# Joint Crediting Mechanism Approved Methodology PH_AM001
# "Electricity generation by installation of run-of-river hydro power generation system(s) in the Philippines"

## A. Title of the methodology

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| Electricity generation by installation of run-of-river hydro power generation system(s) in the Philippines, Version 01.0 |

## B. Terms and definitions

| Terms | Definitions |
|---|---|
| Run-of-river hydro power generation system | A system of power generation that uses water running in a river or a waterway directly into power generation unit without storing water in a dam[1]. |

## C. Summary of the methodology

| Items | Summary |
|---|---|
| *GHG emission reduction measures* | Displacement of grid electricity and/or captive electricity by installation and operation of run-of-river hydro power generation system(s). |
| *Calculation of reference emissions* | Reference emissions are calculated on the basis of the electricity output of the run-of-river hydro power generation system(s) multiplied by the conservative emission factor. |
| *Calculation of project emissions* | Project emissions are the emissions from the run-of-river hydro power generation system(s), which are assumed to be zero. |
| *Monitoring parameters* | The quantity of the electricity generated by the project run-of-river hydro power generation system(s). |

[1] A dam is defined as a structure built across a river with a height of 15m or more from its foundation.

## D. Eligibility criteria

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

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| Criterion 1 | The project installs a run-of-river hydro power generation system(s). |

## E. Emission Sources and GHG types

| Reference emissions | |
|---|---|
| Emission sources | GHG types |
| Consumption of grid electricity and/or captive electricity | $CO_2$ |
| **Project emissions** | |
| Emission sources | GHG types |
| Generation of electricity from run-of-river hydro power generation system(s) | N/A |

## F. Establishment and calculation of reference emissions

### F.1. Establishment of reference emissions

The default emission factor is set in a conservative manner for the Philippines regional grids: Luzon-Visayas and Mindanao systems.

The emission factor is calculated based on the conservative operating margin that reflects on the latest electricity mix including low cost/must run (LCMR) resources for each regional grid in the Philippines during 2015-2017 and refers to the conservative emission factor of each fossil fuel power plant in order to secure net emission reductions.

The conservative emission factor of each plant is calculated to be 0.826 $tCO_2$/MWh for coal-fired power plant and 0.326 $tCO_2$/MWh for gas-fired power plant based on the survey on heat efficiency of power plant in the Philippines. The emission factor for diesel power plant is calculated to be 0.533 $tCO_2$/MWh based on a default heat efficiency of 49%, an efficiency level which is above the value of the world's leading diesel power generators.

In case the run-of-river hydro power generation system(s) in a proposed project activity is directly connected to a regional grid or connected to a regional grid via an internal grid not connecting to a captive power generator (Case 1), the value of operating margin including

LCMR resources, using the best heat efficiency among currently operational plants in the Philippines in calculating emission factors of fossil fuel power plants, are applied. The emission factors to be applied are set as "Emission factor for Case 1 ($tCO_2$/MWh)" in Section I. below.

In case the run-of-river hydro power generation system(s) in a proposed project activity is connected to an internal grid connecting to both a regional grid and a captive power generator (Case 2), the lower value between emission factors of "Emission factor for Case 1 ($tCO_2$/MWh)" shown in Section I below and the conservative emission factor of diesel-fired power plant of 0.533 $tCO_2$/MWh is applied. The emission factors to be applied are set as "Emission factor for Case 2 ($tCO_2$/MWh)" in Section I. below.

In the case that the run-of-river hydro power generation system(s) in a proposed project activity is only connected to an internal grid connecting to a captive power generator (Case 3), the emission factor of a diesel generator calculated by applying the most efficient heat efficiency of 49%, an efficiency level which is above the value of the world's leading diesel generator is applied, which is set as 0.533 $tCO_2$/MWh.

The emission factors for each case are shown in Section I.

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

$$RE_p = \sum_i \left(EG_{i,p} \times EF_{RE,i}\right)$$

$RE_p$ : Reference emissions during the period *p* [$tCO_2$/p]
$EG_{i,p}$ : Quantity of electricity generated by the project run-of-river hydro power generation system *i* during period *p* [MWh/p]
$EF_{RE.i}$ : Reference $CO_2$ emission factor for the project run-of-river hydro power generation system *i* [$tCO_2$/MWh]

## G. Calculation of project emissions

$$PE_p = 0$$

$PE_p$ : Project emissions during period *p* [$tCO_2$/p]

## H. Calculation of emissions reductions

$ER_p = RE_p - PE_p$
$= RE_p$

$ER_p$ : Emission reductions during period *p* [$tCO_2/p$]
$RE_p$ : Reference emissions during period *p* [$tCO_2/p$]
$PE_p$ : Project emissions during 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 |
|---|---|---|
| $EF_{RE,i}$ | The reference $CO_2$ emission factor for the project run-of-river hydro power generation system *i*.<br><br>The value for $EF_{RE,i}$ is selected from the emission factor based on the regional grid ($EF_{RE,grid}$) or based on a captive diesel power generator ($EF_{RE,cap}$) in the following manner:<br><br>In case the run-of-river hydro power generation system(s) in a proposed project activity is connected to a regional grid including through internal grid which is not connected to a captive power generator (Case 1), $EF_{RE,grid}$ is set as follows:<br><br>Emission factor for Case 1 ($tCO_2/MWh$)<br>Regional grid name: Emission factor for Case 1:<br>Luzon-Visayas 0.507 $tCO_2/MWh$<br>Mindanao 0.468 $tCO_2/MWh$<br><br>In case the run-of-river hydro power generation system(s) in a proposed project activity is connected to an internal grid connected to both a regional grid and a captive power generator (Case 2), $EF_{RE,grid}$ is set as follows: | Additional information<br>The default emission factor is obtained from a study of electricity systems in the Philippines and the most efficient diesel power generator (a default value of 49% heat efficiency is above the value of the world's leading diesel generator).<br><br>The default value is revised if deemed necessary by the JC. |

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| | Emission factor for Case 2 ($tCO_2$/MWh)<br>Regional grid name: Emission factor for Case 1:<br>Luzon-Visayas 0.507 $tCO_2$/MWh<br>Mindanao 0.468 $tCO_2$/MWh<br><br>In case the run-of-river hydro power generation system(s) in a proposed project activity is connected to an internal grid which is not connected to the regional grid, and only connected to a captive power generator (Case 3), $EF_{RE,cap}$, 0.533 $tCO_2$/MWh is applied. | |

History of the document

| Version | Date | Contents revised |
|---|---|---|
| 01.0 | 2 February 2020 | Electronic decision by the Joint Committee<br>Initial approval. |
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