CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

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SECTION A. General description of project activity

A.1. Title of the project activity:

TACNA SOLAR 20 TS: 20 MW Solar Photovoltaic Power Plant.
Version: 1 Date: 30/05/2011
Version: 2 Date: 14/10/2011
Version: 3 Date: 15/11/2011
Version 4 Date: 21/11/2011
Version 5 Date: 18/01/2012

A.2. Description of the project activity:

The project activity involves the construction of a 20 MW AC (Alternating Current) solar photovoltaic (PV) power plant on an area of 121.8 ha. located in the Tacna region in Peru. The project activity will have an inverter capacity (AC power) of 20 MW. The peak power (PV module power) of the plant will range between 20 MWp and 22 MWp and it will be finally determined before the start of the construction by the independent technical advisor of the bank to aim for a production of 49,680 MWh/year, which represents an increment of 5% vs. the adjudicated energy under the PPA Contract signed with the Government of Peru. This is a voluntary security cushion set by Solarpack in order to avoid penalties in the adjudicated tariff for not reaching the adjudicated yearly energy quota under the PPA Contract. The modules to be used will polycrystalline photovoltaic modules that will come from a short list of manufacturers approved by the financing banks and their peak power will range between 270 Wp and 290 Wp. Thus, the number of PV modules in the plant will range between 81,481 modules (22 MWp using 270 Wp modules) and 68,966 modules (20 MWp using 290 Wp modules). The project activity is to be developed by Tacna Solar S.A.C[1].

Each photovoltaic module will convert the solar irradiance in Direct Current (DC) electricity, which will be then transformed through DC/AC inverters and converted into 275 V AC. The low voltage electricity will be raised to 23 kV and then sent to the electrical substation of the plant where its voltage will be raised again to 66 kV. Once transformed to 66 kV, the electricity generated by the solar photovoltaic power plant will be transported through a new 66 kV transmission line 1,650 m long to Los Heroes substation which is integrated into the Interconnected National System (SEIN). The transmission line will be implemented by the project proponent in order to connect the project activity to the grid.

The project activity location is a piece of land in the middle of a desert plain in the region of Tacna. If the project activity would not be implemented, no other renewable electrical generation option would be likely to be built on the site due to the lack of water, wind and any other renewable resources in the area. Instead, if the equivalent power for the SEIN were to be injected by an alternative way, the most probable baseline scenario would be power supplied by new or existing fossil fuel-fired power plants connected to the SEIN (continuation of the current situation). SEIN is dominated by fossil fuel-fired power plants, which in 2010 represented approximately the 52% of the total generation of the grid. The baseline emissions correspond to CO_2 emissions attributable to the generation of the 49,680 MWh/year (projected

[1] Owned by the companies “Solarpack Corporación Tecnologica SL” and “Gestamp Asetym Solar, SL”.

generation of the solar PV power plant) that would have been generated by a mix of power plants connected to the SEIN.

The project contributes to sustainable development in the following ways:

- The project activity will contribute to the generation of clean energy in Peru and will displace electricity generation from thermal power plants, reducing 34,006 ton CO_2/year. This will result in the reduction of Greenhouse Gas (GHG) emissions, thus providing a sustainable option in the diversification and increase of energy production in the country.
- The operation of the solar power plant will help to reduce the thermal power plants in operation connected to the SEIN, reducing the emission of local pollutants as NOx, SOx and PM.
- Helping the country to improve its hydrocarbon trade balance through reduction of oil derivates consumption to be used for electricity generation.
- Contributing to the electrical stability of the local grid.
- Contributing to fiscal accounts though the payment of taxes.
- Employing local labor in construction and plant management.
- Improving the commercial activity since the of the floating population during construction and operation of the power plant which will require more services like, food, transport, and others.

A.3. Project participants:

Name of Party involved (*) (host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Peru	Tacna Solar S.A.C.	No
*In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party (ies) involved is required.		
Note: *When the PDD is filled in support of a proposed new methodology* at least the host Party (ies) and any known project participant (e.g. those proposing a new methodology) shall be identified.		

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Republic of Peru.

A.4.1.2. Region/State/Province etc.:

Department of Tacna (Tacna Region) / Tacna province / Tacna distric.

A.4.1.3. City/Town/Community etc.:

Tacna city.

A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):

The project activity will be located approximately at the 1,290 km of the route Panamericana Sur, in Tacna distric, province and Region of Tacna.

The specific coordinates of the project activity are:

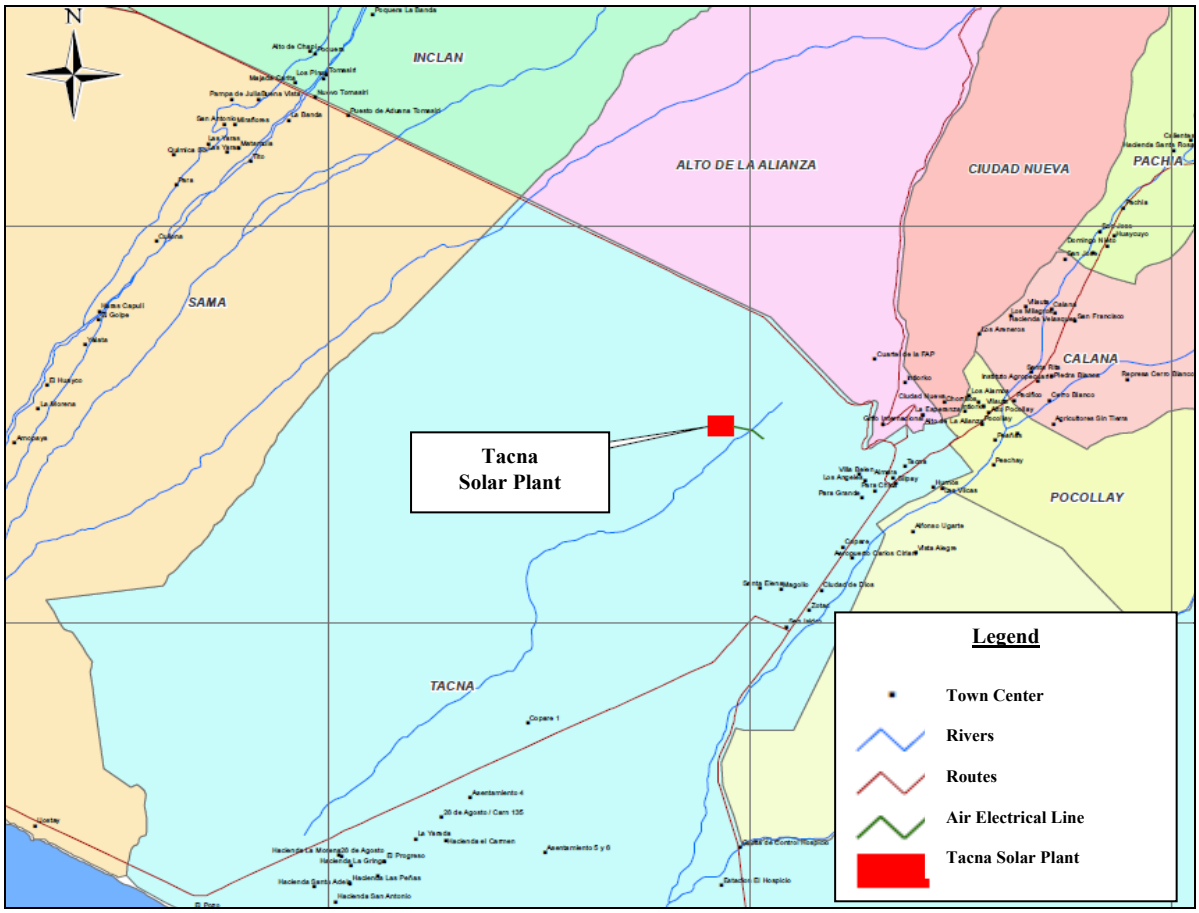
Table 1. Project Geographical Coordinates

Vertex	Geographical Coordinates
A	17^0 59' 23.78689'' S, 70^0 20' 28.26693" W
B	17^0 59' 24.06797'' S, 70^0 19' 47.47278" W
C	17^0 59' 56.80500'' S, 70^0 20' 28.51651" W
D	17^0 59' 57.08623'' S, 70^0 19' 47.72025" W

The location of the project activity is illustrated in the next figures:

Figure 1. Location of the Project Site

Figure 2. Location Project Activity



A.4.2. Category(ies) of project activity:

Sectoral Scope 1: Energy Industry.

Category: Renewable electricity in grid connected applications.

A.4.3. Technology to be employed by the project activity:

The identified baseline scenario is the continuation of the current (previous) situation of delivered electricity in the Peruvian Electric grid. The energy that would be generated by the solar photovoltaic power would have been covered by the operation of grid-connected power plants and by the addition of new generation sources. The scenario existing prior to the start of the implementation of the project activity is equal to the baseline scenario.

The purpose of the project activity involves the installation of a solar photovoltaic power plant of 20MW AC of installed capacity. The annual operational hours are estimated to be 3548 h[2] and the operating life of the equipment can be as long as 35 years. In fact, PV modules manufacturers typically give a 25 year performance guarantee on their equipment assuring that during that period the performance of the modules will be above 80% of the original nameplate performance. After year 25 however, the modules still produce energy. In any case, the live of the project activity has been assumed to be 30 years.

The power plant is equipped with generation units (arrays conformed of PV modules), inverters (power conditioning system), transformation centers (boosting transformer), a sectioning center (grid connecting system), an electrical substation (voltage increase) and a transmission line that will supply electricity to the National Interconnected Electric System (SEIN).

In each of the photovoltaic generation units, the photovoltaic modules will convert the solar irradiance in Direct Current (DC) electricity, which will be then which will be then transformed through DC/AC inverters and converted into 275 V AC. The low electricity voltage will be raised to 23 kV, and then sent to the electrical substation of the power plant where it will be raised again to 66 kV. The generated energy by the solar photovoltaic plant will be transported to Los Heroes substation through a new transmission line of 1650 m which will interconnect the project activity to the National Interconnected Electric System (SEIN). All the power plant will be supervised from an on-site control room.

Regarding the technology, polycrystalline silicon solar cells will be installed for the proposed project and each photovoltaic module will range from of 270 W to 290 W one will be used of power. The load factor, defined as total generation divided by the total AC power of the plant and by the total number of hours within a year, will be approximately 28.4% (49,680 MWh/20 MW /8,760 h x 100= 28.4%). The PV modules will be certified by the International Standard IEC 61215 “Crystalline silicon terrestrial PV modules”, IEC 61730 “Photovoltaic (PV) module safety qualification” and CE Declaration of Conformity.

Solar photovoltaic power is an environmentally friendly energy source as it is clean, renewable, and will not produce greenhouse gas emissions during operation. In addition, the technology adopted by the proposed project will not result in a negative damage to the ecosystem. See section D of the PDD.

The main equipment such as solar modules, inverters and trackers will mainly imported from China and Spain. These equipment will not be substituted during the project period.

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

[2] Please note that this refers to the total number of hours in which the plant is operating at a capacity above 0 Watts. This has nothing to do with the load factor or the equivalent hours ratio, which are just ways of expressing the percentage of the time in a year or the number of hours in which the project would have to be operating at full capacity to produce the total energy generated in one year.

In accordance with the applicable methodology ACM0002 v.12.2.0 (EB 58) the implementation of the project activity in the Peruvian electric system will reduce 34,006 tonnes of CO_2e/year. Based in this estimated annual CO_2e reduction of the project activity, the reduction over the first 7-year crediting period will be of 238,042 tonnes of CO_2e.

Years	Annual estimation of emission reductions in tonnes of CO_2e
2012*	5,668
2013	34,006
2014	34,006
2015	34,006
2016	34,006
2017	34,006
2018	34,006
2019*	28,338
Total Estimated Reductions (tonnes of CO_2e)	**238,042**
Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**34,006**

*Two months of operation. ** Ten months of operation

The emission factor of the grid will be recalculated every year and at the end of each crediting period of 7 years.

The average emissions factor of the grid was estimated with the approved "Tool to calculate the emission factor for an electricity system v.02.2.1", as stated in the ACM0002 v.12.2.0, using the technical information of the electrical sector of Peru and the data of generation and consumption of all the SEIN power plants and units. This information has been provided by COES[3] for the year 2010.

A.4.5. Public funding of the project activity:

The implementation of the project activity will not use public funds.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

[3] "Comité de Operación Económica del Sistema Interconectado Nacional", Operation Economic Committee of the National Interconnected System (www.coes.org.pe).

The baseline calculations for the project activity have been carried out following the large scale methodology ACM0002 v.12.2.0, "Consolidated baseline methodology for grid-connected electricity generation from renewable sources".

The application of this methodology consider the use of:

- Tool to calculate the emission factor for an electricity system, v.02.2.1
- Tool for the demonstration and assessment of additionality, v.05.2.1.

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

The methodology ACM0002 v.12.2.0 is applicable because the project activity is a grid-connected renewable power generation project that involves the installation of a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant).

The project activity fulfils all the applicability conditions of the methodology as demonstrated as follows:

Table 3: Applicability conditions

Applicability conditions	Fulfillment of conditions
The project activity is the installation, capacity addition, retrofit or replacement of a power plant/unit of one of the following types: hydro power plant/unit (either with a run-of-river reservoir or an accumulation reservoir), wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit.	The project activity consists of new power plants (greenfield plant) that sell all energy generated to the national grid.
In the case of capacity additions, retrofits or replacements: the existing plant 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 or retrofit of the plant has been undertaken between the start of this minimum historical reference period and the implementation of the project activity.	This condition does not apply to the project activity since is not a project of capacity addition, retrofit or replacement project.
In case of hydro power plants: • The project activity is implemented in an existing simple or multiple reservoirs, with no change in the volume of any reservoirs; • The project activity is implemented in an existing simple or multiple reservoirs, where the volume of any of reservoirs is increased and the power density of each reservoir, as per definitions given in the Project Emissions section, is greater than 4	Not applicable. The project activity consists of new solar photovoltaic power plant.

W/m^2; • The project activity results in new single or multiple reservoirs and the power density of each reservoir, as per definitions given in the Project Emissions section, is greater than 4 W/m^2.	

The project does not fulfil the conditions of non applicability of the methodology:

Table 4: Non Applicability

Non Applicability conditions	Non Fulfillment of conditions
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.	The project activity does not involve switching from fossil fuels to renewable energy sources since is a new solar photovoltaic power plant connected to the grid.
Biomass fired power plants.	The project activity is a new solar photovoltaic power plant. No biomass fired power plant is part of the Project.
A hydro power plant that result in new single reservoir or in the increase an single existing reservoir where the power density of the power plant is less than 4 W/m^2.	The project activity is a new solar photovoltaic power plant. The project does not correspond to a hydroelectric project. Reservoir does not exist in the project site.

B.3. Description of the sources and gases included in the project boundary:

According to ACM0002 v.12.2.0, the project boundary includes power plant and all plants connected physically to the electricity system[4] where the project is connected National Interconnected Electric System (SEIN).

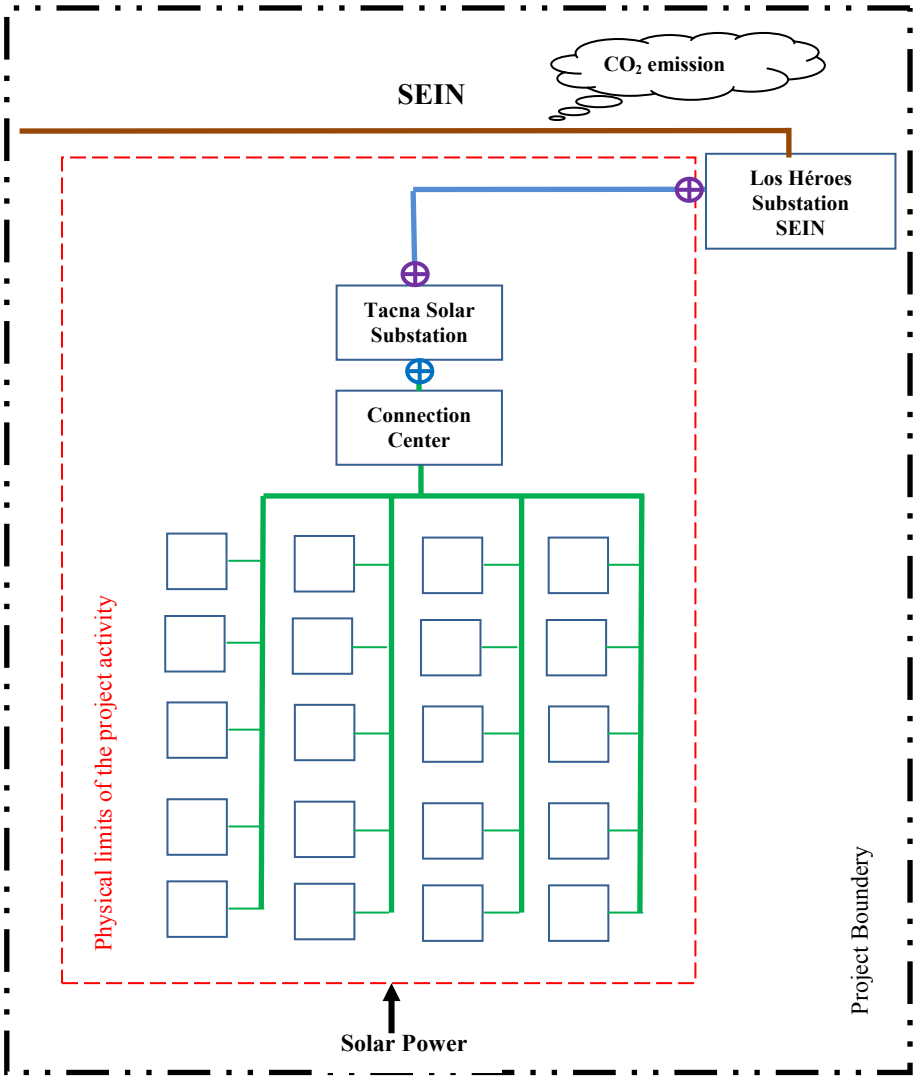
The following table shows which source of emissions and gases are included in the project boundary for the purpose of calculating project emissions and baseline emission:

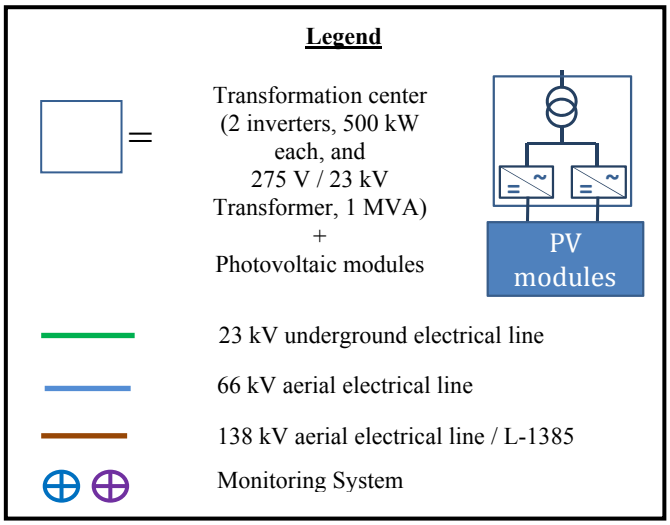
	Source	Gas	Included?	Justification / Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source

[4] Refer to the latest approved version of the "Tool to calculate the emission factor for an electricity system v.02.2.1" for definition of an electricity system.

	that are displaced due to the project activity.	N_2O	No	Minor emission source
Project Activity	For geothermal power plants, fugitive emissions of CH4 and CO2 from non-condensable gases contained in geothermal steam	CO_2	No	Not applicable for solar project
		CH_4	No	Not applicable for solar project
		N_2O	No	Not applicable for solar project
	CO_2 emissions from combustion of fossil fuels for electricity generation in solar thermal power plants and geothermal power plants.	CO_2	No	According to ACM0002, for solar power project, $PE_y = 0$
		CH_4	No	
		N_2O	No	
	For hydro power plants, emissions of CH4 from the reservoir	CO_2	No	Not applicable for solar project
		CH_4	No	Not applicable for solar project
		N_2O	No	Not applicable for solar project

The flowchart of the proposed project is as followings:


SEIN
CO_2 emission
Los Héroes Substation SEIN
Tacna Solar Substation
Connection Center
Physical limits of the project activity
Project Boundery
Solar Power


Legend
=
Transformation center (2 inverters, 500 kW each, and 275 V / 23 kV Transformer, 1 MVA) + Photovoltaic modules
PV modules
23 kV underground electrical line
66 kV aerial electrical line
138 kV aerial electrical line / L-1385
Monitoring System

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

The project activity does not retrofit or replacement an existing electricity generation facility or involve the addition of renewable energy generation units. The proposed project activity is the installation of a new grid-connected renewable power plant thus 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 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.*

The Peruvian electric grid is composed of a combination of thermal power plants that consume fossil fuels (mainly diesel) for the generation of electricity and plants that use renewable resources (mainly hydropower).

The identified baseline scenario is then the continuation of the current (previous) situation of delivered electricity in the Peruvian Electric grid. This energy that would be generated by the project activity will be covered by the operation of power plants that are currently connected to the grid and by the addition of new generation sources, as reflected in the combined margin (CM) calculations.

The baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants and plants that use renewable resources, which are displaced due to the project activity. Thus the implementation of the project activity will contribute to decreased greenhouse gas emissions in the electricity matrix of Peru, due to its activity that will displace some part of the thermal energy sources of the national grid (SEIN).

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

CDM CONSIDERATION

The project developers knew about the relevance for the project activity of the CDM consideration since its conception. A time line indicating the main milestones in the project implementation and CDM consideration is presented below:

Table 5. Milestones of the proposed CDM project development

Date	Activity
August, 2009	Terms of the electricity supply auction with renewable energy resources ("Bases para la subasta de suministro de electricidad con recursos energéticos renovables").
15/01/2010	The Board made the decision to bid with the project Tacna Solar 20TS in the first renewable request for offers tendered in Peru. The offer had to

	include a bid bond of 400.000 USD which, in case the project were adjudicated for a PPA, would have to be converted into a 2.000.000 USD bond. The Board made their decision based on the due diligence carried out by the Solarpack team in November 2009, during which: • The country rating and economic and political stability for long term investments was analyzed • The solar resource was estimated to be adequate for solar PV • Available land was found close to identified electrical infrastructure • Financing was available according to the interviews held with financial institutions • Favorable Bankability of the bid process and the PPA was transmitted verbally by financial institutions • Existing potential equity investors were identified • CER income was analyzed proving that it will allow the project to be more competitive by bidding a lower tariff in the RER auction and therefore by reducing the costs of the SEIN system During this board meeting, the final level of investment of the project to be presented in the bid process was also decided[5] based on their knowledge of the PV market.
January 18th, 2010	Presentation of the Technical and Economical proposal (considering CDM revenue).
February 12th, 2010	Certificate of Award of the Electricity Supply Auction with Renewable Energy Resources ("Acta Notarial de Adjudicación de la Subasta de Suministro de Electricidad con Recursos Energéticos Renovables").
March 31st, 2010 **Start date of the project activity.**	Signature of the contract for the renewable power supply to the National Interconnected Electric System between the Ministry of Energy and Mines and Tacna Solar S.A.C
September 9th, 2010	Submission[6] of the CDM consideration form to the UNFCCC with the intention of Tacna Solar S.A.C. of submitting the project to the CDM.
September 13th, 2010	Submission of the CDM consideration form to the DNA with the intention of Tacna Solar S.A.C. of submitting the project to the CDM.
24/05/2011	The CDM validation contract with DOE was signed
09/06/2011	Global Public Stakeholder Process was opened in UNFCCC website[7]
29/04/2011	Approval of DIA
15/07/2011	The project owner submitted LoA application form to Peruvian DNA
August, 2011	On-site validation
31/08/2011	Peruvian LoA reception
1/03/2012	Expected date of construction start
15/10/2012	Expected date of start commissioning
01/11/2012	Expected date of commissioning start-up

[5] Email communication as of the 15th of January 2010 with the document "258 Estudio de prefactibilidad TACNA SOLAR 20TS.pdf" showing the level of investment has been provided"

[6] http://cdm.unfccc.int/Projects/PriorCDM/notifications/index_html

[7] http://cdm.unfccc.int/Projects/Validation/DB/431B6PESFWJJQTT0F1UJ9F4SK6VEP0/view.html

Considering that the submission of the CDM consideration was done within the 6 months deadline after the commencement of the project activities the project meets the serious consideration requirements.

ADDITIONALITY ANALYSIS

In order to demonstrate that the proposed project activity is not the baseline scenario, the "Tool for the demonstration and assessment of additionality v.05.2.1" has been used, as required by methodology ACM0002 v.12.2.0.

The additionality tool provides a general framework for demonstrating and assessing additionality. These steps are:

Step 1: Identification of alternatives to the project activity
Step 2: Investment analysis
Step 3: Barrier analysis
Step 4: Common practice analysis

The application of the tool is as follows:

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a: Define alternatives to the project activity:

The realistic and credible alternatives available to the project participant that would provide outputs comparable with 20 MW Solar Photovoltaic Power Plant are:

(a) The proposed project activity undertaken without being registered as a CDM project activity.
(b) Continuation of the current situation of electricity supplied by the power plants connected to the SEIN (the electricity delivered to the grid by the project activity is generated by the existing grid-connected power plants and by the addition of new generation sources).
(c) The construction and operation of a fossil fuel power plant (currently COES operates power plants with different technologies as natural gas, fuel oil, diesel and coal fired power plants and hydroelectric power plants).
(d) Building a new power plant generating the same annual power generation from other renewable sources such as biomass power, wind power, hydro power and geothermal power.

The project is located[8] in a desert area with very little vegetation. Under this circumstance, in Tacna province there are no agriculture or forestry lands. Thus Tacna province cannot provide enough biomass[9] resources to build an equivalent biomass power generation plant.

[8] Source: Pages 38 and 40, Environmental Impact Declaration Form

[9] Source: Page 100 "Bioenergy and Food Security" (Bioenergía y Seguridad Alimentaria – BEFS) http://www.fao.org/docrep/013/i1712s/i1712s.pdf

According to the report Nº 017-2011-MEM-AAE/HJCLL, within the area of influence of the project, there are only 3 channels from three dry streams, and the maximum average rainfall is of 47.3mm. Therefore it is impossible for the project owner to build such a hydropower plant with the same/similar capacity. Moreover, from the potential 100 Hydropower plants identified in the Atlas of "Hydro Power Potential of Peru[10]" (Atlas del Potencial Hidroeléctrico del Perú), none of them are located in the department of Tacna.

According to the Wind Atlas[11] (Atlas Eólico de Perú), wind speed of Tacna province varies between 2 m/s and 4 m/s, which are below the optimum speed for operation of a standard turbine. It means that Tacna province is not eligible to install wind farms comparable to the Project.

The geothermal activity[12] in Peru was started in the decade of 70's. However, the development of it is just beginning, due to the given priority to other sources of energy. Currently, there are not generation cost evaluation assessments of geothermal sources. Therefore, under these circumstances, in the province of Tacna, there is not information available to develop a geothermal generation project.

Therefore, Alternative (d) is not realistic and credible.

Sub-step 1b: Consistency with mandatory laws and regulations:

All the alternatives identified in sub-step 1a are in compliance with all mandatory laws (Ley N° 25844 – Ley de Concesiones Eléctricas – LCE or Electric Concession Law, and its modifications) and regulations. Several articles of the LCE and its modifications imply that the alternatives described above are valid and realistic options, including:

- Article 1: Electricity generating activities can be developed by people or legal entities, i.e. private companies, whether they are Peruvian nationals or foreigners, as long as the legal entities are incorporated under Peruvian laws;

None of the identified alternatives is contradictory with any legal or regulatory requirement, or includes a risk to do so in the future since public and private entities can develop energy project in Peru. They do not break technical standards and dispositions of environmental and cultural conservation. Since they are all realistic and credible alternatives available to the project participants, the Project is considered additional under Step 1.

Step 2: Investment analysis

Sub-step 2a: Determine appropriate analysis method

According to the "Tool for the demonstration and assessment of additionality v.05.2.1", three options can be applied to conduct the investment analysis. These are the simple cost analysis (Option I), the investment comparison analysis (Option II) and the benchmark analysis (Option III).

[10] Source: http://sigfoner.minem.gob.pe/hidro/Site/hgis/atlas/01_Atlas_texto.pdf

[11] Source: Wind Atlas (Atlas Eólico de Perú). Click on "Velocidad del viento a 50 m" and enable "Distritos" to identify the area where Tacna belongs to: http://dger.minem.gob.pe/atlaseolico/PeruViento.html

[12] Source: http://intranet2.minem.gob.pe/web/archivos/dge/publicaciones/taller_geotermia/3.pdf

In order to determine whether the proposed project is economically or financially less attractive than the other alternatives without the revenue from the sale of CERs, Option III – "Apply benchmark analysis", is applied.

Sub-step 2b – Option III – Apply benchmark analysis

The indicator that will be used is: Post Tax Project IRR (Unlevered IRR).
The Internal Rate of Return (IRR) has been selected as the most suitable financial indicator and the benchmark is 12%[13] according to the national legislation and electric market operation.

Sub-step 2c – Calculation and comparison of financial indicators
The next table shows the main parameters used in the IRR calculation of the project.

Table 6: Main parameters used for IRR calculation

Main parameters	Unit	Value	Source references
Total initial investment	US$	91,000,000[14]	(1)
Data for Revenues estimation			
Generation capacity	kW	20,000	
Operating life for economic analysis	Years	21	(2)
Load factor	%	28.4	
Hours contained in 1 year	Hours	8,760	
Total Energy Production	MWh	49,680	(3)
Energy Production under contract	MWh	47,196	(4)
Electricity tariff under contract	US$/kWh	0.225	(5)
Indexation of the Tariff	%	2	(6)
Tariff update incremental trigger	%	5	(7)
Average financial income from deferred premium	%	6	(8)
Electricity Tariff in the spot market	US$/kWh	0.03	(9)
Months in the first year	Months	6	(10)
Data for Running cost estimation			
Operation and maintenance	US$/MW	16,479	(11)
Operation and maintenance	US$	329,575	
Toll for connection	US$/kWh	0.00	(12)
Land Lease	US$	60,000	(13)
Inflation	%	2	(14)

[13] Source: The 12% is stated in the article 79º of the LCE to which the following procedure is referring to (article 4.2):
http://www2.osinerg.gob.pe/MarcoLegal/NrmasAprbdasOSIAplcblesRglcionTrfria/GeneracionElectrica/EnergiasRenovables/OSINERGMIN%20No.001-2010-OS-CD.pdf

To see the 12% value go to Article 79º of the LCE:

http://intranet2.minem.gob.pe/web/archivos/dge/publicaciones/compendio/dl25844.pdf

[14] The level of investment has been changed from the previous version to reflect the actual level of investment proposed to OSINERGMIN in the bid submitted on the 18th of January 2010

Insurance	US$	82,848	(15)
Payments to DGE/OSINERGMIN (1% of the revenues)	%	1	(16)
Data for depreciation and Income tax			
Accounting Depreciation 20 years	US$	4,550,000	(17)
20% yearly straight line method accelerated depreciation for RER generation Assets	US$	18,200,000	(18)
Income Tax	%	30	(19)
Data for CDM evaluation			
Price of CER (Certified Emission Reductions)	US$/$tCO_2$	20	(20)
CERS per year	$tC0_2$/yr	29,131	(21)
Annual CERs income	US$	582,627	
Annual CERs Income after income tax	US$	407,839	
Terminal Value on year 21		6,247,023	(22)
Project Post Tax IRR without CER Income		**10.18%**	
Project Post Tax IRR with CER Income		**10.77%**	
Benchmark IRR		**12%**	

Sources[15]:

(1)	Solarpack´s assumptions based on its knowledge of the PV market on January 2010. This level of investment is the one officially stated on the 18th of January in the bid offer documents (page 22 of " 2.5.8 Estudio de Pre Factibilidad. consorcio TACNA SOLAR 20 TS_fdo.pdf") in front of OSINERGMIN. Email communication as of the 15th of January 2010 with the document "258 Estudio de prefactibilidad TACNA SOLAR 20TS.pdf" showing the level of investment has been provided"
(2)	December 2009. Years of PPA + 1 year for the liquidation of the premium of year 20. A terminal value based on cash flows from the operations from year 22 to year 30 is considered
(3)	The energy offered in the bid was 95% of the estimated generated energy.. This security cushion was considered voluntarily by Solarpack in January 2010 in order to make sure to meet the energy offered in the bid without risking any penalties.
(4)	Energy offered in the bid on the 18th of January 2010 which was adjudicated under the PPA
(5)	Offered tariff in the submission of the bid on the 18th of January 2010
(6)	January 2010: 2001-2009 CAGR for WPUSOP3500 (http://www.bls.gov/xg_shells/ro4xgppihi.htm)
(7)	December 2009. Annexure 3 of Bid Documents
(8)	December 2009. Clause 7.4.4 of Bid Documents
(9)	Solarpack assumption of January 2010 based on PLAN REFERENCIAL DE ELECTRICIDAD 2008 – 2017". Page 167 (http://www.minem.gob.pe/descripcion.php?idSector=6&idTitular=1318)
(10)	June 30th 2012 was the starting date of operations included in the bid offer. Therefore the first year of operation at the time of the investment decision was 2012 and the last 6 months of that year were considered for the calculations. The start date of operations was modified to October 31st 2012 in the amendment to the PPA signed on the 25th of May 2011.
(11)	The O&M cost represents c. 15,000 USD/MWp/year and it has been estimated by Solarpack on

[15] All sources for inputs are justified further in the IRR Calculation spreadsheet

	January 2010. This cost is considered as reasonable in a report produced by a technical independent advisor appointed by a bank for a PV project in a similar location. This report, which is confidential, was shown to TÜV SÜD in Tacna on the 23rd of August 2011
(12)	No tolls are considered for this project since the point of connection is the same as the delivery point of the energy in the bid: Los Héroes Tacna 66 kV
(13)	Estimated price given by the SBN (Superintendencia Nacional de Bienes Estatales) on the meeting held on the 17th of November 2009 in Lima for the Usufruct Right of a public land
(14)	Inflation considered in January 2010 in line with (6)
(15)	Indicative verbal input from an insurance company in January 2010
(16)	The contribution to governmental institutions is focused on the contribution to the electric regulator, called OSINERGMIN. This contribution is established in the Supreme Decree No. 136-2002-PCM Article 1which stipulates that the contribution will be 0.65% of sales for OSINERGMIN and 0.35% to Ministry of Energy and Mines. http://www.osinerg.gob.pe/newweb/uploads/JARU/CD/008fiscalizacion/ds136-2002-pcm.pdf
(17)	20 years depreciation considered in January 2010 for the accounting depreciation. Article 22nd of Law of the Income Tax sets a maximum yearly depreciation rate of 10% for "Other Assets". The article is not in contradiction with the special right of renewable assets to depreciate their value in an accelerated way as said in (18). The yearly depreciation rate chosen by Solarpack for accounting purposes is 5%. (http://www.sunat.gob.pe/legislacion/renta/regla/cap6.htm)
(18)	January 2010. Accelerated depreciation for renewable energy generators. In article 1 of the Legislative Decree Nº 1058, the renewable energy generators are allowed to depreciate its assets at the rate of 20%/year (http://intranet2.minem.gob.pe/web/archivos/dge/publicaciones/compendio/dl1058.pdf)
(19)	January 2010. The 30% income tax is established in Chapter VII Article 55 of the Unique Ordered text of the Law of the Income tax. (http://www.sunat.gob.pe/legislacion/renta/ley/capvii.htm)
(20)	The price of the Future December 2012 CER (BNF CER DEC12) was 13.61 € as of the 7th of December 2009 (http://www.bluenext.eu/statistics/downloads.php). Applying the exchange USD/EUR rate of the 7th of December of 2009 (0.6729; http://www.oanda.com/lang/es/currency/historical-rates/), the CER price considered was 20.23 USD/CER (20 USD rounding the price)
(21)	The amount of CERs was calculated in January 2010 considering an Emission Factor of 0,58638. This Emission Factor corresponds to the one calculated in the Santa Cruz I Hydroelectric Power Plant, registered in the 14th of September 2009: http://cdm.unfccc.int/Projects/DB/DNV-CUK1234847056.6/view
(22)	The terminal value was calculated in January 2010 discounting the cash flows from year 22 to year 30 at the 12% rate set by article 79º of the LCE (http://intranet2.minem.gob.pe/web/archivos/dge/publicaciones/compendio/dl25844.pdf). Those cash flows are assumed to come from the sale of energy to the spot market after the PPA at the price set on (9) above and inflated at the rate set on (6) above.

Benchmark:

The benchmark is a specific discount rate for the electric sector which has been determined by MINEM for every energy-related project assessment. Article 79 Electricity Concessions Law (Decree Law 25844).

The benchmark is established as a valid option, since it counts on a legal background and there are official documents that confirm its use: E.g. The Ministry of Economics and Finance has issued the Decree nº 015-2007 "Terms of reference for feasibility studies for rural electrification in Peru" where states that the 12% benchmark should be used in electrification projects which include electric generation projects (both renewable and non-renewable). In May 2005 the "Technical report 085-2005-EF/68.1" regarding the evaluation of projects in the electrical sector establishes that the discount rate is 12% for private sector evaluation, The Ministry of Environment and the Ministry of Energy and Mines have formally confirmed that 12% has being used broadly as a benchmark for the government to evaluate the viability of investments in the electrical sector in Peru, and in independent studies such as a World Bank study in 2008[16] ("Economic and Technical feasibility of Hydropower in Peru") and a Peruvian Agency for the Promotion of Private Investment (PROINVERSION) study confirmed the use of 12% as a benchmark for investment decisions in the sector.

It can be concluded that the 12% benchmark for the post tax project IRR (unlevered IRR) represents an official rate of discount for the Peruvian electric sector, and has been used widely for investment evaluations by both the private and the public sectors.

Additionally, the applied benchmark has been used in other several registered Peruvian projects such as El Platanal (registration Nº:2426), Santa Cruz I Hydroelectric Power Plant (registration Nº: 2405) and Santa Cruz II Hydroelectric Power Plant (registration Nº: 3337), Yanapampa Hydroelectric Power Plant (registration Nº: 3545), Huanza Hydroelectric Project (registration Nº: 4306) as the latest ones.

Comparison of Project IRR to the benchmark:
The project IRR is compared to the benchmark to examine the financial attractiveness of the project, and, 10.18% (Project post tax IRR) is lower than the benchmark of 12%. This indicates that the project activity needs the additional income that brings the CDM to become a more attractive investment and get closer to the benchmark.

Sub-step 2d –Sensitivity Analysis
The following assumptions are established to examine whether the above conclusion regarding the financial attractiveness of the Project is robust*:*

Project IRR:

A sensitivity analysis has been included to the IRR to indentify in which value of this analysis (in every case parameter) reaches the 12% benchmark. To do so, four fundamental parameters have been chosen to do the exercise; Investment costs, load factor, Tariff and O&M. The results are the following:

Table 7: Sensitivity Analysis: IRR

[16] Web: http://siteresources.worldbank.org/INTPERUINSPANISH/Resources/EnriqueCrousillat_Sesion2.pdf

Turning point condition to overpass the benchmark of 12%	
Parameter	**%**
Investment	**-13.0%**
Tariff	**+14.6%**
Load Factor	**>+92.5%**
Operation and Maintenance Cost	**>-100%**

The probability to reach this changes in the variables are practicable impossible. This is because:

- ***Investment***. A reduction of over 13.0% would be required in order to reach the benchmark. In a short period, the solar photovoltaic equipment costs, which represent approximately 80% of the investment cost, is not expected to be reduced from the investment considered. Additionally, the fact that this new solar projects in the Peruvian electric market can potentially lead to additional unknown expenses during the implementation and administration of the project. Therefore, it can be concluded that it is not likely to obtain investment reductions of enough magnitude to reach the benchmark.

- ***Tariff***. Electric tariffs require an increase of over 14.6% in order to reach the benchmark. Considering that the project has a especial base fixed tariff for the next 21 years (not modifiable as a result of the contract signed with the Peruvian government) and that the Electrical Referential Plan 2008-2017 of the Ministry of Energy and Mines[17] does not contemplate tariffs with which a solar project could become economically attractive (At the beginning of the maximum period, values reached over 30US$/MWh and at the end of the minor period values reached about 5 US$/MWh), it can be concluded that it not likely to obtain increased tariffs of enough magnitude to reach the benchmark

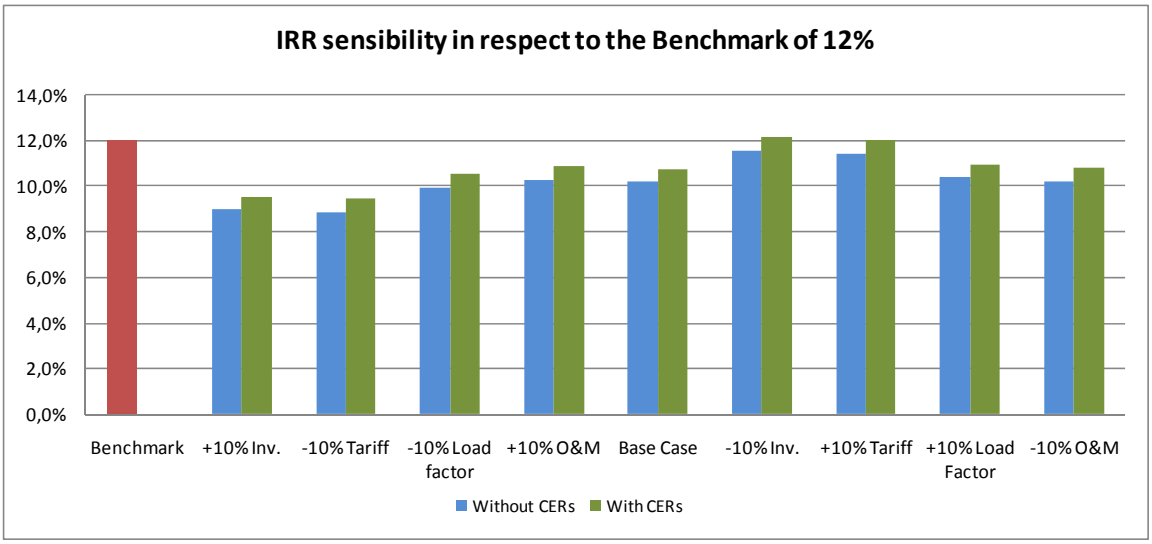
- ***Load Factor.*** It is required an increase of over 92.5% in order to reach the benchmark. Considering the technical specifications of the photovoltaic equipments used in the project activity (available in the market) and the precision of the information used to determine the generation of electricity, it can be concluded that it is neither probable nor possible to obtain an increase in the load factor to reach the benchmark.

- ***Operation and Maintenance.*** The Operation and Maintenance costs of the project have a relatively low impact in the cash flow; therefore if it is reduced or even eliminated, the impact would not be enough to reach the benchmark.

[17] Source: Ministry of Energy and Mines (Ministerio de Energía y Minas), Referential Electricity Plan, 2008-2017 ("PLAN REFERENCIAL DE ELECTRICIDAD 2008-2017"), page167. http://www.minem.gob.pe/area.php?idSector=6&idArea=85&idTitular=1232&idMenu=sub117&idCateg=509

Another sensitivity analysis has been included to indentify the IRR variations produced by +/- 10% variations in the following inputs: Investment costs, load factor, Tariff and O&M. The results are the followings:

		Sensitivity Analisis								
		Resulting Project IRR								
		Pesimistic scenario					Optimistic scenario			
	Benchmark	+10% Inv.	-10% Tariff	-10% Load	+10% O&M	Base Case	-10% Inv.	+10% Tariff	+10% Load	-10% O&M
Without CERs	12,0%	9,02%	8,87%	9,97%	10,30%	10,18%	11,56%	11,46%	10,40%	10,23%
With CERs		9,56%	9,46%	10,56%	10,91%	10,77%	12,20%	12,03%	10,98%	10,81%



Due to the fact that the development of a solar commercial generation plant of large scale is new in the country; there is uncertainty on the radiation level finally obtained during the operation of the plant. The measurement of solar radiation is not regulated, and is not a requirement for other industries or plants, therefore precise and long term on ground measurements do not exist in Peru.

The implementation of a project with new technology in the country and the fact, that still there is not a set of local experienced and qualified personnel, involves risks in the process of implementation and operation that along with potential design errors (supported in the absence of precise on ground measurements of radiation, among others), this can cause a decrease in the final net generation and hence, in the estimated income. Every electricity generation reduction implies a reduction on the incomes of the project activity and also monetary penalties for not compliance with the minimum generation agreed in the supply contract sign with the Peruvian government.

Since extensive land areas are needed, obtaining the concession of the land can be a limiting factor and a source of risk in the proper execution of the implementation timetable and the costs planning. In addition, obtaining other licenses (e.g. electrical connection, environmental permits, definitive concession) are heavily subject to governmental institutions internal timetables, therefore, delays and additional associated costs, like special requirements for peculiarities of the project or the analysis of a new technology in the country, are difficult to predict and quantify.

Also, in the future, additional operation requirements could be contemplated for solar power plants, such as special procedures for calibration of the electricity measurement equipments, as well as the measurement of the energy source. These procedures that did not exist at the moment of evaluation of the project activity may be developed by the COES and the market regulator.

Conclusion:

The sensitivity analysis conducted above confirms that the project activity requires CDM revenues from the sale of CERs to yield a more competitive project IRR that would reduce the gap with its benchmark. These revenues will help the project to become more attractive to private investors and financial institutions.

Step 3. Barrier Analysis

A barrier analysis has not been considered.

Step 4. Common Practice Analysis

Sub-step 4a. Analyze other activities similar to the proposed project activity

In accordance with the *Tool for the Demonstration and Assessment of Additionality*, "Similar activities are defined as activities of similar scale (i.e. technologies or practices), they take place in a comparable environment, inter alia, with regard to the regulatory framework and are undertaken in the relevant geographical area".

According to the Operating Statistics 2010 ("Estadísticas de Operaciones 2010 – COES"), http://www.coes.org.pe/wcoes/coes/estadistica/estadanual.aspx, there are no solar photovoltaic power projects dispatching electricity to the SEIN. Therefore, the proposed project will be the first project in Peru.

Sub-step 4b. Discuss any similar options that are occurring:

As there are no solar power plants installed at the moment in Peru, it can be concluded that, at this moment, there are not similar options to 20 MW Solar Photovoltaic Power Plant project that are occurring in Peru and hence, in addition to the additionality demonstration, the project activity requires CDM registration in order to be implemented.

As Sub-step 4b is satisfied, then the project activity is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The procedures to determine the emission reductions attributable to the Project activity are described below, according to the selected approved methodology ACM0002 v.12.2.0 "*Consolidated baseline methodology for grid-connected electricity generation from renewable sources*".

Project Emissions (PEy)

Project emissions are calculated as follows:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y} \quad (1)$$

Where:

PE_y = Project emissions in year *y* (tCO_2e/yr).
$PE_{FF,y}$ = Project emissions from fossil fuel consumption in year *y* (tCO_2e/yr).
$PE_{GP,y}$ = Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (tCO_2e/yr).
$PE_{HP,y}$ = Project emissions from water reservoirs of hydro power plants in year *y* (tCO_2e /yr).

The project activity uses solar power to generation electricity and hence the emissions from the project activity are taken as nil. It is necessary to indicate that there is no consumption of fossil fuels in the project activity.

Baseline Emissions (BEy)

Baseline emissions include only CO_2 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 above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows:

$$BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y} \quad (6)$$

Where:

BE_y = Baseline emissions in year *y* (tCO_2/year).
$EG_{PJ,y}$ = 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/year).
$EF_{grid,CM,y}$ = 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 v.02.2.1" (tCO_2/MWh).

Calculation of $EG_{PJ,y}$

The project activity is the installation of a new grid-connected renewable power plant/unit at a site where no renewable power plant was operated prior to the implementation of the project activity (Greenfield plant), and then the electricity fed to the grid is:

$$EG_{PJ,y} = EG_{facility,y} \quad (7)$$

Where:

$EG_{PJ,y}$ = 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/year).

$EG_{facility,y}$ = Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y* (MWh/year).

Calculation of the $EF_{grid,CM,y}$

According to ACM0002 version 12.2.0, $EF_{grid,CM,y}$ is calculated using the "Tool to calculate emission factor for an electricity system v.02.2.1". Then Project Participants apply the following six steps to the baseline calculation:

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.

STEP 1 - Identify the relevant electricity systems

For the purpose of determining the electricity emission factors, the electricity system of a project activity is defined by the geographic extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the renewable power plant location or the consumers where electricity is being saved) and that can be dispatched without significant transmission constraints.

Similarly, a connected electricity system, e.g. national or international, is defined as a system that is connected by transmission lines to the project electricity system. Power plants within the connected electricity system can be dispatched without significant transmission.

Like it was explained before, in Peru the project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines in the "National Interconnected Electric System (SEIN).

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

Project participants may choose between the following two options to calculate the operating margin and build margin emission factor.

Option I: Only grid power plants are included in the calculation
Option II: Both grid power plants and off-grid power plants are included in the calculation.

The proposed project chooses the "Option I: only grid power plants are included in the calculation".

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

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.

Out of four options for the OM, the Dispatch Data Analysis OM was selected. The Simple OM method cannot be used due to the low cost / must – run resources constitute more than 50% of the total grid generation in Peru. Regarding the Simple Adjusted OM method and the Average OM method, it was not necessary to use them because public official information of the hourly generation of the power unit that are actually dispatched is available for the Peruvian power units (COES).
Then the calculation will be done in an ex- post basis in order to consider the electric market growth. The data required to calculate the emission factor for year y is usually available before six months after the end of year *y*. Ex- post option will be used throughout all crediting periods.

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

The dispatch data analysis OM emission factor ($EF_{OM\_DD,y}$) is determined based on the grid power units that are actually dispatched at the margin during each hour *h* where the project is displacing grid electricity The $EF_{OM,DD,y}$ will be calculated in an ex-post basis.

The emissions factor is calculated as follows:

$$EF_{grid,OM-DD,y} = \frac{\sum_{h} EG_{PJ,h} \cdot EF_{EL,DD,h}}{EG_{PJ,y}} \quad (10)$$

Where:

$EF_{grid,OM-DD,y}$	= Dispatch data analysis operating margin CO_2 emission factor in year *y* (tCO_2/MWh).
$EG_{PJ,h}$	= Electricity displaced by the project activity in hour *h* of year *y* (MWh).
$EF_{EL,DD,h}$	= CO_2 emission factor for power units in the top of the dispatch order in hour *h* in year *y* (tCO_2/MWh).
$EG_{PJ,y}$	= Total electricity displaced by the project activity in year *y* (MWh).
h	= Hours in year *y* in which the project activity is displacing grid electricity.
y	= Year in which the project activity is displacing grid electricity.

As hourly fuel consumption data is not available. Then the hourly emissions factor is calculated based on the energy efficiency of the power unit and the fuel type used, as follows:

$$EF_{EL,DD,h} = \frac{\sum_{n} EG_{n,h} \times EF_{EL,n,y}}{\sum_{n} EG_{n,h}} \quad (12)$$

Where:

$EF_{EL,DD,h}$ = CO_2 emission factor for grid power units in the top of the dispatch order in hour *h* in year *y* (tCO_2/MWh).
$EG_{n,h}$ = Net quantity of electricity generated and delivered to the grid by power unit *n* in hour *h* (MWh).
$EF_{EL,n,y}$ = CO_2 emission factor of power unit *n* in year *y* (tCO_2/MWh).
n = Power units in the top of the dispatch.
h = Hours in year *y* in which the project activity is displacing grid electricity.

The CO_2 emission factor of the grid power units *n* ($EF_{EL,n,y}$) should be determined according to the guidance for the simple OM, using the option A2, as follows:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \cdot 3.6}{\eta_{m,y}} \quad (3)$$

Where:

$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh).
$EF_{CO2,m,i,y}$ = Average CO_2 emission factor of fuel type *i* used in power unit m in year *y* (tCO_2/GJ).
$\eta_{m,y}$ = Average net energy conversion efficiency of power unit *m* in year *y* (ratio).
m = All power units serving the grid in year *y* except low-cost/must-run power units.
y = Applicable year during monitoring (ex post basis).

Where several fuel types are used in the power unit, use the fuel type with the lowest CO_2 emission factor for $EF_{CO2,n,i,y}$

To determine the set of grid power units *n* that are in the top of the dispatch, obtain from a national dispatch centre:

- The grid system dispatch order for operation of each power unit of the grid of the system including power units from which electricity is imported; and
- The amount of power (MWh) that is dispatched from all grid power units in the system during each hour h that the project activity is displacing electricity.

At each hour *h*, stack each grid power unit's generation using the merit order. The group of grid power units *n* in the dispatch margin includes the units in the top x% of total electricity dispatched in the hour *h*, where x% is equal to the greater of either:
(a) 10%; or

(b) The quantity of electricity displaced by the project activity during hour *h* divided by the total electricity generation by grid power plants during that hour *h.*

STEP 5 - Calculate the build margin (BM) emission factor

In terms of vintage data, the project participant can choose between one of the following two options:

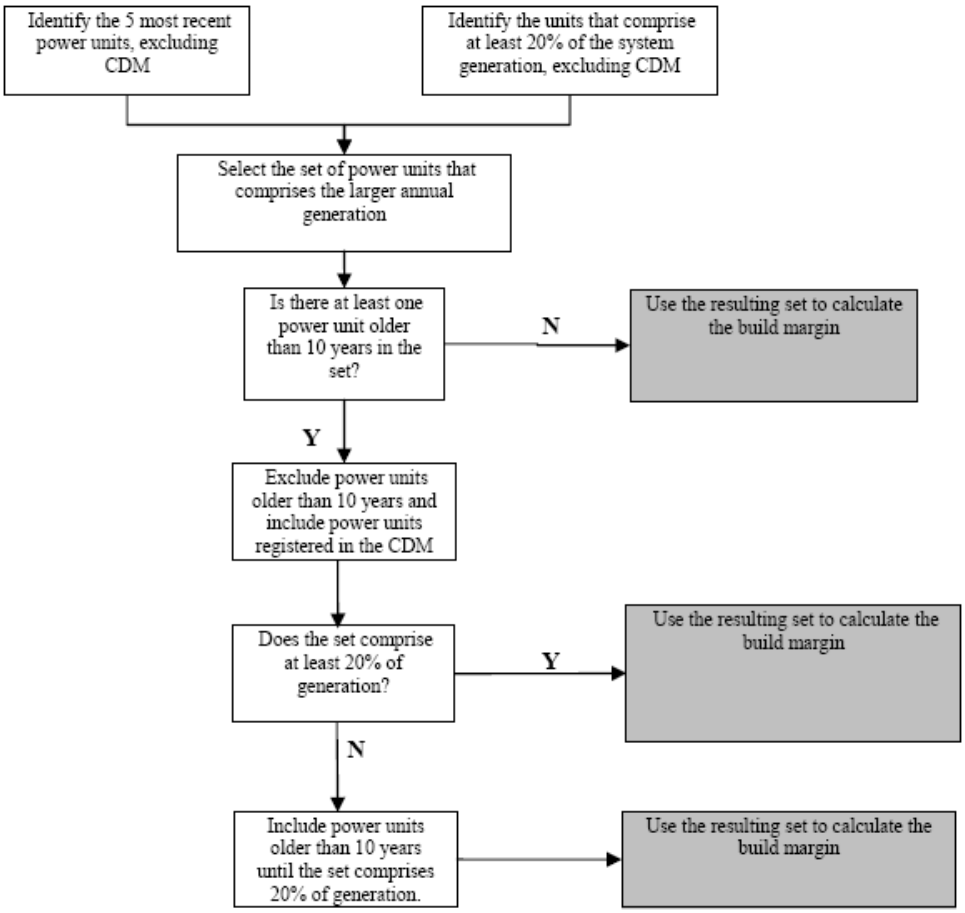
Option 1: For the first crediting period, calculate the build margin emission factor *ex ante* based on the most recent information available on units already built for sample group *m* at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission 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 to the DOE. 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.

Option 2: For the first crediting period, the build margin emission factor shall be updated annually, *ex post*, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated *ex ante*, as described in Option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

In terms of vintage of data, project participants have chosen **option 1.**

The sample group of power units *m* used to calculate the build margin should be determined as per the following diagram, consistent with the data vintage selected above:

Diagram Summarizes



The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units *m* during the most recent year *y* for which electricity generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (12)$$

Where:

$EF_{grid,BM,y}$ = 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 electricity generation data is available.

The CO_2 emission factor of each power unit m ($EF_{EL,m,y}$) is determined as per the guidance in step 4 (a) for the simple OM in the Tool (options A1 or A2), using for "*y*" the most recent historical year for which electricity generation data is available, and using for "*m*" the power units included in the build margin.

For the CO_2 emission factor of the grid power units *m* ($EF_{EL,m,y}$) used the values determined in the calculated of operating margin CO_2 emission factor "the CO_2 emission factor of the grid power units *n* ($EF_{EL,n,y}$)". It should be noted that this factor is applied to the option A.2.

If the only data of a power unit *m* on electricity generation and the fuel types used is available, the emission factor should be determined based on the CO_2 emission factor of the fuel type used and the efficiency of the power unit (Option A2), as follows:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \cdot 3.6}{\eta_{m,y}} \quad (3)$$

Where:

$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh).
$EF_{CO2,m,i,y}$ = Average CO_2 emission factor of fuel type *i* used in power unit *m* in year *y* (tCO_2/GJ).
$\eta_{m,y}$ = Average net energy conversion efficiency of power unit *m* in year *y* (%).
m = Power units included in the build margin.
y = Most recent historical year for which power generation data is available.

Where several fuel types are used in a power unit, the fuel type with the lowest CO_2 emission factor for $EF_{CO2, m, i, y}$. will be used.

The option A.3 is not applicable because there is data available for all the system plants to implement the option A1 or A2

STEP 6 – Calculate the combined margin (MC) emission factor

The calculation of the combined margin (CM) emission factor ($EF_{grid,CM,y}$) is based on one of the following methods:

(a) Weighted average CM; or
(b) Simplified CM.

The project participants have chosen the weighted average CM method (option A).

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times W_{OM} + EF_{grid,BM,y} \times W_{BM} \quad (13)$$

Where:

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year *y* (tCO_2/MWh).
$EF_{grid,OM,y}$ = Operating 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 projects that are solar or wind power generation, w_{OM} = 0.75 and w_{BM} = 0.25 (owing to their intermittent and non-dispatched nature) for the first crediting period, and for subsequent crediting period.

Emission Reductions (ER_Y)

The emission reduction attributable to the project activity during a given year *y* (ER_y) is the difference between the baseline emissions (BE_y) and project emissions (PE_y) as follows:

$$ER_y = BE_y - PE_y \quad (11)$$

Where:

ER_y = Emissions reductions in year *y* (t CO_2e/year).
$BE_{,y}$ = Baseline emissions in year *y*(t CO_2/year).
PE_y = Project emissions in year *y* (t CO_2e/year).

The results of the application of the Equations are presented in section B.6.3.

B.6.2. Data and parameters that are available at validation:

No data and parameters available.

B.6.3. Ex-ante calculation of emission reductions:

According to the selected approved methodology (ACM0002 v.12.2.0), the results of applying the steps and formulas to determine the emission reductions attributable to the Project activity are:

Project Emissions (PEy)

PEy = 0

Baseline Emissions (BEy)

- **Baseline Emissions (BEy)**

The baseline emission which includes only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity are:

$$BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y} \quad (6)$$

Table 8. Baseline Emissions

Year	EG_y (MWh)	BE_y (tCO_2/yr)
2012*	8,280	5,668
2013	49,680	34,006
2014	49,680	34,006
2015	49,680	34,006
2016	49,680	34,006
2017	49,680	34,006
2018	49,680	34,006
2019**	41,400	28,338

*Two months of operation.
** Ten Months of operation

- **Calculation of the $EF_{grid,CM,y}$**

Calculate the operating margin emission factor according to the selected method

The dispatch data analysis operating margin emission factor ($EF_{grid,OM-DD,y}$) is: 0.7229 tCO_2/MWh.
See detail information about this calculation in Annex 3.

Calculate the build margin emission factor
The build margin emissions factor ($EF_{grid,BM,y}$) is: 0.5692 tCO_2/MWh.
See detail information about this calculation in Annex 3.

Calculate the combined margin (CM) emissions factor *EFy.*
The combined margin emissions factor is: 0.6845 tCO_2/MWh.
See detail information about this calculation in Annex 3.

B.6.4 Summary of the ex-ante estimation of emission reductions:

Year	Estimation of project activity emissions (tonnes of CO_2e)	Estimation of baseline emissions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of overall emission reductions (tonnes of CO_2e)
2012*	0	5,668	0	5,668
2013	0	34,006	0	34,006
2014	0	34,006	0	34,006
2015	0	34,006	0	34,006
2016	0	34,006	0	34,006
2017	0	34,006	0	34,006
2018	0	34,006	0	34,006
2019**	0	28,338	0	28,338
Total (tonnes of CO_2e)	**0**	**238,042**	**0**	**238,042**

*Two months of operation.
** Ten months of operation

B.7. Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

The monitoring is developed according to the methodology ACM0002 v.12.2.0, so it consists on the measurement of the electricity generated by the renewable technology.

Project activity will not use fossil fuels or biomass in its operation.

Data / Parameter:	**$EG_{facility,y}$**
Data unit:	MWh/year
Description:	Quantity of net electricity supplied by the project plant/unit to the grid in year *y*.
Source of data to be used:	Directly measured on the project activity site. Project records and/or COES.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	49,680
Description of measurement methods and procedures to be applied:	Electricity supplied to the grid by the proposed project will be directly measured by Tacna Solar S.A.C.'s meter (at the substation plant). The proportion of data to be monitored is 100% and the data will be archived electronically and physically when necessary.

	Data is formally managed in the COES every 15 minutes, this information will be added hourly, monthly and yearly and recorded by the project developer. Invoices of electricity sold to the grid will be monitored.
QA/QC procedures to be applied:	To ensure the consistency, information on invoices of electricity sold to the grid will be crosschecked with measured information and/or COES information. The information from COES, final and formal information, will be seen by the project proponent via internet. This data will be later used in the national electrical statistics, confirming the validity of them. Tacna S.A.C.'s meter will be calibrated at least every two years[18]. Accuracy of the meter is 0.5 % (according to market conditions).
Any comment:	Monitoring frequency: Continuous measurement. Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later. Project proponent meter at Los Heroes substation has to comply with COEs Complete information of every year during the crediting period will be available by COES during the first six months of the following year.

Data / Parameter:	$EF_{grid,CM,y}$
Data unit:	tCO_2/MWh
Description:	Emission factor for the Peruvian interconnected grid (SEIN).
Source of data to be used:	Calculated according to the approved "Tool to calculate the emission factor for an electricity system v.02.2.1" as stated in the methodology ACM0002 v.12.2.0, "Consolidated baseline methodology for grid-connected electricity generation from renewable source". Input data provided by COES.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.6845
Description of measurement methods and procedures to be applied:	The baseline emission factor ($EF_{grid,CM,y}$) is calculated as a combined margin (CM), consisting of the combination of operating margin ($EF_{grid,OM,y}$) and build margin ($EF_{grid,BM,y}$) factors.
QA/QC procedures to be applied:	Calculated using data available (emission factors and annual statistics), that is monitored 100% by COES.
Any comment:	Monitoring frequency: Calculated yearly Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

[18] The calibration procedure is described in the Ministerial Resolution Nº 496-2005- MEM/DM (http://intranet2.minem.gob.pe/web/archivos/dge/publicaciones/compendio/rm496-2005.pdf) and its modification, Ministerial Nº 102-2010-MEM/DM (http://www.minem.gob.pe/minem/archivos/file/electricidad/legislacion/rm%20201-2010-em_.pdf). No frequency for the calibration is set by norm although typically it is done at least every years.

Data / Parameter:	$EF_{grid,OM,y}$
Data unit:	tCO_2/MWh
Description:	The Dispatch Data Analysis OM emission factor.
Source of data to be used:	Calculated according to the approved "Tool to calculate the emission factor for an electricity system v.02.2.1" as stated in the methodology ACM0002 v.12.2.0, "Consolidated baseline methodology for grid-connected electricity generation from renewable source". Input data provided by COES.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.7229
Description of measurement methods and procedures to be applied:	The dispatch data analysis operating margin emission factor ($EF_{OM-DD,y}$ = $EF_{grid,OM,y}$ in tCO_2/MWh) is a method which involves the power unit that are actually dispatched at the margin during each hour *h*, where the power unit are separated in power unit in the top of the dispatch *n* and other power unit.
QA/QC procedures to be applied:	---
Any comment:	Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data / Parameter:	$EF_{grid,BM,y}$
Data unit:	tCO_2/MWh
Description:	The build margin emissions factor.
Source of data to be used:	Calculated according to the approved "Tool to calculate the emission factor for an electricity system v.02.2.1" as stated in the methodology ACM0002 v.12.2.0, "Consolidated baseline methodology for grid-connected electricity generation from renewable source". Input data provided by COES.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.5692
Description of measurement methods and procedures to be applied:	---
QA/QC procedures to be applied:	---
Any comment:	Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data / Parameter:	$EG_{PJ,h}$
Data unit:	MWh

Description:	Electricity displaced by the project activity in hour *h* of year *y*.
Source of data to be used:	Project records and/or COES records This value is not measured twice. It will correspond the value hour of "$\mathbf{EG_{facility,y}}$" (Quantity of net electricity supplied by the project plant/unit to the grid in year *y*).
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Data used is presented in the spreadsheet for "Grid Emission Factor calculation".
Description of measurement methods and procedures to be applied:	Directly measured and/or based on the information provided by COES. This data will be measured every 15 minutes and recorded hourly. The proportion of data to be monitored is 100% and the data will be archived electronically.
QA/QC procedures to be applied:	Information of invoices of the electricity sold to the grid will be crosschecked with measured information and/or COES information to ensure the consistency. The information from COES, final and formal information, will be seen by the project proponent via internet. This data will be later used in the national electrical statistics, confirming the validity of them. To ensure consistency, and if it's applicable other records may be used if it is necessary.
Any comment:	Monitoring frequency: Hourly Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data / Parameter:	$EG_{PJ,y}$
Data unit:	MWh
Description:	Total electricity displaced by the project activity in year *y*. This value is not measured twice. It will correspond the value "$\mathbf{EG_{facility,y}}$" (Quantity of net electricity supplied by the project plant/unit to the grid in year *y*).
Source of data to be used:	Project records and/or COES.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	49,680 MWh/year
Description of measurement methods and procedures to be applied:	The proportion of data to be monitored is 100% and the data will be archived electronically. .
QA/QC procedures to be applied:	---
Any comment:	Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data / Parameter:	$EF_{EL,DD,h}$
Data unit:	tCO_2/MWh
Description:	CO_2 emission factor of power unit in the top of the dispatch order in hour *h* in year *y*.
Source of data to be used:	Calculated according to the approved "Tool to calculate the emission factor for an electricity system v.02.2.1" as stated in the methodology ACM0002 v.12.2.0, "Consolidated baseline methodology for grid-connected electricity generation from renewable source". Input data provided by COES.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Data used is presented in the spreadsheet for "Grid Emission Factor calculation".
Description of measurement methods and procedures to be applied:	To calculate $EF_{EL,DD,h}$ option 2 is based on the energy efficiency of the grid power unit and the fuel type used. The proportion of data to be monitored is 100% and the data will be archived electronically.
QA/QC procedures to be applied:	---
Any comment:	Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data / Parameter:	$EG_{n,h}$
Data unit:	MWh
Description:	Net quantity of electricity generated and delivered to the grid by power units *n* in hour *h*.
Source of data to be used:	Data provided by COES.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Data used is presented in the spreadsheet for "Grid Emission Factor calculation" based on information provided by COES from 2010 public available data.
Description of measurement methods and procedures to be applied:	Information provided by COES. This data will be compiled and processed every 15 minutes and recorded hourly. The proportion of data to be monitored is 100% and the data will be archived electronically.
QA/QC procedures to be applied:	Data available that is monitored 100% by COES.
Any comment:	Monitoring frequency: Hourly Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data / Parameter:	$EF_{EL,n,y}$
Data unit:	tCO_2/MWh
Description:	CO_2 emission factor of power unit *n* in year *y*.
Source of data to be used:	Calculated according to the approved "Tool to calculate the emission factor for an electricity system v.02.2.1" as stated in the methodology ACM0002 v.12.2.0, "Consolidated baseline methodology for grid-connected electricity generation from renewable source". Input data provided by COES.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Data used is presented in the spreadsheet for "Grid Emission Factor calculation".
Description of measurement methods and procedures to be applied:	The $EF_{EL,n,y}$ is determined for method the simple operating margin method option A.2. because only data on electricity generation and fuel types used are available for a power unit. The proportion of data to be monitored is 100% and the data will be archived electronically.
QA/QC procedures to be applied:	---
Any comment:	Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data / Parameter:	$EG_{m,y}$
Data unit:	MWh
Description:	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y*.
Source of data to be used:	Data provided by COES.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Data used is presented in the spreadsheet for "Grid Emission Factor calculation" based on information provided by COES from 2010 public available data.
Description of measurement methods and procedures to be applied:	Information provided by COES. This data will be compiled and processed every 15 minutes and recorded hourly. The proportion of data to be monitored is 100% and the data will be archived electronically.
QA/QC procedures to be applied:	Data available that is monitored 100% by COES.
Any comment:	Monitoring frequency: Hourly Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data / Parameter:	$EF_{EL,m,y}$

Data unit:	tCO_2/MWh
Description:	CO_2 emission factor of power unit *m* in year *y*.
Source of data to be used:	Calculated according to the approved "Tool to calculate the emission factor for an electricity system v.02.2.1" as stated in the methodology ACM0002 v.12.2.0, "Consolidated baseline methodology for grid-connected electricity generation from renewable source". Input data provided by COES.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Data used is presented in the spreadsheet for "Grid Emission Factor calculation".
Description of measurement methods and procedures to be applied:	The $EF_{EL,m,y}$ is determined for method the simple operating margin method option A.2. because only data on electricity generation and fuel types used are available for a power unit. The proportion of data to be monitored is 100% and the data will be archived electronically.
QA/QC procedures to be applied:	---
Any comment:	Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data / Parameter:	$\eta_{m,y}$
Data unit:	---
Description:	Average net energy conversion efficiency of power unit *m* in year *y* (ratio).
Source of data to be used:	Data provided by COES. Net Energy Conversion Efficiencies for all thermal plants are available in the annual statistics of COES.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Data used is presented in the spreadsheet for "Grid Emission Factor calculation".
Description of measurement methods and procedures to be applied:	Once for the crediting period .
QA/QC procedures to be applied:	If the data used is significantly lower than the default value of the applicable technology, project proponents should assess the reliability of the values, and provide appropriate justification if deemed reliable. Otherwise, the default values above shall be used.
Any comment:	Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data / Parameter:	$EF_{CO2,m,i,y}$
Data unit:	tCO_2/GJ

Description:	Average CO_2 emission factor of fuel type i used in power unit *m* in year *y*.
Source of data to be used:	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Diesel Oil = 0.0726 Residual Fuel Oil = 0.0755 Natural Gas = 0.0543 Coal = 0.0873
Description of measurement methods and procedures to be applied:	---
QA/QC procedures to be applied:	Every update of IPCC reports will be taken into account.
Any comment:	Monitoring frequency: Annually Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data / Parameter:	w_{OM}
Data unit:	(%)
Description:	Weighting of operating margin emissions factor.
Source of data to be used:	As indicated in the "Tool to calculate emission factor for an electricity system v.02.2.1".
Value of data applied for the purpose of calculating expected emission reductions in section B.5	75
Description of measurement methods and procedures to be applied:	---
QA/QC procedures to be applied:	---
Any comment:	For projects that are solar or wind power generation. Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data / Parameter:	w_{BM}
Data unit:	(%)
Description:	Weighting of build margin emissions factor.
Source of data to be used:	As indicated in the "Tool to calculate emission factor for an electricity system v.02.2.1".

Value of data applied for the purpose of calculating expected emission reductions in section B.5	25
Description of measurement methods and procedures to be applied:	---
QA/QC procedures to be applied:	---
Any comment:	For projects that are solar or wind power generation. Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

Data / Parameter:	**Merit Order**
Data unit:	Text
Description:	The merit order in which power plants are dispatched by documented evidence.
Source of data to be used:	Data provided by COES.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Data used is presented in the spreadsheet for "Grid Emission Factor calculation".
Description of measurement methods and procedures to be applied:	For each year, the variable cost of thermal plants in the SEIN that are in effect in December will be used. The proportion of data to be monitored is 100% and the data will be archived electronically.
QA/QC procedures to be applied:	---
Any comment:	Data will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.

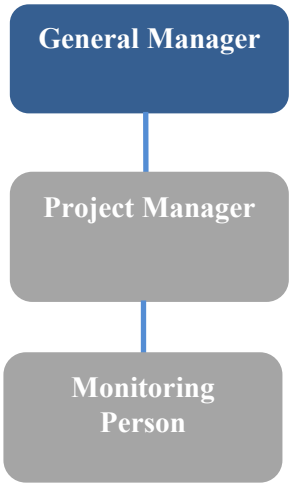
B.7.2. Description of the monitoring plan:

The Monitoring Plan describes the procedures for data collection and auditing required for the project, in order to determine and verify emission reductions achieved by the project. This project will require only very straightforward collection of data, described in this PDD, which will be collected routinely.

The purpose of the monitoring plan is to ensure that the required data is accurately monitored and recorded to enable the calculation of emission reductions achieved by the project, then, before the start date of the crediting period of the project activity, the following procedures and activities will be implemented:

Management Structure of Monitoring

The monitoring management structure will be established for implementation of the monitoring plan, the roles and responsibilities of monitoring management structure are as follows:



General Manager: Will be responsible of the following activities:

- Supervise and guarantee the quality of registered data in spreadsheets
- Supervise and guarantee the quality of annual final reports and monthly reports.
- File data and final reports.
- Will have knowledge of the calibration activities and maintance of equipments, and also will file the procedure certificates.

Project Manger: Will be responsible of the following activities:

- Supervise and guarantee the quality of registered data in spreadsheets
- Comparison of registered data with other available data (invoices, official information, formal communications of a electric sector entity, or others).
- Processing of data and generation of final reports
- Updating the Baseline Emission Factor and CER calculation.
- File data and final reports
- Inform the requirements of inspection for calibration and maintance of equipment and file the procedure certificates

Monitoring Person: Will be responsible of the following activities:

- Responsible for data collecting and archiving.

Management of Project Registration, Monitoring, Measurement and Reporting

The General Manager will have final responsibility for all aspects related to data measurements, monitoring of data recording and emissions and will sign off all reports on monitoring.

Data will be collected and consolidated in monthly and annual emission reduction internal reports.

Most of data required for the monitoring of emission reductions will come from data already collected as part of the plant' s operations or officially reported by the competent governmental entity (COES).

Data will be recorded in regular intervals. The actual monitored data will be entered into an "ER Spreadsheet" (or informatic program) to calculate the emission reductions for the period or the spreadsheet or informatic program used to determine the grid emission factor.

Every documentation paper will be collected in a central location, together with this monitoring plan. In order to facilitate auditor's reference, monitoring results should be indexed. All paper-based information will be stored and at least one copy (paper or electronic) will be kept. All the reports will also have an electronic copy in order to be sent to the audit team or consultant is required.

The data monitored which is required for verification and issuance will be kept at least for two years after the end of the crediting period or the last issuance of CERs for this proposed project activity, whatever occurs later.

Training of Monitoring Personnel
All people that participate in the monitoring process for the CDM project will be suitably qualified and trained for the operation and maintenance of the plant. The training for operating and maintaining the plant may be provided by the supplier of the electro-mechanical and hydro-mechanical equipments as part of the contract terms with the suppliers, or they will have a special training under the guidance of the project developer. They will also receive appropriate training on the CDM monitoring requirements, which will include an overview of the CDM and all elements of the monitoring plan in detail. A copy of the project monitoring plan will be distributed to all people involved and an additional copy will be easily accessible in appropriate locations on site.

Monitoring Equipment and Installation
In compliance with the requirements of COES (The solar PV plant, Tacna Solar 20TS will have Class 0.2 energy monitoring devices in the following locations:

- The 23 kV side of the 23kV/66 kV transformer of the Tacna Solar 20TS electrical substation (main meter used for CERs measurements which is shown in blue in the chart in section B.3)
- The 66 kV bus bar of the Tacna Solar 20TS electrical substation (backup meter which appears in purple in the chart in section B.3)
- The 66 kV bus bar of the Los Heroes electrical substation. This monitoring device will be installed voluntarily by Tacna Solar S.A.C. in order to calculate the real losses from the Tacna Electrical Substation to the Los Heroes Substation. It will also be a backup meter and it appears in purple in the chart in section B.3

Therefore, there will be 1 main meter and 2 backup meters. On total there will be 3 meters.

The energy monitoring devices to be used are ION 8600 or similar for the 23 kV levels and ION 8600A Class 0.2 or similar for the 66 kV points and the measurements to be monitored will be:

- Position of electrical switches
- Active Power
- Reactive Power
- Current
- Tension
- Tap position

Calibration of monitoring equipment
The metering equipment used to record the net electricity sold to the grid will be calibrated at least every two years.

Monitoring data adjustment procedures
Data will be consolidated on a monthly basis where it will be checked for quality control purposes with official reports or statistics, or with other documents (e.g. invoices). If there are discrepancies in the data, the source of the variation will be identified.

When reviewing the information and the emission reductions reports the Project Manager will examine the report for data anomalies and compare the report with previous ones for consistency.

If any discrepancies are found they will be investigated and corrected. The discrepancies and corrective actions will be recorded in an appendix in the relevant report. If the corrective actions result in any adjustments to monitoring data in the relevant report will be revised.

Emission Reductions
Emission reductions will be calculated on a monthly and yearly basis, as well as part of the monitoring reports at every verification process. Emission reductions occurring as a result of the project activity will be summarized in a report that will be prepared by the Project Manager.

Updating the Baseline Emission Factor
The baseline emission factor will be updated every year and at the end of each crediting period. The baseline emission factor will be calculated in accordance with the Tool to calculate the emission factor for an electricity system. The information used for updates will be summarized every time the emission factor is calculated. The update process will be made or revised by the Project Manager.

Data and reports review procedures
Data will be reviewed by the Monitoring Person and signed off on a monthly basis.

B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):

Date of completing the final draft of this baseline section: 14/10/2010.

The entity involved in the study is as follows:

Company: Deuman, Energy and Climate Change consultant.

Av. San Borja Sur Nº 325 Oficina 302, San Borja, Lima

Telephone number: + 51 1 593 6531
E-mail: info@deuman.com
Website: www.deuman.com

The above entity is not project participant.

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

The starting date of the CDM project activity is 31/03/2010 when the contract for the renewable power supply to the National Interconnected Electric System was signed with the Ministry of Energy and Mines and Tacna Solar S.A.C. This date is recognised as the start date of the project, because of the contract signature, the company Tacna Solar S.A.C presented a guarantee of faithful work execution fulfillment valued in two million dollars (hundred thousand dollars per MW installed), which according to the "guidelines on the Demonstration and Assessment of Prior Consideration of the CDM" version 4, considers like a earliest real action of project implementation.

It should be noted, that in addition, the company had to demonstrate a minimum capital of two million dollars (hundred thousand dollars per MW installed).

C.1.2. Expected operational lifetime of the project activity:

The expected operational lifetime of the project activity considered is 30 years. As indicated in A.4.3., the lifetime of PV plants can go as far as 35 years and in fact PV module manufacturers typically give a 25 year performance guarantee on their modules ensuring a power output of 80% of the initial power of their equipment. Therefore, it is conservative to assume that the project activity will be able to operate during 30 years, which is also the length of the usufruct contract signed with the Regional Government of Tacna on November 10th 2011.

As for the economic analysis, the project proponent has considered an operational period of 21 years (length of the PPA plus year 21 for the liquidation of the premium of year 20) after which a terminal value is considered based on the discounted estimated cash flows generated from year 22 to year 30.

C.2. Choice of the crediting period and related information:

C.2.1. Renewable crediting period:

A renewable crediting period will be used

C.2.1.1. Starting date of the first crediting period:

01/11/2012.

C.2.1.2. Length of the first crediting period:

7 years and 0 months.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable.

C.2.2.2. Length:

Not applicable.

SECTION D. Environmental impacts

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

According to the paragraph a), article 4 of the Law of the National Environmental Impact Assessment System, those projects where their execution do not cause negative significant environmental impacts (catalogued as Category I), only require the submission of an Environmental Impact Declaration (DIA).

The environmental impact assessment of TACNA SOLAR 20 TS: 20 MW Solar Photovoltaic Power Plant (including transmission line of the project) was documented by a DIA, which was evaluated by the General Direction of Environmental and Energy Issues (Dirección General de Asuntos Ambientales Energéticos – DGAAE) that is part of the Ministry of Energy and Mines and approved by Directorial Resolution ("Resolución Directorial", RD) No 118- 2011-MEM/AAE on April 29th, 2011 and No 119-2011-MEM/AAE on May 3th, 2011(rectification of previos RD).

According with the article 3 of the Electrical Concession Law (Ley de Concesiones Eléctricas - LCE) activities generating electricity with Renewable Energy Resources (RER) with an installed capacity greater than 500 kW require a definitive concession. Since the project activity is 20 MW, the company made the necessary efforts to obtain a definitive generation concession. Through Resolution No. 299-2011-MEM-DM on July 04th, 2011, this concession was issued by the Ministry of Energy and Mines.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

Project impacts are considerer non significant (According to the current regulation it only requires an Environmental Impact Declaration (Declaración de Impacto Ambiental - DIA)). The project will be located in an open land with no vegetation and it is not in the middle of a local population (the nearest town is at about 5 km away).

The construction, operation and closing of the solar plant could generate environmental impacts due to the activities developed in each stage. The possible impacts are:

Construction Stage:

- Possible alteration of the air quality due to the mobilization of machineries, vehicles and equipment, load and discharge of aggregate material and material work surplus.
- Possible change in sound levels due to the mobilization of vehicles, machinery and equipment.
- Possible soil contamination due to fuel spill and oil spill and inadequate disposition of dangerous and not dangerous solid residues.
- Possible displacement of wildlife due to the noise generated by the mobilization machinery, vehicles and equipment.
- Possible alteration of the landscape due to the presence of auxiliary facilities, machinery and vehicles.

Operation Stage:

- Possible soil contamination by oil spill used for machinery maintenance
- Possible alteration of landscape because of the solar plant presence

Closing Stage

- Possible alteration of the air quality due to the mobilization of machineries, vehicles and equipment, load and discharge of residues.
- Possible change in sound levels due to the mobilization of vehicles, machinery and equipment.
- Possible soil contamination due to fuel and oil to spill.

It is clear that because of the project and area characteristics, where it will be implemented, all the possible impacts would be non significant since they are of low magnitude and with temporary persistence.

The generated impacts in the construction of the 66 kV transmission line of 1,650 meters length (distance from the substation plant to Los Heroes substation), also would be no significant because of the low magnitude of the facilities.

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

As stated in Section D, the implementation of the solar photovoltaic plant and the construction of the 66 kV transmission line does not need an EIA but a DIA, and therefore a public consultation is not required by the environmental law. However, in order to inform the stakeholders about the construction and operation of the solar photovoltaic plant (including the transmission line) and its benefits for the community and its participation as a CDM project activity, the project developer voluntarily made a public consultation event, which consisted in the following activities:

Tacna Solar SAC invited stakeholders (institutions, organizations and public in general) through letters, press notes and informative panels to a Meeting. Tacna Solar SAC hired to the CCanto Group Consultores EIRL Company to send an invitation to each identified stakeholder and to control their assistance to the Meeting.

Tacna Meeting:

It took place on February 8th, 2011 at 4:00 p.m in the Jorge Bassadre Grohmann Convention Center, located in the district of Tacna. Fifty four people attended to the workshop. Among them there were: community representatives, regional and municipal government entities, representatives of universities and NGOs with presence in the project influence area.

The agenda included the reproduction of an introduction video of clean energies; a presentation of the "Solar Photovoltaic Power Plant Project "(Proyecto Central de Generación Eléctrica Solar Fotovoltaica), where the main technical characteristics and social and economic benefits of the project were explained. Moreover, causes and effects of climate change topics were also appointed to give clarity on how this type of project helps to mitigate climate change.

In addition, on February 5th, 2011, Tacna Solar SAC incorporated information about the CDM project on its Web Site to inform about the project and welcoming comments[19], in order to take them into consideration at the moment of implementation and operation of the project. For major detail the link is enclosed:

http://www.solarpack.es/cas/bonos_peru.aspx

It should be noted that such information will be available until the start of validation.

The following pictures correspond to the meeting in Tacna.

[19] In the press note in newspaper "El Correo" published on February 6th, 2011, Tacna Solar S.A.C. invited the general public to participate in the Public Consultation. The note invited to visit the website of the project developer for further information on the Project and facilitated an email for receive their comments.




E.2. Summary of the comments received:

To ensure the information exchange and the interaction between the Stakeholders and Tacna Solar SAC, the meeting had a question round.

The questions asked by the Stakeholders to Tacna Solar SAC covered technical and social aspects. This consultations were:

- Is the solar energy generation an alternative to the local hydroelectric power generation?
- Is the energy generated by the plant cheaper than conventional energy?
- How many families will be supplied with the power produced by the power plant?
- What is the lifetime of the project?
- How does the power plant operate in winter time?
- What type of maintenance will be applied to the power plant?
- How many workers will be required for the maintenance of the power plant?
- What is the payment system of carbon credits? Who buys the CERs? What is their price?
- How will the company contribute to supporting the community?

In conclusion, positive reactions and comments from the different Stakeholders were observed after the event with regards to the implementation of the project. A compilation of all the questions and the video sessions of the meeting will be available to be submitted to the DOE during the validation process of the project.

E.3. Report on how due account was taken of any comments received:

All questions of stakeholders were answered and clarified directly by Tacna Solar SAC during the meeting. Evidence of the answers and clarifications will be submitted to the DOE during the validation process of the project.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Tacna Solar S.A.C.
Street/P.O.Box:	Av. Víctor Andrés Belaúnde 147 – San Isidro
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E-Mail:	
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Represented by:	Ignacio Careaga
Title:	
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The implementation of the Project will not use public funds.

Annex 3

BASELINE INFORMATION

I. NATIONAL REGULATION

- **Electricity concessions law (Decree-Law Number 25844) and its regulatory supreme Decree Nº 009 – 93 – EM.**
  Establish the legal provisions with respect to the regulatory issues on generation, transmission, distribution and commercialization of electricity. The Ministry of Energy and mining and OSINERGMIN on behalf of Peru's government and considering its surveillance functions shall oversee compliance of this law. Generation, transmission and distribution activities could be carried out by national or international individuals or companies.

- **Legislative Decree Nº 1002 (LD 1002)[20] and its regulatory Supreme Decree Nº 050-2008-EM.**
  Establish the necessity of promoting energy infrastructure and renewable energy as a part of it. The LD 1002 and its regulation say that is necessary to promote the use of CDM in renewable energy projects.
  The LD 1002 and its regulation establish that Renewable Energy Resources (RER)[21] projects will have a priority to connect to the grid up to a maximum limit of 5%. For the next 5 years the percentage will be of 5.

- **Law of the National Environmental Impact Assessment (Decree-Law Number 27446) and its regulatory supreme Decree Nº 019 – 2009 – EM.**
  Establish the National Environmental Impact Assessment System (SEIA). It is a single and coordinated system for the identification, prevention, supervision; control and early correction of the negative environmental impacts derived from the human actions by means of the investment project. The Law Nº 27446 and its regulation establish the project categorization in accordance with the environmental risk as follows:

  – Category I, Environmental Impact Declaration.- Includes those projects which does not cause significant negative environmental impacts.
  – Category III, **Semi-detailed Environmental Impact Studies.-** Includes projects which can cause moderate environmental impact and whose negative effects can be eliminated or minimized by means of the adoption of easily applicable measurements.
  – Category III, Detailed Environmental Impact Studies.- Includes those projects whose characteristics, can cause significant negative environmental impacts, quantitatively or qualitatively, requiring a deep analysis to check its impacts and the development of a corresponding environmental management strategy.

II. DETERMINATION OF GRID EMISSION FACTOR

[20] http://www.minem.gob.pe/archivos/dge/publicaciones/compendio/DLEG-1002-2008.pdf
[21] Article 3º: comprises energy resources like biomass, wind, solar, geothermic, tidal and hydro power plants when the installed capacity is not over 20 MW.

a) Required information

A summary of the information sources of the variables and parameters used for the calculation of the Baseline Emission Factor is shown below.

Required information

Variable	Unit	Source
Name	-	COES*
Energy efficiency of the grid power unit	%	COES*
Marginal Cost of the grid power unit	US$/MWh	COES*
Start operation of the grid power unit	day/month/year	COES*
Electrical Generation	MWh/year	COES
Emission Factor for the fuel type (Fuel Oil, diesel, natural gas, coal):	$kgCO_2/TJ$	IPCC**

* Operation Economic Committee of the National Interconnected System- "Comité de Operación Económica del Sistema Interconectado Nacional", (www.coes.org.pe)

** 2006 IPCC Guidelines for National Greenhouse Gas Inventories, CHAPTER 1, Table 1.4 (lower limit of the 95% confidence intervals)

b) Procedure to determine the EF of the SEIN (Combined Margin - CM)

Build Margin

The sample group *m* of power units used to calculate the build margin, has been determinate according the "Tool to calculate the emission factor for an electricity system v.02.2.1" which indicates that the participants project activity must apply the following procedure:

a) Identify the set of five power units that started to supply electricity to the grid most recently ($SET_{5\text{-units}}$) and their annual electricity generation ($AEG_{SET\text{-}5\text{-}units}$):

$AEG_{SET\text{-}5\text{-}units}$ = 33,177 MWh

b) Identify the set of power units, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} and their annual electricity generation ($AEG_{SET\text{-}\geq 20\%}$):

$AEG_{SET\text{-}\geq 20\%}$= 6,302,174 MWh

c) From $SET_{5\text{-units}}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation. If none of them 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).

Due that the $AEG_{SET-\geq 20\%}$ is larger than $AEG_{SET-5-units}$ and none of the power units started to supply electricity to the grid more than 10 years ago, then the sample group *m* of power units used to calculate the build margin is $AEG_{SET-\geq 20\%}$.

Power Plant Additions in the SEIN (2006-2010)

Plant Name	Start Operation	Technology	Installed Capacity (MW)	2010 total Generation (GWh)
El Roncador - G2	11/12/2010	Hydro	1.80	1.03
Independencia	Oct-10	Diesel 2	34.39	5.27
Pisco - TG1	02/10/2010	Gas turbine Natural Gas	36.70	3.60
Pisco - TG2	03/09/2010	Gas turbine Natural Gas	36.50	10.20
Santa Cruz II - G1	10/06/2010	Hydro	3.40	
Las Flores - TG1	27/05/2010	Gas turbine Natural Gas	197.10	13.08
Santa Cruz II - G2	15/05/2010	Hydro	3.30	0.00
Poechos II	30/04/2010	Hydro	10.00	0.00
El Roncador - G1	28/04/2010	Hydro	1.30	6.62
El Platanal	31/03/2010	Hydro	216.90	
Kallpa - TG3	24/03/2010	Gas turbine Natural Gas	197.80	1,078.30
Paramonga	17/03/2010	Cogeneration - Steam Turbine	20.00	77.48
La Joya	01/10/2009	Hydro	9.60	
Santa Rosa - TG8	02/09/2009	Gas turbine Natural Gas	193.20	763.86
Chilca - TG3	02/08/2009	Gas turbine Natural Gas	194.60	930.46
Trujillo Norte	07/07/2009	Diesel 2	62.00	120.97
Kallpa - TG2	25/06/2009	Gas turbine Natural Gas	194.60	1,252.34
Santa Cruz I -G2	30/05/2009	Hydro	3.01	
Oquendo	06/03/2009	Cogeneration Natural Gas	28.00	203.60
Santa Cruz I-G1	19/02/2009	Hydro	3.15	
Caña Brava	19/02/2009	Hydro	5.71	
Carhuaquero-G4	22/05/2008	Hydro	9.98	
Chilca - TG2	09/07/2007	Gas turbine Natural Gas	180.00	406.19
Kallpa - TG1	01/07/2007	Gas turbine Natural Gas	180.00	880.43
Chilca - TG1	11/12/2006	Gas turbine Natural Gas	171.46	1,092.95
				6,846.37

Registered CDM

Build Margin Power Plant

Plant Name	2010 Generation (MWh)	CO_2 Emission Factor (tCO_2/MWh)	EG x EF_{EL}

El Roncador - G2	**1.03**	**0.000**	**-**
Independencia	**5.27**	**0.501**	**2.64**
Pisco - TG1	**3.60**	**0.724**	**2.61**
Pisco - TG2	**10.20**	**0.724**	**7.38**
Las Flores - TG1	**13.08**	**0.575**	**7.52**
El Roncador - G1	**6.62**	**0.000**	**-**
Kallpa - TG3	**1,078.30**	**0.575**	**619.92**
Paramonga	**77.48**	**0.000**	**-**
Santa Rosa - TG8	**763.86**	**0.559**	**426.62**
Chilca - TG3	**930.46**	**0.592**	**551.20**
Trujillo Norte	**120.97**	**0.688**	**83.20**
Kallpa - TG2	**1,252.34**	**0.575**	**719.97**
Oquendo	**203.60**	**0.575**	**117.05**
Chilca - TG2	**406.19**	**0.559**	**226.85**
Kallpa - TG1	**880.43**	**0.592**	**521.57**
Chilca - TG1	**1,092.95**	**0.559**	**610.41**
Total	**6,846.37**		**3,896.95**

The development of the equation of the Build Margin (BM) emission factor is:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} x EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

$$EF_{grid,BM,y} = \mathbf{0.5692\ tCO_2/MWh}$$

Operating Margin

The CO_2 emission factor of each power unit n ($EF_{EL,n,y}$) has been determined as per the guidance in step 4 (a) for the simple operating margin using the option A.2, the result is shown in the following table:

CO_2 Emission Factor for Thermal Units in the SEIN

Thermal Plants	Technology	Fuel	ηm,y Real NECs (1)	EFCO$_2$ (2) KgCO$_2$/TJ	CO$_2$ Emissions Factor (tCO$_2$/MWh)

	Thermal Plants	Technology	Fuel	ηm,y Real NECs (1)	EFCO$_2$ (2) KgCO$_2$/TJ	CO$_2$ Emissions Factor (tCO$_2$/MWh)
	KALLPA TG3	Gas Turbine Natural Gas	Natural Gas	34.00%	54,300	0.5749
	KALLPA TG2	Gas Turbine Natural Gas	Natural Gas	34.00%	54,300	0.5749
	KALLPA TG1	Gas Turbine Natural Gas	Natural Gas	33.00%	54,300	0.5924
	VENTANILLA TV	Combined Cycle - Gas Turbine	Natural Gas	50.00%	54,300	0.3910
	TG1 CHILCA	Gas Turbine Natural Gas	Natural Gas	35.00%	54,300	0.5585
	TG2 CHILCA	Gas Turbine Natural Gas	Natural Gas	35.00%	54,300	0.5585
	TG3 CHILCA	Gas Turbine Natural Gas	Natural Gas	33.00%	54,300	0.5924
	TG VENTANILLA-3	Gas Turbine Natural Gas	Natural Gas	35.00%	54,300	0.5585
	TG VENTANILLA-4	Gas Turbine Natural Gas	Natural Gas	34.00%	54,300	0.5749
	TG8 S.ROSA	Gas Turbine Natural Gas	Natural Gas	35.00%	54,300	0.5585
	TG WESTINGHOUSE	Gas Turbine Natural Gas	Natural Gas	30.00%	54,300	0.6516
	INDEPENCENCIA GAS	Diesel 2	Natural Gas	39.00%	54,300	0.5012
	PISCO TG1	Gas Turbine Natural Gas	Natural Gas	27.00%	54,300	0.7240
	PISCO TG2	Gas Turbine Natural Gas	Natural Gas	27.00%	54,300	0.7240
	TG S.ROSA UTI5	Gas Turbine Natural Gas	Natural Gas	29.00%	54,300	0.6741
	TG S.ROSA UTI6	Gas Turbine Natural Gas	Natural Gas	27.00%	54,300	0.7240
	LF FLORES TG1	Gas Turbine Natural Gas	Natural Gas	34.00%	54,300	0.5749
	OQUENDO TG1	Gas Turbine Natural Gas	Natural Gas	34.00%	54,300	0.5749
	AGUAYTIA 1	Gas Turbine Natural Gas	Natural Gas	30.00%	54,300	0.6516
	AGUAYTIA 2	Gas Turbine Natural Gas	Natural Gas	30.00%	54,300	0.6516
	ILO 2 TV1	Steam Turbine / Coal	Coal	40.00%	87,300	0.7857
	MALACAS TGN4	Gas Turbine Natural Gas	Natural Gas	27.00%	54,300	0.7240
	MOLLENDO 1,2,3	Diesel 2 / Residual	Diesel 2	43.00%	72,600	0.6078
	TUMBES	Diesel 2 / Residual	Diesel 2	43.00%	72,600	0.6078
	MALACASTG2	Gas Turbine Diesel	Natural Gas	22.00%	54,300	0.8885
	SULZER CHILINA	Diesel 2 / Residual	Diesel 2	39.00%	72,600	0.6702
	MALACAS TG1	Gas Turbine Diesel	Natural Gas	21.00%	54,300	0.9309
(*)	ILO TV3	Steam Turbine / Residual	R500	33.60%	75,500	0.8089
	ILO TV2	Steam Turbine / Residual	R500	34.90%	75,500	0.7788
	ILO TV4	Steam Turbine / Residual	R500	34.50%	75,500	0.7878
	TV3 SHOUGESA	Steam Turbine / Residual	R500	30.00%	75,500	0.9060
	TV1 SHOUGESA	Steam Turbine / Residual	R500	28.00%	75,500	0.9707
	TV2 SHOUGESA	Steam Turbine / Residual	R500	29.00%	75,500	0.9372
(**)	DOLORESPATA	Diesel 2	Diesel 2	34.50%	72,600	0.7576
	CATKATO	Diesel 2 / Residual	Diesel 2	42.00%	72,600	0.6223
	Yarinacocha	Diesel 2 / Residual	Diesel 2	39.00%	72,600	0.6702
	TV3 CHILINA	Steam Turbine / Residual	R500	23.00%	75,500	1.1817

	Thermal Plants	Technology	Fuel	ηm,y Real NECs (1)	EFCO$_2$ (2) KgCO$_2$/TJ	CO$_2$ Emissions Factor (tCO$_2$/MWh)
	SAN NICOLAS CUMMINS	Diesel 2 / Residual	Diesel 2	38.00%	72,600	0.6878
	DS PIURA2	Diesel 2 / Residual	Diesel 2	37.00%	72,600	0.7064
	DS PIURA1	Diesel 2 / Residual	Diesel 2	37.00%	72,600	0.7064
	BELLAVISTA	Diesel 2 / Residual	Diesel 2	38.00%	72,600	0.6878
	TV2 CHILINA	Steam Turbine / Residual	R500	21.00%	75,500	1.2943
	TRUJILLO NORTE	Diesel 2 / Residual	Diesel 2	38.00%	72,600	0.6878
	DS CHICLAYO OESTE-D	Diesel 2 / Residual	Diesel 2	35.00%	72,600	0.7467
	DS PAITA 1	Diesel 2 / Residual	Diesel 2	34.00%	72,600	0.7687
	DS SULLANA	Diesel 2 / Residual	Diesel 2	34.00%	72,600	0.7687
	Taparachi	Diesel 2 / Residual	Diesel 2	35.00%	72,600	0.7467
	TG2 ILO	Gas Turbine Diesel	Diesel 2	33.00%	72,600	0.7920
	DS PAITA2	Diesel 2 / Residual	Diesel 2	32.00%	72,600	0.8168
	CHILINA C.C.	Gas Turbine Diesel	Diesel 2	29.00%	72,600	0.9012
	TG1 ILO	Gas Turbine Diesel	Diesel 2	30.00%	72,600	0.8712
(***)	TG1 CHIMBOTE	Gas Turbine Diesel	Diesel 2	22.70%	72,600	1.1514
	TG3 CHIMBOTE	Gas Turbine Diesel	Diesel 2	24.00%	72,600	1.0890
	TG PIURA	Diesel 2 / Residual	Diesel 2	21.00%	72,600	1.2446

(1) Source: COES. Estadística de Operaciones 2010. Cuadro No 4.7. Eficiencia Térmica %

(2) See table bellow

	Diesel 2	Residual	Natural Gas	Coal
EFco2 (Kg/TJ)	72,600	75,500	54,300	87,300

(*) There is no published data on thermal efficiency, information not avialable. The COES recommended using the values of the last available year, which corresponds to 2009 (Source: COES. Estadistica de Operaciones 2009. Cuadro No 4.7. Eficiencia Termica %).

(**) There is no published data on thermal efficiency, the central re-entry into commercial operation due to the emergency electrical system in the department of Cusco. The COES recommended using the values of the last available year, which corresponds to 2007 (Source: COES. Estadistica de Operaciones 2007. Cuadro No 4.7. Eficiencia Termica %).

(***) There is no published data on thermal efficiency; the central was removed from commercial operation the April 01, 2010. The COES recommended using the values of the last available year, which corresponds to 2009 (Source: COES. Estadistica de Operaciones 2009. Cuadro No 4.7. Eficiencia Termica %).

The information on the hourly generation in 2010 of all plants in the SEIN is provided by COES, presented in the spreadsheet for Grid Emission Factor calculation, which are shown in columns on a monthly basis to their grid dispatch merit order. The power units in the top of the dispatch include the units in the top 10% of total electricity dispatched in the hour *h*.

For the approximation the hourly and total generation of the activity project was considered that load factor expected is 28.4% (the estimated electricity generation is 49,680 MWh)[22] and dispatched equally during all hours of the year. This information is presented in the spreadsheet for Grid Emission Factor calculation.

The development of the equation of the Operating Margin (OM) emission factor is:

$$EF_{grid,OM-DD,y} = \frac{\sum_h EG_{PJ,h} \cdot EF_{EL,DD,h}}{EG_{PJ,y}}$$

$EF_{grid,OM-DD,y}$ = **0.7229 tCO_2/MWh**

Emission factor of the grid EF SEIN (Combined Margin)

The Emission Factor for the SEIN is:

$EF_{grid,CM,y} = EF_{grid,OM,y} xw_{OM} + EF_{grid,BM,y} xw_{BM}$ **0.7229*0.75+0.5692*0.25 = 0.6845 tCO_2/MWh**

[22] According to CSR-NREL, the solar irradiation in the area where the project is located.

Annex 4

No other information.

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