Joint Crediting Mechanism Approved Methodology ID_AM029

"Installation of closed drain recovery system and utilization for boiler feed water"

A. Title of the methodology

Installation of closed drain recovery system and utilization for boiler feed water, Version 01.0

B. Terms and definitions

Terms	Definitions
Drain	Drain is a waste hot water which is trapped and condensed after waste steam at process of works is caught by steam trap.
Closed drain recovery system	Drain recovery system is an equipment which recovers drain with some heating energy and reuses for boiler feed water. Recovered drain is once stocked in a tank before reuse. Closed drain recovery system has a tank with the lid. Drained water is kept at high temperature.
Open drain recovery system	Open drain recovery system has a tank without covering. Temperature of drained water is down to 100 ºC or less because vapor of drained water is released to atmosphere.

C. Summary of the methodology

Items	Summary
GHG emission reduction measures	By installing a closed drain recovery system, boiler feed water is heated up. Consequently, fossil fuel consumption of boiler(s) is reduced, leading to the reduction of GHG emissions.
Calculation of reference emissions	Reference emissions are calculated using the following parameters: ・ Saving rate of boiler fuel consumption per degree of risen temperature for boiler feed water ・ Temperature of boiler feed water including both of makeup feed water and hot water recovered by the project closed drain recovery system

	• Reference temperature of boiler feed water including both of makeup feed water and hot water recovered by the reference drain recovery system • Fossil fuel consumption of boiler(s) utilizing hot water recovered by the project closed drain recovery system • Net calorific value of fossil fuel consumed by boiler(s) • CO_2 emission factor of fossil fuel consumed by boiler(s)
Calculation of project emissions	Project emissions are not considered as a project closed drain recovery system does not utilize electricity and any fossil fuels.
Monitoring parameters	• Amount of the fossil fuel consumed by boiler(s) utilizing hot water recovered by the project closed drain recovery system • Temperature of hot water recovered by the project closed drain recovery system • Temperature of boiler feed water including both of makeup feed water and hot water recovered by the project closed drain recovery system

D. Eligibility criteria

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

Criterion 1	The project newly installs closed drain recovery system(s) to heat up boiler feed water.
Criterion 2	Project closed drain recovery system does not additionally utilize electricity and any fossil fuels other than those utilized in open drain recovery systems.

E. Emission Sources and GHG types

Reference emissions	
Emission sources	GHG types
Fossil fuel(s) consumed by boiler(s) to generate the amount of heat recovered by a project closed drain recovery system	CO_2
Project emissions	
Emission sources	GHG types
N/A	N/A

F. Establishment and calculation of reference emissions

F.1. Establishment of reference emissions

In this methodology, it is assumed that an open drain recovery system is set as the reference one, because in many factories in Indonesia, a drain recovery system is not introduced, or an open drain recovery system is applied. In case that an open drain system is introduced, the temperature of recovered drain water is comparatively low, and the amount of boiler fuel is needed more than the case when a closed drain recover system is introduced.

In order to secure net emission reductions in this methodology, the reference emission is conservatively calculated in the following manners.

-Setting "temperature of makeup feed water into boiler(s)" as 30.3 ºC based on the highest value in the monthly average atmospheric temperatures for 2 years (November 2018 - October 2020) in Jakarta, Medan, Palembang, Balikpapan, Semarang, Denpasar, Cirebon, Serang, Tegal, Cilacap and Curug.

-Setting "Rate of decrease in boiler fuel consumption per degree rise in temperature of boiler feed water" as 0.0015 [dimensionless /ΔK] in case that boiler feed water is 20 ºC. The saving rate at the temperature range of boiler feed water higher than 20 ºC is slightly higher than 0.0015 [dimensionless /ΔK].

-Setting "reference temperature of boiler feed water including both of makeup feed water and hot water recovered by a project closed drain recovery system" as 100 ºC in case that $TDW_{PJ,p}$ is not monitored.

F.2. Calculation of reference emissions

$$RE_p = SRF_{boiler} \times DT_{PJ,p}/(1- SRF_{boiler} \times DT_{PJ,p}) \times \sum_i FC_{PJ,i,p} \times NCV_{fuel,i} \times EF_{fuel,i}$$

$$DT_{PJ,p} = TFW_{PJ,p} - TFW_{RE,p}$$

$$TFW_{RE,p} = \frac{TMW + R_{dw/mw,p} \times TDW_{RE}}{1 + R_{dw/mw,p}}$$

$$R_{dw/mw,p} = \frac{TFW_{PJ,p} - TMW}{TDW_{PJ,p} - TFW_{PJ,p}}$$

Where;

RE_p	:	Reference emissions during the period p [tCO_2/p]
i	:	Identification number of fossil fuel type consumed by boiler(s) utilizing hot water recovered by the project closed drain recovery system [dimensionless]
SRF_{boiler}	:	Rate of decrease in boiler fuel consumption per degree rise in temperature of boiler feed water [dimensionless /ΔK]
$DT_{PJ,p}$	:	Risen temperature of boiler feed water heated by the project closed drain recovery system during the period p [ΔK]
$TFW_{PJ,p}$	:	Temperature of boiler feed water including both of makeup feed water and hot water recovered by the project closed drain recovery system during the period p [degrees C]
$TFW_{RE,p}$	:	Reference temperature of boiler feed water including both of makeup feed water and hot water recovered by the reference drain recovery system during the period p [degrees C]
$FC_{PJ,i,p}$	:	Amount of fossil fuel type i consumed by boiler(s) utilizing hot water recovered by the project closed drain recovery system during the period p [mass or volume/p]
$NCV_{fuel,i}$	:	Net calorific value of fossil fuel type i consumed by boiler(s) [GJ/mass or volume unit]
$EF_{fuel,i}$	:	CO_2 emission factor of fossil fuel type i consumed by boiler(s) [tCO_2/GJ]
$R_{dw/mw,p}$		The ratio of flow rate of hot water recovered by the project closed drain recovery system to flow rate of makeup feed water during the period p [dimensionless]
TDW_{RE}	:	Temperature of hot water recovered by the reference drain recovery system [degrees C]
TMW	:	Temperature of makeup feed water into boiler(s) [degrees C]
$TDW_{PJ,p}$	:	Temperature of hot water recovered by the project drain recovery system during the period p [degrees C]

Note) In case that $TDW_{PJ,p}$ is not monitored, a value of 100 ºC is applied to $TFW_{RE,p}$ in a conservative manner.

G. Calculation of project emissions

Project emissions are not assumed in the methodology as a project closed drain recovery system does not utilize electricity and any fossil fuels, which is prescribed in the eligibility criterion 2. Therefore, the following formula is used to express the project emissions:

$$PE_p = 0$$

Where;

PE_p : Project emissions during the period p [tCO_2/p]

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
SRF_{boiler}	Rate of decrease in boiler fuel consumption per degree rise in temperature of boiler feed water [dimensionless /ΔK] For a conservative default value, a value of 0.0015 may be applied based on the case that boiler feed water is 20 ºC, because the saving rate at the temperature range of boiler feed water higher than 20 ºC is slightly higher than 0.0015 [dimensionless /K].	Figure 3.5.1 "Relationship between feed water temperature and saving rate of boiler fuel consumption" in "Nomograph collection for energy saving in boiler" published by Japan Boiler Association

$NCV_{fuel,i}$	Net calorific value of fossil fuel type *i* consumed by boiler(s) [GJ/mass or volume]	In the order of preference: a) values provided by the fuel supplier; b) measurement by the project participants; c) regional or national default values published by the Ministry of Energy and Mineral Resources, Indonesia; 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.
$EF_{fuel,i}$	CO_2 emission factor of fossil fuel type *i* consumed by boiler(s) [tCO_2/GJ]	In the order of preference: a) values provided by the fuel supplier; b) measurement by the project participants; c) regional or national default values published by the Ministry of Energy and Mineral Resources, Indonesia; 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.
TDW_{RE}	Temperature of hot water recovered by the reference drain recovery system [degrees C]	Default value set in the methodology

	A value of 100 ºC is applied, because the reference drain recovery system is assumed to be an open one.	
$TFW_{RE,p}$	Reference temperature of boiler feed water including both of makeup feed water and hot water recovered by the reference drain recovery system [degrees C] (In case that $TDW_{PJ,p}$ is not monitored, a value of 100 ºC is applied in a conservative manner.)	Default value
TMW	Temperature of makeup feed water into boiler(s) [degrees C] A value of 30.3 ºC is applied in a conservative manner based on the highest value in the monthly average atmospheric temperatures for 2 years (November 2018 – October 2020) in Jakarta, Medan, Palembang, Balikpapan, Semarang, Denpasar, Cirebon, Serang, Tegal, Cilacap and Curug.	Climate data tool in the world (ClimatView Monthly statistic) by Japan Meteorological Agency

History of the document

Version	Date	Contents revised
01.0	18 December 2024	JC10 Initial approval.