

GENNEIA SOLAR PROJECTS IN ARGENTINA

Document Prepared by Swiss Carbon Value Ltd.

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1 PROJECT DETAILS

1.1 Summary Description of the Project

The proposed project consists of the implementation of three solar farms located in the same region within the Argentine territory. The implementation of these project instances (hereafter collectively called the “project” or “project activity”) ensures energy security, diversification of the grid generation mix and sustainable growth of the electricity sector in Argentina.

Before the implementation of the project activity, no power plants were installed at the project site. The energy that will be generated by the project is currently dispatched by other power plants that are connected to the respective grid, including fossil fuel power plants. Hence, the baseline scenario and the scenario prior to project implementation are the same and the project will help to reduce thermal power generation in the Argentine Interconnected System (SADI¹) by increasing the share of renewable energy in the grid.

The project has a total installed capacity of 82 MW and an expected average generation of around 208.89 GWh per year, which will be delivered to the SADI; avoiding part of the electricity generated by the grid-connected power plants. Thus, it will contribute to sustainability by increasing the share of renewable energy and reducing GHG emissions.

The average emission reduction over a 10-year credit period are expected to be approximately 84,351 tCO₂e per year. A summary of individual project instances of the project is shown in Table 1.

Table 1: Summary of individual solar project instances

Project Instance	Location	Install capacity (MW)	Average generation (GWh/yr)	PV panels	Estimated ERs (tCO ₂ /yr)
ULLUM I	San Juan's Province	25	63,788	86,400	28,358
ULLUM II	San Juan's Province	25	63,750	86,400	28,341
ULLUM III	San Juan's Province	32	81,349	110,520	36,166
Total		82	208,887	283,320	92,865

1.2 Sectoral Scope and Project Type

Sectoral Scope: 01 – Energy industries (renewable / non-renewable sources)

Project Type: Renewable Energy Projects

Project Category: Large-scale

The project is not a grouped power activity.

1.3 Project Proponent

¹ in Spanish: Sistema Argentino de Interconexión

Organization name	Genneia S.A.
Contact person	Edwin King
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1.4 Other Entities Involved in the Project

Organization name	Swiss Carbon Value Ltd.
Role in the project	Consultant
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1.5 Project Start Date

The first instance of the project under consideration started operations on 17 November of 2018. This project instance is ULLUM I Solar farm. Hence the project start date is 17 November 2018.

1.6 Project Crediting Period

Project crediting period for the project activity is taken as 10 years from the start date.

Accordingly, to the start date of the project activity, the first crediting period started on 17/11/2018 and will finish on 16/11/2028.

First crediting period: 17/11/2018 - 16/11/2028.

Type of crediting period: Renewable. It is planned to be renewed twice, adding up 30 years in total.

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	
Large project	x

Year	Estimated GHG emission reductions or removals (tCO ₂ e)
2018	7,728
2019	92,865
2020	92,865
2021	92,865
2022	92,865
2023	92,865
2024	92,865
2025	92,865
2026	92,865
2027	92,865
2028	81,670
Total estimated ERs	925,183
Total number of crediting years	10
Average annual ERs	84,351

1.8 Description of the Project Activity

The renewable energy generation technologies planned to be employed under the project activity instances correspond to PV solar projects.

The activity of the proposed project consists of the installation of three solar grid-connected power plants located in different regions of the country of Argentina. The total installed capacity of the three solar power plants is 82 MW, with an average power generation of 208.887 GWh per year. The projects will be implemented at a site where no renewable power plant was operating prior to the implementation of the project activity (green-field plant).

The electricity generated by the project will be exported to the SADI. Therefore, the project will displace an equivalent amount of electricity that would otherwise have been generated by fossil fuels. In the baseline scenario, all the electricity supplied to the grid by the project activity would otherwise have been generated by the operation of grid-connected power plants. The full implemented project will reduce approximately 579.182 tCO₂ per year, by displacing partially fossil fuel based generation of conventional power plants in the Argentine Interconnection System, as reflected in the grid emission factor.

The project activity instances are large scale projects (with a power generation capacity exceeding 15 MW each). The project activity applies the approved CDM methodology ACM0002 (Version 19) based on the scale of the power plants.

In the following, further details of the individual instances included in the project activity are provided.

Ullum I Solar Farm:

The "Ullum I Solar Farm" consists of the construction and operation of a solar farm with 86,400 solar photovoltaic (PV) modules and an installed capacity of 25 MW. It is expected to generate 63.788 GWh per year on average. The project will be composed of five sub-units called solar fields (PV-11, PV-12, PV-13, PV-14 and PV-15), each interconnected by a medium voltage (33 kV) underground electrical grid, from which the energy will be conducted to the electrical output cabin. From there an overhead line of 10 km will be constructed connecting project to the Solar Transformer Station San Juan (ET)², where the voltage will be increased to 132 kV to supply to the SADI.

Table 2: Ullum I Solar Farm

PV Module Manufacturer	Jinko
PV Module Types	JKM345M-72-V
PV Module Capacity	345 Wp
No. of PV Modules	86,400
No. of Inverters	6 FS2400CH15 4 FS2800CH15
Total Capacity	25 MW
Average generation	63.788 GWh/year

Ullum II Solar Farm:

The "Ullum II Solar Farm" consists of the construction and operation of a solar farm with 86,400 solar photovoltaic (PV) modules and an installed capacity of 25 MW. It is expected to generate 63.750 GWh per year on average. The project will be composed of six sub-units called solar fields (PV-21, PV-22, PV-23, PV-24, PV-25 and PV-26), each interconnected by a medium voltage (33 kV) underground electrical grid, from which the energy will be conducted to the electrical output cabin. From there an overhead line of 10 km will be constructed connecting project to the Solar ET San Juan, where the voltage will be increased to 132 kV to supply to the SADI.

Table 3: Ullum II Solar Farm

PV Module Manufacturer	Jinko
PV Module Types	JKM345M-72-V
PV Module Capacity	345 Wp
No. of PV Modules	86,400
No. of Inverters	6 FS2400CH15 4 FS2800CH15

² In Spanish: Estación de Transformación

Total Capacity	25 MW
Average generation	63.750 GWh/year

Ullum III Solar Farm:

The "Ullum III Solar Farm" consists of the construction and operation of a solar farm with 86,400 solar photovoltaic (PV) modules and an installed capacity of 32 MW. It is expected to generate 8.349 GWh per year on average. The project will be composed of seven sub-units called solar fields (PV-31, PV-32, PV-33, PV-34, PV-35, PV-36 and PV-37), each interconnected by a medium voltage (33 kV) underground electrical grid, from which the energy will be conducted to the electrical output cabin. From there an overhead line of 10 km will be constructed connecting project to the Solar ET San Juan, where the voltage will be increased to 132 kV to supply to the SADI.

Table 4: Ullum III Solar Farm

PV Module Manufacturer	Jinko
PV Module Types	JKM345M-72-V
PV Module Capacity	345 Wp
No. of PV Modules	110,520
No. of Inverters	2 FS2400CH15 10 FS2800CH15
Total Capacity	32 MW
Average generation	81.349 GWh/year

Below are the technical specifications of each type of technology according to manufacturer:

Table 5: Solar PV Module and Inverter technical specifications

Solar PV Module	JKM345M-72-V	
Cell Type	Mono-crystalline 156x156mm (6 inch)	
No. of Cells	72 (6x12)	
Orientation	1-axis horizontal tracker with backtracking	
Rated Maximum Power	345 Wp	
Module Efficiency STC (%)	17.78%	
Maximum system voltage	1500 VDC	
Inverter	FS2400CH15	FS2800CH15
Manufacturer	Power Electronics	
Max. AC Output Current (A)	2570	30000
Operating Grid Voltage (VAC)	645 ± 10%	
	50 Hz/60 Hz	

1.9 Project Location

All the project activity instances in the proposed project activity would be located within geographical boundaries of Argentina. Thus, geographical area of the project is Argentina.

Table 1 presents the geographic coordinates summary of each solar power plant.

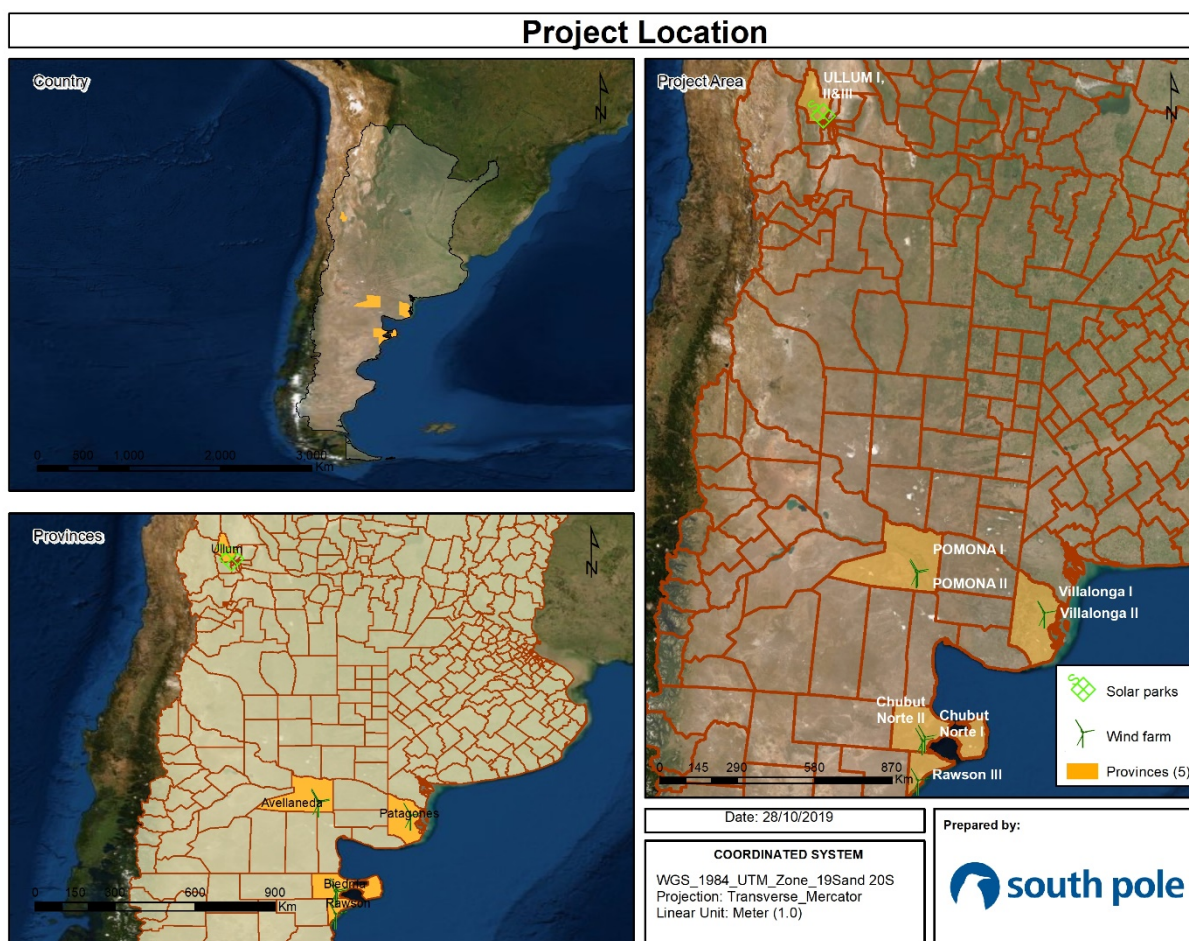


Figure 1: Project location

Ullum I,II&III Solar Farm:

The Ullum I, II and III solar farms site is located approx. 12 km north-east of the municipality of Villa Ibáñez, in the province San Juan, Argentina.

Table 6 presents the geographic coordinates summary of each corner point of the solar farms project activity instances.

Table 6: Coordinates of each corner point of the solar farms project activity instances.

Project instance name	South	West
Ullum I Solar Farm	31°20'40.42''	68°39'36.76''
	31°20'48.28''	68°39'36.76''
	31°20'52.92''	68°40'16.74''
	31°20'13.94''	68°40'14.88''
	31°20'13.88''	68°39'51.15''
Ullum II Solar Farm	31°19'25.90''	68°39'55.94''

	31°20'08.16''	68°39'54.26''
	31°20'13.88''	68°39'51.15''
	31°20'13.94''	68°40'14.88''
	31°19'25.39''	68°40'12.51''
Ullum III Solar Farm	31° 19' 06.88''	68° 40' 14.09''
	31° 19' 40.13''	68° 40' 15.23''
	31° 20' 53.15''	68° 40' 18.91''
	31° 20' 53.41''	68° 40' 33.28''
	31° 20' 35.68''	68° 40' 30.67''
	31° 20' 14.82''	68° 40' 28.26''
	31° 19' 47.33''	68° 40' 31.45''
	31° 19' 39.19''	68° 40' 31.23''
	31° 19' 13.91''	68° 40' 29.03''
	31° 19' 05.34''	68° 40' 26.76''

1.10 Conditions Prior to Project Initiation

Prior to project implementation, no solar PV panels are installed at the site. The energy that will be delivered to the grid is generated by a mix of thermal and renewable power generation as reflected in the combined margin emissions factor (as per the tool applied).

Since the project does not generate any GHG emissions by itself, but reduces emissions that would be generated from other power plants, it is clear that it has not been implemented to generate GHG emissions for the purpose of their subsequent reduction, removal or destruction.

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

The following list summarizes the applicable regulatory framework met by the project:

National level

- National Constitution
- Law N° 24,065 "Electric Energy Regime" and its Decree N°1,398/92
- Law N°25,675 "General Environment Law"
- Law N°25,019 "National Regime of Solar and Wind Energy" and its Decrees N°1,220/98 and N°1,597/99.
- Law N°26,190 "Renewable Sources of Energy Promotion Regime"

The Project complies with all national law and regulations applicable since the Environmental Impact Assessments (EIA) of the each solar power plant and the transmission line between the project and the substation were approved by the Ministry of Environment and Sustainable Development.

The following table presents each of the provisions by which the Ministry of Environment and Sustainable Development approved the EIAs for each of the power plants.

Power plant name	Document
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ULLUM I	
ULLUM II	
ULLUM III	

Additionally, in the context of the Argentinean electricity market, all new agents (generators, selfgenerators, cogenerators or transmission agent) that aim to participate in the Wholesale Electricity Market (MEM) have to present the request to be a MEM agent in conjunction with the Environmental Impact Assessment to the Argentinean Ministry of Energy.

The Project is in compliance with this requirement given that it obtained the authorization to be a MEM agent by resolutions (see table xx) of the Secretariat of Electric Energy of the Argentinean Government.

Power plant name	Resolution
ULLUM I	
ULLUM II	
ULLUM III	

1.12 Ownership and Other Programs

1.12.1 Project Ownership

The renewable energy technology, i.e. the photovoltaic panels including all relevant equipment and installations for its operation are under the ownership of Genneia S.A.

1.12.2 Emissions Trading Programs and Other Binding Limits

Net GHG emission reductions or removals generated by the project activity will not be used for compliance with any emissions trading program or to meet binding limits on GHG emissions in any Emission Trading program or other binding limits.

1.12.3 Other Forms of Environmental Credit

The project activity neither has nor intends to generate any other form of GHG related environmental credit for GHG emission reductions or removals claimed under any type of standards.

1.12.4 Participation under Other GHG Programs

The Project Proponent hereby confirms that they have not applied or will apply to any other GHG program to generate, certify or verify emission reductions achieved from this project activity while it is active under the VCS program.

1.12.5 Projects Rejected by Other GHG Programs

The project has not been rejected by other GHG programs.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

This is not a grouped project activity. Thus, this section is not applicable for this project.

Leakage Management

Since the project activity is a renewable energy project based on solar technology, no leakage emissions are considered as per the applied methodology.

Thus, leakage management plan and implementation of leakage and risk mitigation measures are not applicable for this project activity.

Commercially Sensitive Information

No commercially sensitive information has been excluded from the public version of the project description.

Sustainable Development

In line with the Sustainable Development Goals and the 2030 Agenda for Sustainable Development that Argentina adopted in 2015, the project contributes to sustainable development by contributing to several of its environmental, social, economic and technological objectives, both directly and indirectly, such as:

- Increasing the percentage of renewable energy from the energy mix.
- Expanding infrastructure and improving technology to provide modern and sustainable energy service.
- Achieving levels of economic productivity through diversification and technological modernization.
- The project will decrease emissions of sulphur oxides (SOx), nitrogen oxides (NOx), carbon monoxide, particulate matter, other pollutants, as well as carbon dioxide associated with the combustion of fossil fuels.
- The project will reduce the dependence on fossil fuels, which are non-renewable and limited in supply.
- During construction, the project will provide employment opportunities. To the extent practical, these jobs will be filled by local residents. Besides, employment will also be generated for operation and maintenance activities.
- Ensuring sustainable production and the efficient use of natural resources.
- As renewable energy projects produce no end products in the form of solid waste (ash etc.), they address the problem of solid waste disposal encountered by most other sources of

power. Being a renewable resource, to generate electricity contributes to resource conservation and therefore, responsible consumption.

Further Information

Not applicable.

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

For this project, the approved large-scale CDM methodology ACM0002 “*Grid-connected electricity generation from renewable sources*”. Version 19.0. Sectoral Scope 01. Available at: <https://cdm.unfccc.int/methodologies/DB/VJI9AX539D9MLOPXN2AY9UR1N4IYGD>

The emission factor of the relevant power-grid is determined based on the procedures of the CDM “Tool to calculate the emission factor for an electricity system” (version 7.0). Available at: https://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-07-v7.0.pdf/history_view.

2.2 Applicability of Methodology

The project activity complies with all the applicability conditions established by the approved CDM methodology ACM0002: “Grid-connected electricity generation from renewable sources” (version 19.0). and listed in the following table:

Table 7: Methodology applicability

Applicability Conditions	Project Activity
This methodology is applicable to grid-connected renewable energy power generation project activities that: a) Install a Greenfield power plant; b) Involve a capacity addition to (an) existing plant(s); c) Involve a retrofit of (an) existing operating plants/units; d) Involve a rehabilitation of (an) existing plant(s)/unit(s); e) Involve a replacement of (an) existing plant(s)/unit(s).	The project activity consists of the installation of solar Greenfield power plants. Thus, this condition is met.
The project activity may include renewable energy power plant/unit of one of the following types: hydro power plant/unit with or without reservoir, wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit	The proposed project activity involves renewable energy power generation through the installation of three solar power plants. Thus, this condition is met.

In the case of capacity additions, retrofits, rehabilitations or replacements (except for wind, solar, wave or tidal power capacity addition projects) the existing plant/unit started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion, retrofit, or rehabilitation of the plant/unit has been undertaken between the start of this minimum historical reference period and the implementation of the project activity.	The proposed project activity involves the installation of three solar Greenfield power plants. Thus, this condition is not applicable.
In case of hydro power plants, one of the following conditions shall apply: a) The project activity is implemented in existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or b) The project activity is implemented in existing single or multiple reservoirs, where the volume of the reservoir(s) is increased and the power density, calculated using equation (3), is greater than 4 W/m²; or c) The project activity results in new single or multiple reservoirs and the power density, calculated using equation (3), is greater than 4 W/m²; or d) The project activity is an integrated hydro power project involving multiple reservoirs, where the power density for any of the reservoirs, calculated using equation (3), is lower than or equal to 4 W/m², all of the following conditions shall apply: i. The power density calculated using the total installed capacity of the integrated project, as per equation (4), is greater than 4 W/m²; ii. Water flow between reservoirs is not used by any other hydropower unit which is not a part of the project activity; iii. Installed capacity of the power plant(s) with power density lower than or equal to 4 W/m² shall be: a. than or equal to 15 MW; and b. Less than 10 per cent of the total installed capacity of integrated hydro power project.	The project activity involves the installation of three solar power plants. Thus, these criteria are not relevant.
In the case of integrated hydro power projects, project proponent shall: a) Demonstrate that water flow from upstream power plants/units spill directly to the downstream reservoir and that collectively constitute to the generation capacity of the integrated hydro power project; or b) Provide an analysis of the water balance covering the water fed to power units, with all possible combinations of reservoirs and without the construction of reservoirs. The purpose of water balance is to demonstrate the requirement of specific combination of reservoirs constructed under CDM project activity for the optimization of power output. This demonstration has to be carried out	The project activity involves the installation of three solar power plants. Thus, these criteria are not relevant.

in the specific scenario of water availability in different seasons to optimize the water flow at the inlet of power units. Therefore, this water balance will take into account seasonal flows from river, tributaries (if any), and rainfall for minimum five years prior to implementation of CDM project activity.	
The methodology is not applicable to: a) Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site; b) Biomass fired power plants/units.	The proposed project activity does not involve switching from fossil fuels to renewable energy sources at the project site or the installation of biomass fired power plants. Thus, this condition is met.
In the case of retrofits, rehabilitations, replacements, or capacity additions, this methodology is only applicable if the most plausible baseline scenario, as a result of the identification of baseline scenario, is “the continuation of the current situation, that is to use the power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance”.	The proposed project activity involves the installation of three solar Greenfield power plant. Thus, this condition is not applicable.
In addition, the applicability conditions included in the tools referred to below apply.	The applicability criteria of the “Tool to calculate the emission factor for an electricity system” are analysed below.
This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity that is where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand side energy efficiency projects).	The proposed project activity supplies electricity to the local grid, avoiding part of the electricity generated by the grid connected power plants. Thus, this condition is met.
Under this tool, the emission factor for the project electricity system can be calculated either for grid power plants only or, as an option, can include off-grid power plants. In the latter case, the conditions specified in —Appendix 2: Procedures related to off-grid power generationll should be met. Namely, the total capacity of off-grid power plants (in MW) should be at least 10 per cent of the total capacity of grid power plants in the electricity system; or the total electricity generation by off-grid power plants (in MWh) should be at least 10 per cent of the total electricity generation by grid power plants in the electricity system; and that factors which negatively affect the reliability and stability of the grid are primarily due to constraints in generation and not to other aspects such as transmission capacity.	In this case, the emission factor for the project electricity system is calculated for grid power plants only. Thus, this condition is met.
The tool is not applicable if the project electricity system is located partially or totally in an Annex I country.	In this case, the project electricity system is located totally in Argentina. Thus, this condition is met.

Thus, the methodology is applicable to the proposed project activity.

2.3 Project Boundary

According to the guidance specified in the Methodology ACM0002 (version 19.0), the spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system, which will be connected to each of the solar power plants (see Figure 2). The measuring equipment of each power plant will be located at the interconnection point of the project instances with the SADI, which will be their respective substations.

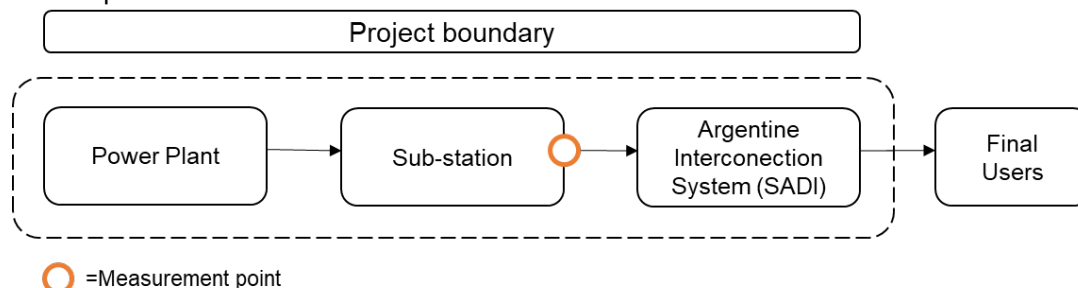


Figure 2: Project boudary

The spatial extent of the project boundary is the Argentine Interconnected System (SADI). Therefore, all GHG emissions generated by the power plants connected to the SADI are accounted for the baseline emissions.

Source		Gas	Included?	Justification/Explanation
Baseline	CO ₂ emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO ₂	Yes	Main emission source
		CH ₄	No	Minor emission source
		N ₂ O	No	Minor emission source
		Other	No	No other emission sources
Project	The project will generate zero emissions (renewable energy to the grid)	CO ₂	No	No CO ₂ emissions are envisaged
		CH ₄	No	No CH ₄ emissions are envisaged
		N ₂ O	No	No N ₂ O emissions are envisaged
		Other	No	No other emissions are envisaged

2.4 Baseline Scenario

As stated in the approved methodology ACM0002 “Grid-connected electricity generation from renewable sources” (version 19.0): If the project activity is the installation of a new grid-connected renewable power plant/unit, the baseline scenario is the following:

Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the “Tool to calculate the emission factor for an electricity system”.

Therefore, the baseline scenario consists of the electricity that would have been generated and delivered to the grid in the absence of the proposed project activity by:

- a) Other plants currently connected to the SADI; and
- b) New capacity additions to the SADI.

Hence, the baseline scenario is identified as the continuation of the common practice of power generation, i.e. mainly thermal power stations that emit large quantities of carbon dioxide (CO₂) to the atmosphere.

2.5 Additionality

The additionality of the project activity is demonstrated and assessed applying the simplified procedure to demonstrate additionality as stated in the methodology ACM0002 (version 19.0.0) and accepted by the VCS Standard 3 (version 3).

The simplified procedure to demonstrate additionality is applicable to the following grid connected electricity generation technologies (positive list):

- (a) Solar photovoltaic technologies;
- (b) Solar thermal electricity generation including concentrating Solar Power (CSP);
- (c) Off-shore wind technologies;
- (d) Marine wave technologies;
- (e) Marine tidal technologies;
- (f) Ocean thermal technologies.

Since all three power plants use a photovoltaic solar panel technology, the simplified procedure to demonstrate additionality is applicable for this project.

A specific technology in the positive list, in this case Solar photovoltaic technologies, it is defined as automatically additional if at the time of PDD submission any of the following conditions is met:

- (a) The percentage share of total installed capacity of the specific technology in the total installed grid connected power generation capacity in the host country is equal to or less than two per cent; or
- (b) The total installed capacity of the technology in the host country is less than or equal to 50 MW.

As can be seen in the information available for download on the website of the wholesale electricity market management company³, the percentage of installed capacity of PV solar technology corresponds to a value of less than 2% of the total installed capacity in Argentina.

Therefore, the project is automatically considered additional.

2.6 Methodology Deviations

Not applicable. No methodology deviations are made.

³ Information available at: <http://portalweb.cammesa.com/memnet1/Pages/descargas.aspx>

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

The baseline scenario and the emission rate calculation are based on the electricity that otherwise would have been generated by the plants connected to the grid and by addition of future plants. According to the methodology, no leakage emissions are considered.

Baseline emissions are calculated by multiplying the combined margin emission factor ($EF_{grid,y}$, in tCO₂e/MWh) by the electricity generated by the proposed project activity during the year y (EG_y , in MWh).

Baseline emissions include only CO₂ emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation by the project activity would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants.

The detailed calculations and data of the baseline emissions are presented in the emission factor Excel spreadsheet. In the following, the relevant methodological approaches and equations are presented.

$$BE_y = EG_{PJ,y} \times EF_{grid,CM,y} \quad \text{Equation 1}$$

Where:

BE_y	=	Baseline emissions in year y (tCO ₂ /yr)
$EG_{PJ,y}$	=	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr)
$EF_{grid,CM,y}$	=	Combined margin CO ₂ emission factor for grid connected power generation in year y calculated using the latest version of the “Tool to calculate the emission factor for an electricity system” (tCO ₂ /MWh) ⁴

Since it is a green-field project, according to Equation (12) of ACM0002 (version 19.0),

$$EG_{PJ,y} = EG_{facility,y}$$

The expression $EG_{PJ,y}$ is used in this Project Document Design (PDD).

The combined margin emission factor ($EF_{grid,CM,y}$) is calculated following the guidance in the “Tool to calculate the emission factor for an electricity system” (version 7.0) by applying the following steps:

- STEP 1. Identify the relevant electricity systems;
- STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional);
- STEP 3. Select a method to determine the operating margin (OM);
- STEP 4. Calculate the operating margin emission factor according to the selected method;
- STEP 5. Calculate the build margin (BM) emission factor;
- STEP 6. Calculate the combined margin (CM) emissions factor.

The following explains how each step is applied:

STEP 1. Identify the relevant electricity systems.

⁴ Calculated by equation 6 of this document

For determining the electricity emission factors, the project electricity system is defined by the spatial extent of the power plants that are physically connected (Including imports) through transmission and distribution lines to the multiple project instances (i.e., ULLUM I,II&III solar farms) and that can be dispatched without significant transmission constraints. In this case, the project electricity system is given as the Argentine Interconnection System (SADI⁵).

STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional).

In accordance with the tool, this step is optional. For the proposed project activity, off-grid power plants are not included in the project electricity system (Option 1).

STEP 3. Select a method to determine the operating margin (OM).

In accordance with the tool, the calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

- (a) Simple OM; or
- (b) Simple adjusted OM; or
- (c) Dispatch data analysis OM; or
- (d) Average OM.

For the project activity, the simple OM is applied, using the ex ante data vintage:

Ex ante option: if the ex ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the PDD to the DOE for validation. For off-grid power plants, use a single calendar year within the five most recent calendar years prior to the time of submission of the PDD for validation.

The Operating Margin was calculated using the Simple Operating Margin method (**Option A**), because as stated in the methodology the “Tool to calculate the emission factor for an electricity system” (Version 07.0) the following requirement is satisfied:

Low-Cost/Must-Run resources constitute less than 50% of total grid generation (excluding electricity generated by off-grid power plants) in average of the five most recent years.

As seen in the following table, the average of the five most recent years is below 50%:

Table 8: Percentage of LCMR Participation⁶

	2014	2015	2016	2017	2018	Average
LCMR (GWh)	47.940	50.245	47.720	48.362	50.099	
Total (GWh)	131.205	136.870	138.070	137.200	137.825	
%	37%	37%	35%	35%	36%	

⁵ In spanish: Sistema Argentino de Interconexión

⁶ See Excel “191023_EG_SADI_Argentina_2018” spreadsheet for more details

All power plants connected to the SEN are included for the simple OM calculation. Power plants registered as CDM, VERRA or GS project activities are also included as suggested by the tool. Historical data of the three most recent years is available at the Wholesale Electricity Market Management Company web page⁷.

STEP 4. Calculate the operating margin emission factor according to the selected method.

The simple OM emission factor is calculated as the generation-weighted average CO₂ emissions per unit net electricity generation (tCO₂/MWh) of all generating power plants serving the system, not including the low-cost/must-run power plants/units.

According to the “Tool to calculate the emission factor for an electricity system” (Version 07.0), the simple OM may be calculated by one of the following options:

- **Option A:** Based on the net electricity generation and a CO₂ emission factor of each power unit.
- **Option B:** Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

As data for option A is actually available, this option will be used for the calculation. Under this option, the simple OM emission factor is calculated based on the net electricity generation and an emission factor for each power unit, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad \text{Equation 2}$$

Where:

$EF_{grid,OMsimple,y}$	= Simple Operating Margin CO ₂ emission factor in a year y (tCO ₂ /MWh)
$EG_{m,y}$	= Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh).
$EF_{EL,m,y}$	= CO ₂ emission factor of power unit m in year y (tCO ₂ /MWh).
m	= All grid power units serving the grid in year y except LC/MR power units.
y	= The relevant year as per the data vintage chosen in step 3.

Ex ante $EF_{grid,OMsimple,y}$ is calculated as an annual generation weighted average of: $EF_{grid,OMsimple,2016}$, $EF_{grid,OMsimple,2017}$, $EF_{grid,OMsimple,2018}$.

Determination of $EF_{EL,m,y}$

The emission factor of each power unit m should be determined as follows:

Option A1: If for a power unit m data on fuel consumption and electricity generation is available, the emission factor ($EF_{EL,m,y}$) should be determined as follows:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \times NCV_{i,y} \times EF_{O2,i,y}}{EG_{m,y}} \quad \text{Equation 3}$$

Where:

$EF_{EL,m,y}$	= CO ₂ emission factor for power unit m in year y (tCO ₂ /MWh).
$FC_{i,m,y}$	= Amount of fuel type i consumed by power unit m in year y (mass or volume unit)

⁷ Information available at: <http://portalweb.cammesa.com/memnet1/Pages/descargas.aspx>

NCV _{i,y}	= Net calorific value (energy content) of fuel type <i>i</i> in year <i>y</i> (tCO ₂ /GJ).
EF _{CO₂,i,y}	= CO ₂ emission factor of fuel type <i>i</i> in year <i>y</i> (tCO ₂ /GJ).
EG _{m,y}	= Net quantity of electricity generated and delivered to the grid by power unit <i>m</i> in year <i>y</i> (MWh).
<i>m</i>	= All power units serving the grid in year <i>y</i> except LC/MR power units.
<i>i</i>	= All fuel types combusted in power unit <i>m</i> in year <i>y</i>
<i>y</i>	= The relevant year as per the data vintage chosen in step 3.

However, for the calculation of the emission factor of each power unit *m*, the following options should be considered as well according to the availability of information:

Option A2: If for a power unit *m* only data on electricity generation and the fuel types used is available, the emission factor should be determined based on the CO₂ emission factor of the fuel type used and the efficiency of the power unit, as follows:

$$EF_{El,m,y} = \frac{EF_{CO_2,m,i,y} \times 3.6}{\eta_{m,y}} \quad \text{Equation 4}$$

Where:

EF _{EL,m,y}	= CO ₂ emission factor for power unit <i>m</i> in year <i>y</i> (tCO ₂ /MWh).
EF _{CO₂,m,i,y}	= Average CO ₂ emission factor of fuel type <i>i</i> used in power unit <i>m</i> in year <i>y</i> (tCO ₂ /GJ).
η _{m,y}	= Average net energy conversion efficiency of power unit <i>m</i> in year <i>y</i> (ratio).
<i>m</i>	= All power units serving the grid in year <i>y</i> except LC/MR power units.
<i>y</i>	= The relevant year as per the data vintage chosen in step 3.
3.6	= Conversion factor (GJ/MWh)

Option A3: If for a power unit *m* only data on electricity generation is available, an emission factor of 0 tCO₂/MWh can be assumed as a simple and conservative approach.

Determination of EG_{m,y}

For grid power plants, EG_{m,y} has been determined according to the data collected by the monitoring systems of each power generation plant, these data are referenced in the emission factor Excel spreadsheet. Using the data from the emission factor Excel spreadsheet it is possible to calculate the OM for the required 3 years (2016, 2017, 2018).

- EF_{grid,OM 2016}: tCO₂/MWh
- EF_{grid,OM 2017}: tCO₂/MWh
- EF_{grid,OM,2018}: tCO₂/MWh

Therefore the average EF_{grid,OM,2016,2017,2018} remains as:

EF _{grid,OM 2016,2017,2018}	t CO ₂ /MWh
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STEP 5. Calculate the build margin (BM) emission factor

In terms of vintage of data, option 1 of the tool is chosen, i.e. the *ex ante* approach:

Option 1: For the first crediting period, calculate the build margin emission factor *ex ante* based on the most recent information available on units already built for sample group *m* at the time of PDD submission for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period. For the third crediting period, the build margin emission factor calculated

for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Capacity additions from retrofits of power plants are not included in the calculation of the build margin emission factor.

The sample group of power units m used to calculate the build margin is determined as per the following procedure:

- (a) Identify the set of five power units, excluding power units registered as CDM, VCS or GS project activities, that started⁸ to supply electricity to the grid most recently ($SET_{5-units}$) and determine their annual electricity generation ($AEG_{SET-5-units}$, in MWh);
- (b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM, VCS or GS project activities (AEG_{total} , in MWh). Identify the set of power units, excluding power units registered as CDM, VCS or GS project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and determine their annual electricity generation ($AEG_{SET-\geq 20\%}$, in MWh);
- (c) From $SET_{5-units}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample});

Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin. Ignore steps (d), (e) and (f).

Otherwise:

- (d) Exclude from SET_{sample} the power units which started to supply electricity to the grid more than 10 years ago. Include in that set the power units registered as CDM, VCS or GS project activity, starting with power units that started to supply electricity to the grid most recently, until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) to the extent is possible. Determine for the resulting set ($SET_{sample-CDM}$) the annual electricity generation ($AEG_{SET-sample-CDM}$, in MWh); If the annual electricity generation of that set is comprising at least 20% of the annual electricity generation of the project electricity system (i.e. $AEG_{SET-sample-CDM} \geq 0.2 \times AEG_{total}$), then use the sample group $SET_{sample-CDM}$ to calculate the build margin. Ignore steps (e) and (f).

Otherwise:

- (e) Include in the sample group $SET_{sample-CDM}$ the power units that started to supply electricity to the grid more than 10 years ago until the electricity generation of the new set comprises 20% of the

⁸ The date on which the plants started to supply electricity to the grid is available on:
<https://infotecnica.coordinador.cl/instalaciones/centrales>

annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation);

- (f) The sample group of power units m used to calculate the build margin is the resulting set ($SET_{\text{sample-CDM->10yrs}}$).

As can be seen in the emission factor Excel spreadsheet, in this case all steps (a) to (f) need to be applied and the resulting sample group of power units m is the $SET_{\text{sample-CDM->10yrs}}$.

The build margin emissions factor is the generation-weighted average emission factor (tCO₂/MWh) of all power units m during the most recent year y for which power generation data is available, i.e. in this case the year 2018. The calculation is made as follows:

$$EF_{\text{grid,BM},y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad \text{Equation 5}$$

Where:

$EF_{\text{grid,BM},y}$	= Build margin CO ₂ emission factor in year y (tCO ₂ /MWh)
$EG_{m,y}$	= Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$	= CO ₂ emission factor of power unit m in year y (tCO ₂ /MWh)
m	= Power units included in the build margin
y	= Most recent historical year for which power generation data is available

The emission factor of each power unit m in the build margin is determined analogous as for the operating margin by Equation 3 or other listed methods depending on the available information.

The detailed calculations are provided in the worksheet "Build Margin (BM)" of the emission factor Excel spreadsheet.

The resulting BM emission factor is (rounded):

EF_{BM,2018}	t CO₂/MWh
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Step 6: Calculate the combined margin (CM) emissions factor

The combined margin emission factor is calculated as follows:

$$EF_{\text{grid,CM},y} = EF_{\text{grid,OM},y} \times w_{OM} + EF_{\text{grid,BM},y} \times w_{BM} \quad \text{Equation 6}$$

Where:

$EF_{\text{grid,OM},y}$	= Operating margin CO ₂ emission factor in year y (tCO ₂ /MWh)
$EF_{\text{grid,BM},y}$	= Build margin CO ₂ emission factor in year y (tCO ₂ /MWh)
w_{OM}	= Weighting of operating margin emissions factor (%)
w_{BM}	= Weighting of build margin emissions factor (%)

For solar projects the weighting of operating and build margin is done as indicated in the tool for the first crediting period, i.e. $w_{OM} = 0.75$ and $w_{BM} = 0.25$.

The combined margin emission factor is (rounded):

$EF_{\text{grid,CM,y}}$	$t \text{ CO}_2/\text{MWh}$
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The rounded emission reductions ex-ante for each instance of the project result in:

Table 9: Summary of the expected annual emission reduction

Power plant	Estimated ERs (tCO ₂ /yr)

3.2 Project Emissions

Since the project activity are the installation of three solar parks, the project emissions are zero.

$$PE_y = 0$$

3.3 Leakage

No leakage emissions are considered as provided in the methodology:

$$LE_y = 0$$

3.4 Net GHG Emission Reductions and Removals

Since project emissions and leakage emissions are zero, emission reductions are directly given as the baseline emissions as follows:

$$ER_y = BE_y - PE_y - LE_y - BE_y \quad \text{Equation 7}$$

Where:

ER_y	=	Emission reductions in year y (tCO ₂ e/yr)
BE_y	=	Baseline emissions in year y (tCO ₂ /yr)
PE_y	=	Project emissions in year y (tCO ₂ e/yr)
LE_y	=	Project emissions in year y (tCO ₂ e/yr)

See more details in the attached emission factor Excel spreadsheet.

As shown in the attached spreadsheet, the value of annual emission reductions estimated for the project activity is rounded.

Year	Estimated baseline emissions or removals (tCO ₂ e)	Estimated project emissions or removals (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated net GHG emission reductions or removals (tCO ₂ e)
2018		0	0	
2019		0	0	
2020		0	0	
2021		0	0	
2022		0	0	
2023		0	0	
2024		0	0	
2025		0	0	
2026		0	0	
2027		0	0	
2028		0	0	
Total		0	0	

4 MONITORING

4.1 Data and Parameters Available at Validation

Data / Parameter	EF _{grid,CM,y}
Data unit	tCO ₂ /MWh
Description	Combined margin CO ₂ emission factor for grid connected power generation in year y calculated using the latest version of the “Tool to calculate the emission factor for an electricity system”
Source of data	Calculated based on information provided by the electricity wholesale market management company (CAMMESA ⁹)
Value applied	XXXX

⁹ Information available at: <http://portalweb.cammesa.com/memnet1/Pages/descargas.aspx>

Justification of choice of data or description of measurement methods and procedures applied	As per the most recent "Tool to calculate the emission factor for an electricity system"
Purpose of Data	Calculation of baseline emissions
Comments	-

4.2 Data and Parameters Monitored

Data / Parameter	$EG_{\text{facility},y}$
Data unit	MWh/yr
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
Source of data	Measurement in the power plant
Description of measurement methods and procedures to be applied	The following parameters will be measured: The meters installed will be bi-directional, taking into account both the quantity of electricity supplied by the project plant to the grid and the quantity of electricity delivered to the project plant from the grid. In this case the individual values are not required
Frequency of monitoring/recording	Continuous measurement and at least monthly recording. Typically, the measured data is read once every 24 hours using tele-metering technology (remotely).
Value applied	xxxx
Monitoring equipment	A main and a backup meter will be installed for each power plant.
QA/QC procedures to be applied	The verification of the meters will be done as established by the national authorities or alternatively at least once every three years. In addition, the generation values will be crosschecked with the information available on the website of the electricity wholesale market management company.
Purpose of data	Calculation of baseline emissions.
Calculation method	Not applicable.
Comments	All data collected as part of the monitoring process is archived electronically and kept at least for two years after the end of the last crediting period.

4.3 Monitoring Plan

5 SAFEGUARDS

5.1 No Net Harm

5.2 Environmental Impact

5.3 Local Stakeholder Consultation

5.4 Public Comments