Joint Crediting Mechanism Approved Methodology ID_AM025

"Installation of all-electric injection molding machine with power regeneration"

A. Title of the methodology

Installation of all-electric injection molding machine with power regeneration, Version 1.0

B. Terms and definitions

Terms	Definitions
Injection molding machine	Injection molding machine which consists of injection unit, plasticizing unit, clamping unit and ejection unit, and is used for manufacturing plastic products.
All-electric injection molding machine	Injection molding machine which is operated by electric press. All of 4 servo-motors for injection unit, plasticizing unit, clamping unit, and ejection unit are directly electrically driven. All-electric injection molding machine is designed by opened control system.
Hydraulic injection molding machine	Injection molding machine which is operated with hydraulic press by the oil pumps. Hydraulic injection molding machine is designed by closed control system.
Power regeneration	To regenerate electric power efficiently by kinetic energy at deceleration of motors.

C. Summary of the methodology

Items	Summary
GHG emission reduction measures	Installation of all-electric injection molding machine with a function of power regeneration leads to reducing electricity consumption by the oil pumps which are used for reference injection molding machine (hydraulic injection molding machine), and consequently GHG emissions.
Calculation of reference emissions	Reference emissions are calculated with the electricity consumption of all-electric injection molding machine,

	reduction ratio of electricity consumption and CO_2 emission factor for consumed electricity.
Calculation of project emissions	Project emissions are calculated with the electricity consumption of all-electric injection molding machine and CO_2 emission factor for consumed electricity.
Monitoring parameters	● Electricity consumption of the project injection molding machine

D. Eligibility criteria

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

Criterion 1	All-electric injection molding machine with a function of power regeneration is newly installed.

E. Emission Sources and GHG types

Reference emissions	
Emission sources	GHG types
Electricity consumption by hydraulic injection molding machine	CO_2
Project emissions	
Emission sources	GHG types
Electricity consumption by all-electric injection molding machine	CO_2

F. Establishment and calculation of reference emissions

F.1. Establishment of reference emissions

Reduction ratio of specific electricity consumption of the project injection molding machine to the reference injection molding machine (RR) is provided as a default value in this methodology and is conservatively set *ex ante* in the following manner to ensure the net emission reductions.

Specific electricity consumption (SEC) is an electricity consumption of injection molding machine to manufacture one unit of plastic product. SEC can be estimated from design specification of injection molding machine.

1. The hydraulic injection molding machine is currently available and commonly used in the Indonesian market. Therefore, it is determined as a reference injection molding machine.
2. SEC data of all-electric injection molding machine (SEC_{PJ}) and hydraulic injection molding machine (SEC_{RE}) to manufacture several types of plastic products have been collected from the manufacturer of injection molding machine.
3. Values of RR are derived as a ratio of SEC_{PJ} to SEC_{RE} to manufacture the same type of plastic product. The maximum RR value amongst the RR values derived as above is selected and set as a default RR value in a conservative manner to ensure net emission reductions, which is described in Section I of this methodology.

F.2. Calculation of reference emissions

$$RE_p = \sum_i \left(EC_{PJ,i,p} \times \frac{1}{RR} \times EF_{elec} \right)$$

Where:

RE_p	: Reference emissions during the period p [tCO_2/p]
$EC_{PJ,i,p}$	: Electricity consumption of the project injection molding machine i during the period p [MWh/p]
RR	: Reduction ratio of specific electricity consumption of the project injection molding machine to the reference injection molding machine [-]
EF_{elec}	: CO_2 emission factor for consumed electricity [tCO_2/MWh]
i	: Identification number of the project injection molding machine

G. Calculation of project emissions

$$PE_p = \sum_i \left(EC_{PJ,i,p} \times EF_{elec} \right)$$

Where:

PE_p	: Project emissions during the period p [tCO_2/p]
$EC_{PJ,i,p}$	: Electricity consumption of the project injection molding machine i during the period p [MWh/p]
EF_{elec}	: CO_2 emission factor for consumed electricity [tCO_2/MWh]

i	: Identification number of the project injection molding machine

H. Calculation of emissions reductions

$$ER_p = RE_p - PE_p$$

Where:

ER_p	: Emission reductions during the period p [tCO_2/p]
RE_p	: Reference emissions during the period p [tCO_2/p]
PE_p	: Project emissions during the period p [tCO_2/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
RR	Reduction ratio of specific electricity consumption of the project injection molding machine to the reference injection molding machine [-] The default value of RR is set at the maximum value in a conservative manner, as follows; $\mathbf{RR = 0.532}$	Data collected from the manufacturer of injection molding machine. The default value should be revised if necessary.
EF_{elec}	CO_2 emission factor for consumed electricity. When the project electricity consumes only grid electricity or captive electricity, the project participant applies the CO_2 emission factor respectively. When the project molding machine may consume both grid electricity and captive electricity, the project participant applies the CO_2 emission factors with lower value.	[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

	[CO_2 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, it is determined based on the following options: a) Calculated from its power generation efficiency (η_{elec} [%]) 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; $EF_{elec} = 3.6 \times \frac{100}{\eta_{elec}} \times EF_{fuel}$ b) Calculated from measured data The power generation efficiency calculated from monitored data of the amount of fuel input for power generation ($FC_{PJ,p}$) and the amount of electricity generated ($EG_{PJ,p}$) during the monitoring period p is applied. The measurement is conducted with the monitoring equipment to which calibration certificate is issued by an entity accredited under national/international standards; $EF_{elec} = FC_{PJ,p} \times NCV_{fuel} \times EF_{fuel} \times \frac{1}{EG_{PJ,p}}$ Where: NCV_{fuel} : Net calorific value of consumed fuel [GJ/mass or volume] Note: In case the captive electricity generation system	Energy and Mineral Resources, Indonesia, unless otherwise instructed by the Joint Committee. [Captive electricity] For the option a) Specification of the captive power generation system provided by the manufacturer (η_{elec} [%]). CO_2 emission factor of the fossil fuel type used in the captive power generation system (EF_{fuel} [tCO_2/GJ]) For the option b) Generated and supplied electricity by the captive power generation system ($EG_{PJ,p}$ [MWh/p]). Fuel amount consumed by the captive power generation system ($FC_{PJ,p}$ [mass or volume/p]). Net calorific value (NCV_{fuel} [GJ/mass or volume]) and CO_2 emission factor of the fuel (EF_{fuel} [tCO_2/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

<table>
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<td>meets all of the following conditions, the value in the following table may be applied to EF_{elec} depending on the consumed fuel type.

・ The system is non-renewable generation system
・ Electricity generation capacity of the system is less than or equal to 15 MW

<table>
<tr><th>Fuel type</th><th>Diesel fuel</th><th>Natural gas</th></tr>
<tr><td>EF_{elec}</td><td>0.8 *1</td><td>0.46 *2</td></tr>
</table>

*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_2 emission factor for natural gas (0.0543tCO_2/GJ), and the most efficient value of default efficiency for off-grid gas turbine systems (42%) are applied.</td>
<td>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.

[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.</td>
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History of the document

Version	Date	Contents revised
01.0	23 December 2020	Electronic decision by the Joint Committee Initial approval.