Joint Crediting Mechanism Approved Methodology MN_AM003

"Installation of Solar PV System"

A. Title of the methodology

Installation of Solar PV System, Ver. ~~02.0~~03.0

B. Terms and definitions

Terms	Definitions
Solar photovoltaic (PV) system	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).

C. Summary of the methodology

Items	Summary
GHG emission reduction measures	Displacement of grid electricity and/or captive electricity by installation and operation of solar PV system(s).
Calculation of reference emissions	Reference emissions are calculated on the basis of the AC output of the solar PV system(s) multiplied by either; 1) the conservative emission factor of the grid, or 2) conservative emission factor of diesel power generator.
Calculation of project emissions	Project emissions are the emissions from the solar PV system(s), which are assumed to be zero.
Monitoring parameters	The quantity of the electricity generated by the project solar PV system(s).

D. Eligibility criteria

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

Criterion 1	The project newly installs solar PV system(s).

Criterion 2	The PV modules obtained a certification of design qualifications (IEC 61215, IEC 61646 or IEC 62108) and safety qualification (IEC 61730-1 and IEC 61730-2).
Criterion 3	The equipment used to monitor output power of the solar PV system(s) and irradiance is installed at the project site.

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 the solar PV system(s)	N/A

F. Establishment and calculation of reference emissions

F.1. Establishment of reference emissions

The default emission factors are set in a conservative manner based on the Mongolian national grid which consists of Central Energy System (CES), Altai-Uliastai Energy System (AUES), Western Energy System (WES), Eastern Energy System (EES), and Southern (Gobi) Energy System (SES) and based on the most efficient heat efficiency of a diesel power generator.

In order to identify the emission factor based on the national grid simplistically and secure net emission reductions, this methodology applies the lowest emission factor of coal-fired power plant supplying electricity to the national grid, which is set to be ~~0.797~~0.68 tCO_2/MWh. This value is lower than the latest grid emission factors for CES, which ~~is~~ are ~~1.154~~0.884 tCO_2/MWh (~~combined~~ operating margin, ~~2012~~2015) and 0.833 tCO_2/MWh (build margin, 2015) published by ~~Mongolian government~~CDM EB, and it ensures net emission reductions.

In addition, the conservative emission factor based on a captive diesel power generator is calculated by applying the default heat efficiency of 49%, an efficiency level which is above the value of the world's leading diesel power generator, and set to 0.533 tCO_2/MWh.

F.2. Calculation of reference emissions

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

RE_p : Reference emissions during the period *p* [tCO_2/p]
$EG_{i,p}$: Quantity of the electricity generated by the project solar PV system *i* during the period *p* [MWh/p]
$EF_{RE,i}$: Reference CO_2 emission factor for the project solar PV system *i* [tCO_2/MWh]

G. Calculation of project emissions

Project emissions are not assumed in the methodology as electricity consumption by any PV system is negligible.

$PE_p = 0$

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

H. Calculation of emissions reductions

$$ER_p = RE_p - PE_p$$
$$= RE_p$$

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
$EF_{RE,i}$	Reference CO_2 emission factor for the project solar PV system *i*. The value for $EF_{RE,i}$ is selected from the emission	Additional information The default emission factors are derived from a study of

	factor based on the national grid ($EF_{RE,grid}$) or based on captive diesel power generator ($EF_{RE,cap}$) in the following manner: In case the PV system in a proposed project activity is connected to the national grid (CES, WES, AUES, EES, and/or SES) including internal grid which is not connected to a captive power generator, $EF_{RE,grid}$, ~~0.797~~0.68 tCO_2/MWh is applied. In case the PV system in a proposed project activity is connected to internal grid which is connected to both the national grid (CES, WES, AUES, EES, and/or SES) and a captive power generator, $EF_{RE,cap}$, 0.533 tCO_2/MWh is applied. In case the PV system in a proposed project activity is connected to internal grid which is not connected to the national grid, $EF_{RE,cap}$, 0.533 tCO_2/MWh is applied.	electricity systems in Mongolia and the default heat efficiency of 49% which is set above the value of the most efficient diesel power generator. The default value is revised if deemed necessary by the JC.

History of the document

Version	Date	Contents revised
03.0	4 August 2024	Revision to: ● Update the reference emission factor based on the national grid to ensure conservativeness and net emission reductions.
02.0	30 January 2017	Revision to: ● Change the description of "Measurement methods and procedures" to clarify the requirement for calibration in the Monitoring Spreadsheet: JCM_MN_AM003.
01.0	29 September 2016	JC4, annex 1 Initial approval.

Monitoring Spreadsheet: JCM_MN_AM003_ver~~02.0~~03.0

Reference Number:

Monitoring Plan Sheet (Input Sheet) [Attachment to Project Design Document]

Table 1: Parameters to be monitored *ex post*

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Monitoring point No.	Parameters	Description of data	Estimated Values	Units	Monitoring option	Source of data	Measurement methods and procedures	Monitoring frequency	Other comments
(1)	$EG_{i,p}$	Quantity of the electricity generated by the project solar PV system *i* during the period *p*	0	MWh/p	Option B/C	Invoice or receipts/ Measured data	Invoice or receipts for selling electricity, or the measured AC output of the inverters is used to determine the amount of net electricity generation by the solar PV system. In case the measured AC output of the inverters is used, the reading is taken from an electricity meter or the inverters. The reading is taken manually or electronically using a data logger. The electricity meter is replaced or calibrated at an interval following the regulations in the country in which the electricity meter is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the electricity meter has been prepared by the time of installation.	Monthly recording	Input on "MPS(input_separate)" sheet

Table 2: Project-specific parameters to be fixed *ex ante*

(a)	(b)	(c)	(d)	(e)	(f)
Parameters	Description of data	Estimated Values	Units	Source of data	Other comments
$EF_{RE,i}$	Reference CO_2 emission factor for the project solar PV system *i*	-	tCO_2/MWh	In case the PV system in a proposed project activity is connected to the national grid (CES, WES, AUES, EES, and/or SES) including through internal grid which is not connected to a captive power generator, EF_{REgrid}, 0.680~~0.797~~ tCO_2/MWh is applied. In case the PV system in a proposed project activity is connected to internal grid which is connected to both the national grid (CES, WES, AUES, EES, and/or SES) and a captive power generator, $EF_{RE,cap}$, 0.533 tCO_2/MWh is applied. In case the PV system in a proposed project activity is connected to an internal grid which is not connected to the national grid, $EF_{RE,cap}$, 0.533 tCO_2/MWh is applied.	Input on "MPS(input_separate)" sheet

Table3: *Ex-ante* estimation of CO_2 emission reductions

CO_2 emission reductions	Units
0	tCO_2/p

[Monitoring option]

Option A	Based on public data which is measured by entities other than the project participants (Data used: publicly recognized data such as statistical data and specifications)
Option B	Based on the amount of transaction which is measured directly using measuring equipments (Data used: commercial evidence such as invoices)
Option C	Based on the actual measurement using measuring equipments (Data used: measured values)

	Parameters to be monitored *ex post*	Project-specific parameters to be fixed *ex ante*
i	$EG_{i,p}$	$EF_{RE,i}$
Solar PV system number	Quantity of the electricity generated by the project solar PV system *i* during the period *p*	Reference CO_2 emission factor for the project solar PV system *i*
	MWh/p	tCO_2/MWh
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Monitoring Spreadsheet: JCM_MN_AM003_ver02.003.0

Reference Number:

Monitoring Plan Sheet (Calculation Process Sheet) [Attachment to Project Design Document]

1. Calculations for emission reductions	Fuel type	Value	Units	Parameter
Emission reductions during the period *p*	N/A	0	tCO_2/p	ER_p
2. Selected default values, etc.				
The reference CO_2 emission factor of electricity				
The reference CO_2 emission factor based on the national grid	Mixed	~~0.797~~0.68	tCO_2/MWh	$EF_{RE,grid}$
The reference CO_2 emission factor based on the captive power generator	Diesel	0.533	tCO_2/MWh	$EF_{RE,cap}$
3. Calculations for reference emissions				
Reference emissions during the period *p*	N/A	0	tCO_2/p	RE_p
4. Calculations of the project emissions				
Project emissions during the period *p*	N/A	0	tCO_2/p	PE_p

[List of Default Values]

The reference CO_2 emission factor based on the national grid (CES, WES, AUES, EES, SES)	Mixed	~~0.797~~0.68
The reference CO_2 emission factor based on the captive power generator	Diesel	0.533

Monitoring Structure Sheet [Attachment to Project Design Document]

Responsible personnel	Role

Monitoring Spreadsheet: JCM_MN_AM003_ver02.003.0

Reference Number:

Monitoring Report Sheet (Input Sheet) [For Verification]

Table 1: Parameters monitored *ex post*

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
Monitoring period	Monitoring point No.	Parameters	Description of data	Monitored Values	Units	Monitoring option	Source of data	Measurement methods and procedures	Monitoring frequency	Other comments
	(1)	$EG_{i,p}$	Quantity of the electricity generated by the project solar PV system *i* during the period *p*	0	MWh/p	Option B/C	Invoice or receipts/ Measured data	Invoice or receipts for selling electricity, or the measured AC output of the inverters is used to determine the amount of net electricity generation by the solar PV system. In case the measured AC output of the inverters is used, the reading is taken from an electricity meter or the inverters. The reading is taken manually or electronically using a data logger. The electricity meter is replaced or calibrated at an interval following the regulations in the country in which the electricity meter is commonly used or according to the manufacturer's recommendation, unless a type approval, manufacturer's specification, or certification issued by an entity accredited under international/national standards for the electricity meter has been prepared by the time of installation.	Monthly recording	Input on "MRS(input_separate)" sheet

Table 2: Project-specific parameters fixed *ex ante*

(a)	(b)	(c)	(d)	(e)	(f)
Parameters	Description of data	Estimated Values	Units	Source of data	Other comments
$EF_{RE,i}$	Reference CO_2 emission factor for the project solar PV system *i*	-	tCO_2/MWh	In case the PV system in a proposed project activity is connected to the national grid (CES, WES, AUES, EES, and/or SES) including through internal grid which is not connected to a captive power generator, EFREgrid, 0.680.797 tCO2/MWh is applied. In case the PV system in a proposed project activity is connected to internal grid which is connected to both the national grid (CES, WES, AUES, EES, and/or SES) and a captive power generator, EFRE,cap, 0.533 tCO2/MWh is applied. In case the PV system in a proposed project activity is connected to an internal grid which is not connected to the national grid, EFRE,cap, 0.533 tCO2/MWh is applied.	Input on "MPS(input_separate)" sheet

Table3: *Ex-post* calculation of CO_2 emission reductions

Monitoring Period	CO_2 emission reductions	Units
	0	tCO_2/p

[Monitoring option]

Option A	Based on public data which is measured by entities other than the project participants (Data used: publicly recognized data such as statistical data and specifications)
Option B	Based on the amount of transaction which is measured directly using measuring equipments (Data used: commercial evidence such as invoices)
Option C	Based on the actual measurement using measuring equipments (Data used: measured values)

	Parameters monitored *ex post*	Project-specific parameters fixed *ex ante*
i	$EG_{i,p}$	$EF_{RE,i}$
Solar PV system number	Quantity of the electricity generated by the project solar PV system *i* during the period *p*	Reference CO_2 emission factor for the project solar PV system *i*
	MWh/p	tCO_2/MWh
1		0.000
2		0.000
3		0.000
4		0.000
5		0.000
6		0.000
7		0.000
8		0.000
9		0.000
10		0.000
11		0.000
12		0.000
13		0.000
14		0.000
15		0.000
16		0.000
17		0.000
18		0.000
19		0.000
20		0.000
21		0.000
22		0.000
23		0.000
24		0.000
25		0.000
26		0.000
27		0.000
28		0.000
29		0.000
30		0.000
31		0.000
32		0.000
33		0.000
34		0.000
35		0.000
36		0.000
37		0.000
38		0.000
39		0.000
40		0.000
41		0.000
42		0.000
43		0.000
44		0.000
45		0.000
46		0.000
47		0.000
48		0.000
49		0.000
50		0.000

51		0.000
52		0.000
53		0.000
54		0.000
55		0.000
56		0.000
57		0.000
58		0.000
59		0.000
60		0.000
61		0.000
62		0.000
63		0.000
64		0.000
65		0.000
66		0.000
67		0.000
68		0.000
69		0.000
70		0.000
71		0.000
72		0.000
73		0.000
74		0.000
75		0.000
76		0.000
77		0.000
78		0.000
79		0.000
80		0.000
81		0.000
82		0.000
83		0.000
84		0.000
85		0.000
86		0.000
87		0.000
88		0.000
89		0.000
90		0.000
91		0.000
92		0.000
93		0.000
94		0.000
95		0.000
96		0.000
97		0.000
98		0.000
99		0.000
100		0.000

Monitoring Spreadsheet: JCM_MN_AM003_ver02.003.0

Reference Number:

Monitoring Report Sheet (Calculation Process Sheet) [For Verification]

1. Calculations for emission reductions	Fuel type	Value	Units	Parameter
Emission reductions during the period *p*	N/A	0	tCO_2/p	ER_p
2. Selected default values, etc.				
The reference CO_2 emission factor of electricity				
The reference CO_2 emission factor based on the national grid	Mixed	~~0.797~~0.68	tCO_2/MWh	$EF_{RE,grid}$
The reference CO_2 emission factor based on the captive power generator	Diesel	0.533	tCO_2/MWh	$EF_{RE,cap}$
3. Calculations for reference emissions				
Reference emissions during the period *p*	N/A	0	tCO_2/p	RE_p
4. Calculations of the project emissions				
Project emissions during the period *p*	N/A	0	tCO_2/p	PE_p

[List of Default Values]

The reference CO_2 emission factor based on the national grid (CES, WES, AUES, EES, SES)	Mixed	~~0.797~~0.68
The reference CO_2 emission factor based on the captive power generator	Diesel	0.533