procedures: | As per the "Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion" |
| Any comment: | - |

**Appendix I**

**Source of data and reference for the default efficiency values provided in Table 1**

| Heat supply system | Efficiency | Source |
|---|---|---|
| Gas fired boilers | 75-92% | Efficiency of gas boilers. Source: Beijing Heating Energy Conservation Project, World Bank 2005 - internal working note. |
| Oil fired boilers | 82% (Range: 65-90%) | Average value of sample measurements in 80 existing oil-fired boilers in Peru. Source: Herold / Schneider / Vizcarra (2003): Improving Energy Efficiency in Peruvian Boilers with the CDM. GTZ/Öko-Institut, Berlin, January 2003 |
| Coal fired boiler | 85% | Age: new, condition: excellent, remaining lifetime: many years. Poland. Source: Coal to Gas Conversion Project, GEF Project Document, Report No: 13054, 1994/10/31 |
| Coal fired boiler | 65% | Age: middle, condition: good, remaining lifetime: several years. Poland. Source: Coal to Gas Conversion Project, GEF Project Document, Report No: 13054, 1994/10/31 |
| Coal fired boiler | 50% | Age: old, condition: poor/fair, remaining lifetime: none/few years. Poland. Source: Coal to Gas Conversion Project, GEF Project Document, Report No: 13054, 1994/10/31 |
| Coal-fired boiler | 80% | Efficiency of heat-only boiler in good condition. Estimate of Chinese expert. Source: Personal communication from COWI. |
| Coal-fired boiler | 45-75% | Average efficiency of heat-only boilers (depending on size, year, location as well as operation and management). Estimate of Chinese expert. Source: Personal communication from COWI. |
| Coal-fired boiler | above 80% | Efficiency level for coal-fired industrial boilers in developed countries. Source: China: Efficient industrial boilers, GEF Focal area: Climate Change, http://www.gefweb.org/COUNCIL/council7/wp/china_br.htm |
| Coal fired boiler | 60-65% | Typical efficiency levels for Chinese coal-fired industrial boilers. Source: China: Efficient industrial boilers, GEF Focal area: Climate Change, http://www.gefweb.org/COUNCIL/council7/wp/china_br.htm |
| Coal fired boiler | 65% (70-80%) | Efficiency of a coal fired industrial boiler (under operation) in 2000 (2010). Source: China Medium and Long Term Energy Conservation Plan, November 25, 2004, National Development and Reform Commission, Table 2. Energy Efficiency Indicators of Major Energy Consuming Equipment |
| Coal fired boiler | 50-75% | Efficiency of coal boilers. Source: Beijing Heating Energy Conservation Project, World Bank 2005 - internal working note. |