JCM Project Planning Study on 10MW-scale solar power plant and rooftop solar power generation system

December, 2013

Shimizu Corporation

Index

What is Shimizu?

Shimizu Corporation is
- Leading construction and engineering company
- Founded in 1804
- Annual sales of 1,217 billion yen for 2012 fiscal year
- 11,050 employees as of 2013/04/01

Shimizu Corporation was founded in 1804. The company experienced continued growth during the mid and latter part of the 19th century, and was reorganized as a modern construction contractor by being incorporated in 1937. Today Shimizu Corporation is a leading multinational general contractor, involved in construction, civil engineering, and real estate development projects throughout the world.

WEB site
http://www.shimz.co.jp/english/index.html

Founder of Shimizu
(Mr. Kisuke SHIMIZU)

Shimizu's accomplishment on CDM, JI, and new mechanism

Shimizu's Activities on CDM priject, JI Project, and so on

Year	Project Name	Host	Scheme	Sponsored	UN
2000	Study of Energy Saving for Improving Thermal Energy Efficiency in the Republic of Uzbekistan	Uzbekistan	CDM	NEDO	
2001	Energy Conservation and Efficiency Improvement by Introducing The Co-Generation System in Samarkand,	Uzbekistan	CDM	NEDO	
2001	Renovation and Rehabilitation of Didi Digomi District Heat Supply Plant in Tbilisi (Feasibility Study)	Georgia	CDM	NEDO	
2002	Introduction of Co-Generation System into District Heating System in Yerevan, Republic Armenia	Armenia	CDM	NEDO	
2002	Utilization of Mathane(CH4) Gas and Power Generation of Municipal Wastes in Yerevan Armenia	Armenia	CDM	NEDO	
2002	Feasibility Study on Development of Hydro Power Plant Project in Republic of Armenia	Armenia	CDM	JETRO	
2003	FIntroduction of Co-generation System into District Heating System in Dnepropetrovsk, Ukraine	Ukraine	JI	NEDO	
2003	Feasibility Study on Modernization of District Heating System in Bukhara, Republisc of Uzbekistan	Uzbekistan	CDM	NEDO	
2004	Feasibility Study on effective using of Landfill gas in Dnepropetrovsk, Ukraine	Ukraine	JI	NEDO	
2004	Nubarashen Landfill Gas Capture and Power Generation Project in Yerevan	Armenia	CDM	GEC	28-Nov-05
2004	Utilization of Mathane (CH4) Gas from sewage sludge and introdution of Co-generation in Dalian, China	China	CDM	GEC	
2005	Feasibility Study on Effective Using of Landfill Gas in Lugansk, Ukraine	Ukraine	JI	GEC	
2005	Akhangaran Landfill Gas Capture Project in Tashkent	Uzbekistan	CDM	NEDO	19-Dec-09
2006	Feasibility Study on Effective Using of Landfill Gas in Poltava, Ukraine	Ukraine	JI	NEDO	
2006	Feasibility Study on Effective Using of Landfill Gas in Gyumri and Vanadzor, Armenia	Armenia	CDM	NEDO	
2006	Effective Using of Methane Gas from Sludge Field at the Waste Water Treatment Plant in Kiev, Ukraine	Ukraine	JI	GEC	
2005	Landfill Gas Capture and Power Generation Project in Tbilisi	Georgia	CDM	NEDO	06-Apr-07
2006	Feasibility Study on Effective Using of Landfill Gas in Amman, Jordan	Jordan	CDM	GEC	
2006	Feasibility Study on Effective Using of Landfill Gas in Skopje, Macedonia	Macedonia	CDM	GEC	
2006	Feasibility Study on Effective Using of Landfill Gas in Zhitomir, Ukraine	Ukraine	JI	GEC	
2007	Feasibility Study on Effective Using of Landfill Gas in Al Akidar, Jordan	Jordan	CDM	GEC	
2007	Feasibility Study on Effective Using of Landfill Gas in Belaya Tserkov, Ukraine	Ukraine	JI	GEC	
2007	Feasibility Study on Effective Using of Landfill Gas in Indonesia	Indonesia	CDM	NEDO	
2008	Dir Baalbeh Landfill Gas Capture Project in Homs, Syria	Syria	CDM	-	16-Mar-09
2008	Tal Dman Landfill Gas Capture Project in Aleppo, Syria	Syria	CDM	-	25-Sep-09
2008	Piyungan Landfill Gas Capture Project in Yogyakarta	Indonesia	CDM	-	01-Jan-10
2008	Effective use of the waste gas emitted from ammonia production plant in Syria	Syria	CDM	GEC	
2009	Catalytic N2O abatement project in the tail gas of the nitric acid production plant in G.F.C, Syria	Syria	CDM	-	4-Apr-11
2010	PTPNVI Bunut Mill POME Biogas Project in Jambi Province, Sumatera in Indonesia	Indonesia	CDM	-	19-Oct-12
2010	Programme CDM for Palm Oil Mills Waste to Energy Project under the Ministry of National Companies, Indonesia	Indonesia	CDM	NEDO	
2010	Sustainable Peatland Management in Indonesia	Indonesia	NAMA	GEC	
2011	Program exploration research of Indonesian state palm-oil factory's industrial waste biomass boiler power generation project	Indonesia	BOCM	NEDO	
2011	New Mechanism FS for Avoidance of Peat Aerobic Degradation and Rice Husk-based Power Generation in Jambi Province, Indonesia	Indonesia	BOCM	GEC	
2011	New Mechanism FS for Energy Saving at Buildings by Utilising Geothermal Heat Pump and Other Technologies in Mongolia	Mongolia	BOCM	GEC	
2012	Program organization research of Indonesian state palm-oil factory's industrial waste biomass boiler power generation project	Indonesia	BOCM	NEDO	
2012	Prevention of Peat Degradation through Groundwater Management, and Rice Husk-based Power Generation	Indonesia	BOCM	GEC	
2012	Replacement of Coal-Fired Boiler by Geo-Thermal Heat Pump for Heating	Mongolia	BOCM	GEC	
2013	Dissemination program of high efficient inverter air	Thailand	BOCM	GEC	
2013	10MW-scale solar power plant and rooftop solar power generation system	Mongolia	BOCM	GEC	

Shimizu's real CDM projects in Armenia and Uzbekistan

ARMENIA

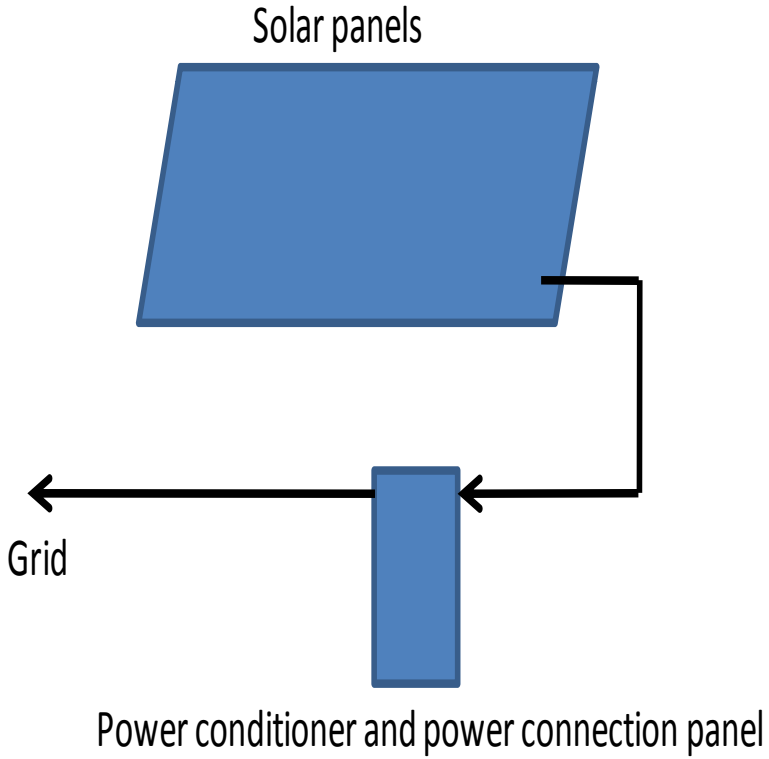
"NUBARASHEN LANDFILL GAS CAPTURE AND POWER GENERATION PROJECT IN YEREVAN"
REF. NO. 0069
TOTAL 64,374 CER ISSUED

UZBEKISTAN

"AKHANGARAN LANDFILL GAS CAPTURE PROJECT IN TASHKENT"
REF. NO. 2750
TOTAL 100,227 CER ISSUED

Project description (Durgun 10MW)

This project intends to install 10MW solar power plant in Durgun that is connected to the grid and to sell generated power to the grid. This project is now being studied by National Renewable Energy Centre (NREC) in Mongolia.



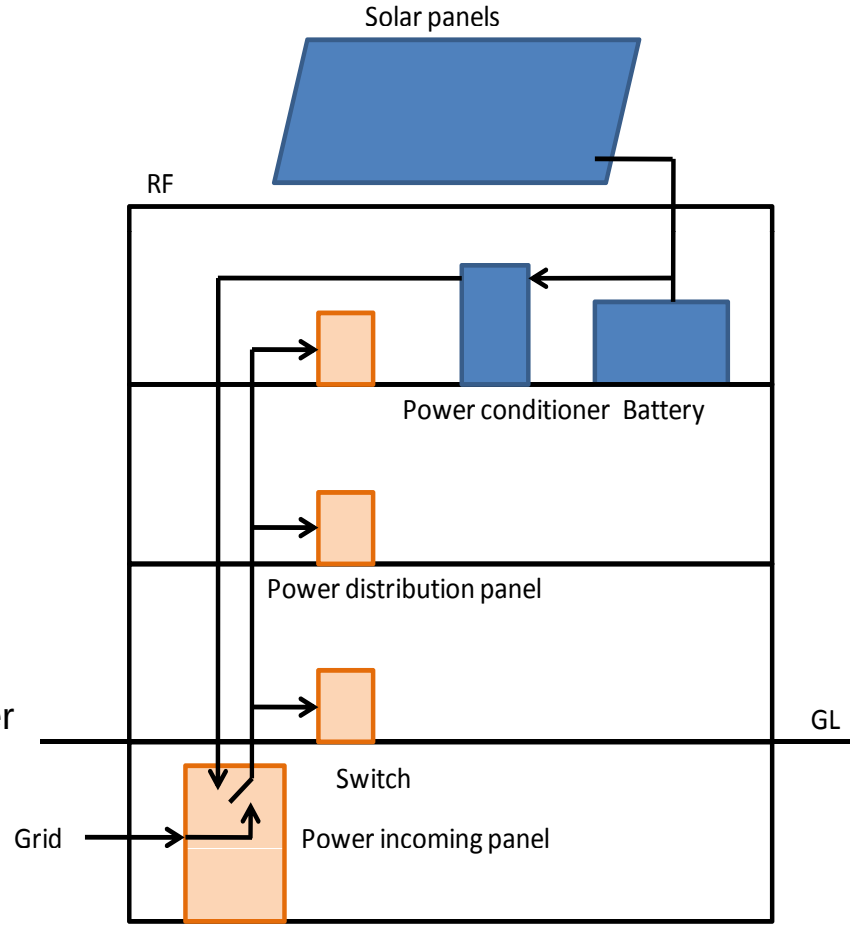
Project description (Durgun 10MW)

Durgun

Durgun Hydro Power Plant

Project description (example of rooftop project)

This project intends to install solar power generation system to the roof of buildings, to utilize generated power in the buildings



sell the generated power to the grid if possible

Eligibility Criteria - Criteria 1&2

Eligibility Criteria	
Criterion 1	A project which newly introduces solar power generation facilities in Mongolia.
Criterion 2	A project which has been purchasing electricity from the grid.

Eligibility Criteria - Criteria 3

Eligibility Criteria	
Criterion 3	Case 1: Facilities constantly have system interconnection with the grid. Along with power generation facilities, storage batteries are installed as necessary. When power generation exceeds the power demand of the facilities, electricity is sold or charged in storage batteries and when power generation is below the demand electricity is purchased or storage batteries is discharged.
	Case 2: Power generation facilities operate independently when they are able to provide electricity to the respective facilities; otherwise, the power generation facilities are detached, and the facilities purchase electricity from the grid. Along with power generation facilities, storage batteries are installed as necessary.
	Case 3: They always operate independently. Along with power generation facilities, storage batteries are installed as necessary.

Calculation of Reference Emissions

Reference emissions are calculated by the following formula:

$$RE_y = EG_{PJ,y} \times EF_{PJ,y}$$

where

RE_y : Reference emission (tCO_2/y)

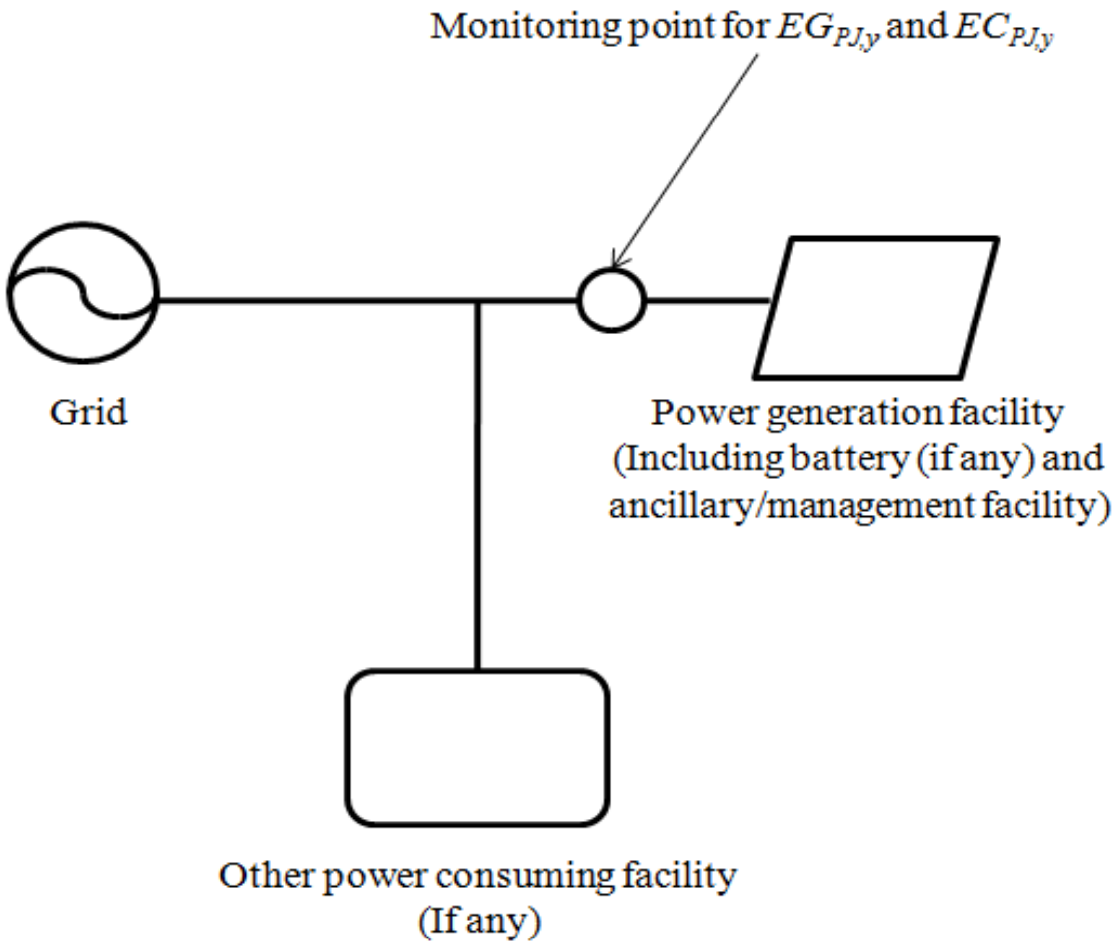
$EG_{PJ,y}$: Amount of electricity generation (MWh/y)

$EF_{PJ,y}$: Grid emission factor in year y (tCO_2/MWh)

Monitoring Plan

Parameters	Description of data	Measurement Method
$EG_{PJ,y}$	Amount of electricity generation (MWh)	Obtained by recording values on watt hour meters at the beginning and end of the monitoring period. Monitored point shall be where net electricity generation could be monitored.
$EF_{PJ,y}$	Grid emission factor in year y (tCO2/MWh)	Please refer to our 6 options.

Monitoring Plan (Figure)



Monitoring Plan (Grid emission factor)

Grid emission factor	
Op-1	A value admitted by the joint committee
Op-2	A valued calculated by the latest CDM tool. Vintage of the data should be the latest available. Combined margin or weighted average emission factor should be used.
Op-3	An emission factor of the area used in a monitoring report of any registered CDM project. Vintage of the data should be within 2 years.
Op-4	An emission factor of the area used in a PDD of any registered CDM project. Vintage of the data should be within 2 years.
Op-5	An emission factor of the area or the whole Mongolia reported by the Mongolian government or international organizations. Combined margin or weighted average emission factor should be used.
Op-6	An emission factor that takes into account (1) transmission end power generation efficiency of the latest coal-fired power plant in commercial and practical application in developing countries at the time of project registration and (2) coal emission factors used in Mongolia.

Monitoring Plan (Grid emission factor)

Grid Emission factor of Central Grid

combined margin can be calculated by the following formula:

$$CM = (OM + BM) \div 2$$

where

CM	: Combined margin
OM	: Operating margin
BM	: Build margin

OM=1.1501 tonCO_2/MWh

BM=1.0559tonCO_2/MWh

CM↵ ↖ 1.1501↙ 1.0559↗ ч2↵ 1.1030 tonCO_2/MWh

How to decide emission factor of the western grid

Electricity Supply in Western grid

* Only Durgun HPP is operating.
* Electricity has been imported from abroad.

Grid emission factor of Western grid

* Both of OM and BM are 0 tonCO_2MWh.
* Calculation result of grid emission factor will be 0 tonCO_2/MWh

JCM credit could not be issued.

How to decide emission factor of the western grid

case	How to decide emission factor	Our conclusions
1	Apply the most conservative emission factor of coal fired thermal power plant. The reason for this idea is that Mongolia will deal with increasing power demand by hiring coal fired thermal plant.	This is the most plausible explanation, although the value will be eventually similar to emission factor of on-site diesel power generation.
2	Apply emission factor of on-site diesel power generation, which is as same as the existing CDM project of Durgun HPP. (This idea was also proposed in the discussion between the Ministry of Environment and Green Development and NREC)	On-site diesel power generation as an independent power source of soums is now being vanished with increasing accessibility of grid, because diesel generation is costly. In view of this fact, this is not a appropriate reference scenario.
3	Apply emission factor of the western power grid considering new coal fired thermal power plants planned at coal mine sites.	It may not be possible for us to receive accurate information of the new plants, because coal mine companies are a private company (There is no obligation for them to provide such information to us.). In addition, it is disadvantageous that emission factor of this project depends on such a vague plan.

How to decide emission factor of the western power grid

case	How to decide emission factor	Our conclusions
4	Apply emission factor based on the idea that this project supplies power that would be supplied by Durgun HPP, because the HPP is not being operated as planned.	If the HPP is operated as planned, this project will not reduce emissions. (Because planned annual power generation of the HPP is 38GWh (Operation rate is 38GWh/4MW/2units/8760hr=54%), and predicted power generation of this project will be 10GWh, there will be little margin even if power generation of the HPP is less than plan.) In addition, it is not disadvantageous that emission factor of this project depends on such unstable operation of the HPP.
5	Apply emission factor of the central power grid considering that the western power grid will connect to the central power grid in near future. (This idea was also proposed in the discussion between the Ministry of Environment and Green Development and NREC)	The connection is planned to be realize in 2016, but we can't find any reasons why we can use emission factor of the central power grid until the connection.

How to decide emission factor of the western grid

case	How to decide emission factor	Our conclusions
6	Apply emission factor of Russia, because this project will reduce power import from Russia.	Neither TPE nor Joint Committee will accept this idea, because claiming emission reduction at thermal plant in Russia will result in double counting.
7	Apply emission factor that is decided by the Ministry of Environment and Green Development.	This is the most appropriate approach, but so far, the Ministry of Environment and Green Development has not yet decided anything.
8	Apply emission factor of the central power grid that is published in the web site by the Ministry of Environment and Green Development. Or, apply emission factor of the central power grid that will be elaborated in collaboration with IGES and will be published by the end of this year.	Neither TPE nor Joint Committee will accept emission factor of the central power grid.

How to decide emission factor of the western grid

For case 1, the following formula is used:

Emission factor of the latest coal-fired power plant (tCO_2/MWh)

↵ Emission factor of coal (tCO_2/MWh)

ø Transmission end power generation efficiency of the latest coal-fired power plant (-)

How to decide emission factor of the western power grid

The emission factor of coal ↖ IPCC Guideline↗

: 94.6tCO_2/TJØ 0.0036TJ/MWh↵ 0.34056tCO_2/MWh

The transmission end power generation efficiency

of the latest coal-fired power plant (JCOAL)

: 0.41

Emission factor of the latest coal-fired power plant

: 0.34056tCO_2/MWhø 0.41↵ 0.8306tCO_2/MWh

How to decide emission factor of the western power grid

Consolidated emission factor (provisional calculation)

Consolidated emission factor of central grid and western grid
=(EFC × ECC ＋ EFW × ECW) ÷ (ECC ＋ ECW)

Emission factor of central grid = EFC (1.103 tonCO_2MWh)
Emission factor of western grid = EFW (0 tonCO_2MWh)
Electricity consumption of central grid = ECC
Electricity consumption of western grid = ECW
(The source of ECC and ECW is Ministry of Energy)

Calculation result of consolidated grid emission factor is
1.065tonCO_2/MWh
(almost same as emission factor of central grid)

Calculation of Project Emissions

Project emissions are calculated by the following formula:

$$PE_y = EC_{PJ,y} \times EF_{PJ,y}$$

where

PE_y : Project emissions (tCO_2/y)

$EC_{PJ,y}$: Grid electricity consumption (MWh/y)

$EF_{PJ,y}$: Grid emission factor in year y (tCO_2/MWh)

Calculation of Project Emissions (Monitoring Parameters)

Parameters	Description of data	Measurement Method
$EC_{PJ,y}$	Grid electricity consumption (MWh)	Obtained by recording values on watt hour meters at the beginning and end of the monitoring period.
$EF_{PJ,y}$	Grid emission factor in year y (tCO_2/MWh)	Please refer to our 6 options.

Calculation of Emissions Reductions

Emissions reductions are calculated by the following formula:

$$ER_y = RE_y - PE_y$$

where

ER_y : Emissions reduction (tCO_2/y)

RE_y : Reference emission (tCO_2/y)

PE_y : Project emission (tCO_2/y)

Estimated Amount of Emission Reduction

Amount of Emission Reduction (provisional calculation)

Estimated amount of Net Electricity Generation : 11,434MWh/year
(Electricity Generation － Grid Electricity Consumption)

grid emission factor : 0.8306tonCO_2/MWh
(in accordance with case 1)

Estimated amount of Emission Reduction is
11,434 × 0.8306 ＝ 9,497 ton/year

Calculation of Emissions Reductions

JCM_MN_F_PMS_ver01.0

Joint Crediting Mechanism Proposed Methodology Spreadsheet Form (input sheet) [Attachment to Proposed Methodology Form]

Table 1: Parameters to be monitored *ex post*

(a) Monitoring point No.	(b) Parameters	(c) Description of data	(d) Estimated Values	(e) Units	(f) Monitoring option	(g) Source of data	(h) Measurement methods and procedures	(i) Monitoring frequency	(j) Other comments
1	$EF_{PJ,y}$	Grid emission factor		tonCO2/MW	A or C	See methodology	See methodology	When preparing monitoring report	-
2	$EG_{PJ,y}$	Amount of electricity generation		MWh	B or C	Watt hour meter	Watt hour meter	Start and end of each monitoring period	-
3	$EC_{PJ,y}$	Grid electricity consumption		MWh	B or C	Watt hour meter	Watt hour meter	Start and end of each monitoring period	-

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

(a) Parameters	(b) Description of data	(c) Estimated Values	(d) Units	(e) Source of data	(f) Other comments
					-

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

CO_2 emission reductions	Units
0	tCO_2/y

[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)

Calculation of Emissions Reductions

Joint Crediting Mechanism Proposed Methodology Spreadsheet Form (Calculation Process Sheet)

[Attachment to Proposed Methodology Form]

1. Calculations for emission reductions	Fuel type	Value	Units	Parameter
Emission reductions during the period of year y		0	tCO_2/y	ER_y
2. Selected default values, etc.				
3. Calculations for reference emissions				
Reference emissions during the period of year y		0	tCO_2/y	RE_y
Amount of electricity generation		0.0	MWh	$EG_{PJ,y}$
Grid emission factor		0.0	tonCO2/MWh	$EF_{PJ,y}$
4. Calculations of the project emissions				
Project emissions during the period of year y		0	tCO_2/y	PE_y
Grid electricity consumption		0.0	MWh	$EC_{PJ,y}$
Grid emission factor		0.0	$tonCO_2/MWh$	$EF_{PJ,y}$

Contribution to sustainable development in Mongolia

Solar Power generation project can make a contribution to sustainable development in Mongolia.

The project will help to achieve the Target of Renewable Energy Program.

Renewable Energy Ratio : 20-25% by 2020

Mitigation of air pollution is also expected.

How to contact us

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Our new head office in Tokyo