Joint Crediting Mechanism Approved Methodology TH_AM001

"Installation of Solar PV System"

A. Title of the methodology

Installation of Solar PV System, Ver 021.0

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 using fossil fuel as power source by installation and operation of the 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 the conservative emission factor of grid electricity and/or captive electricity.
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 installs solar PV system(s).

Criterion 2	The solar PV system is connected to the internal power grid of the project site and/or to the grid for displacing grid electricity and/or captive electricity at the project site.
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).
Criterion 4	The equipment to monitor output power of the solar PV system and irradiance is installed at the project site.

E. Emission Sources and GHG types

Reference emissions	
Emission sources	GHG types
Consumption of grid and/or captive electricity	CO_2
Project emissions	
Emission sources	GHG types
Generation of electricity from solar PV system(s)	N/A

F. Establishment and calculation of reference emissions

F.1. Establishment of reference emissions

The emission factor of the Thai grid published by the Thailand Greenhouse Gas Management Organization (TGO) is 0.5661 tCO_2/MWh (combined margin, 2014).

Most of the grid power is derived from natural gas in Thailand (around 70%). The generation efficiency of major natural gas-fired power plants in Thailand ranges from 41 to 61%. The emission factors of these plants are in the range of 0.477 to 0.319 tCO_2/MWh.

Considering that it is difficult to identify which of the natural gas-fired power plants is displaced by solar PV system(s) installed in this project, the grid emission factor is established by assuming that the most efficient natural gas-fired power plant in Thailand is displaced in conservative manner, which will lead to ensuring net emission reductions. The grid emission factor is set to be 0.319 tCO_2/MWh which corresponds to the most efficient natural gas-fired power plant in Thailand (generation efficiency: 61.2%).

F.2. Calculation of reference emissions

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

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} : Reference CO_2 emission factor of grid electricity and/or captive electricity [tCO_2/MWh]

G. Calculation of project emissions

$$PE_p = 0$$

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}	Reference CO_2 emission factor of grid and/or captive electricity, calculated based on the	Additional information The default emission factor is

	power generation efficiency of 61.2% using natural gas as the power source. The default value for EF_{RE} is set to be 0.319 tCO_2/MWh.	derived from the result of the survey on the generation efficiency of major natural gas-fired power plants in Thailand. The default value should be revised if necessary from survey result which is conducted by the JC or project participants.

History of the document

Version	Date	Contents revised
02.0	28 September 2020	Electronic decision by the Joint Committee. Revision to: Change the description of "Measurement methods and procedures" to clarify the requirement for calibration in the Monitoring Spreadsheet: JCM_TH_AM001
01.0	23 August 2016	Decision by the Joint Committee. Initial approval.

Monitoring Spreadsheet: JCM_TH_AM001_ver02.0

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)	ΣEGi,p	Total quantity of the electricity generated in the project during the period *p*	0.00	MWh/p	Option C	Measured data	The AC output of the inverters is measured to determine the amount of net electricity generation by the solar PV system. 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. ~~The electricity meter is certified by an entity accredited under international/national standards. The electricity meter is replaced or tested for accuracy at an interval following the regulations in the country in which the electricity meter is commonly used or according to the manufacturer's recommendation. The electricity meter is calibrated or replaced when it fails to pass the test.~~	Monthly recording	N/A

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}	Reference CO_2 emission factor of grid and/or captive electricity	0.319	tCO_2/MWh	The default emission factor is derived from the result of the survey on the generation efficiency of major natural gas-fired power plants in Thailand. The default value should be revised if necessary from survey result which is conducted by the JC or project participants.	N/A

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)

Monitoring Spreadsheet: JCM_TH_AM001_ver02.0
Reference Number:

i	$EG_{i,p}$
solar PV system number	Quantity of the electricity generated by the project solar PV system *i* during the period *p*
	MWh/p
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
30	
31	
32	
33	
34	
35	
36	
37	
38	
39	
40	
41	
42	
43	
44	
45	
46	
47	
48	
49	
50	

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

Monitoring Spreadsheet: JCM_TH_AM001_ver02.0

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	0.0	tCO_2/p	ER_p
2. Selected default values, etc.				
Reference CO_2 emission factor of grid and/or captive electricity	Electricity	0.319	tCO_2/MWh	EF_{RE}
3. Calculations for reference emissions				
Reference emissions during the period *p*	N/A	0.0	tCO_2/p	RE_p
Total quantity of the electricity generated in the project during the period *p*	Electricity	0.00	MWh/p	$\Sigma EG_{i,p}$
Reference CO_2 emission factor of grid and/or captive electricity	Electricity	0.319	tCO_2/MWh	EF_{RE}
4. Calculations of the project emissions				
Project emissions during the period *p*	N/A	0.0	tCO_2/p	PE_p

[List of Default Values]

Reference CO_2 emission factor of grid and/or captive electricity	0.319	tCO_2/MWh

Monitoring Structure Sheet [Attachment to Project Design Document]

Responsible personnel	Role

Monitoring Spreadsheet: JCM_TH_AM001_ver02.0

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)	ΣEGi,p	Total quantity of the electricity generated in the project during the period *p*	0.00	MWh/p	Option C	Measured data	The AC output of the inverters is measured to determine the amount of net electricity generation by the solar PV system. 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. ~~The electricity meter is certified by an entity accredited under international/national standards. The electricity meter is replaced or tested for accuracy at an interval following the regulations in the country in which the electricity meter is commonly used or according to the manufacturer's recommendation. The electricity meter is calibrated or replaced when it fails to pass the test.~~	Monthly recording	N/A

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}	Reference CO_2 emission factor of grid and/or captive electricity	0.319	tCO_2/MWh	The default emission factor is derived from the result of the survey on the generation efficiency of major natural gas-fired power plants in Thailand. The default value should be revised if necessary from survey result which is conducted by the JC or project participants.	N/A

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)

Monitoring Spreadsheet: JCM_TH_AM001_ver02.0

Reference Number:

i	$EG_{i,p}$
solar PV system number	Quantity of the electricity generated by the project solar PV system *i* during the period *p*
	MWh/p
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
30	
31	
32	
33	
34	
35	
36	
37	
38	
39	
40	
41	
42	
43	
44	
45	
46	
47	
48	
49	
50	

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

Monitoring Spreadsheet: JCM_TH_AM001_ver02.0

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	0.0	tCO_2/p	ER_p
2. Selected default values, etc.				
Reference CO_2 emission factor of grid and/or captive electricity	Electricity	0.319	tCO_2/MWh	EF_{RE}
3. Calculations for reference emissions				
Reference emissions during the period *p*	N/A	0.0	tCO_2/p	RE_p
Total quantity of the electricity generated in the project during the period *p*	Electricity	0.00	MWh/p	$\Sigma EG_{i,p}$
Reference CO_2 emission factor of grid and/or captive electricity	Electricity	0.319	tCO_2/MWh	EF_{RE}
4. Calculations of the project emissions				
Project emissions during the period *p*	N/A	0.0	tCO_2/p	PE_p

[List of Default Values]

Reference CO_2 emission factor of grid and/or captive electricity	0.319	tCO_2/MWh