

**Joint Crediting Mechanism Approved Methodology ID\_AM023**  
**“Installation of gas engine cogeneration system with absorption chiller to supply electricity, heating energy and cooling energy”**

**A. Title of the methodology**

Installation of gas engine cogeneration system with absorption chiller to supply electricity, heating energy and cooling energy, Version 01.10

**B. Terms and definitions**

Terms	Definitions
Cogeneration System (CGS)	A system that consists of power generator(s) and heat generating equipment (e.g. heat recovery steam generator, exhaust heat exchanger, etc.) that supplies both electricity and heating energy, recovering waste heat exhausted from the power generator(s). The power generator(s) in this methodology is a gas engine(s).
Absorption chiller	Refrigerating machine using heat source such as heating energy generated by fuel combustion and/or waste heat in the form of hot water, steam or exhaust gas, refrigerant (eg. water) and absorption solution (eg. Lithium bromide, ammonia) to generate chilled water or other chilled liquids by absorption refrigeration cycle.
Recipient Facility	A cluster of buildings and/or plants (or building/plant itself) to which electricity, heating energy and cooling energy generated by CGS are supplied.
Boiler Efficiency	Net quantity of heat generated per quantity of energy contained in fuel fired in the boiler.
Cooling capacity	Capability of individual chiller to remove heat. In this methodology, “cooling capacity” is used to represent a cooling capacity per a single chiller unit and not for a system with multiple chiller units.

### C. Summary of the methodology

Items	Summary
<i>GHG emission reduction measures</i>	Electricity and heating energy generated by a CGS installed in a project site substitute all or part of grid and/or captive electricity as well as heating energy. Absorption chiller utilizing heating energy generated by a CGS is also introduced to save energy for cooling energy demand. Installation of CGS and absorption chiller leads to efficient energy use of recipient facility(ies) and in turn GHG emission reductions.
<i>Calculation of reference emissions</i>	<p>[Reference emissions for CGS]</p> <p>Reference emissions are CO<sub>2</sub> emissions from the use of grid and/or captive electricity and heating energy (e.g. steam and hot water) generated by a reference boiler, which are calculated with the amount of electricity consumed by the recipient facility(ies) which is generated by the CGS, the amount of heating energy consumed by the recipient facility(ies) which is generated by the CGS, CO<sub>2</sub> emission factors for consumed electricity in the recipient facility(ies), reference boiler efficiency and CO<sub>2</sub> emission factor for fossil fuel consumed by the reference boiler.</p> <p>[Reference emissions for absorption chiller]</p> <p>Reference emissions are GHG emissions from using reference chiller(s) which is determined as centrifugal chiller in this methodology. Reference emissions are calculated with cooling energy of project chiller(s), COP of reference chiller, and CO<sub>2</sub> emission factor for electricity consumed.</p> <p>GHG emissions from using chilled water pump, cooling water pump and cooling tower are excluded from calculation since those pumps exist in both reference and project chiller system and they can cancel each other out.</p>
<i>Calculation of project emissions</i>	<p>[Project emissions from CGS]</p> <p>Project emissions are CO<sub>2</sub> emissions from the use of CGS, which are calculated with the amount of gas fuel consumed by the CGS, net calorific value of gas fuel consumed by the CGS, and CO<sub>2</sub> emission factor for gas fuel consumed by the CGS.</p>

	<p>[Project emissions from absorption chiller]</p> <p>Project emissions are GHG emissions from using project chiller(s), which are the sum of emissions from electricity consumption and fossil fuel consumption. GHG emissions from electricity consumption are calculated with electricity consumption of pumps absorbing solution and refrigerant built in the project chiller(s) and CO<sub>2</sub> emission factor for electricity consumed.</p> <p>GHG emissions from fossil fuel consumption, where applicable, are calculated with fuel consumption of project chiller(s) and CO<sub>2</sub> emission factor for fuel consumed.</p> <p>GHG emissions from using chilled water pump, cooling water pump and cooling tower are excluded from calculation since those pumps exist in both reference and project chiller system and they can be canceled each other out.</p>
<p><i>Monitoring parameters</i></p>	<ul style="list-style-type: none"> <li>● Electricity consumption by the recipient facility(ies) which is generated by the CGS</li> <li>● Heating energy consumption by the recipient facility(ies) which is generated by the CGS</li> <li>● Cooling energy generated by the project absorption chiller</li> <li>● Gas fuel consumption by the CGS</li> <li>● Electricity consumption by the project absorption chiller</li> <li>● Gas fuel consumption by the project absorption chiller, where applicable</li> <li>● The amount of fuel consumed and/or the amount of electricity generated by captive power, where applicable</li> </ul>

#### D. Eligibility criteria

This methodology is applicable to projects that satisfy all of the following criteria.

<p>Criterion 1</p>	<p>A CGS, whose electricity is generated by a gas engine(s), with absorption chiller(s) utilizing waste heat from CGS is installed and supplies electricity, heating energy and cooling energy (e.g. steam, hot water and chilled water) to recipient facility(ies).</p>
<p>Criterion 2</p>	<p>Electricity and heating energy, each of which is generated in separate systems, is supplied to and consumed by recipient facility(ies) before the installation of</p>

	a project CGS.
Criterion 3	<p>In the case of replacing the existing chiller with the project chiller, a plan for prevention of releasing refrigerant used in the existing chiller to the air (e.g. re-use of the equipment) is prepared. Execution of this plan is checked at the time of verification, in order to confirm that refrigerant used for the existing one replaced by the project is prevented from being released to the air.</p> <p>In the case that the existing chiller is NOT replaced with the project chiller, this criterion is not applied.</p>

#### E. Emission Sources and GHG types

Reference emissions	
Emission sources	GHG types
Electricity consumption in recipient facility(ies)	CO <sub>2</sub>
Fossil fuel consumption for production of heating energy consumed in recipient facility(ies)	CO <sub>2</sub>
Electricity consumption by reference chiller	CO <sub>2</sub>
Project emissions	
Emission sources	GHG types
Gas fuel consumption by CGS	CO <sub>2</sub>
Electricity consumption by project chiller	CO <sub>2</sub>
Gas fuel consumption by project chiller	CO <sub>2</sub>

#### F. Establishment and calculation of reference emissions

##### F.1. Establishment of reference emissions

The following two measures are taken into consideration to ensure the net emission reductions in this methodology.

[Reference boiler efficiency for the CGS]

Reference emissions are calculated with the amount of electricity generated by the CGS and consumed by the recipient facility(ies), the amount of heating energy generated by the CGS and consumed by the recipient facility(ies), reference boiler efficiency, CO<sub>2</sub> emission factors for consumed electricity in the recipient facility(ies) and fossil fuel consumed by the reference

boiler.

A default value for the reference boiler efficiency is conservatively set to 89 [%] taking the highest value among those products sold in Indonesia, so as to ensure net emission reductions.

[Reference COP for the absorption chiller]

Reference emissions are calculated with cooling energy of project chiller(s), COP of reference chiller, and CO<sub>2</sub> emission factor for electricity consumed.

GHG emissions from using chilled water pump, cooling water pump and cooling tower are excluded from calculation since those pumps exist in both reference and project chiller system and they can cancel each other out.

The COP of reference chiller, which is centrifugal chiller, is conservatively set as a default value in the following manner to ensure the net emission reductions.

1. The COP value tends to increase as the cooling capacity becomes larger.
2. The reference COP value varies by its cooling capacity.
3. The maximum values of COP in each cooling capacity range set for this methodology are defined as COP<sub>RE,j</sub> as described in Section I.

## F.2. Calculation of reference emissions

$$\begin{aligned}
 RE_p &= \sum_i RE_{elec,i,p} + \sum_i RE_{heat,i,p} + \sum_j RE_{chiller,j,p} \\
 &= \sum_i (EC_{i,p} \times EF_{elec,i}) + \sum_i HC_{i,p} \times \frac{100}{\eta_{RE}} \times EF_{fuel,RE} \\
 &\quad + \sum_j \left( \frac{C_{pj,j,p}}{COP_{RE,j}} \times EF_{elec,j} \right)
 \end{aligned}$$

Where

$RE_p$  : Reference emissions during the period  $p$  [tCO<sub>2</sub>/p]

$RE_{elec,i,p}$  : Reference emissions for electricity consumed by the recipient facility  $i$  which is generated by the CGS during the period  $p$  [tCO<sub>2</sub>/p]

$RE_{heat,i,p}$  : Reference emissions for heating energy consumed by the recipient facility  $i$  which is generated by the CGS during the period  $p$  [tCO<sub>2</sub>/p]

$RE_{chiller,j,p}$  : Reference emissions by reference chiller  $j$  during the period  $p$  [tCO<sub>2</sub>/p]

$EC_{i,p}$  : Electricity consumption by the recipient facility  $i$  which is generated by the CGS during the period  $p$  [MWh/p]

$EF_{elec,i}$  : CO<sub>2</sub> emission factor for consumed electricity in the recipient facility  $i$

	[tCO <sub>2</sub> /MWh]
$HC_{i,p}$	: Heating energy consumption by the recipient facility $i$ which is generated by the CGS during the period $p$ [GJ/p]*1
$\eta_{RE}$	: Reference boiler efficiency [%]
$EF_{fuel,RE}$	: CO <sub>2</sub> emission factor for fossil fuel consumed by the reference boiler [tCO <sub>2</sub> /GJ]
$C_{PJ,j,p}$	: Cooling energy generated by the project absorption chiller $j$ during the period $p$ [MWh/p]
$COP_{RE,j}$	: COP of reference chiller $j$ [dimensionless]
$EF_{elec,j}$	: CO <sub>2</sub> emission factor for consumed electricity by the project absorption chiller $j$ [tCO <sub>2</sub> /MWh]
$i$	: Identification number of the recipient facility to which electricity and heating energy generated by the CGS is supplied
$j$	: Identification number of the project absorption chiller
*1: Amount of heating energy generated by the CGS and consumed by the project absorption chiller is not included in $HC_{i,p}$	

## G. Calculation of project emissions

$PE_p$	=	$PE_{PJ,CGS,p} + PE_{PJ,chiller,p}$
Where		
$PE_{PJ,CGS,p}$	=	$FC_{PJ,CGS,p} \times NCV_{fuel,CGS} \times EF_{fuel,CGS}$
		$\sum_j (EC_{PJ,CL,j,p} \times EF_{elec,j})$
$PE_{PJ,chiller,p}$	=	$\sum_j (FC_{PJ,CL,j,p} \times NCV_{fuel,CL,j} \times 1,000^{-1} \times EF_{fuel,CL,j})$
Where		
$PE_p$	:	Project emissions during the period $p$ [tCO <sub>2</sub> /p]
$PE_{PJ,CGS,p}$	:	Project emissions from the CGS during the period $p$ [tCO <sub>2</sub> /p]
$PE_{PJ,chiller,p}$	:	Project emissions from project absorption chiller during the period $p$

	[tCO <sub>2</sub> /p]
$FC_{PJ,CGS,p}$	: Gas fuel consumption by the CGS during the period $p$ [mass or volume/p]
$NCV_{fuel,CGS}$	: Net calorific value of gas fuel consumed by the CGS [GJ/mass or volume]
$EF_{fuel,CGS}$	: CO <sub>2</sub> emission factor for gas fuel consumed by the CGS [tCO <sub>2</sub> /GJ]
$EC_{PJ,CL,j,p}$	: Electricity consumption by project absorption chiller $j$ during the period $p$ [MWh/p] <sup>*2</sup>
$EF_{elec,j}$	: CO <sub>2</sub> emission factor for electricity consumed by the project absorption chiller $j$ [tCO <sub>2</sub> /MWh]
$FC_{PJ,CL,j,p}$	: Gas fuel consumption by project absorption chiller $j$ during the period $p$ [Nm <sup>3</sup> /p]
$NCV_{fuel,CL,j}$	: Net calorific value of gas fuel consumed by project absorption chiller $j$ [MJ/Nm <sup>3</sup> ]
$EF_{fuel,CL,j}$	: CO <sub>2</sub> emission factor for gas fuel consumed by project absorption chiller $j$ [tCO <sub>2</sub> /GJ]
$j$	: Identification number of the project absorption chiller
<u>*2: When project absorption chiller consumes electricity only generated by the project CGS, <math>EC_{PJ,CL,j,p}</math> can be omitted or equal to zero (0), since CO<sub>2</sub> emissions from electricity consumption by project absorption chiller are included in project emissions from the CGS (<math>PE_{PJ,CGS,p}</math>).</u>	

## H. Calculation of emissions reductions

$$ER_p = RE_p - PE_p$$

Where

$ER_p$  : Emission reductions during the period  $p$  [tCO<sub>2</sub>/p]

$RE_p$  : Reference emissions during the period  $p$  [tCO<sub>2</sub>/p]

$PE_p$  : Project emissions during the period  $p$  [tCO<sub>2</sub>/p]

## I. Data and parameters fixed *ex ante*

The source of each data and parameter fixed *ex ante* is listed as below.

Parameter	Description of data	Source
$EF_{elec,i}$	CO <sub>2</sub> emission factor for consumed electricity in the recipient facility $i$ [tCO <sub>2</sub> /MWh]	<b>[Grid electricity]</b> The most recent value

	<p>When the recipient facility consumes only grid electricity or captive electricity, the project participant applies the CO<sub>2</sub> emission factor respectively.</p> <p>When both grid electricity and captive electricity may be consumed in the recipient facility, the project participant applies the CO<sub>2</sub> emission factor with lower value.</p> <p>[CO<sub>2</sub> emission factor]</p> <p>For grid electricity: The most recent value available from the source stated in this table at the time of validation</p> <p>For captive electricity including cogeneration system, it is determined based on the following options:</p> <p>a) Calculated from its power generation efficiency (<math>\eta_{cap,i}</math> [%]) obtained from manufacturer's specification The power generation efficiency based on lower heating value (LHV) of the captive power generation system from the manufacturer's specification is applied;</p> $EF_{elec,i} = 3.6 \times \frac{100}{\eta_{cap,i}} \times EF_{fuel,cap,i}$ <p>b) Calculated from measured data The power generation efficiency calculated from monitored data of the amount of fuel input for power generation (<math>FC_{cap,i,p}</math>) and the amount of electricity generated (<math>EG_{cap,i,p}</math>) during the monitoring period <math>p</math> is applied. The measurement is conducted with the monitoring</p>	<p>available at the time of validation is applied and fixed for the monitoring period thereafter. The data is sourced from "Emission Factors of Electricity Interconnection Systems", National Committee on Clean Development Mechanism (Indonesian DNA for CDM), based on data obtained by Directorate General of Electricity, Ministry of Energy and Mineral Resources, Indonesia, unless otherwise instructed by the Joint Committee.</p> <p><b>[Captive electricity]</b> For the option a) Specification of the captive power generation system connected to the recipient facility <math>i</math>, provided by the manufacturer (<math>\eta_{cap,i}</math> [%]). CO<sub>2</sub> emission factor of the fuel consumed by the captive power generation system connected to the recipient facility <math>i</math> (<math>EF_{fuel,cap,i}</math> [tCO<sub>2</sub>/GJ]) in order of preference: 1) values provided by the fuel supplier; 2) measurement by the</p>
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<p>equipment to which calibration certificate is issued by an entity accredited under national/international standards;</p> $EF_{elec,i} = FC_{cap,i,p} \times NCV_{fuel,cap,i} \times EF_{fuel,cap,i} \times \frac{1}{EG_{cap,i,p}}$ <p>Where: <math>NCV_{fuel,cap,i}</math> : Net calorific value of the fuel consumed by the captive power generation system connected to the recipient facility <math>i</math> [GJ/mass or volume]</p> <p>Note: In case the captive electricity generation system connected to the recipient facility <math>i</math> meets all of the following conditions, the value in the following table may be applied to <math>EF_{elec,i}</math> depending on the consumed fuel type.</p> <ul style="list-style-type: none"> <li>• The system is non-renewable generation system</li> <li>• Electricity generation capacity of the system is less than or equal to 15 MW</li> </ul> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="padding: 5px;">fuel type</th> <th style="padding: 5px;">Diesel fuel</th> <th style="padding: 5px;">Natural gas</th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;"><math>EF_{elec,i}</math></td> <td style="padding: 5px;">0.8 *1</td> <td style="padding: 5px;">0.46 *2</td> </tr> </tbody> </table> <p>*1 The most recent value at the time of validation is applied. *2 The value is calculated with the equation in the option a) above. The lower value of default effective CO<sub>2</sub> emission factor for natural gas (0.0543 tCO<sub>2</sub>/GJ), and the most efficient value of default efficiency for off-grid gas turbine systems (42%) are applied.</p>	fuel type	Diesel fuel	Natural gas	$EF_{elec,i}$	0.8 *1	0.46 *2	<p>project participants;</p> <p>3) regional or national default values;</p> <p>4) IPCC default values provided in table 1.4 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Lower value is applied.</p> <p>For the option b) Generated and supplied electricity by the captive power generation system connected to the recipient facility <math>i</math> (<math>EG_{cap,i,p}</math> [MWh/p]). Fuel amount consumed by the captive power generation system connected to the recipient facility <math>i</math> (<math>FC_{cap,i,p}</math> [mass or volume/p]). Net calorific value (<math>NCV_{fuel,cap,i}</math> [GJ/mass or volume]) and CO<sub>2</sub> emission factor of the fuel (<math>EF_{fuel,cap,i}</math> [tCO<sub>2</sub>/GJ]) in order of preference:</p> <ol style="list-style-type: none"> <li>1) values provided by the fuel supplier;</li> <li>2) measurement by the project participants;</li> <li>3) regional or national default values;</li> <li>4) IPCC default values provided in tables 1.2 and 1.4 of Ch.1 Vol.2 of 2006 IPCC</li> </ol>
fuel type	Diesel fuel	Natural gas					
$EF_{elec,i}$	0.8 *1	0.46 *2					

		<p>Guidelines on National GHG Inventories. Lower value is applied.</p> <p>[Captive electricity with diesel fuel] CDM approved small scale methodology: AMS-I.A.</p> <p>[Captive electricity with natural gas] 2006 IPCC Guidelines on National GHG Inventories for the source of EF of natural gas. CDM Methodological tool "Determining the baseline efficiency of thermal or electric energy generation systems version02.0" for the default efficiency for off-grid power plants.</p>
$\eta_{RE}$	<p>Reference boiler efficiency</p> <p>Default value is set to 89 [%].</p>	<p>Value derived from the result of survey. The default value, 89 [%], should be revised if necessary.</p>
$EF_{fuel,RE}$	<p>CO<sub>2</sub> emission factor for fossil fuel consumed by the reference boiler [tCO<sub>2</sub>/GJ]</p> <p>CO<sub>2</sub> emission factor of natural gas is applied in this methodology in a conservative manner.</p>	<p>In the order of preference:</p> <ul style="list-style-type: none"> <li>a) values provided by fuel supplier;</li> <li>b) measurement by the project participants;</li> <li>c) regional or national default values; or</li> <li>d) IPCC default values provided in table 1.4 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National</li> </ul>

		GHG Inventories. Lower value is applied.										
$COP_{RE,j}$	<p>COP of reference chiller <math>j</math></p> <p>The COP of the reference chiller <math>j</math> is selected from the default COP value in the following table in line with cooling capacity of the project chiller <math>j</math>. (“x” in the table represents cooling capacity per unit.)</p> <p>[Default COP values of reference chillers]</p> <table border="1"> <thead> <tr> <th>Cooling capacity per unit (USRt)</th> <th>300≤ x ≤350</th> <th>350&lt; x ≤550</th> <th>550&lt; x ≤750</th> <th>750&lt; x ≤1,300</th> </tr> </thead> <tbody> <tr> <td><math>COP_{RE,i}</math></td> <td>5.46</td> <td>5.69</td> <td>5.90</td> <td>6.03</td> </tr> </tbody> </table>	Cooling capacity per unit (USRt)	300≤ x ≤350	350< x ≤550	550< x ≤750	750< x ≤1,300	$COP_{RE,i}$	5.46	5.69	5.90	6.03	<p>Specifications of project chiller <math>j</math> prepared for the quotation or factory acceptance test data by manufacturer.</p> <p>The default COP values are derived from the result of survey on COP of chillers from manufacturers that have high market share. The survey should prove the use of clear methodology. The default COP values should be revised if necessary from survey result which is conducted by JC or project participants.</p>
Cooling capacity per unit (USRt)	300≤ x ≤350	350< x ≤550	550< x ≤750	750< x ≤1,300								
$COP_{RE,i}$	5.46	5.69	5.90	6.03								
$NCV_{fuel,CGS}$	Net calorific value of gas fuel consumed by the CGS [GJ/mass or volume]	<p>In the order of preference:</p> <ol style="list-style-type: none"> <li>values provided by fuel supplier;</li> <li>measurement by the project participants;</li> <li>regional or national default values; or</li> <li>IPCC default values provided in table 1.2 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Upper value is applied.</li> </ol>										
$EF_{fuel,CGS}$	CO <sub>2</sub> emission factor for gas fuel consumed by the CGS [tCO <sub>2</sub> /GJ]	<p>In order of preference:</p> <ol style="list-style-type: none"> <li>values provided by fuel supplier;</li> <li>measurement by the</li> </ol>										

		<p>project participants;</p> <p>c) regional or national default values; or</p> <p>d) IPCC default values provided in table 1.4 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Upper value is applied.</p>
$EF_{elec,j}$	<p>CO<sub>2</sub> emission factor for consumed electricity by the project absorption chiller <math>j</math> [tCO<sub>2</sub>/MWh]</p> <p>When the absorption chiller consumes only grid electricity or captive electricity, the project participant applies the CO<sub>2</sub> emission factor respectively.</p> <p>When both grid electricity and captive electricity may be consumed in the absorption chiller, the project participant applies the CO<sub>2</sub> emission factor with lower value.</p> <p>[CO<sub>2</sub> emission factor]</p> <p>For grid electricity: The most recent value available from the source stated in this table at the time of validation</p> <p>For captive electricity including cogeneration system, it is determined based on the following options:</p> <p>a) Calculated from its power generation efficiency (<math>\eta_{cap,j}</math> [%]) obtained from manufacturer's specification</p> <p>The power generation efficiency based on lower heating value (LHV) of the captive power generation system from the</p>	<p><b>[Grid electricity]</b></p> <p>The most recent value available at the time of validation is applied and fixed for the monitoring period thereafter. The data is sourced from "Emission Factors of Electricity Interconnection Systems", National Committee on Clean Development Mechanism (Indonesian DNA for CDM), based on data obtained by Directorate General of Electricity, Ministry of Energy and Mineral Resources, Indonesia, unless otherwise instructed by the Joint Committee.</p> <p><b>[Captive electricity]</b></p> <p>For the option a) Specification of the captive power generation system connected to the absorption chiller <math>j</math>, provided by the</p>

	<p>manufacturer's specification is applied;</p> $EF_{elec,j} = 3.6 \times \frac{100}{\eta_{cap,j}} \times EF_{fuel,cap,j}$ <p>b) Calculated from measured data The power generation efficiency calculated from monitored data of the amount of fuel input for power generation (<math>FC_{cap,j,p}</math>) and the amount of electricity generated (<math>EG_{cap,j,p}</math>) during the monitoring period <math>p</math> is applied. The measurement is conducted with the monitoring equipment to which calibration certificate is issued by an entity accredited under national/international standards;</p> $EF_{elec,j} = FC_{cap,j,p} \times NCV_{fuel,cap,j} \times EF_{fuel,cap,j} \times \frac{1}{EG_{cap,j,p}}$ <p>Where: <math>NCV_{fuel,cap,j}</math> : Net calorific value of the fuel consumed by the captive power generation system connected to the absorption chiller <math>j</math> [GJ/mass or volume]</p> <p>Note: In case the captive electricity generation system connected to the absorption chiller <math>j</math> meets all of the following conditions, the value in the following table may be applied to <math>EF_{elec,j}</math> depending on the consumed fuel type.</p> <ul style="list-style-type: none"> <li>• The system is non-renewable generation system</li> <li>• Electricity generation capacity of the system is less than or equal to 15 MW</li> </ul> <table border="1" data-bbox="427 1899 962 1973"> <tr> <td data-bbox="427 1899 603 1973">fuel type</td> <td data-bbox="603 1899 762 1973">Diesel fuel</td> <td data-bbox="762 1899 962 1973">Natural gas</td> </tr> </table>	fuel type	Diesel fuel	Natural gas	<p>manufacturer (<math>\eta_{cap,j}</math> [%]). CO<sub>2</sub> emission factor of the fuel consumed by the captive power generation system connected to the absorption chiller <math>j</math> (<math>EF_{fuel,cap,j}</math> [tCO<sub>2</sub>/GJ]) in order of preference: 1) values provided by the fuel supplier; 2) measurement by the project participants; 3) regional or national default values; 4) IPCC default values provided in table 1.4 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Lower value is applied.</p> <p>For the option b) Generated and supplied electricity by the captive power generation system connected to the absorption chiller <math>j</math> (<math>EG_{cap,j,p}</math> [MWh/p]). Fuel amount consumed by the captive power generation system connected to the recipient facility <math>j</math> (<math>FC_{cap,j,p}</math> [mass or volume/p]). Net calorific value (<math>NCV_{fuel,cap,j}</math> [GJ/mass or volume]) and CO<sub>2</sub> emission factor of the fuel</p>
fuel type	Diesel fuel	Natural gas			

	$EF_{elec,i}$	0.8 * <sub>1</sub>	0.46 * <sub>2</sub>	<p><math>(EF_{fuel,cap,j}</math> [tCO<sub>2</sub>/GJ]) in order of preference:</p> <ol style="list-style-type: none"> <li>1) values provided by the fuel supplier;</li> <li>2) measurement by the project participants;</li> <li>3) regional or national default values;</li> <li>4) IPCC default values provided in tables 1.2 and 1.4 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Lower value is applied.</li> </ol> <p>[Captive electricity with diesel fuel] CDM approved small scale methodology: AMS-I.A.</p> <p>[Captive electricity with natural gas] 2006 IPCC Guidelines on National GHG Inventories for the source of EF of natural gas. CDM Methodological tool "Determining the baseline efficiency of thermal or electric energy generation systems version02.0" for the default efficiency for off-grid power plants.</p>
$NCV_{fuel,CL,j}$	<p>Net calorific value of gas fuel consumed by the project absorption chiller <math>j</math> [GJ/mass or volume]</p>			<p>In the order of preference:</p> <ol style="list-style-type: none"> <li>a) values provided by fuel supplier;</li> <li>b) measurement by the</li> </ol>

		<p>project participants;</p> <p>c) regional or national default values; or</p> <p>d) IPCC default values provided in table 1.2 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Upper value is applied.</p>
$EF_{fuel,CLj}$	CO <sub>2</sub> emission factor for gas fuel consumed by the project absorption chiller $j$ [tCO <sub>2</sub> /GJ]	<p>In order of preference:</p> <p>a) values provided by fuel supplier;</p> <p>b) measurement by the project participants;</p> <p>c) regional or national default values; or</p> <p>d) IPCC default values provided in table 1.4 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Upper value is applied.</p>

History of the document

Version	Date	Contents revised
<a href="#">01.1</a>	<a href="#">18 December 2024</a>	<a href="#">JC10</a> <a href="#">Revision to:</a> <a href="#">Supplementary information about electricity consumption by project absorption chiller is added in Section G.</a>
01.0	17 September 2020	Electronic decision by the Joint Committee Initial approval.

**Monitoring Plan Sheet (Input Sheet) [Attachment to Project Design Document]**

**Table 1: Parameters to be monitored ex post**

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Monitoring point No.	Parameters	Description of data	Estimated Values	Units	Monitoring option	Source of data	Measurement methods and procedures	Monitoring frequency	Other comments
(1)	EC <sub>i,p</sub>	Electricity consumption by the recipient facility <i>i</i> which is generated by the CGS during the period <i>p</i>	-	MWh/p	Option C	Monitored data	<p>Measuring instrument(s) is installed at the point(s) where the amount of electricity consumed by the recipient facility <i>i</i> which is generated by the CGS can be measured.</p> <p>The measuring instrument(s) is replaced or calibrated at an interval following the regulations in the country in which the measuring instrument(s) is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the measuring instrument(s) has been prepared by the time of validation.</p>	Continuously	Input on "MPS(input_separate)" sheet
(2)	HC <sub>i,p</sub>	Heating energy consumption by the recipient facility <i>i</i> which is generated by the CGS during the period <i>p</i>	-	GJ/p	Option C	Monitored data	<p>Measuring instrument(s) is installed at the point(s) where the amount of heating energy consumed by the recipient facility <i>i</i> which is generated by the CGS can be measured.</p> <p>The measuring instrument(s) is replaced or calibrated at an interval following the regulations in the country in which the measuring instrument(s) is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the measuring instrument(s) has been prepared by the time of validation.</p>	Continuously	Input on "MPS(input_separate)" sheet
(3)	C <sub>P,j,p</sub>	Cooling energy generated by the project absorption chiller <i>j</i> during the period <i>p</i>	-	MWh/p	Option C	Monitored data	<p>Measuring instrument(s) is installed at the point(s) where the amount of cooling energy consumed by the recipient facility <i>i</i> which is generated by the CGS can be measured.</p> <p>The measuring instrument(s) is replaced or calibrated at an interval following the regulations in the country in which the measuring instrument(s) is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the measuring instrument(s) has been prepared by the time of validation.</p>	Continuously	Input on "MPS(input_separate)" sheet
(4)	FC <sub>P,j,CGS,p</sub>	Gas fuel consumption by the CGS during the period <i>p</i>		mass or volume/p	Option B or Option C	Invoice or Monitored data	<p>[Option B] Data on invoice provided by gas fuel supplier</p> <p>[Option C] The measuring instrument(s) is replaced or calibrated at an interval following the regulations in the country in which the measuring instrument(s) is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the measuring instrument(s) has been prepared by the time of validation.</p>	Monthly or Continuously	
(5)	EC <sub>P,CL,j,p</sub>	Electricity consumption by project absorption chiller <i>j</i> during the period <i>p</i>	-	MWh/p	Option C	Monitored data	<p>The measuring instrument(s) is replaced or calibrated at an interval following the regulations in the country in which the measuring instrument(s) is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the measuring instrument(s) has been prepared by the time of validation.</p> <p>When project absorption chiller consumes electricity only generated by the project CGS, this parameter can be omitted or equal to zero (0), since CO<sub>2</sub> emissions from electricity consumption by project absorption chiller are included in project emissions from the CGS.</p>	Continuously	Input on "MPS(input_separate)" sheet

(6)	$FC_{P,j,CL,j,p}$	Gas fuel consumption by project absorption chiller $j$ during the period $p$	-	$Nm^3/p$	Option C	Monitored data	The measuring instrument(s) is replaced or calibrated at an interval following the regulations in the country in which the measuring instrument(s) is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the measuring instrument(s) has been prepared by the time of validation.	Monthly or Continuously	Input on "MPS(input_separate)" sheet
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Table 1-annex: Parameters to be monitored *ex post* (in case of  $EF_{elec,i}$  and or  $EF_{elec,j}$  is calculated from measured data)

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Monitoring point No.	Parameters	Description of data	Estimated Values	Units	Monitoring option	Source of data	Measurement methods and procedures	Monitoring frequency	Other comments
(7)	$FC_{cap,i,p}$	Amount of fuel consumed by the captive power generation system connected to the recipient facility <i>i</i> during the period <i>p</i>	-	mass or volume/p	Option B or Option C	Invoice or Monitored data	[Option B] Data on invoice provided by gas fuel supplier  [Option C] The measuring instrument(s) is replaced or calibrated at an interval following the regulations in the country in which the measuring instrument(s) is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the measuring instrument(s) has been prepared by the time of validation.	Monthly or Continuously	Input on "MPS(input_separate)" sheet
(8)	$EG_{cap,i,p}$	Amount of electricity generated by the captive power generation system connected to the recipient facility <i>i</i> during the period <i>p</i>	-	MWh/p	Option C	Monitored data	Measuring instrument(s) is installed at the point(s) where the amount of electricity generated by the captive power generation system connected to the recipient facility <i>i</i> can be measured.  The measuring instrument(s) is replaced or calibrated at an interval following the regulations in the country in which the measuring instrument(s) is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the measuring instrument(s) has been prepared by the time of validation.	Continuously	Input on "MPS(input_separate)" sheet
(9)	$FC_{cap,i,p}$	Amount of fuel consumed by the captive power generation system connected to the absorption chiller <i>j</i> during the period <i>p</i>	-	mass or volume/p	Option B or Option C	Invoice or Monitored data	[Option B] Data on invoice provided by gas fuel supplier  [Option C] The measuring instrument(s) is replaced or calibrated at an interval following the regulations in the country in which the measuring instrument(s) is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the measuring instrument(s) has been prepared by the time of validation.	Monthly or Continuously	Input on "MPS(input_separate)" sheet
(10)	$EG_{cap,i,p}$	Amount of electricity generated by the captive power generation system connected to the absorption chiller <i>j</i> during the period <i>p</i>	-	MWh/p	Option C	Monitored data	Measuring instrument(s) is installed at the point(s) where the amount of electricity generated by the captive power generation system connected to the absorption chiller <i>j</i> can be measured.  The measuring instrument(s) is replaced or calibrated at an interval following the regulations in the country in which the measuring instrument(s) is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the measuring instrument(s) has been prepared by the time of validation.	Continuously	Input on "MPS(input_separate)" sheet

Table 2: Project-specific parameters to be fixed *ex ante*

(a)	(b)	(c)	(d)	(e)	(f)
Parameters	Description of data	Estimated Values	Units	Source of data	Other comments
$\eta_{RE}$	Reference boiler efficiency	89.0	%	Value derived from the result of survey. The default value, 89 [%], should be revised if necessary.	
$NCV_{fuel,CGS}$	Net calorific value of gas fuel consumed by the CGS		GJ/mass or volume	In the order of preference: a) values provided by fuel supplier; b) measurement by the project participants; c) regional or national default values; or d) IPCC default values provided in table 1.2 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Upper value is applied.	
$EF_{fuel,RE}$	CO <sub>2</sub> emission factor for fossil fuel consumed by the reference boiler (CO <sub>2</sub> emission factor of natural gas is applied in this methodology)		tCO <sub>2</sub> /GJ	In the order of preference: a) values provided by fuel supplier; b) measurement by the project participants; c) regional or national default values; or d) IPCC default values provided in table 1.4 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Lower value is applied.	
$EF_{fuel,CGS}$	CO <sub>2</sub> emission factor for gas fuel consumed by the CGS		tCO <sub>2</sub> /GJ	In the order of preference: a) values provided by fuel supplier; b) measurement by the project participants; c) regional or national default values; or d) IPCC default values provided in table 1.4 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Upper value is applied.	
$EF_{elec,i}$	<b>[For grid electricity]</b> CO <sub>2</sub> emission factor for consumed electricity in the recipient facility <i>i</i>	-	tCO <sub>2</sub> /MWh	The most recent value available at the time of validation is applied and fixed for the monitoring period thereafter. The data is sourced from "Emission Factors of Electricity Interconnection Systems", National Committee on Clean Development Mechanism (Indonesian DNA for CDM), based on data obtained by Directorate General of Electricity, Ministry of Energy and Mineral Resources, Indonesia, unless otherwise instructed by the Joint Committee.	Input on "MPS(input_separate)" sheet
$EF_{elec,i}$	<b>[For captive electricity]</b> CO <sub>2</sub> emission factor for consumed electricity in the recipient facility <i>i</i> <b>Option a</b>	-	tCO <sub>2</sub> /MWh	Power generation efficiency obtained from manufacturer's specification; and CO <sub>2</sub> emission factor for the fuel consumed by the captive power generation system connected to the recipient facility <i>i</i> .	Calculated
$EF_{elec,i}$	<b>[For captive electricity]</b> CO <sub>2</sub> emission factor for consumed electricity in the recipient facility <i>i</i> <b>Option b</b>	-	tCO <sub>2</sub> /MWh	The power generation efficiency calculated from monitored data of the amount of fuel input for power generation and the amount of electricity generated; Net calorific value of the fuel consumed by the captive power generation system connected to the recipient facility <i>i</i> ; and CO <sub>2</sub> emission factor for the fuel consumed by the captive power generation system connected to the recipient facility <i>i</i> .	Calculated

EF <sub>elec,i</sub>	<b>[For captive electricity]</b> CO <sub>2</sub> emission factor for consumed electricity in the recipient facility <i>i</i>	-	tCO <sub>2</sub> /MWh	[Captive electricity with diesel fuel] CDM approved small scale methodology: AMS-I.A.  [Captive electricity with natural gas] 2006 IPCC Guidelines on National GHG Inventories for the source of EF of natural gas. CDM Methodological tool "Determining the baseline efficiency of thermal or electric energy generation systems version02.0" for the default efficiency for off-grid power plants.	Input on "MPS(input_separate)" sheet
η <sub>cap,i</sub>	Power generation efficiency of the captive power generation system connected to the recipient facility <i>i</i>	-	%	Specification of the captive power generation system connected to the recipient facility <i>i</i> , provided by the manufacturer.	Input on "MPS(input_separate)" sheet
NCV <sub>fuel,cap,i</sub>	Net calorific value of the fuel consumed by the captive power generation system connected to the recipient facility <i>i</i>	-	GJ/mass or volume	In the order of preference: a) values provided by fuel supplier; b) measurement by the project participants; c) regional or national default values; or d) IPCC default values provided in table 1.2 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Lower value is applied.	Input on "MPS(input_separate)" sheet
EF <sub>fuel,cap,i</sub>	CO <sub>2</sub> emission factor for the fuel consumed by the captive power generation system connected to the recipient facility <i>i</i>	-	tCO <sub>2</sub> /GJ	In the order of preference: a) values provided by fuel supplier; b) measurement by the project participants; c) regional or national default values; or d) IPCC default values provided in table 1.4 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Lower value is applied.	Input on "MPS(input_separate)" sheet
COP <sub>RE,j</sub>	COP of reference chiller <i>j</i>	-	dimensionless	Specifications of project chiller <i>j</i> prepared for the quotation or factory acceptance test data by manufacturer.  The default COP values are derived from the result of survey on COP of chillers from manufacturers that have high market share. The survey should prove the use of clear methodology. The default COP values should be revised if necessary from survey result which is conducted by JC or project participants.	Input on "MPS(input_separate)" sheet
EF <sub>elec,j</sub>	<b>[For grid electricity]</b> CO <sub>2</sub> emission factor for consumed electricity by the project absorption chiller <i>j</i>	-	tCO <sub>2</sub> /MWh	The most recent value available at the time of validation is applied and fixed for the monitoring period thereafter. The data is sourced from "Emission Factors of Electricity Interconnection Systems", National Committee on Clean Development Mechanism (Indonesian DNA for CDM), based on data obtained by Directorate General of Electricity, Ministry of Energy and Mineral Resources, Indonesia, unless otherwise instructed by the Joint Committee.	Input on "MPS(input_separate)" sheet
EF <sub>elec,j</sub>	<b>[For captive electricity]</b> CO <sub>2</sub> emission factor for consumed electricity by the project absorption chiller <i>j</i> <b>Option a</b>	-	tCO <sub>2</sub> /MWh	Power generation efficiency obtained from manufacturer's specification; and CO <sub>2</sub> emission factor for the fuel consumed by the captive power generation system connected to the project absorption chiller <i>j</i> .	Calculated
EF <sub>elec,j</sub>	<b>[For captive electricity]</b> CO <sub>2</sub> emission factor for consumed electricity by the project absorption chiller <i>j</i> <b>Option b</b>	-	tCO <sub>2</sub> /MWh	The power generation efficiency calculated from monitored data of the amount of fuel input for power generation and the amount of electricity generated; Net calorific value of the fuel consumed by the captive power generation system connected to the project absorption chiller <i>j</i> ; and CO <sub>2</sub> emission factor for the fuel consumed by the captive power generation system connected to the project absorption chiller <i>j</i> .	Calculated

EF <sub>elec,j</sub>	<b>[For captive electricity]</b> CO <sub>2</sub> emission factor for consumed electricity by the project absorption chiller <i>j</i>	-	tCO <sub>2</sub> /MWh	[Captive electricity with diesel fuel] CDM approved small scale methodology: AMS-I.A.  [Captive electricity with natural gas] 2006 IPCC Guidelines on National GHG Inventories for the source of EF of natural gas. CDM Methodological tool "Determining the baseline efficiency of thermal or electric energy generation systems version02.0" for the default efficiency for off-grid power plants.	Input on "MPS(input_separate)" sheet
η <sub>cap,j</sub>	Power generation efficiency of the captive power generation system connected to the project absorption chiller <i>j</i>	-	%	Specification of the captive power generation system connected to the project absorption chiller <i>j</i> , provided by the manufacturer.	Input on "MPS(input_separate)" sheet
NCV <sub>fuel,cap,j</sub>	Net calorific value of the fuel consumed by the captive power generation system connected to the project absorption chiller <i>j</i>	-	GJ/mass or volume	In the order of preference: a) values provided by fuel supplier; b) measurement by the project participants; c) regional or national default values; or d) IPCC default values provided in table 1.2 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Lower value is applied.	Input on "MPS(input_separate)" sheet
EF <sub>fuel,cap,j</sub>	CO <sub>2</sub> emission factor for the fuel consumed by the captive power generation system connected to the project absorption chiller <i>j</i>	-	tCO <sub>2</sub> /GJ	In the order of preference: a) values provided by fuel supplier; b) measurement by the project participants; c) regional or national default values; or d) IPCC default values provided in table 1.4 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Lower value is applied.	Input on "MPS(input_separate)" sheet
NCV <sub>fuel,CL,j</sub>	Net calorific value of gas fuel consumed by the project absorption chiller <i>j</i>	-	GJ/mass or volume	In the order of preference: a) values provided by fuel supplier; b) measurement by the project participants; c) regional or national default values; or d) IPCC default values provided in table 1.2 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Upper value is applied.	Input on "MPS(input_separate)" sheet
EF <sub>fuel,CL,j</sub>	CO <sub>2</sub> emission factor for gas fuel consumed by the project absorption chiller <i>j</i>	-	tCO <sub>2</sub> /GJ	In the order of preference: a) values provided by fuel supplier; b) measurement by the project participants; c) regional or national default values; or d) IPCC default values provided in table 1.4 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Lower value is applied.	Input on "MPS(input_separate)" sheet

Table3: Ex-ante estimation of CO<sub>2</sub> emission reductions

CO <sub>2</sub> emission reductions	Units
0	tCO <sub>2</sub> /p

[Monitoring option]

Option A	Based on public data which is measured by entities other than the project participants (Data used: publicly recognized data such as statistical data and specifications)
Option B	Based on the amount of transaction which is measured directly using measuring equipments (Data used: commercial evidence such as invoices)
Option C	Based on the actual measurement using measuring equipments (Data used: measured values)

Monitoring Plan Sheet (Input Separate Sheet) [Attachment to Project Design Document]

Table 4: Ex-ante estimation of reference emissions for electricity consumed by the recipient facility which is generated by the CGS

parameters	Identification No.	Parameters to be monitored ex post				Project-specific parameters to be fixed ex ante							Ex-ante estimation of reference emissions
		EC <sub>ij,p</sub>	FC <sub>ref(i),p</sub>	EQ <sub>ref(i),p</sub>	EF <sub>ref(i),j</sub>	EF <sub>ref(i),j</sub>	EF <sub>ref(i),j</sub>	EF <sub>ref(i),j</sub>	η <sub>ref(i),j</sub>	NCV <sub>ref(i),ref(j),p</sub>	EF <sub>ref(i),ref(j),p</sub>	RE <sub>ref(i),j,p</sub>	
Description of data	Identification number for the recipient facility to which electricity and heat generated by the CGS is supplied	Electricity consumption by the recipient facility <i>i</i> which is generated by the CGS during the period <i>p</i>	Amount of fuel consumed by the captive power generation system connected to the recipient facility <i>i</i> during the period <i>p</i>	Amount of electricity generated by the captive power generation system connected to the recipient facility <i>i</i> during the period <i>p</i>	[For grid electricity] CO <sub>2</sub> emission factor for consumed electricity in the recipient facility <i>i</i>	[For captive electricity] CO <sub>2</sub> emission factor for consumed electricity in the recipient facility <i>i</i>	[For captive electricity] CO <sub>2</sub> emission factor for consumed electricity in the recipient facility <i>i</i>	[For captive electricity] CO <sub>2</sub> emission factor for consumed electricity in the recipient facility <i>i</i>	Power generation efficiency of the captive power generation system connected to the recipient facility <i>i</i>	Net calorific value of the fuel consumed by the captive power generation system connected to the recipient facility <i>i</i>	CO <sub>2</sub> emission factor for the fuel consumed by the captive power generation system connected to the recipient facility <i>i</i>	Reference emissions for electricity consumed by the recipient facility <i>i</i> which is generated by the CGS during the period <i>p</i>	
Units	-	MWh/p	mass or volume/p	MWh/p	tCO <sub>2</sub> /MWh	tCO <sub>2</sub> /MWh	tCO <sub>2</sub> /MWh	tCO <sub>2</sub> /MWh	%	GJ/mass or volume	tCO <sub>2</sub> /GJ	tCO <sub>2</sub> /p	
Estimated Values	1					0.000	0.000					0.00	
	2					0.000	0.000					0.00	
	3					0.000	0.000					0.00	
	4					0.000	0.000					0.00	
	5					0.000	0.000					0.00	
	6					0.000	0.000					0.00	
	7					0.000	0.000					0.00	
	8					0.000	0.000					0.00	
	9					0.000	0.000					0.00	
	10					0.000	0.000					0.00	
Total	-	-			-	-	-	-	-	-	-	0.00	

Table 5: Ex-ante estimation of reference emissions for heating energy consumed by the recipient facility which is generated by the CGS

parameters	Identification No.	Parameters to be monitored ex post		Project-specific parameters to be fixed ex ante		Ex-ante estimation of reference emissions
		HC <sub>ij,p</sub>	η <sub>ref</sub>	EF <sub>fuel,ref</sub>	RE <sub>fuel,ref,p</sub>	
Description of data	Identification number for the recipient facility to which electricity and heat generated by the CGS is supplied	Heating energy consumption by the recipient facility <i>i</i> which is generated by the CGS during the period <i>p</i>	Reference boiler efficiency	CO <sub>2</sub> emission factor for fossil fuel consumed by the reference boiler (CO <sub>2</sub> emission factor of natural gas is applied in this methodology)	Reference emissions for heat consumed by the recipient facility <i>i</i> which is generated by the CGS during the period <i>p</i>	
Units	-	GJ/p	%	tCO <sub>2</sub> /GJ	tCO <sub>2</sub> /p	
Estimated Values	1		89.0	0	0.00	
	2		89.0	0	0.00	
	3		89.0	0	0.00	
	4		89.0	0	0.00	
	5		89.0	0	0.00	
	6		89.0	0	0.00	
	7		89.0	0	0.00	
	8		89.0	0	0.00	
	9		89.0	0	0.00	
	10		89.0	0	0.00	
Total	-	-	-	-	0.00	

Table 6: Ex-ante estimation of reference emissions and project emissions by reference chiller

parameters	Identification No.	Parameters to be monitored ex post				Parameters to be monitored ex post (in case of EF <sub>ref(i),j</sub> is calculated from measured data)		Project-specific parameters to be fixed ex ante								Ex-ante estimation of reference emissions	Ex-ante estimation of project emissions		
		C <sub>ref(i),j,p</sub>	EC <sub>ref(i),j,p</sub>	FC <sub>ref(i),j,p</sub>	FC <sub>ref(i),j,p</sub>	EQ <sub>ref(i),j,p</sub>	COP <sub>ref(i),j</sub>	EF <sub>ref(i),j</sub>	EF <sub>ref(i),j</sub>	EF <sub>ref(i),j</sub>	EF <sub>ref(i),j</sub>	EF <sub>ref(i),j</sub>	η <sub>ref(i),j</sub>	NCV <sub>ref(i),ref(j),p</sub>	EF <sub>ref(i),ref(j),p</sub>			NCV <sub>ref(i),ref(j),p</sub>	EF <sub>ref(i),ref(j),p</sub>
Description of data	Identification number of the project absorption chiller	Cooling energy generated by the project absorption chiller <i>j</i> during the period <i>p</i>	Electricity consumption by project absorption chiller <i>j</i> during the period <i>p</i>	Gas fuel consumption by project absorption chiller <i>j</i> during the period <i>p</i>	Amount of fuel consumed by the captive power generation system connected to the absorption chiller <i>j</i> during the period <i>p</i>	Amount of electricity generated by the captive power generation system connected to the absorption chiller <i>j</i> during the period <i>p</i>	COP of reference chiller <i>j</i>	[For grid electricity] CO <sub>2</sub> emission factor for consumed electricity by the project absorption chiller <i>j</i>	[For captive electricity] CO <sub>2</sub> emission factor for consumed electricity by the project absorption chiller <i>j</i>	[For captive electricity] CO <sub>2</sub> emission factor for consumed electricity by the project absorption chiller <i>j</i>	[For captive electricity] CO <sub>2</sub> emission factor for consumed electricity by the project absorption chiller <i>j</i>	[For captive electricity] CO <sub>2</sub> emission factor for consumed electricity by the project absorption chiller <i>j</i>	Power generation efficiency of the captive power generation system connected to the project absorption chiller <i>j</i>	Net calorific value of the fuel consumed by the captive power generation system connected to the project absorption chiller <i>j</i>	CO <sub>2</sub> emission factor for the fuel consumed by the captive power generation system connected to the project absorption chiller <i>j</i>	Net calorific value of gas fuel consumed by the project absorption chiller <i>j</i>	CO <sub>2</sub> emission factor for gas fuel consumed by the project absorption chiller <i>j</i>	Reference emissions by reference chiller <i>j</i> during the period <i>p</i>	Project emissions by reference chiller <i>j</i> during the period <i>p</i>
Units	-	MWh/p	MWh/p	Nm <sup>3</sup> /p	mass or volume/p	MWh/p	dimensionless	tCO <sub>2</sub> /MWh	tCO <sub>2</sub> /MWh	tCO <sub>2</sub> /MWh	tCO <sub>2</sub> /MWh	tCO <sub>2</sub> /MWh	%	GJ/mass or volume	tCO <sub>2</sub> /GJ	GJ/mass or volume	tCO <sub>2</sub> /GJ	tCO <sub>2</sub> /p	tCO <sub>2</sub> /p
Estimated Values	1									0.000	0.000							0.00	0.00
	2									0.000	0.000							0.00	0.00
	3									0.000	0.000							0.00	0.00
	4									0.000	0.000							0.00	0.00
	5									0.000	0.000							0.00	0.00
	6									0.000	0.000							0.00	0.00
	7									0.000	0.000							0.00	0.00
	8									0.000	0.000							0.00	0.00
	9									0.000	0.000							0.00	0.00
	10									0.000	0.000							0.00	0.00
	11									0.000	0.000							0.00	0.00
	12									0.000	0.000							0.00	0.00
	13									0.000	0.000							0.00	0.00
	14									0.000	0.000							0.00	0.00
	15									0.000	0.000							0.00	0.00
	16									0.000	0.000							0.00	0.00
	17									0.000	0.000							0.00	0.00
	18									0.000	0.000							0.00	0.00
	19									0.000	0.000							0.00	0.00
	20									0.000	0.000							0.00	0.00
Total	-	-								-	-							0.00	0.00

**Monitoring Plan Sheet (Calculation Process Sheet) [Attachment to Project Design Document]**

1. Calculations for emission reductions		Fuel type	Value	Units	Parameter
Emission reductions during the period <i>p</i>		N/A	0.00	tCO <sub>2</sub> /p	ER <sub>p</sub>
2. Selected default values, etc.					
Reference boiler efficiency		N/A	89.0	%	η <sub>RE</sub>
3. Calculations for reference emissions					
Reference emissions during the period <i>p</i>		N/A	0.00	tCO <sub>2</sub> /p	RE <sub>p</sub>
Reference emissions for electricity consumed by the recipient facility(ies) which is generated by the CGS		N/A	0.00	tCO <sub>2</sub> /p	RE <sub>elec,i,p</sub>
Reference emissions for heat consumed by the recipient facility(ies) which is generated by the CGS		N/A	0.00	tCO <sub>2</sub> /p	RE <sub>heat,i,p</sub>
Reference emissions by reference chiller		N/A	0.00	tCO <sub>2</sub> /p	RE <sub>chiller,j,p</sub>
4. Calculations of the project emissions					
Project emissions during the period <i>p</i>		N/A	0.00	tCO <sub>2</sub> /p	PE <sub>p</sub>
Project emissions from the CGS during the period <i>p</i>		Gas	0.00	tCO <sub>2</sub> /p	PE <sub>PJ,CGS,p</sub>
Gas fuel consumption by the CGS during the period <i>p</i>		Gas	0.00	mass or volume/p	FC <sub>CGS,p</sub>
Net calorific value of gas fuel consumed by the CGS		Gas	0.0000	GJ/mass or volume	NCV <sub>fuel,CGS</sub>
CO <sub>2</sub> emission factor for gas fuel consumed by the CGS		Gas	0.0000	tCO <sub>2</sub> /GJ	EF <sub>fuel,PJ</sub>
Project emissions from project absorption chiller during the period <i>p</i>		N/A	0.00	tCO <sub>2</sub> /p	PE <sub>PJ,chiller,p</sub>

[List of Default Values]

η <sub>RE</sub>	Reference boiler efficiency	89.0	%
COP <sub>RE,j</sub>	Cooling capacity per unit (300<=x<=350USRt)	5.46	-
	Cooling capacity per unit (350<x<=550USRt)	5.69	-
	Cooling capacity per unit (550<x<=750USRt)	5.90	-
	Cooling capacity per unit (750<x<=1300USRt)	6.03	-

**Monitoring Structure Sheet [Attachment to Project Design Document]**

Responsible personnel	Role

**Monitoring Report Sheet (Input Sheet) [For Verification]**

**Table 1: Parameters monitored ex post**

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
Monitoring period	Monitoring point No.	Parameters	Description of data	Monitored Values	Units	Monitoring option	Source of data	Measurement methods and procedures	Monitoring frequency	Other comments
	(1)	EC <sub>i,p</sub>	Electricity consumption by the recipient facility <i>i</i> which is generated by the CGS during the period <i>p</i>	-	MWh/p	Option C	Monitored data	<p>Measuring instrument(s) is installed at the point(s) where the amount of electricity consumed by the recipient facility <i>i</i> which is generated by the CGS can be measured.</p> <p>The measuring instrument(s) is replaced or calibrated at an interval following the regulations in the country in which the measuring instrument(s) is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the measuring instrument(s) has been prepared by the time of validation.</p>	Continuously	Input on "MRS(input_separate)" sheet
	(2)	HC <sub>i,p</sub>	Heating energy consumption by the recipient facility <i>i</i> which is generated by the CGS during the period <i>p</i>	-	GJ/p	Option C	Monitored data	<p>Measuring instrument(s) is installed at the point(s) where the amount of heating energy consumed by the recipient facility <i>i</i> which is generated by the CGS can be measured.</p> <p>The measuring instrument(s) is replaced or calibrated at an interval following the regulations in the country in which the measuring instrument(s) is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the measuring instrument(s) has been prepared by the time of validation.</p>	Continuously	Input on "MRS(input_separate)" sheet
	(3)	C <sub>PJ,j,p</sub>	Cooling energy generated by the project absorption chiller <i>j</i> during the period <i>p</i>	-	MWh/p	Option C	Monitored data	<p>Measuring instrument(s) is installed at the point(s) where the amount of cooling energy consumed by the recipient facility <i>i</i> which is generated by the CGS can be measured.</p> <p>The measuring instrument(s) is replaced or calibrated at an interval following the regulations in the country in which the measuring instrument(s) is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the measuring instrument(s) has been prepared by the time of validation.</p>	Continuously	Input on "MRS(input_separate)" sheet
	(4)	FC <sub>PJ,CGS,p</sub>	Gas fuel consumption by the CGS during the period <i>p</i>		mass or volume/p	Option B or Option C	Invoice or Monitored data	<p>[Option B] Data on invoice provided by gas fuel supplier</p> <p>[Option C] The measuring instrument(s) is replaced or calibrated at an interval following the regulations in the country in which the measuring instrument(s) is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the measuring instrument(s) has been prepared by the time of validation.</p>	Monthly or Continuously	
	(5)	EC <sub>PJ,CL,j,p</sub>	Electricity consumption by project absorption chiller <i>j</i> during the period <i>p</i>	-	MWh/p	Option C	Monitored data	<p>The measuring instrument(s) is replaced or calibrated at an interval following the regulations in the country in which the measuring instrument(s) is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the measuring instrument(s) has been prepared by the time of validation.</p> <p><b>When project absorption chiller consumes electricity only generated by the project CGS, this parameter can be omitted or equal to zero (0), since CO<sub>2</sub> emissions from electricity consumption by project absorption chiller are included in project emissions from the CGS.</b></p>	Continuously	Input on "MRS(input_separate)" sheet
	(6)	FC <sub>PJ,CL,j,p</sub>	Gas fuel consumption by project absorption chiller <i>j</i> during the period <i>p</i>	-	Nm <sup>3</sup> /p	Option C	Monitored data	<p>The measuring instrument(s) is replaced or calibrated at an interval following the regulations in the country in which the measuring instrument(s) is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the measuring instrument(s) has been prepared by the time of validation.</p>	Monthly or Continuously	Input on "MRS(input_separate)" sheet

Table 1-annex: Parameters monitored *ex post* (in case of  $EF_{elec,i}$  and or  $EF_{elec,j}$  is calculated from measured data)

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
Monitoring period	Monitoring point No.	Parameters	Description of data	Monitored Values	Units	Monitoring option	Source of data	Measurement methods and procedures	Monitoring frequency	Other comments
	(7)	$FC_{cap,i,p}$	Amount of fuel consumed by the captive power generation system connected to the recipient facility <i>i</i> during the period <i>p</i>	-	mass or volume/p	Option B or Option C	Invoice or Monitored data	[Option B] Data on invoice provided by gas fuel supplier  [Option C] The measuring instrument(s) is replaced or calibrated at an interval following the regulations in the country in which the measuring instrument(s) is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the measuring instrument(s) has been prepared by the time of validation.	Monthly or Continuously	Input on "MRS(input_separate)" sheet
	(8)	$EG_{cap,i,p}$	Amount of electricity generated by the captive power generation system connected to the recipient facility <i>i</i> during the period <i>p</i>	-	MWh/p	Option C	Monitored data	Measuring instrument(s) is installed at the point(s) where the amount of electricity generated by the captive power generation system connected to the recipient facility <i>i</i> can be measured.  The measuring instrument(s) is replaced or calibrated at an interval following the regulations in the country in which the measuring instrument(s) is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the measuring instrument(s) has been prepared by the time of validation.	Continuously	Input on "MRS(input_separate)" sheet
	(9)	$FC_{cap,i,p}$	Amount of fuel consumed by the captive power generation system connected to the absorption chiller <i>j</i> during the period <i>p</i>	-	mass or volume/p	Option B or Option C	Invoice or Monitored data	[Option B] Data on invoice provided by gas fuel supplier  [Option C] The measuring instrument(s) is replaced or calibrated at an interval following the regulations in the country in which the measuring instrument(s) is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the measuring instrument(s) has been prepared by the time of validation.	Monthly or Continuously	Input on "MRS(input_separate)" sheet
	(10)	$EG_{cap,i,p}$	Amount of electricity generated by the captive power generation system connected to the absorption chiller <i>j</i> during the period <i>p</i>	-	MWh/p	Option C	Monitored data	Measuring instrument(s) is installed at the point(s) where the amount of electricity generated by the captive power generation system connected to the absorption chiller <i>j</i> can be measured.  The measuring instrument(s) is replaced or calibrated at an interval following the regulations in the country in which the measuring instrument(s) is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the measuring instrument(s) has been prepared by the time of validation.	Continuously	Input on "MRS(input_separate)" sheet

Table 2: Project-specific parameters fixed ex ante

(a)	(b)	(c)	(d)	(e)	(f)
Parameters	Description of data	Estimated Values	Units	Source of data	Other comments
$\eta_{RE}$	Reference boiler efficiency	89.0	%	Value derived from the result of survey. The default value, 89 [%], should be revised if necessary.	
$NCV_{fuel,CGS}$	Net calorific value of gas fuel consumed by the CGS	0.0000	GJ/mass or volume	In the order of preference: a) values provided by fuel supplier; b) measurement by the project participants; c) regional or national default values; or d) IPCC default values provided in table 1.2 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Upper value is applied.	
$EF_{fuel,RE}$	CO <sub>2</sub> emission factor for fossil fuel consumed by the reference boiler (CO <sub>2</sub> emission factor of natural gas is applied in this methodology)	0.0000	tCO <sub>2</sub> /GJ	In the order of preference: a) values provided by fuel supplier; b) measurement by the project participants; c) regional or national default values; or d) IPCC default values provided in table 1.4 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Lower value is applied.	
$EF_{fuel,CGS}$	CO <sub>2</sub> emission factor for gas fuel consumed by the CGS	0.0000	tCO <sub>2</sub> /GJ	In the order of preference: a) values provided by fuel supplier; b) measurement by the project participants; c) regional or national default values; or d) IPCC default values provided in table 1.4 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Upper value is applied.	
$EF_{elec,i}$	<b>[For grid electricity]</b> CO <sub>2</sub> emission factor for consumed electricity in the recipient facility <i>i</i>	-	tCO <sub>2</sub> /MWh	The most recent value available at the time of validation is applied and fixed for the monitoring period thereafter. The data is sourced from "Emission Factors of Electricity Interconnection Systems", National Committee on Clean Development Mechanism (Indonesian DNA for CDM), based on data obtained by Directorate General of Electricity, Ministry of Energy and Mineral Resources, Indonesia, unless otherwise instructed by the Joint Committee.	Input on "MPS(input_separate)" sheet
$EF_{elec,i}$	<b>[For captive electricity]</b> CO <sub>2</sub> emission factor for consumed electricity in the recipient facility <i>i</i> <b>Option a</b>	-	tCO <sub>2</sub> /MWh	Power generation efficiency obtained from manufacturer's specification; and CO <sub>2</sub> emission factor for the fuel consumed by the captive power generation system connected to the recipient facility <i>i</i> .	Calculated
$EF_{elec,i}$	<b>[For captive electricity]</b> CO <sub>2</sub> emission factor for consumed electricity in the recipient facility <i>i</i> <b>Option b</b>	-	tCO <sub>2</sub> /MWh	The power generation efficiency calculated from monitored data of the amount of fuel input for power generation and the amount of electricity generated; Net calorific value of the fuel consumed by the captive power generation system connected to the recipient facility <i>i</i> ; and CO <sub>2</sub> emission factor for the fuel consumed by the captive power generation system connected to the recipient facility <i>i</i> .	Calculated
$EF_{elec,i}$	<b>[For captive electricity]</b> CO <sub>2</sub> emission factor for consumed electricity in the recipient facility <i>i</i>	-	tCO <sub>2</sub> /MWh	[Captive electricity with diesel fuel] CDM approved small scale methodology: AMS-I.A.  [Captive electricity with natural gas] 2006 IPCC Guidelines on National GHG Inventories for the source of EF of natural gas. CDM Methodological tool "Determining the baseline efficiency of thermal or electric energy generation systems version02.0" for the default efficiency for off-grid power plants.	Input on "MPS(input_separate)" sheet

$\eta_{cap,i}$	Power generation efficiency of the captive power generation system connected to the recipient facility <i>i</i>	-	%	Specification of the captive power generation system connected to the recipient facility <i>i</i> , provided by the manufacturer.	Input on "MPS(input_separate)" sheet
$NCV_{fuel, cap,i}$	Net calorific value of the fuel consumed by the captive power generation system connected to the recipient facility <i>i</i>	-	GJ/mass or volume	In the order of preference: a) values provided by fuel supplier; b) measurement by the project participants; c) regional or national default values; or d) IPCC default values provided in table 1.2 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Lower value is applied.	Input on "MPS(input_separate)" sheet
$EF_{fuel, cap,i}$	CO <sub>2</sub> emission factor for the fuel consumed by the captive power generation system connected to the recipient facility <i>i</i>	-	tCO <sub>2</sub> /GJ	In the order of preference: a) values provided by fuel supplier; b) measurement by the project participants; c) regional or national default values; or d) IPCC default values provided in table 1.4 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Lower value is applied.	Input on "MPS(input_separate)" sheet
$COP_{RE,j}$	COP of reference chiller <i>j</i>	-	dimensionless	Specifications of project chiller <i>j</i> prepared for the quotation or factory acceptance test data by manufacturer.  The default COP values are derived from the result of survey on COP of chillers from manufacturers that have high market share. The survey should prove the use of clear methodology. The default COP values should be revised if necessary from survey result which is conducted by JC or project participants.	Input on "MPS(input_separate)" sheet
$EF_{elec,j}$	<b>[For grid electricity]</b> CO <sub>2</sub> emission factor for consumed electricity by the project absorption chiller <i>j</i>	-	tCO <sub>2</sub> /MWh	The most recent value available at the time of validation is applied and fixed for the monitoring period thereafter. The data is sourced from "Emission Factors of Electricity Interconnection Systems", National Committee on Clean Development Mechanism (Indonesian DNA for CDM), based on data obtained by Directorate General of Electricity, Ministry of Energy and Mineral Resources, Indonesia, unless otherwise instructed by the Joint Committee.	Input on "MPS(input_separate)" sheet
$EF_{elec,j}$	<b>[For captive electricity]</b> CO <sub>2</sub> emission factor for consumed electricity by the project absorption chiller <i>j</i> <b>Option a</b>	-	tCO <sub>2</sub> /MWh	Power generation efficiency obtained from manufacturer's specification; and CO <sub>2</sub> emission factor for the fuel consumed by the captive power generation system connected to the project absorption chiller <i>j</i> .	Calculated
$EF_{elec,j}$	<b>[For captive electricity]</b> CO <sub>2</sub> emission factor for consumed electricity by the project absorption chiller <i>j</i> <b>Option b</b>	-	tCO <sub>2</sub> /MWh	The power generation efficiency calculated from monitored data of the amount of fuel input for power generation and the amount of electricity generated; Net calorific value of the fuel consumed by the captive power generation system connected to the project absorption chiller <i>j</i> ; and CO <sub>2</sub> emission factor for the fuel consumed by the captive power generation system connected to the project absorption chiller <i>j</i> .	Calculated
$EF_{elec,j}$	<b>[For captive electricity]</b> CO <sub>2</sub> emission factor for consumed electricity by the project absorption chiller <i>j</i>	-	tCO <sub>2</sub> /MWh	[Captive electricity with diesel fuel] CDM approved small scale methodology: AMS-I.A.  [Captive electricity with natural gas] 2006 IPCC Guidelines on National GHG Inventories for the source of EF of natural gas. CDM Methodological tool "Determining the baseline efficiency of thermal or electric energy generation systems version02.0" for the default efficiency for off-grid power plants.	Input on "MPS(input_separate)" sheet
$\eta_{cap,j}$	Power generation efficiency of the captive power generation system connected to the project absorption chiller <i>j</i>	-	%	Specification of the captive power generation system connected to the project absorption chiller <i>j</i> , provided by the manufacturer.	Input on "MPS(input_separate)" sheet

$NCV_{fuel, cap, j}$	Net calorific value of the fuel consumed by the captive power generation system connected to the project absorption chiller $j$	-	GJ/mass or volume	In the order of preference: a) values provided by fuel supplier; b) measurement by the project participants; c) regional or national default values; or d) IPCC default values provided in table 1.2 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Lower value is applied.	Input on "MPS(input_separate)" sheet
$EF_{fuel, cap, j}$	CO <sub>2</sub> emission factor for the fuel consumed by the captive power generation system connected to the project absorption chiller $j$	-	tCO <sub>2</sub> /GJ	In the order of preference: a) values provided by fuel supplier; b) measurement by the project participants; c) regional or national default values; or d) IPCC default values provided in table 1.4 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Lower value is applied.	Input on "MPS(input_separate)" sheet
$NCV_{fuel, CL, j}$	Net calorific value of gas fuel consumed by the project absorption chiller $j$	-	GJ/mass or volume	In the order of preference: a) values provided by fuel supplier; b) measurement by the project participants; c) regional or national default values; or d) IPCC default values provided in table 1.2 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Upper value is applied.	Input on "MPS(input_separate)" sheet
$EF_{fuel, CL, j}$	CO <sub>2</sub> emission factor for gas fuel consumed by the project absorption chiller $j$	-	tCO <sub>2</sub> /GJ	In the order of preference: a) values provided by fuel supplier; b) measurement by the project participants; c) regional or national default values; or d) IPCC default values provided in table 1.4 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Lower value is applied.	Input on "MPS(input_separate)" sheet

Table3: Ex-post calculation of CO<sub>2</sub> emission reductions

Monitoring period	CO <sub>2</sub> emission reductions	Units
	0	tCO <sub>2</sub> /p

[Monitoring option]

Option A	Based on public data which is measured by entities other than the project participants (Data used: publicly recognized data such as statistical data and specifications)
Option B	Based on the amount of transaction which is measured directly using measuring equipments (Data used: commercial evidence such as invoices)
Option C	Based on the actual measurement using measuring equipments (Data used: measured values)

Monitoring Report Sheet (Input Separate Sheet) [For Verification]

Table 4: Ex-post calculation of reference emissions for electricity consumed by the recipient facility which is generated by the CGS

parameters	Identification No.	Parameters monitored ex post		Parameters monitored ex post (in case of EF <sub>elec,j</sub> is calculated from measured data)		Project-specific parameters fixed ex ante								Ex-post calculation of reference emissions	
		i	EC <sub>ij,p</sub>	FC <sub>cap,ij,p</sub>	EQ <sub>cap,ij,p</sub>	EF <sub>elec,j</sub>	EF <sub>elec,j</sub>	EF <sub>elec,j</sub>	EF <sub>elec,j</sub>	η <sub>elec,j</sub>	NCV <sub>fuel,elec,j</sub>	EF <sub>fuel,elec,j</sub>	RE <sub>elec,ij,p</sub>		
Description of data	Identification number for the recipient facility to which electricity and heat generated by the CGS is supplied	Electricity consumption by the recipient facility i which is generated by the CGS during the period p	Amount of fuel consumed by the captive power generation system connected to the recipient facility i during the period p	Amount of electricity generated by the captive power generation system connected to the recipient facility i during the period p	[For grid electricity] CO <sub>2</sub> emission factor for consumed electricity in the recipient facility i	[For captive electricity] CO <sub>2</sub> emission factor for consumed electricity in the recipient facility i	[For captive electricity] CO <sub>2</sub> emission factor for consumed electricity in the recipient facility i	[For captive electricity] CO <sub>2</sub> emission factor for consumed electricity in the recipient facility i	Power generation efficiency of the captive power generation system connected to the recipient facility i	Net calorific value of the fuel consumed by the captive power generation system connected to the recipient facility i	CO <sub>2</sub> emission factor for the fuel consumed by the captive power generation system connected to the recipient facility i	Reference emissions for electricity consumed by the recipient facility i which is generated by the CGS during the period p			
Units	-	MWh/p	mass or volume/p	MWh/p	tCO <sub>2</sub> /MWh	tCO <sub>2</sub> /MWh	tCO <sub>2</sub> /MWh	tCO <sub>2</sub> /MWh	%	GJ/mass or volume	tCO <sub>2</sub> /GJ	tCO <sub>2</sub> /p			
Monitored/ Estimated Values	1				0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.00			
	2				0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.00			
	3				0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.00			
	4				0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.00			
	5				0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.00			
	6				0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.00			
	7				0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.00			
	8				0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.00			
	9				0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.00			
	10				0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.00			
Total	-	-	-	-	-	-	-	-	-	-	-	0.00			

Table 5: Ex-post calculation of reference emissions for heating energy consumed by the recipient facility which is generated by the CGS

parameters	Identification No.	Parameters monitored ex post		Project-specific parameters fixed ex ante		Ex-post calculation of reference emissions	
		i	HC <sub>ij,p</sub>	η <sub>HE</sub>	EF <sub>fuel,HE</sub>	RE <sub>fuel,ij,p</sub>	
Description of data	Identification number for the recipient facility to which electricity and heat generated by the CGS is supplied	Heating energy consumption by the recipient facility i which is generated by the CGS during the period p	Reference boiler efficiency	CO <sub>2</sub> emission factor for fossil fuel consumed by the reference boiler (CO <sub>2</sub> emission factor of natural gas is applied in this methodology)	Reference emissions for heat consumed by the recipient facility i which is generated by the CGS during the period p		
Units	-	GJ/p	%	tCO <sub>2</sub> /GJ	tCO <sub>2</sub> /p		
Monitored/ Estimated Values	1			89.0	0	0.00	
	2			89.0	0	0.00	
	3			89.0	0	0.00	
	4			89.0	0	0.00	
	5			89.0	0	0.00	
	6			89.0	0	0.00	
	7			89.0	0	0.00	
	8			89.0	0	0.00	
	9			89.0	0	0.00	
	10			89.0	0	0.00	
Total	-	-	-	-	-	0.00	

Table 6: Ex-post calculation of reference emissions and project emissions by reference chiller

parameters	Identification No.	Parameters monitored ex post			Parameters monitored ex post (in case of EF <sub>elec,j</sub> is calculated from measured data)		Project-specific parameters fixed ex ante										Ex-post calculation of reference emissions		Ex-post calculation of project emissions	
		j	C <sub>chiller,j</sub>	EC <sub>proj,CL,j,p</sub>	FC <sub>proj,CL,j,p</sub>	FC <sub>cap,ij,p</sub>	EQ <sub>cap,ij,p</sub>	COP <sub>ref,j</sub>	EF <sub>elec,j</sub>	EF <sub>elec,j</sub>	EF <sub>elec,j</sub>	EF <sub>elec,j</sub>	EF <sub>elec,j</sub>	η <sub>elec,j</sub>	NCV <sub>fuel,elec,j</sub>	EF <sub>fuel,elec,j</sub>	NCV <sub>fuel,CL,j</sub>	EF <sub>fuel,CL,j</sub>	RE <sub>elec,ij,p</sub>	PE <sub>chiller,ij,p</sub>
Description of data	Identification number of the project absorption chiller	Cooling energy generated by the project absorption chiller j during the period p	Electricity consumption by project absorption chiller j during the period p	Gas fuel consumption by project absorption chiller j during the period p	Amount of fuel consumed by the captive power generation system connected to the absorption chiller j during the period p	Amount of electricity generated by the captive power generation system connected to the absorption chiller j during the period p	COP of reference chiller j	[For grid electricity] CO <sub>2</sub> emission factor for consumed electricity by the project absorption chiller j	[For captive electricity] CO <sub>2</sub> emission factor for consumed electricity by the project absorption chiller j	[For captive electricity] CO <sub>2</sub> emission factor for consumed electricity by the project absorption chiller j	[For captive electricity] CO <sub>2</sub> emission factor for consumed electricity by the project absorption chiller j	[For captive electricity] CO <sub>2</sub> emission factor for consumed electricity by the project absorption chiller j	Power generation efficiency of the captive power generation system connected to the project absorption chiller j	Net calorific value of the fuel consumed by the captive power generation system connected to the project absorption chiller j	CO <sub>2</sub> emission factor for the fuel consumed by the captive power generation system connected to the project absorption chiller j	Net calorific value of gas fuel consumed by the project absorption chiller j	CO <sub>2</sub> emission factor for gas fuel consumed by the project absorption chiller j	Reference emissions by reference chiller j during the period p	Project emissions by reference chiller j during the period p	
Units	-	MWh/p	MWh/p	Nm <sup>3</sup> /p	mass or volume/p	MWh/p	dimensionless	tCO <sub>2</sub> /MWh	tCO <sub>2</sub> /MWh	tCO <sub>2</sub> /MWh	tCO <sub>2</sub> /MWh	tCO <sub>2</sub> /MWh	%	GJ/mass or volume	tCO <sub>2</sub> /GJ	GJ/mass or volume	tCO <sub>2</sub> /GJ	tCO <sub>2</sub> /p	tCO <sub>2</sub> /p	
Monitored/ Estimated Values	1							0.0	0.000	0.000	0.000	0.000	0.0	0.0000	0.0000	0.0000	0.0000	0.00	0.00	
	2							0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.0000	0.0000	0.00	0.00	
	3							0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.0000	0.0000	0.00	0.00	
	4							0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.0000	0.0000	0.00	0.00	
	5							0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.0000	0.0000	0.00	0.00	
	6							0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.0000	0.0000	0.00	0.00	
	7							0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.0000	0.0000	0.00	0.00	
	8							0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.0000	0.0000	0.00	0.00	
	9							0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.0000	0.0000	0.00	0.00	
	10							0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.0000	0.0000	0.00	0.00	
	11							0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.0000	0.0000	0.00	0.00	
	12							0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.0000	0.0000	0.00	0.00	
	13							0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.0000	0.0000	0.00	0.00	
	14							0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.0000	0.0000	0.00	0.00	
	15							0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.0000	0.0000	0.00	0.00	
	16							0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.0000	0.0000	0.00	0.00	
	17							0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.0000	0.0000	0.00	0.00	
	18							0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.0000	0.0000	0.00	0.00	
	19							0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.0000	0.0000	0.00	0.00	
	20							0.0	0.000	0.000	0.000	0.000	0.0	0.00	0.0000	0.0000	0.0000	0.00	0.00	
Total	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	0.00	

**Monitoring Report Sheet (Calculation Process Sheet) [For Verification]**

1. Calculations for emission reductions		Fuel type	Value	Units	Parameter
Emission reductions during the period <i>p</i>		N/A	0.00	tCO <sub>2</sub> /p	ER <sub>p</sub>
2. Selected default values, etc.					
Reference boiler efficiency		N/A	89.0	%	η <sub>RE</sub>
3. Calculations for reference emissions					
Reference emissions during the period <i>p</i>		N/A	0.00	tCO <sub>2</sub> /p	RE <sub>p</sub>
Reference emissions for electricity consumed by the recipient facility(ies) which is generated by the CGS		N/A	0.00	tCO <sub>2</sub> /p	RE <sub>elec,i,p</sub>
Reference emissions for heat consumed by the recipient facility(ies) which is generated by the CGS		N/A	0.00	tCO <sub>2</sub> /p	RE <sub>heat,i,p</sub>
Reference emissions by reference chiller		N/A	0.00	tCO <sub>2</sub> /p	RE <sub>chiller,j,p</sub>
4. Calculations of the project emissions					
Project emissions during the period <i>p</i>		N/A	0.00	tCO <sub>2</sub> /p	PE <sub>p</sub>
Project emissions from the CGS during the period <i>p</i>		Gas	0.00	tCO <sub>2</sub> /p	PE <sub>PJ,CGS,p</sub>
Gas fuel consumption by the CGS during the period <i>p</i>		Gas	0.00	mass or volume/p	FC <sub>CGS,p</sub>
Net calorific value of gas fuel consumed by the CGS		Gas	0.0000	GJ/mass or volume	NCV <sub>fuel,CGS</sub>
CO <sub>2</sub> emission factor for gas fuel consumed by the CGS		Gas	0.0000	tCO <sub>2</sub> /GJ	EF <sub>fuel,PJ</sub>
Project emissions from project absorption chiller during the period <i>p</i>		N/A	0.00	tCO <sub>2</sub> /p	PE <sub>PJ,chiller,p</sub>

[List of Default Values]

η <sub>RE</sub>	Reference boiler efficiency	89.0	%
COP <sub>RE,j</sub>	Cooling capacity per unit (300<=x<=350USRt)	5.46	-
	Cooling capacity per unit (350<x<=550USRt)	5.69	-
	Cooling capacity per unit (550<x<=750USRt)	5.90	-
	Cooling capacity per unit (750<x<=1300USRt)	6.03	-