

# Standardized Crediting Framework (SCF) Bangladesh:

## Methodology for Solar Home Systems

### 1. Methodology title, version, and date

Methodology title	Solar Home Systems for Bangladesh
Version	1.0
Date	XX/XX/2024

### 2. Definitions

For this methodology, the following definitions shall apply:

**Individual renewable energy system** – solar PV electricity generation system that supplies electricity to a single consumer (e.g., a home or school) and that is not connected with other facilities or generation systems (i.e., stand-alone solar home systems).

**New consumer(s)** – the end-user(s)/facility(ies) (households) that, prior to the activity, had no connection to an operational source of electricity.

### 3. Summary

Typical activity(ies) <sup>1</sup>	Rural communities are supplied with electricity from the individual renewable energy system. The activity supplies electricity to consumers who, prior to activity implementation, were not connected to a national or regional grid, or mini grids.
Type of GHG emissions mitigation action	Displacement of fossil fuel use.

### 4. Eligibility criteria

Technology	Individual renewable energy systems: solar home systems (SHS)
Consumers	Consumers that were not connected to a national or regional grid or mini-grid prior to the installation of the SHS
Legal	The activity must comply with relevant Bangladeshi national laws and regulations
Technical standards	The activity equipment must comply with the International Electrotechnical Commission standards <a href="#">IEC 61215:2016</a> , 60904-1:2013, 60904-2:2013 and 60904-9:2013 and applicable national and/or international standards. <sup>2</sup>
Double counting	The activity, or parts of the activity, may not be registered with any other emission reduction standard or registry. If the activity had historically been registered with another emission reduction standard or registry, it must not issue any further carbon credits under that standard or registry.

<sup>1</sup> The activity (i.e., projects or programs) described in the activity documentation under the CDM, SCF, Article 6.4 Mechanism, or another Crediting Mechanism, capable of generating Emission Reductions under a crediting mechanism.

<sup>2</sup> Inverters should meet IEC 62109-1:2016 and 62109-2:2016, charge controllers IEC 62509:2016, and batteries IEC 61427-1:2016.

## 5. Emission sources and gases

The methodology covers only CO<sub>2</sub> from the combustion of fossil fuels. For the baseline, this is the fossil fuel consumption that will be displaced by the activity technologies (e.g., diesel generators or kerosene for lighting). For the activity, there are no emissions directly from individual renewable energy systems (i.e., solar home systems).

## 6. Baseline emission factor for electrification

This methodology uses a baseline emission factor composed of parameters fixed ex-ante, through the following options:

- a) Based on a trend-adjusted projection of historical fuel consumption.<sup>3</sup>
- b) Based on the device capacity according to different system sizes. In this case, the baseline emission factor is calculated based on the annual amount of renewable electricity consumed per consumer each year.<sup>4</sup>

## 7. Emissions reductions

Total emissions reductions are calculated as follows:

$$ER_y = BE_y - AE_y - LE_y \quad \text{Equation (1)}$$

Where:

$ER_y$	Emissions reductions in the year $y$ (tCO <sub>2</sub> e)
$BE_y$	Baseline emissions in the year $y$ (tCO <sub>2</sub> e)
$AE_y$	Activity emissions in the year $y$ (tCO <sub>2</sub> e)
$LE_y$	Leakage emissions in the year $y$ (tCO <sub>2</sub> e)

## 8. Baseline emissions

Baseline emissions for solar home systems are calculated by choosing one of the following approaches, as shown below:

- a) Trend-adjusted projection of historical fuel consumption (i.e., kerosene) approach:

$$BE_y = OS_{OG,y} \times \sum_j^n [N_{j,y} \times N_{OG,j,y} \times (KC_{j,y} \times NCV \times EF_k)] \quad \text{Equation (2)}$$

Where:

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<sup>3</sup> Based on baseline Option 3 of the approved CDM methodology AMS.I-A. "Electricity generation by the user". Version 19.0.

<sup>4</sup> Based on the approved CDM methodology AMS.I-L. "Electrification of rural communities using renewable energy". Version 5.0

$BE_y$	Baseline emissions in year $y$ (tCO <sub>2</sub> )
$OS_{OG,y}$	Share of operational devices in year $y$ (fraction)
$N_{j,y}$	Number of kerosene lamps per device type $j$ in year $y$
$N_{OG,j,y}$	Number of solar home systems type $j$ since the start of the activity, in year $y$
$KC_{j,y}$	Kerosene consumption per lamp that replaces a device type $j$ in the year $y$ (t/y)
$NCV$	Net calorific value of kerosene (GJ/t)
$EF_K$	Emission factor of kerosene (tCO <sub>2</sub> /GJ)
$j$	Index for device type (i.e., system sizes)
$n$	Index for the total number of device types

And where  $N_{j,y}$  is determined as per Table 1:

Table 1. Kerosene lamps replaced by device type  $j$ ,

SHS size (Wp) (device type $j$ )	20-39	40-74	75-119	≥ 120
Number of kerosene lamps that would be used in the absence of the device	1	2	3	4

- b) Electricity delivered by project renewable electricity generation system based on the system capacity

$$BE_y = OS_{OG,y} \times \sum_j^n [N_{OG,j,y} \times (EC_{OG,j} \times EF_{OG,j})] \quad \text{Equation (3)}$$

Where:

$BE_y$	=	Baseline emissions for solar home systems activity in year $y$ (tCO <sub>2</sub> )
$OS_{OG,y}$	=	Share of operational devices in year $y$ (fraction)
$N_{OG,j,y}$	=	Number of solar home systems type $j$ since the start of the activity, in year $y$
$EC_{OG,j}$	=	Calculated annual electricity consumption in solar home systems type $j$ in year $y$ (MWh)
$EF_{OG,j}$	=	Baseline emission factor for solar home system type $j$ (tCO <sub>2</sub> /MWh)
$j$		Index for solar home system type (i.e., system sizes)
$n$		Index for the total number of device types

To calculate the electricity consumption in solar home system type  $j$

$$EC_{OG,j} = C_j \times Av \times 8760 \quad \text{Equation (4)}$$

Where:

- $C_j$  = Capacity of solar home system type  $j$  (MW)
- $Av$  = Solar availability in Bangladesh (%)
- 8760 = Hours per year

For the baseline emission factor for solar home system ( $EF_{OG,i}$ )<sup>5</sup>:

- For consumption up to 55 kWh per year, the emissions factor is 2.72 tCO<sub>2</sub>/MWh
- For consumption over 55 kWh per year, the emission factor for this additional consumption is 1.0 tCO<sub>2</sub>/MWh.

The emission factor system type with annual consumption greater than 55 kWh is therefore:

$$EF_{OG,j} = \frac{((EC_{OG,j} - 0.055) * 1.0) + 0.15}{EC_{OG,i}} \quad \text{Equation (5)}$$

Where:

- $EC_{OG,i}$  = Calculated annual electricity consumption in new solar home system by consumer  $i$  (MWh)
- 1.0 = Emission factor for consumption greater than 55 kWh (tCO<sub>2</sub>/MWh)
- 0.15 = Emissions from the consumption of the first 55 kWh (i.e., 0.055 MWh x 2.72 tCO<sub>2</sub>/MWh)

## 9. Activity emissions

The emission factor for solar home systems is zero in all cases. Then, activity emissions are considered zero for this activity.

$$AE_y = 0 \quad \text{Equation (6)}$$

## 10. Leakage emissions

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<sup>5</sup> Based on CDM "Tool 33 Default values for common parameters" Version 2.0. This tool considers conservative emission factors where, in the baseline, kerosene usage for lighting purposes is envisaged. The rural population in Bangladesh largely uses kerosene lamps for lighting. Since there is a lack of specific information on the share of technologies used for lighting in rural population without connexion to a national or regional grid, the conservative approach provided by this tool is applied.

Because there are no leakage effects from solar PV electricity generation, leakage emissions are zero

$$LE_y = 0 \quad \text{Equation (7)}$$

For the application of this methodology based on types of devices by size tranches, only full years of operation will be considered, so partial years (i.e., years of installation) will be discarded.

## 11. Data and parameters fixed ex-ante

Parameter	Description	Value
$N_{j,y}$	Number of kerosene lamps per device type $j$ in year $y$	Determined based on the number of solar home systems continuously recorded in the activity database, according to values in Table 1.
$KC_{j,y}$	Kerosene consumption per lamp that replaces a device type $j$ in the year $y$ (t/y)	0.0357 <sup>6</sup>
$NCV_K$	Net calorific value of kerosene (GJ/t)	43.8 <sup>7</sup>
$EF_K$	Emission factor of kerosene (tCO <sub>2</sub> /GJ)	71.9 X 10 <sup>-38</sup>
$EF_{OG,i}$	Baseline emission factor for solar home system by consumer $i$ : <ul style="list-style-type: none"> <li>- For annual consumption up to 55 kWh</li> <li>- For consumption beyond 55 kWh</li> </ul>	2.72 tCO <sub>2</sub> /MWh 1.0 tCO <sub>2</sub> /MWh
$Av$	Solar PV availability in Bangladesh (%)	13.30%

## 12. Monitoring requirements

Parameter	Description	Monitoring approach
$j$	Device type (i.e., size)	Recorded in the database.
$N_{OG,j,y}$	Cumulative number of solar home systems type $j$ since the start of the activity in year $y$	Continuously recorded in the activity database.
$OS_{OG,y}$	Share of operational devices in the year $y$	Option A: Survey of 60 randomly selected consumers out of the complete number (of new consumers under

<sup>6</sup> This is the product of 47.6 litres of Kerosene per lamp per year and kerosene density (0.75 kg/litre). The consumption of kerosene per lamp per year is based on a conservative value of 0.04 litres per hour is considered based on Grameen Shakti survey from 2009. In the specific case of lighting devices, a daily usage of 3.5 hours per day is assumed. Also, 25 days per annum are deducted to include any nonfunctioning days due to SHS system maintenance.

<sup>7</sup> The NCV of the kerosene is 43.8 TJ/Gg according to IPCC 2006 (Energy, Chapter 1, Table 1.2).

<sup>8</sup> The emission factor for kerosene is 71.9 kgCO<sub>2</sub>/GJ according to IPCC, 2006 (Energy, Chapter 1, Table 1.4).

		<p>the activity (i.e., total SHS population) to determine whether system is operational (could include phone-based surveys).</p> <p>Option B: Representative data reported from other credible monitoring standards (e.g., CDM program monitoring)</p> <p>Option C: Representative data from utility or other official sources</p> <p>Frequency: annual (or each monitoring period if period is longer than 12 months)</p>
$EC_{OG,i}$	Annual electricity consumption in solar home system by consumer $i$	<p>Calculated for each system at installation based on 13.30% availability (see equation 2).</p> <p>Capacity of the device (<math>C_i</math>) based on technical specifications and recorded in the database.</p>

### 13. Version history

Version	Date	Contents revised
1.0	XX/XX2024	Initial adoption by Article 6 DNA Governing Board

## Appendix 1. Justification of selected default parameters

### Solar PV availability in Bangladesh

Solar availability was calculated based on the widely used RETScreen tool.<sup>9</sup> The average daily horizontal irradiation at Bangladesh is 4.69 kWh/m<sup>2</sup>-d, according to the RETScreen climate database<sup>10</sup>. Based on these inputs, the minimum availability factor for solar home systems in Bangladesh, across the range of possible slopes, would be 13.30%.

The technical assumptions to estimate the solar availability are based on the typical characteristics of a residential solar panel:

Residential panel	18 unit =	10 kW
Efficiency	21%	
Irradiation	4.65	kWh/m <sup>2</sup> /day
Frame area	1.8	m <sup>2</sup>

$$\text{Solar availability (\%)} = \frac{(18 \text{ units} \times 365 \text{ days} \times 0.21 \times \frac{4.69 \text{ kWh}}{\text{m}^2 \text{ day}} \times 1.8 \text{ m}^2)}{10 \text{ kW} \times 8760 \text{ hours per year}}$$

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<sup>9</sup> RETScreen Expert software. Visualization 9.0.0.0. Minister of Natural Resources Canada 1997-2022. Available at <https://www.nrcan.gc.ca/maps-tools-and-publications/tools/modelling-tools/retscreen/7465>.

<sup>10</sup> Average value based on the provinces of Barisal, Dhaka, Rangpur, Rajshahi, Maimansingh, Dinajpur, Chittagong, Khulna and Sylhet