Joint Crediting Mechanism Approved Methodology ET_AM002

"Electrification by photovoltaic power generation in Ethiopia"

A. Title of the methodology

Electrification by photovoltaic power generation in Ethiopia, ver01.0

B. Terms and definitions

Terms	Definitions
Photovoltaic power generation system (PV)	An electricity generation system which converts sunlight into electricity by the use of photovoltaic (PV) modules. The system also includes ancillary equipment such as inverters required to change the electrical current from direct current (DC) to alternating current (AC).
Recipient	Facilities that receive and consume the electricity generated by the project, e.g. households, public buildings, small office or production facility.

C. Summary of the methodology

Items	Summary
GHG emission reduction measures	Displacement of electricity using diesel fuel and/or lighting using kerosene by installation and operation of the PV.
Calculation of reference emissions	Reference emissions are calculated on the basis of the consumption of electricity generated by the PV multiplied by emission factor of diesel or kerosene.
Calculation of project emissions	The project does not assume any project emissions.
Monitoring parameters	✓ The actual amount of electricity consumed by all the recipients (*Calculation method 1*). ✓ The actual amount of electricity consumed by each recipient (*Calculation method 2*).

D. Eligibility criteria

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

Criterion 1	The project newly installs the PV[1] to supply electricity for recipients, who are not connected to national grid and who have not used renewable electricity until the earliest date of construction for the project.
Criterion 2	The total capacity of PV installed by the project is less than 135 kW.[2]
Criterion 3	The PV modules have obtained a certification of design qualifications (IEC 61215, IEC 61646 or IEC 62108) and safety qualification (IEC 61730-1 and IEC 61730-2).

E. Emission Sources and GHG types

Reference emissions	
Emission sources	GHG types
Fuel consumption by kerosene lamps	CO_2
Fuel consumption by electricity generation	CO_2
Project emissions	
Emission sources	GHG types
Generation of electricity from PV	N/A

F. Establishment and calculation of reference emissions

F.1. Establishment of reference emissions

The project is executed in the off-grid area. Therefore, the reference scenario assumes the emissions due to electricity supplied by diesel generation unit or kerosene lamps.

In order to achieve net emission reductions, the reference emissions are calculated based upon the conservatively selected emission factors for diesel generation unit based on Table 2 in CDM

[1]This methodology is also applicable to projects which newly install PVs together with the "micro hydropower generation unit" as defined by the latest version of ET_AM001, "Electrification of communities using Micro hydropower generation".
[2]In the case mentioned in footnote 1, the total capacity of the project is determined as the sum of the capacity of the units installed under this methodology and "micro hydropower generation unit" as defined in ET_AM001.

approved small scale methodology, AMS-I.F by applying the lowest value within the next higher capacity range of diesel generators to that of the project generation systems.
Accordingly, in the case of $x_p < 35$ (x_p: the total capacity of the project generation systems [kW][2]), the emission factor of 1.0 [tCO_2/MWh] is applied, which is the lowest value within the range of $35 \leq x_d < 135$ (x_d: the capacity of the diesel generator systems [kW]) in the table. In the case of $35 \leq x_p < 135$, the emission factor 0.8 [tCO_2/MWh] is applied, which is the lowest value within the range of $135 \leq x_d < 200$.

F.2. Calculation of reference emissions

If electricity consumption of each recipient is monitored, the *Calculation method 2* can be applied as necessary. If each is not monitored, the *Calculation method 1* is applied.

Calculation method 1

$$RE_p = EC_{total,p} \times EF_{CO2}$$

Where:

RE_p	Reference emissions during the period p [tCO_2/p]
$EC_{total,p}$	Total electricity consumption by all the recipients during the period p [MWh/p][3]
EF_{CO2}	CO_2 emission factor of the diesel generation unit [tCO_2/MWh]

Calculation method 2

$$RE_p = \sum_{i=1}^{M_p} RE_{i,p}$$

$$v_b = (v_y / 365) \times p$$

[3]In the case mentioned in footnote 1, these electricity consumptions include the electricity supplied by "micro hydropower generation unit" defined by the ET_AM001, and the consumed electricity generated by the PV and the "micro hydropower generation unit" can be monitored collectively.

- In case of $EC_{i,p} \leq v_b$

$$RE_{i,p} = EC_{i,p} \times EF_{CO2,FUEL}$$

- In case of $EC_{i,p} > v_b$

$$RE_{i,p} = v_b \times EF_{CO2,FUEL} + (EC_{i,p} - v_b) \times EF_{CO2}$$

Where:

RE_p	Reference emissions during the period p [tCO_2/p]
p	The period of the monitoring [day]
$RE_{i,p}$	Reference emissions of the recipient i during the period p [tCO_2/p]
M_p	The number of the recipients in the project activity during the period p
v_b	The threshold of the electricity consumption for the recipient i during the period p [MWh], accounted as displacement of kerosene lamps.
v_y	The minimum electricity consumption for lighting per recipient per year [MWh], the default value is 0.055 [MWh].
$EC_{i,p}$	Electricity consumption of the recipient i during the period p [MWh/p][3]
$EF_{CO2,FUEL}$	CO_2 emission factor of the lighting by kerosene lamps [tCO_2/MWh]
EF_{CO2}	CO_2 emission factor of the diesel generation unit [tCO_2/MWh]

G. Calculation of project emissions

There are no project emissions.

$$PE_p = 0$$

Where:

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

H. Calculation of emissions reductions

Emission reductions are calculated as the difference between the reference emissions and project emissions, as follows.

$$ER_p = RE_p - PE_p$$

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
EF_{CO2}	CO_2 emission factor of the diesel generation unit [tCO_2/MWh] In the case of x_p< 35 (x_p: the total capacity of the project generation systems [kW][2]), the emission factor of 1.0 [tCO_2/MWh] is applied. In the case of 35 ≤x_p<135, the emission factor 0.8 [tCO_2/ MWh] is applied.	Refer to the available value in "Table 2. Emission factors for diesel generator systems (in [kg CO_2e/kWh]) for three different levels of load factors" of CDM approved small scale methodology AMS-I.F. This parameter is determined at the time of validation in accordance with the latest version of the above source.
$EF_{CO2,FUEL}$	CO_2 emission factor of the lighting by kerosene lamps [tCO_2/MWh] Default value: 6.8 [tCO_2/MWh]	Refer to the available value of the CDM Methodology, AMS-I.L. "Electrification of rural communities using renewable energy". This parameter is determined at the time of validation in accordance with the latest version of the above source.
v_y	The minimum electricity consumption for lighting per recipient per year [MWh] (Two 15W CFLs which are equivalent to kerosene lamp run for 5 [hrs/day] for 365 days consuming 0.055 [MWh]) Default value: 0.055 [MWh]	Refer to the available value in the CDM Methodology, AMS-I.L "Electrification of rural communities using renewable energy". This parameter is determined at the time of validation in accordance with the latest version of the above source.

History of the document

Version	Date	Contents revised
01.0	21 March 2017	JC3, Annex 2 Initial approval.