**Joint Crediting Mechanism Approved Methodology ID\_AM016**

**“Installation of gas engine cogeneration system to supply electricity and heat to facility”**

|  |
| --- |
| * 1. **Title of the methodology** |

|  |
| --- |
| Installation of gas engine cogeneration system to supply electricity and heat to facility, Version 01.0 |

|  |
| --- |
| * 1. **Terms and definitions** |

|  |  |
| --- | --- |
| Terms | Definitions |
| Cogeneration System (CGS) | A system that consists of power generator(s) and boiler(s) supplying both electricity and heat, recovering waste heat exhausted by the power generator(s). The power generator is a gas engine in this methodology. |
| Facility | A cluster of buildings and/or plants (or building/plant itself) to which electricity and heat generated by CGS is supplied. |
| Power Generation Efficiency | Net quantity of electricity generated per quantity of energy contained in fuel fired in the power generator. |
| Boiler Efficiency | Net quantity of heat generated per quantity of energy contained in fuel fired in the boiler. |

|  |
| --- |
| * 1. **Summary of the methodology** |

|  |  |
| --- | --- |
| Items | Summary |
| *GHG emission reduction measures* | Electricity and heat generated by CGS(s) installed in the project facility(ies) substitutes all or part of grid and/or captive electricity consumed and heat generated by fossil fuel, which leads to efficient energy use of the facility(ies) and in turn GHG emission reductions. |
| *Calculation of reference emissions* | Reference emissions are CO2 emissions from the use of grid and/or captive electricity and heat generated by reference boiler in the facility(ies), which are calculated based on: the amount of electricity consumption by the facility(ies) which is generated by the CGS(s); the amount of heat consumption by the facility(ies) which is generated by the CGS(s); reference boiler efficiency; and CO2 emission factors for consumed electricity and fossil fuel consumed by the reference boiler in the facility(ies). |
| *Calculation of project emissions* | Project emissions are CO2 emissions from the use of CGS(s), which are calculated based on: the amount of gas fuel consumption by the CGS(s); net calorific value of gas fuel consumed by the CGS(s); and CO2 emission factor for gas fuel consumed by the CGS(s). |
| *Monitoring parameters* | * Amount of electricity consumption by the facility(ies) which is generated by the CGS(s) [MWh/p] * Amount of heat consumption by the facility(ies) which is generated by the CGS(s) [GJ/p] (Option 1) * Amount of heat supply to the facility(ies) which is generated by the CGS(s) [GJ/p] (Option 2) * Number of days during the monitoring period [day/p] (Option 2) * Amount of gas fuel consumption by the CGS(s) [Nm3/p] |

|  |
| --- |
| * 1. **Eligibility criteria** |

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

|  |  |
| --- | --- |
| Criterion 1 | Gas engine CGS(s) is installed and supplies electricity and heat to facility(ies). |
| Criterion 2 | The power generation efficiency of the CGS(s) stated in catalogs or other information prepared by its manufacturer is equal to or greater than the threshold value in the following table corresponding to the electrical output of CGS(s) installed.   |  |  | | --- | --- | | **Electrical output** | **Efficiency threshold** | |  | 40 [%] | |  | 47 [%] | |

|  |
| --- |
| * 1. **Emission Sources and GHG types** |

|  |  |
| --- | --- |
| Reference emissions | |
| Emission sources | GHG types |
| Electricity consumed in facility(ies) | CO2 |
| Fossil fuel to generate heat in facility(ies) | CO2 |
| Project emissions | |
| Emission sources | GHG types |
| Gas fuel consumption by CGS(s) | CO2 |

|  |
| --- |
| * 1. **Establishment and calculation of reference emissions** |

**F.1. Establishment of reference emissions**

|  |
| --- |
| Reference emissions are calculated based on: the amount of electricity consumption by the facility(ies) which is generated by the CGS(s); the amount of heat consumption by the facility(ies) which is generated by the CGS(s); reference boiler efficiency; and CO2 emission factors for consumed electricity and fossil fuel consumed by the reference boiler in the facility(ies).  A default value for the reference boiler efficiency is conservatively set *ex ante* to 89.0 [%] so as to ensure net emission reductions. |

**F.2. Calculation of reference emissions**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  | | --- | --- | --- | |  |  |  | |  |  |  |  |  |  | | --- | --- | | Where |  | |  | : Reference emissions during the period *p* [tCO2/p] | |  | : Reference emissions for electricity consumption by the facility *j* which is generated by the CGS *i* during the period *p* [tCO2/p] | |  | : Reference emissions for heat consumption by the facility *j* which is generated by the CGS *i* during the period *p* [tCO2/p] | |  | : Amount of electricity consumption by the facility *j* which is generated by the CGS *i* during the period *p* [MWh/p] | |  | : CO2 emission factor for consumed electricity in the facility *j* [tCO2/MWh] | |  | : Amount of heat consumption by the facility *j* which is generated by the CGS *i* during the period *p* [GJ/p] | |  | : Reference boiler efficiency [%] | |  | : CO2 emission factor for fossil fuel consumed by the reference boiler in the facility *j* [tCO2/GJ] | |  | : Identification number for the CGS | |  | : Identification number for the facility to which electricity and heat generated by the CGS *i* is supplied |   <**Monitoring Options for** >  Project participants may select either of the following two monitoring options to obtain a value for .   |  |  | | --- | --- | | Option 1: | Monitor the amount of heat consumption by the facility *j* which is generated by the CGS *i* during the period *p* [GJ/p] | | Option 2: | Monitor the amount of heat supply to the facility *j* which is generated by the CGS *i* during the period *p* [GJ/p] |   Option 1 can be selected when the project participants monitor the amount of heat “consumption”.  Option 2 can be selected when the project participants monitor the amount of heat “supply”, instead of “consumption”, and there has been existing boiler(s) generating steam and/or hot water and supplying to the facility prior to the implementation of the JCM project. In this option, no emission reductions can be claimed from the amount of heat generated by the CGS *i* and supplied to the facility *j* which exceeds the maximum capacity of heat generation by the existing boiler(s) supplying to the facility *j*. The formula written below is applied.   |  |  | | --- | --- | |  | **, for any facility *j*** | |  | **, for steam boiler** | | **, for hot water boiler** |  |  |  | | --- | --- | | Where |  | |  | : Amount of heat consumption by the facility *j* which is generated by the CGS *i* during the period *p* [GJ/p] | |  | : Amount of heat supply to the facility *j* which is generated by the CGS *i* during the period *p* [GJ/p] | |  | : Maximum capacity of heat generation by the existing boiler *k* supplying to the facility *j* during the period *p* [GJ/p] | |  | : Heat generative capacity of the existing steam boiler *k* [kg/h] or hot water boiler *k* [kW] | |  | : Number of days during the period *p* [day/p] | |  | : Identification number for the CGS | |  | : Identification number for the facility to which electricity and heat generated by the CGS *i* is supplied | |  | : Identification number for the existing boiler which supplies steam or hot water to the facility *j* | |

|  |
| --- |
| * 1. **Calculation of project emissions** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  | | --- | --- | --- | |  |  |  | |  |  |  |  |  |  | | --- | --- | | Where |  | |  | : Project emissions during the period *p* [tCO2/p] | |  | : Project emissions for the CGS *i* during the period *p* [tCO2/p] | |  | : Amount of gas fuel consumption by the CGS *i* during the period *p* [Nm3/p] | |  | : Net calorific value of gas fuel consumed by the CGS *i* [MJ/Nm3] | |  | : CO2 emission factor for gas fuel consumed by the CGS *i* [tCO2/GJ] | |  | : Identification number for the CGS | |

|  |
| --- |
| * 1. **Calculation of emissions reductions** |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  | | --- | --- | --- | |  |  |  |  |  |  | | --- | --- | | Where |  | |  | : Emission reductions during the period *p*[tCO2/p] | |  | : Reference emissions during the period *p* [tCO2/p] | |  | : Project emissions during the period *p* [tCO2/p] | |

|  |
| --- |
| * 1. **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 |
|  | Reference boiler efficiency.  Default value is set to 89.0 [%]. | Value derived from the result of survey. The default value, 89.0 [%], should be revised if necessary. |
|  | Net calorific value of gas fuel consumed by the CGS *i* [MJ/Nm3]. | In the order of preference:   1. value provided by fuel supplier; 2. value measured by the project participants; 3. regional or national default value; or 4. IPCC default value provided in table 1.2 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Upper value is applied. |
|  | CO2 emission factor for consumed electricity in the facility *j* [tCO2/MWh].  When the facility consumes only grid electricity or captive electricity, the project participant applies the CO2 emission factor respectively.  When the facility consumes both grid electricity and captive electricity, the project participant applies the CO2 emission factor with lower value.  **[CO2 emission factor]**  For grid electricity: the most recent value available from the source stated in this table at the time of validation.  For captive electricity: 0.8\* [tCO2/MWh]  \*The most recent value available from CDM approved small scale methodology AMS-I.A at the time of validation is applied. | **[Grid electricity]**  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.  **[Captive electricity]**  CDM approved small scale methodology AMS-I.A. |
|  | CO2 emission factor for fossil fuel consumed by the reference boiler in the facility *j* [tCO2/GJ].  CO2 emission factor of natural gas is applied in this methodology in a conservative manner. | In the order of preference:   1. value provided by fuel supplier; 2. value measured by the project participants; 3. regional or national default value; or 4. IPCC default value provided in table 1.4 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Lower value is applied. |
|  | CO2 emission factor for gas fuel consumed by the CGS *i* [tCO2/GJ]. | In order of preference:   1. value provided by fuel supplier; 2. value measured by the project participants; 3. regional or national default value; or 4. IPCC default value provided in table 1.4 of Ch.1 Vol.2 of 2006 IPCC Guidelines on National GHG Inventories. Higher value is applied. |
|  | Heat generative capacity of the existing steam boiler *k* [kg/h] or hot water boiler *k* [kW]. The value prepared by manufacturer is applied in the use of Option 2 only.  Equivalent evaporation is used for steam boilers, and rated thermal output for hot water boilers. | Catalogs, specifications prepared for the quotation or factory acceptance test data by manufacturer. |

History of the document

|  |  |  |
| --- | --- | --- |
| Version | Date | Contents revised |
| 01.0 | 10 July 2018 | JC8, Annex 5  Initial approval. |
|  |  |  |
|  |  |  |