PROJECT DESIGN DOCUMENT FORM
FOR CDM PROJECT ACTIVITIES (F-CDM-PDD)
Version 04.1

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Ouarzazate I Concentrated Solar Power Project
Version number of the PDD	Version 9
Completion date of the PDD	10/12/2012
Project participant(s)	Moroccan Agency for Solar Energy (Masen)
Host Party(ies)	Morocco
Sectoral scope and selected methodology(ies)	Sectoral scope: I Methodology: ACM0002 version 13.0.0
Estimated amount of annual average GHG emission reductions	278,695 tCO_2 per year

SECTION A. Description of project activity
A.1. Purpose and general description of project activity

The Ouarzazate I Concentrated Solar Power Project (hereafter referred as Project) consists of the implementation of a framework to enable the construction of a solar power plant with an expected installed capacity of around 160MW[1]; the plant uses concentrated solar power (CSP) parabolic trough technology and includes 3 hours of thermal energy storage. The project is expected to supply around 497.5 GWh[2] per year to the Moroccan electricity grid, which is dominated by fossil fuels, thereby reducing greenhouse gas emissions through the provision of clean energy to the grid. It is expected to result in a reduction of an average of 278,695 tCO_2 per year and 2,786,950 tCO_2 over the crediting period.

The proposed project is the first stage of a 500 MW solar power complex, and represents the first step of the Solar Plan launched in 2009 by the Moroccan Government, which aims at installing at least 2,000 MW of solar generation capacity by 2020. The Solar Plan promotes the use of solar energy in Morocco, along with the development of local skills in manufacturing, construction and operation of power plants, and it supports education, research and development activities in the solar sector.

The Project contributes to sustainable development by[3]:

- Promoting the use of solar energy, a form of renewable energy which is abundant in Morocco;
- Increasing the part of renewable energy in the country's energy mix, contributing to Morocco's objective of a more secure energy supply and reduced dependency on fossil fuels (approximately 97% of Morocco's energy is imported; oil represents 61% of primary energy demand and coal 28% of the demand);
- Meeting Morocco's fast-growing electricity demand (6% per year on average since the 1990s) without compromising energy security and environmental sustainability;
- Displacing carbon intensive electricity and reducing greenhouse gas emissions;
- Promoting the development of a new green industry in Morocco, creating local jobs during the development, construction and the operation of the power plant, and encouraging training in the renewable energy field. ;
- Supporting the worldwide development of a clean technology and helping decrease the technology costs, promoting the transfer of technology, knowledge and skills to Morocco.

The scenario existing prior to the implementation of the project activity and the baseline scenario are the same, which is that electricity delivered to the Moroccan grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources.

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[1] A bidding process to select the consortium that will design, finance, build, commission, operate and maintain the power plant along with Masen is being finalised. The tender process prepared with the assistance of Masen's technical advisors WorleyParsons specified that bidders should prepare a proposal for a concentrated solar power plants with a gross capacity between 125 and 160 MW. The most likely installed capacity at the beginning of the validationwas 160 MW based on WorleyParsons opinion (Cf. WorleyParsons (2012): Memorandum). This value is therefore used in this PDD. This installed capacity was then confirmed by Masen on 24th September 2012 when it announced the winning bidder for the project.

[2] WorleyParsons (2012): Memorandum

[3] Climate Investment Funds (2011): CTF Trust Fund Committee, Joint AfDB-WB Submission Document, Morocco: Ouarzazate I Concentrated Solar Power Project, Washington

A.2. Location of project activity
A.2.1. Host Party(ies)

Morocco

A.2.2. Region/State/Province etc.

Souss Massa Draâ Region
Ouarzazate Province

A.2.3. City/Town/Community etc.

Ghessate

A.2.4. Physical/Geographical location

The Project site is located 10km south-west of Ghessate and 14km north-east of Ouarzazate City, as shown on the maps below.

The geographic coordinates of the centre of the site are 31.0083 N, 6.8643 W

The table below provides the Lambert coordinates of the site limits[4]:

Limits	X	Y	Z
North-West corner	358791.58	48423.99	1240 NGM
North-East corner	360787.69	48423.99	1231 NGM
South-East corner	361093.97	46019.26	1210 NGM
South-West corner	359332.23	46019.35	1217 NGM

The table below provides the same coordinates in geographic format (longitude and latitude) of the site limits:

[4] Apendix E of the MFS

Limits	Longitude	Latitude
North-West corner	-6,8782	31,0219
North-East corner	-6,8573	31,0218
South-East corner	-6,8538	31,0002
South-West corner	-7,0388	31,0003

Figure 1: Location of the proposed Project[5]

[5] Googlemap (2012)

Figure 2: Location of the Project site[6].

A.3. Technologies and/or measures

Technologies and measures to be employed by the project activity are described in this section[7].

1. **Technology**

In the Ouarzazate I CSP plant, electricity is generated through a multi-step process. The direct normal irradiance provided by the sun is concentrated onto a receiver tube using parabolic mirrors. A heat transfer fluid is circulated inside the receiver to collect the solar heat, which is then used to generate high pressure steam through a series of solar steam generation heat exchangers. The superheated steam is expanded through a steam turbine which in turn rotates the generator producing electricity. The steam turbine exhaust is condensed and then pressurized to complete the Rankine cycle.

2. **Plant Design Description**

The main components of the plant are as follows (also summarized in Figure 3):

[6] Prepared by Masen based on the coordinates provided in Apendix I of the MFS.
[7] Masen (2012): Ouarzazate Solar Power Complex – First Phase – Extracts from the Minimum Functional Specifications, Rabat; Burgeap – Phenixa (2011); WorleyParsons (2012)

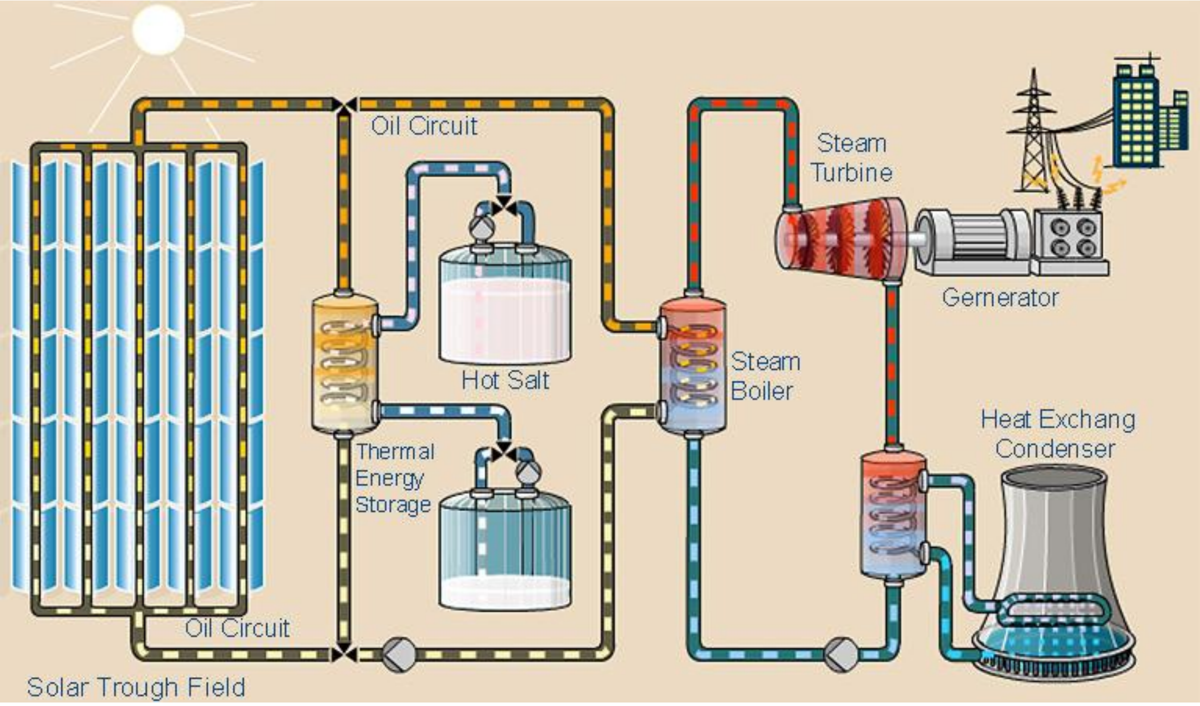


Figure 3: General design elements of Ouarzazate I CSP plant

Solar Field

The collector field is made up of multiple single-axis-tracking parabolic trough solar collectors aligned on a north-south axis. Each system of parabola will be composed by four monolithic parabolic mirrors, two inner symmetrical ones and two outer symmetrical ones. All mirrors will be constructed of low iron glass with a silver reflective backing. The receiver system of each module consist of a steel inner tube that conveys the heat transfer fluid encased by a glass outer tube used to maintain a vacuum space to minimize receiver heat losses. Metallic getters are installed in this vacuum space to absorb hydrogen that if present would increase heat losses. Linking of the steel inner tube and glass envelope is done using flexible bellows to account for differences in thermal expansion. A coating is applied to the steel tube to maximize solar absorptance.

Heat Transfer Fluid (HTF)

The HTF is a high-temperature synthetic oil that is commonly used in operating CSP trough plants and other heat transfer processes. It has a maximum operating temperature of about 400°C and a freezing temperature of about 12°C.

Thermal Storage System (TES)

The TES is dimensioned to provide thermal storage capacity to support turbine operation from storage equivalent to 3 full load hours. During the day, the HTF is used to heat molten salts, which are a binary salt mixture of sodium nitrate ($NaNO_3$) and potassium nitrate (KNO_3). The heat stored in the molten salts is recovered to be used to operate the turbine-generator unit and generate electricity after sunset.

Solar Steam Generator and Steam Turbine System

The solar steam generator transfers solar energy from the HTF to feedwater, generating steam used in a traditional reheat Rankine cycle for electricity generation.

The turbine consists of high-pressure (HP) turbine and low pressure (LP) turbine constructed of alloy cast steel.

Cooling System

A wet cooling system consisting of a cooling tower and a condenser designed for the design ambient wet bulb temperature and humidity will be used for condensation of the steam. The cooling tower will be of an induced flow type.

Electrical System

The electrical systems will consist of a generator with step-up transformer, an auxiliary supply for the power block, a distribution system for the solar field, and a transmission tie line with an interconnecting substation.

Auxiliary Heater/Boiler

The plant will be provided with at least 2 auxiliary heaters: HTF heaters for HTF freeze protection and auxiliary boiler(s) for gland seal steam during plant start-up, running on diesel. Diesel will be used as an auxiliary fuel only and not for generation of power for the grid. According to the Minimum Functional Specification (MFS)[8] the bidder shall have the option to install auxiliary systems using fossil fuel. However, power shall be generated exclusively from solar energy.

The power plant will be connected to the ONE grid at a 225 kV substation owned by ONE. The quantity of net electricity generation supplied by the Project to the grid will be metered by electricity meters. Further details are provided in section B.7 of the PDD.

Framework

The role of Moroccan Agency for Solar Energy (Masen) is to facilitate the implementation of CSP technology, by:

- providing the land necessary to install CSP plants;
- negotiating with the IPP an electricity tariff which is higher than the electricity tariffs typically available to power producers in Morocco;
- providing financing support through concessional loans that the Masen has negotiated with the World Bank, the African Development Bank and other international financial institutions; acting as lender to the IPP.

A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Morocco	Moroccan Agency for Solar Energy (Masen)	No

A.5. Public funding of project activity

The following entities are providing funding to the proposed project:

- Clean Technology Funds (CTF)

[8] The MFS provides the minimum technical specifications for the project to the bidders submitting technical offers to the project.

- World Bank
- African Development Bank (AfDB)
- Agence Française de Développement (AFD)
- European Investment Bank (EIB)
- Kreditanstalt fur Wiederaufbau (KfW)
- Neighbourhood Investment Facility (NIF)

None of these funding entities will buy CERs generated by the Project as a counterpart to their financing obligations with respect to the proposed project. As a result it can be concluded that such funding does not result in a diversion of official development assistance and is separate from and is not counted towards the financial obligations of those Parties.

SECTION B. Application of selected approved baseline and monitoring methodology

B.1. Reference of methodology

The following baseline and monitoring methodology is applied to the proposed project:
- ACM0002 Consolidated baseline methodology for grid-connected electricity generation from renewable sources, version 13.0.0

The following tools are applied to the proposed project:
- Tool to calculate the emission factor for an electricity system, version 2.2.1
- Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion, version 2
- Tool for the demonstration and assessment of additionality, version 6.0.0

B.2. Applicability of methodology

ACM0002 version 13.0.0 is applicable to the proposed project, as shown in the table below.

Criteria	**Are the criteria met?**	**Justification**
This methodology is applicable to grid-connected renewable power generation project activities that (a) install a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant); (b) involve a capacity addition; (c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of (an) existing plant(s).	Yes	The proposed project activity is a new solar power plant installed at a site where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant), and it is connected to the Moroccan grid.
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.	Yes	The project activity is the installation of a solar power plant.
In the case of capacity additions, retrofits or replacements specific conditions apply.	Not applicable	The Project is a new power plant and therefore does not include any capacity addition, retrofit or replacement.
In case of hydro power plants, conditions linked to reservoirs apply.	Not applicable	The Project is a new solar power plant, which is not a hydropower

		plant.
In case of hydro power plants using multiple reservoirs where the power density of any of the reservoirs is lower than 4 W/m^2 after the implementation of the project activity specific conditions apply.	Not applicable	The Project is a new solar power plant, which is not a hydropower plant.
The methodology is not applicable to the following: • 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; • Biomass fired power plants; • A hydro power plant that results in the creation of a new single reservoir or in the increase in an existing single reservoir where the power density of the reservoir is less than 4 W/m^2.	Not applicable	The Project is a new solar power plant, which does not involve fuel switch, which is not a biomass fired power plant, and which is not a hydropower plant.

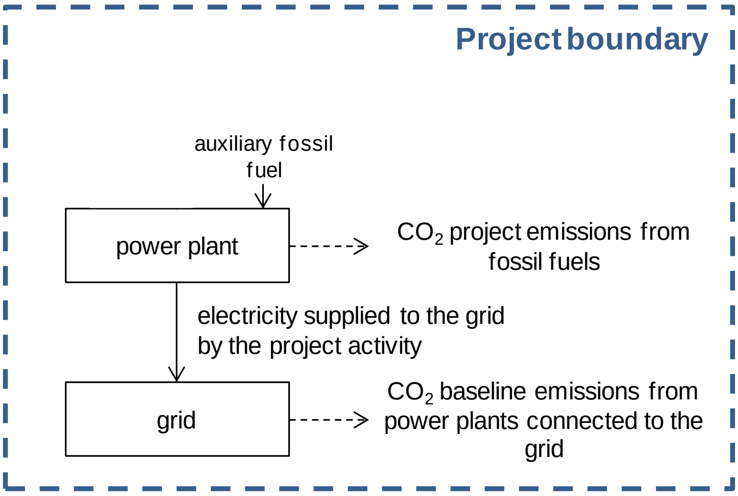
The "*Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion*" (version 02) is applicable in cases where CO_2 emissions from fossil fuel combustion are calculated based on the quantity of fuel combusted and its properties. The Project will use diesel for auxiliary systems and therefore the tool applies for the Project.

The "*Tool to calculate the emission factor for an electricity system"* (version 2.2.1) is applied to calculate baseline emissions for a project activity that substitutes grid electricity. Under this tool, the emission factor for the project electricity system can be calculated either for grid power plants only or, as an option, can include off-grid power plants. In the latter case, there are specific conditions that should be met. Since the electricity system affected by the proposed project activity includes only grid connected power plants, no specific conditions applies. The tool is not applicable if the project electricity system is located partially or totally in an Annex-I country. The Project will deliver electricity to the Moroccan grid system that is operated by ONE, and this system is not located partially or totally in any Annex I country, therefore, the tool is applicable to this particular project activity.

The *"Tool for the demonstration and assessment of additionality*", version 6.0.0 is applicable whenever required by the methodology. Given ACM0002 is applicable to the Project, the tool is as well.

B.3. Project boundary

Source		GHG	Included?	Justification/Explanation
Baseline scenario	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project scenario	CO_2 emissions from combustion of fossil fuels for electricity generation in solar thermal power plants	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source



B.4. Establishment and description of baseline scenario

Since the proposed Project involves the installation of a new grid-connected solar power plant, according to ACM0002 version 13.0.0 the baseline scenario is the following: the electricity delivered to the Moroccan grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system", version 2.2.1.

B.5. Demonstration of additionality

In accordance with ACM0002 version 13.0.0, the additionality of the project activity is demonstrated using the latest version of the "Tool for the demonstration and assessment of additionality", version 6.0.0.

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

Sub-step 1a: Define alternatives to the project activity
As per paragraph 4 of the "Tool for the demonstration and assessment of additionality" version 6.0.0, project activities that apply this tool in context of approved consolidated methodology ACM0002 only need to identify that there is at least one credible and feasible alternative that would be more attractive than the proposed project activity.

The following realistic and credible alternatives are identified:
Alternative 1: The proposed project activity without the CDM, i.e. the construction of a new grid-connected solar power plant with an installed capacity of around 160 MW, implemented without considering CDM revenues.
Alternative 2: Continuation of the current situation, i.e. electricity continues to be generated by the operation of grid-connected power plants.

Sub-step 1b: Consistency with mandatory laws and regulations
A renewable law 13-09 was approved in 2010. It provides a legal framework for the creation and operation of facilities producing electricity from renewable energy sources. It allows private companies to produce electricity from renewable energy and transmit it through the electricity transmission system operated by ONE, the publicly owned utility, to their local (or foreign in the future) customers. Masen was set up by the Moroccan Government to implement the Solar Plan it launched in 2009[9]. Masen is allowed by law 57-09 to produce electricity and sell it locally or export it through the transmission system operated by ONE.
Nevertheless, neither laws 13-09 and 57-09 nor any other law in Morocco compels the project developer to develop any specific kind of energy source or project, or forbids the project developer to develop a solar power plant. Therefore, both alternatives are in compliance with all mandatory applicable laws and regulatory requirements.
Please note the framework for Ouarzazate I CSP was the first framework for IPPs to implement CSP in Morocco and no other entities have been indicated and defined by the Moroccan government before/after Masen to establish a framework for Solar Energy or to develop Solar Power Plants

Step 2: Investment analysis
This step is not applied.

Step 3: Barrier analysis

Sub-step 3a: Identify barriers that would prevent the implementation of the proposed CDM project activity
The proposed project activity would not be implemented if it was not registered as a CDM activity because of barriers due to the project being the "first of its kind".

As per the "Tool for the demonstration and assessment of additionality" version 6.0.0, the applicable geographical area covers the entire host country if it can be proven that the technology applied in the project is country specific. The criteria that influence the design of solar technology will vary significantly based on national policies, incentives and geographical differences in the availability of the resource[10].

[9] Climate Investment Funds (2011)
[10] http://www.nrel.gov/docs/fy07osti/40116.pdf

Compared to other countries in the world Morocco has very limited natural oil reserves[11] and is one of the largest energy importers with 96 per cent of its energy needs being sourced externally[12]. In order to reduce its dependence from energy imports, meet the country's increasing energy demand (expected to double by 2020 and to quadruple by 2030) and fulfil its will to protect the environment, in the recent years the Moroccan Government has made significant efforts to strengthen the legal and regulatory framework in order to facilitate the development of the renewable energy sector in the country. The new national energy strategy seeks to increase the contribution of renewable energies to the country's installed power capacities, the goal being to bring that contribution to 42% by 2020, equally distributed among hydropower, wind-power and solar-power. The Moroccan Solar Plan, which is part of this strategy aims to develop at least 2000 MW solar capacity by 2020.

The mission to develop the Moroccan Solar Power Program was entrusted to the Moroccan Agency for Solar Energy (Masen), a Joint Stock Company, established in March 2010 under law 57-09.

The first phase of the framework described in law 57-09 include the development of an appropriate project framework to enable an IPP to implement a solar CSP project (please refer to Article 2, item 7 of the law 57-09).

Such framework is unique and Masen is the only government entity entitled to develop the Moroccan Solar Plan including the CSP technology in Ouarzazate. Therefore the framework for the Ouarzazate I CSP Project can be considered the "first of its kind" in line with the "Tool for the demonstration and assessment of additionality".

Please note that before the creation of Masen, the generation, transmission and distribution of electricity was controlled by ONEE and no CSP solar power project were developed by them as previously demonstrated. Therefore, the framework for Ouarzazate I CSP was the first framework for IPPs to implement CSP in Morocco

In order to select the technology of the solar power projects, Masen has been working jointly with ONE (as a grid operator) in order to define the most appropriate solar technology for the country.

During this process, Masen was assisted by a technical advisor, named Worley Parsons, who has developed a specific methodology based on the analysis of the Moroccan hourly demand curves, and more specifically on the coverage of peak demand to define the most appropriate solar technologies[13].

The coordinated work between Masen, ONE and the technical consultant demonstrated that a stand-alone solar thermal power plant technology coupled with thermal storage can contribute effectively to provide peak load and replace electricity fired by imported fuel oil and diesel.

In other countries of the region that have a high availability of domestic fossil fuel, solar thermal power would usually be coupled to a gas power plant (like Kuraymat plant in Egypt, which operates as combined cycle gas power plant during the night) or operate without thermal storage (like Shams plant in Abu Dhabi). Both forms of technology are substantially different from the technology applied in the Ouarzazate project both in terms of power plant configuration as well as operational cost.
In the context of FOIK, the additionality tool define different technologies are technologies that deliver the same output and differ by Energy source/fuel, Feed stock or Size of installation.

[11] 680,000 bbl as per January 2011, see https://www.cia.gov/library/publications/the-world-factbook/geos/mo.html
[12] http://data.worldbank.org/indicator/EG.IMP.CONS.ZS?order=wbapi_data_value_2010+wbapi_data_value+wbapi_data_value-last&sort=asc
[13] Technical Summary Report Ouarzazate SPP projet (section 5)

The project consists of a 160MW CSP plant, therefore solar power plants with installed capacity above 15MW should be considered to apply the same technology as the project activity in the scope of the FoiK analysis.
Based on information publically available on ONE's website, there are no other solar power plants with installed capacity above 15MW operating in Morroco.
Based on the above, there are no other plants which use technology similar to the technology used in the proposed project and the project can be deemed to be the first of its kind.

Since:

- The Project is the first in the applicable geographical area that applies a technology that is different from any other technologies able to deliver the same output and that have started commercial operation in the applicable geographical area before the start date of the project; and
- The Project is covered in paragraph 6.(b) of the "Tool for the demonstration and assessment of additionality" version 6.0.0; and
- Project participants selected a crediting period for the project activity that is a maximum of 10 years with no option of renewal,

then, as per paragraph 40.2 (a) of the "Tool for the demonstration and assessment of additionality" version 6.0.0, the proposed project activity is deemed the first of its kind.

Sub-step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity)
Not applicable, since the proposed project is the first-of-its-kind and the measure applied is listed in paragraph 6 of the "Tool for the demonstration and assessment of additionality" version 6.0.0.

Step 4: Common practice analysis

Not applicable, since the proposed project is the first-of-its-kind and the measure applied is listed in paragraph 6 of the "Tool for the demonstration and assessment of additionality" version 6.0.0.

Based on the analysis above, the proposed project activity is deemed additional.

B.6. Emission reductions
B.6.1. Explanation of methodological choices

Project emissions
Since fossil fuel (diesel) is used for auxiliary processes, project emissions are calculated as follows, in accordance with ACM0002 version 13.0.0:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$$

Where:

PE_y	Project emissions in year y (tCO_2)
$PE_{FF,y}$	Project emissions from fossil fuel consumption in year y (tCO_2)
$PE_{GP,y}$	Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year y (tCO_2 e/yr)
$PE_{HP,y}$	Project emissions from water reservoirs of hydro power plants in year y (tCO_2 e/yr)

The project does not involve geothermal power plants or water reservoir of hydro power plants, therefore:

$$PE_y = PE_{FF,y}$$

Calculation of $PE_{FF,y}$
$PE_{FF,y}$ are calculated as per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" version 2 as follows:

$$PE_{FF,y} = \sum_i FC_{i,j,y} \times COEF_{i,y}$$

Where:

$FC_{i.j.y}$	Quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr)
$COEF_{i,y}$	CO_2 emission coefficient of fuel type i in year y (tCO_2/mass or volume unit)
i	Fuel types combusted in process j during the year y

Since data to calculate $COEF_{i,y}$ using option A is not available, option B of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" version 2 is used.

Option B: $COEF_{i,y}$ is calculated based on net calorific value and CO_2 emission factor of the fuel type i, as follows:

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y}$$

Where:

$NCV_{C,i.y}$	Weighted average net calorific value of the fuel type i in year y (GJ/mass or volume unit)
$EF_{CO2,i,y}$	Weighted average CO_2 emission factor of fuel type i in year y (tCO_2/GJ)

Baseline emissions
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. In accordance with the methodology, the baseline emissions are to be calculated as follows:

$$BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y}$$

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)
$EF_{grid,CM,y}$	Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the "Tool to calculate the emission factor for an electricity system" version 2.2.1 (tCO_2/MWh)

Calculation of $EG_{PJ,y}$

Since the project activity is the installation of a new grid-connected renewable power plant at a site where no renewable power plant was operated prior to the implementation of the project activity, i.e. it is a greenfield power plant, $EG_{PJ,y}$ is calculated as follows:

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

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

$EG_{facility,y}$ is the quantity of net electricity generation supplied by the project plant to the grid. It is determined as a difference between the quantity of electricity supplied by the project plant to the grid and the quantity of electricity delivered to the project plant from the grid.

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

The grid emission factor is calculated based on data provided by ONE in accordance with the "Tool to calculate the emission factor for an electricity system" version 2.2.1.

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

Step 1: Identify the relevant electricity systems

The relevant project electricity system is the grid owned by the state power utility Office National d'Electricité (ONE), to which the proposed project is connected. As a public utility ONE has the monopoly of electricity transport and it manages the unique national grid in Morocco. It includes power plants connected by 18,920 km of 400 kV, 225 kV, 150 kV and 60 kV lines. It covers the entire country and is connected to the Algerian and Spanish power grids via regional links. The capacity of the connection between Morocco and Spain is 1,400 MW via two 400 kV sub-sea cables, between Algeria and Morocco there is a 1,200 MW connection via three 400 kV lines. ONE imports electricity from these two connected electricity systems. For the purpose of determining the operating margin emission factor, the CO_2 emission factor(s) for net electricity imports from these two systems is considered 0 tCO_2/MWh.

Step 2. Choose whether to include off-grid power plants in the project electricity system (optional)
Project participants choose Option I: Only grid power plants are included in the calculation.

Step 3. Select a method to determine the operating margin (OM)
The “Tool to calculate the emission factor for an electricity system” version 2.2.1 offers four methods to calculate the operating margin emission factor ($EF_{grid,OM,y}$). Of those, the simple OM method (Option a) can only be used if low-cost/must-run (LC/MR) resources constitute less than 50% of total grid generation in:

1. Average of the five most recent years, or
2. Based on long-term averages for hydroelectricity production.

The table below provides the average share of LC/MR resources in Morocco for the past five years (based on the most recent data available):

	Power generation (GWh)[14]			
Yea r	Hydro	Wind	Total	Average share of LC/MR
2011	2,139	692	28,900	10%
2010	3,631	659	26,731	16%
2009	2,952	391	25,508	13%
2008	1,360	298	24,563	7%
2007	1,318	279	23,177	7%
Average over 5 years:				**10.5%**

As shown in the table, LC/MR run resources constituted less than 50% of total grid generation in the five most recent years. The simple OM method (Option a) is therefore selected for the calculation of $EF_{grid,OM,y}$.

$EF_{grid,OM,y}$ is calculated *ex-ante*, using a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation (2009, 2010, 2011).

Step 4. Calculate the operating margin emission factor according to the selected method
The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including LC/MR power plants / units, for the years 2009, 2010 and 2011.

The simple OM may be calculated using one of the following two options:

- Option A: Based on the net electricity generation and a CO_2 emission factor of each power unit; or
- Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

Since data of fuel consumption and net electricity generation of each power plant / unit is available, Option A is selected. Under this option, the simple OM emission factor is calculated based on the net electricity generation of each power unit and an emission factor for each power unit, as follows:

[14] Based on ONE, per personal meeting/email, 02.03.2012 and ONE BILAN DES ACTIVITES - Industrielles et commerciales 2006-2011, available at http://www.one.org.ma/FR/pages/interne.asp?esp=2&id1=10&id2=75&t2=1

$$EF_{grid,OMsimple,y} = \frac{\sum_{i,m} EG_{m,y} \cdot EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

Where:

$EF_{grid,OMsimple,y}$	Simple operating 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	All power units serving the grid in year y except low-cost / must-run power units
y	The years 2009 to 2011

The emission factor of each power unit is determined as per Option A.1 since fuel consumption and electricity generation is available per power unit *m*:

$$EF_{EL,m,y} = \frac{\sum_{i,m} FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{EG_{m,y}}$$

Where:

$EF_{EL,m,y}$	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$FC_{i,m,y}$	Amount of fossil fuel type *i* consumed by power unit *m* in year *y* (Mass or volume unit)
$NCV_{i,y}$	Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
m	All power units serving the grid in year *y* except low-cost/must-run power units
i	All fossil fuel types combusted in power unit *m* in year *y*
y	The years 2009to2011

The amount of fossil fuel consumed by power unit and the net quantity of electricity generated and delivered to the grid by power unit have been provided by ONE. The net calorific values are based on national average and have been provided by ONE. The CO_2 emission factor of each fossil fuel is based on IPCC default values.

Imports from Algeria and Spain are taken into account using an emission factor of 0 tCO_2/MWh.

The Operating Margin emission factors for 2009, 2010 and 2011 are presented in the table below. $EF_{grid,OMsimple,y}$ is calculated as the 3-year generation-weighted average. Details of the calculation are provided in Appendix 4.

Year	**Operating Margin emission factor (tCO_2/MWh)**	**Power generation excluding LC/MR and including imports (MWh)**
2009	0.603	22,164,605
2010	0.647	22,441,932
2011	0.637	26,069,018
$EF_{grid,OMsimple,y}$	0.630	

Step 5. Calculate the build margin (BM) emission factor

Of the two options available for choice of the vintage of data, Option 1(the build margin emission factor is calculated based on the most recent information on available units already built for sample group m at the time of CDM-PDD submission to the DOE for validation) is chosen.

The sample group of power units m used to calculate the build margin is determined following the step-wise procedure provided in the "Tool to calculate the emission factor for an electricity system" version 2.2.1, consistent with the data vintage selected above.

Set of power units	Annual electricity generation in 2011 (MWh)[15]
AEG_{total}	23,540,405
$AEG_{SET\text{-}5\text{-}units}$	3,224,291
$AEG_{SET\text{-}\geq 20\%}$	5,580,031

The set of capacity additions in the electricity system that comprises 20% of the system generation comprises an annual generated larger than the set of five power units that have been built the most recently, $AEG_{SET\text{-}\geq 20\%} > AEG_{SET\text{-}5\text{-}units}$. Therefore $SET_{\text{-}\geq 20\%}$ is defined as SET_{sample}. None of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, so SET_{sample} is used to calculate the build margin.

Appendix 4 provides details of the power plant capacity additions to the electricity system that comprise 20% of the system generation ($SET_{\text{-}\geq 20\%}$).

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 power generation data is available (2011), calculated as follows:

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

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	2011

The CO_2 emission factor of each power unit m ($EF_{EL,m,y}$) is determined as per the guidance in step 4 (a) of the "Tool to calculate the emission factor for an electricity system" version 2.2.1 for the simple OM, applying option A.1, using the year 2011 for y, and using for m the power units included in the build margin.

The build margin emissions factor is calculated as $EF_{grid,BM,y} = 0.450\ tCO_2/MWh$.

Step 6. Calculate the combined margin emissions factor
The combined margin (CM) emission factor ($EF_{grid,CM,y}$) can be calculated using one of the following two methods:
(a) Weighted average CM; or

[15] Based on ONE, per personal meeting/email, 02.03.2012 and ONE BILAN DES ACTIVITES - Industrielles et commerciales 2006-2011, available at http://www.one.org.ma/FR/pages/interne.asp?esp=2&id1=10&id2=75&t2=1

(b) Simplified CM.

Option a) is chosen and $EF_{grid,CM,y}$ is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid.BM,y} \times w_{BM}$$

Where:

w_{OM}	Weighting of operating margin emissions factor (%)
w_{BM}	Weighting of build margin emissions factor (%)

In accordance with the guidance provided by the "Tool to calculate the emission factor for an electricity system" version 2.2.1, for solar power generation project activities: w_{OM} = 0.75 and w_{BM} = 0.25 for the first crediting period and for subsequent crediting periods. Therefore,

$EF_{grid,CM,y}$ = 0.630 * 0.75 + 0.450 * 0.25
= 0.585 tCO_2/MWh

Leakage emissions
As per ACM0002, no leakage emissions are considered.
Therefore, $L_y = 0$

Emission reductions
Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - L_y$$

Where:

ER_y	Emission reductions in year y (tCO_2e)
$BE_{,y}$	Baseline emissions in year y (tCO_2e)
$PE_{,y}$	Project emissions in year y (tCO_2e)
$L_{,y}$	Leakage in year y (tCO_2e)

B.6.2. Data and parameters fixed ex ante

Data / Parameter	$\boldsymbol{EF_{grid,CM,y}}$
Unit	tCO_2/MWh
Description	Combined margin emission factor
Source of data	National power utility (ONE), IPCC
Value(s) applied	0.585
Choice of data or Measurement methods and procedures	Official statistics released by the national power utility (ONE), reliable data source, latest data available (2009, 2010, 2011) 2006 IPCC Guidelines on National GHG Inventories default values
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EF_{grid,OM,y}$
Unit	tCO_2/MWh
Description	Operating margin emission factor
Source of data	National power utility (ONE), IPCC
Value(s) applied	0.630
Choice of data or Measurement methods and procedures	Official statistics released by the national power utility (ONE), reliable data source, latest data available (2009, 2010, 2011) 2006 IPCC Guidelines on National GHG Inventories default values
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EF_{grid,BM,y}$
Unit	tCO_2/MWh
Description	Build margin emission factor
Source of data	National power utility (ONE), IPCC
Value(s) applied	0.450
Choice of data or Measurement methods and procedures	Official statistics released by the national power utility (ONE), reliable data source, latest data available (2009, 2010, 2011) 2006 IPCC Guidelines on National GHG Inventories default values
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$FC_{i,m,y}$
Unit	Tonnes (solid fuels); m^3 (gaseous fuel)
Description	Amount of fossil fuel type i consumed by power plant / unit m in year y
Source of data	National power utility (ONE)
Value(s) applied	See Appendix 4
Choice of data or Measurement methods and procedures	Official statistics released by the national power utility (ONE), reliable data source, latest data available (2009, 2010, 2011) 2006 IPCC Guidelines on National GHG Inventories default values
Purpose of data	Calculation of baseline emissions
Additional comment	OM: values for the years 2009-2011 BM: values for the year 2011

Data / Parameter	***$NCV_{i,y}$***
Unit	GJ/mass or volume unit
Description	Net calorific value of fossil fuel type i in year y
Source of data	National power utility (ONE) where available Default values from 2006 IPCC Guidelines if ONE data is not available
Value(s) applied	See Appendix 4
Choice of data or Measurement methods and procedures	According to the “Tool to calculate the emission factor for an electricity system” version 2.2.1, the national average default value shall be used if values are reliable and documented in regional or national energy statistics / energy balances. Otherwise IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories shall be used.
Purpose of data	Calculation of baseline emissions
Additional comment	OM: values for the years 2009-2011 BM: value for the year 2011.

Data / Parameter	***$EF_{CO2,i,y}$***
Unit	tCO_2/GJ
Description	CO_2 emission factor of fossil fuel type i in year y
Source of data	National power utility (ONE) where available Default values from 2006 IPCC Guidelines if ONE data is not available
Value(s) applied	See Appendix 4
Choice of data or Measurement methods and procedures	Default values from 2006 IPCC Guidelines if ONE data is not available
Purpose of data	Calculation of baseline emissions
Additional comment	OM: values for the years 2009-2011 BM: value for the year 2011

Data / Parameter	***$EG_{m,y}$***
Unit	MWh
Description	Net quantity of electricity generated by power plant/unit m in year y
Source of data	National power utility (ONE)
Value(s) applied	See Appendix 4
Choice of data or Measurement methods and procedures	Official statistics released by the national power utility (ONE), reliable data source, latest data available (2011)
Purpose of data	Calculation of baseline emissions
Additional comment	OM: values for the years 2009-2011 BM: value for the year 2011

B.6.3. Ex ante calculation of emission reductions

Ex-ante calculations of emission reductions are presented below. Sources for each parameter are given in sections B.6.2 and B.6.4. If only one value is given for a parameter, this means that the value of the parameter is constant throughout the crediting period.

Project emissions

$$PE_y = PE_{FF,y}$$

Parameter	Value
$PE_y = PE_{FF,y}$	10,995 tCO_2/y

$$PE_{FF,y} = \sum_i FC_{i,j,y} \times COEF_{i,y}$$

Parameter	Value
$PE_{FF,y}$	10,995 tCO_2/y
$FC_{i,j,y}$	3,395 tonnes diesel/y
$COEF_{i,y}$	3.24 tCO_2/t

Option B:

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y}$$

Parameter	Value
$COEF_{i,y}$	3.24 tCO_2/t
$NCV_{C,i.y}$	43.3 GJ/t
$EF_{CO2,i,y}$	0.0748 tCO_2/GJ

Baseline emissions

$$BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y}$$

Parameter	$EG_{PJ,y}$ MWh	$EF_{grid,CM,y}$ tCO_2/MWh	$BE_{,y}$ tCO_2/y
2015	497,429	0.585	290,996
2016	496,931		290,705
2017	496,434		290,414
2018	495,938		290,124
2019	495,442		289,834
2020	494,946		289,543
2021	494,451		289,254
2022	493,957		288,965
2023	493,463		288,676
2024	492,970		288,387

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

Parameter	$EG_{PJ,y} = EG_{facility,y}$ MWh
2015	497,429
2016	496,931
2017	496,434
2018	495,938
2019	495,442
2020	494,946
2021	494,451
2022	493,957
2023	493,463
2024	492,970

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid.BM,y} \times w_{BM}$$

Parameter	Value
$EF_{grid,CM,y}$	0.585 tCO_2/MWh
$EF_{grid,OM,y}$	0.630 tCO_2/MWh
$w_{OM,y}$	0.75
$EF_{grid,BM,y}$	0.450 tCO_2/MWh
$w_{BM,y}$	0.25

Leakage

$$L_y = 0$$

Parameter	Value
L_y	0

Emission reductions

$$ER_y = BE_y - PE_y - L_y$$

Parameter	$BE_{,y}$ tCO_2/y	PE_y tCO_2/y	L_y tCO_2/y	ER_y tCO_2/y
2015	290,996	10,995	0	280,001
2016	290,705	10,995	0	279,710
2017	290,414	10,995	0	279,419
2018	290,124	10,995	0	279,129
2019	289,834	10,995	0	278,839
2020	289,543	10,995	0	278,549
2021	289,254	10,995	0	278,259
2022	288,965	10,995	0	277,970
2023	288,676	10,995	0	277,681
2024	288,387	10,995	0	277,393

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (tCO_2e)	Project emissions (tCO_2e)	Leakage (tCO_2e)	Emission reductions (tCO_2e)
2015	290,996	10,995	0	280,001
2016	290,705	10,995	0	279,710
2017	290,414	10,995	0	279,419
2018	290,124	10,995	0	279,129
2019	289,834	10,995	0	278,839
2020	289,543	10,995	0	278,549
2021	289,254	10,995	0	278,259
2022	288,965	10,995	0	277,970
2023	288,676	10,995	0	277,681
2024	288,387	10,995	0	277,393
Total	2,896,898	109,950	0	2,786,950
Total number of crediting years	10			
Annual average over the crediting period	289,690	10,995	0	278,695

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	$EG_{facility,j,y}$
Unit	MWh
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y*
Source of data	Electricity meter(s)
Value(s) applied	2015: 497,429 2016: 496,931 2017: 496,434 2018: 495,938 2019: 495,442 2020: 494,946 2021: 494,451 2022: 493,957 2023: 493,463 2024: 492,970
Measurement methods and procedures	Bi-directional electricity meters, which will measure the quantity of electricity supplied by the project plant to the grid and the quantity of electricity delivered to the project plant from the grid.
Monitoring frequency	Continuous measurement and at least monthly recording
QA/QC procedures	Measurements from the CDM meter will be cross checked with records for sold electricity periodically. The accuracy of the meters will be 0.2 %. In case of failure of the CDM meter used for reporting and transaction purposes, check meter(s) can be used. The maintenance and calibration regime will follow the requirements defined in the PPA. The electricity meter should meet the standards specified by the International Electrotechnical Commission (IEC). The calibration interval will be one hundred and eighty 180 days..
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$FC_{i,j,y}$
Unit	tonnes/y or m^3/y
Description	Quantity of fuel type i combusted in process j during the year y
Source of data	Onsite measurements
Value(s) applied	3,395 tonnes/y
Measurement methods and procedures	Mass or volume meters
Monitoring frequency	Continuously and at least quarterly recording
QA/QC procedures	The consistency of metered fuel consumption quantities should be cross-checked by an annual mass balance that is based on purchased quantities and stock changes. Metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records if appropriate. Meters should be installed, maintained and calibrated according to equipment manufacturer instructions..
Purpose of data	Calculation of project emissions
Additional comment	-

<table>
<tr><td>Data / Parameter</td><td>$NCV_{i,y}$</td></tr>
<tr><td>Unit</td><td>GJ/t</td></tr>
<tr><td>Description</td><td>Weighted average net calorific value of fuel type i in year y</td></tr>
<tr><td>Source of data</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><th>Data source</th><th>Conditions for using the data source</th></tr>
<tr><td>a) Values provided by the fuel supplier in invoices</td><td>This is the preferred option.</td></tr>
<tr><td>b) Regional or national default values</td><td>If a) is not available
These sources should be based on well-documented, reliable sources (such as energy balances)</td></tr>
<tr><td>c) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If a) is not available</td></tr>
</table></td></tr>
<tr><td>Value(s) applied</td><td>43.3 (IPCC default value)</td></tr>
<tr><td>Measurement methods and procedures</td><td>For a): Measurements should be undertaken in line with national or international fuel standards</td></tr>
<tr><td>Monitoring frequency</td><td>For a): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated
For b): Review appropriateness of the values annually
For c): Any future revision of the IPCC Guidelines should be taken into account</td></tr>
<tr><td>QA/QC procedures</td><td>Verify if the values under a) and b) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a) and b) should have ISO17025 accreditation or justify that they can comply with similar quality standards.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of project emissions</td></tr>
<tr><td>Additional comment</td><td>Applicable since Option B is used</td></tr>
</table>

<table>
<tr><td>Data / Parameter</td><td>$EF_{CO2,i,y}$</td></tr>
<tr><td>Unit</td><td>tCO_2/GJ</td></tr>
<tr><td>Description</td><td>Weighted average CO_2 emission factor of fuel type i in year y</td></tr>
<tr><td>Source of data</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><td>Data source</td><td>Conditions for using the data source</td></tr>
<tr><td>a) Values provided by the fuel supplier in invoices</td><td>This is the preferred option</td></tr>
<tr><td>b) Regional or national default values</td><td>If a) is not available
These sources should be based on well-documented, reliable sources (such as energy balances)</td></tr>
<tr><td>c) IPCC default values at the upper 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</td><td>If a) is not available</td></tr>
</table></td></tr>
<tr><td>Value(s) applied</td><td>0.0748 (IPCC default value)</td></tr>
<tr><td>Measurement methods and procedures</td><td>For a): Measurements should be undertaken in line with national or international fuel standards</td></tr>
<tr><td>Monitoring frequency</td><td>For a): The CO_2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated.
For b): Review appropriateness of the values annually
For c): Any future revision of the IPCC Guidelines should be taken into account</td></tr>
<tr><td>QA/QC procedures</td><td>Values used in the calculations will be cross checked against appropriate source during the verification of the Project.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of project emissions</td></tr>
<tr><td>Additional comment</td><td>Applicable since option B is used.
For a): If the fuel supplier does provide the NCV value and the CO_2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, Options b) or c) should be used.</td></tr>
</table>

B.7.2. Sampling plan
Not applicable

None of the data and parameters included in section B.7.1 is determined by a sampling approach – they are all monitored.

B.7.3. Other elements of monitoring plan

1. Monitoring organisation

Roles and responsibilities of the relevant staff involved in CDM monitoring will be in place at the start of the crediting period of the project activity.

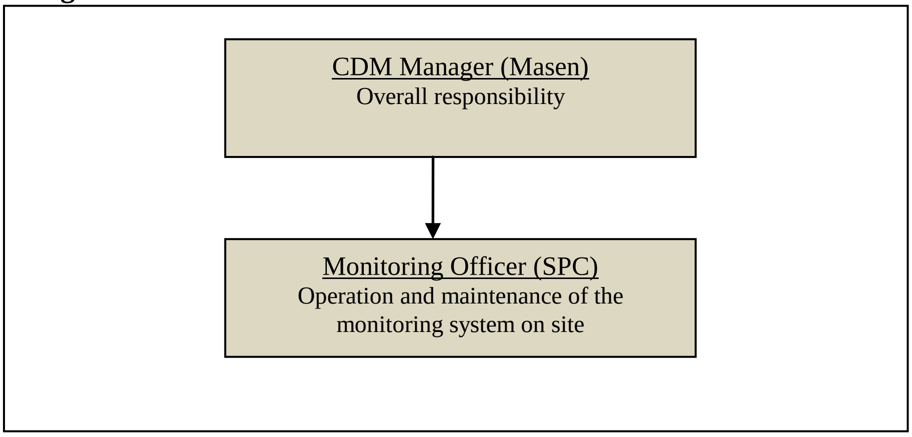
Masen will hold the overall responsibility for the monitoring system on this project and will assign this responsibility to a member of its staff ("CDM Manager").

The Solar Project Company (SPC) selected to design, finance, build, commission, operate and maintain the power plant will be responsible for the operation and maintenance of all the monitoring equipment on site, except for the CDM electricity meter that will be operated, maintained and calibrated by ONE, with the presence of Masen.

A formal set of monitoring procedures will be defined and established prior to the start of the project. These procedures will detail the organisation, control and steps required for certain key monitoring system features, and include:

(a) CDM staff training
(b) CDM data and record keeping arrangements
(c) Data collection
(d) CDM data quality control and quality assurance
(e) Equipment maintenance
(f) Equipment calibration
(g) Procedures in case of equipment failure.

Figure B.2 Management structure in order to monitor emission reductions



2. Staff training

Training will be conducted to ensure Masen's staff involved in monitoring activities is capable of performing their designated tasks to high standards. This will include CDM specific training to ensure that they understand the importance of complete and accurate data and records for CDM monitoring.

3. Monitoring equipment

Electricity meter(s) will measure the quantity of net electricity generation supplied by the power plant to the grid.
The electricity meters' accuracy shall be within 0.2%. The maintenance and calibration regime will follow the relevant standards and/or the manufacturer's specifications.

The CDM electricity meter corresponds to the one used for transaction purposes. In case of CDM meter(s) failure, check meter(s) can be used to estimate the quantity of net electricity generation supplied by the power plant to the grid.

Mass or volume meters may be installed to monitor the consumption of fossil fuel. Meters should be installed, maintained and calibrated according to equipment manufacturer instructions if applicable.

3. Monitoring data

The requirements for the electricity supply measurement are detailed in the power purchase agreement between Masen and the SPC. Data measured by meters will be double-checked against the electronic data received at the remote monitoring station.

All CDM relevant data will be measured & collected as detailed in section B.7.1. All data required for verification and issuance will be backed-up and kept for at least two years after the end of the crediting period or the last issuance of CERs of this project, whichever occurs later.

While the project is expected to start operating in 2015, the exact configuration of the meters and the exact design of the monitoring plan for the proposed project activity may be subject to change given the fact that the PDD is completed at an early stage of project development.

4. Data Quality Control and Quality Assurance

All data collected on-site by the SPC can be verified by Masen through a remote station connected to the plant. Masen will be responsible for the following:

- perform a check of all the relevant data received from the SPC,
- perform the ER calculations, and
- analyze emission reduction performance periodically.

The main obligations of the SPC under the CDM monitoring plan as specified above has been included in the Request for Proposal for the Ouarzazate I Concentrated Solar Power Project, and specifically in the Minimum Function Specification and the power purchase agreement in order to ensure that the winning bidder which will create the SPC will implement the monitoring according to this monitoring plan.

SECTION C. Duration and crediting period
C.1. Duration of project activity
C.1.1. Start date of project activity

31/12/2012 (Expected final results of the bidding process and signature/effectiveness of contracts)

C.1.2. Expected operational lifetime of project activity

25 years

C.2. Crediting period of project activity
C.2.1. Type of crediting period

Fixed

C.2.2. Start date of crediting period

01/01/2015

C.2.3. Length of crediting period

10 years

SECTION D. Environmental impacts
D.1. Analysis of environmental impacts

In accordance with Law number 12-03 on environmental impact assessment (EIA), a Framework Environmental and Social Impact Assessment (FESIA) was prepared for the proposed project by Burgeap and Phenixa in 2011[16].

The FESIA assesses the potential impacts of the proposed project as well as the subsequent phases that will increase the capacity to around 500 MW. Once the results of the bidding process are known and as required by Masen in the FESIA, the selected bidder that will design, finance, build, commission, operate and maintain the power plant in accordance with FESIA mitigation measures will also organise for a Project Specific Environmental and Social Impact Assessment report (PSESIA) to be carried out for the proposed project. This PSESIA will be prepared in accordance with Moroccan Law and relevant requirements from, among others, the World Bank Group safeguards policies, standards and guidelines, the European Investment Bank environmental and social practices handbook guidelines, and the African Development Bank health and safety guidelines.

The main potential impacts the FESIA highlighted and the suggested mitigation measures are presented in the table below.

	Impact	**Mitigation measures**
Environmental impacts		
Soils and geology	Possible risk or accidental pollution due to - Synthetic oil (heat transfer fluid) - Molten salt (thermal storage) - Fossil fuel (back-up power) Large area to waterproof due to civil engineering structure	Choice of least polluting products Strict waste and wastewater management and treatment Procedure for spillage prevention and emergency procedure in case of spillage
Water	High water consumption depending on the chosen cooling system Possible localised risk of accidental water contamination with synthetic oil and fossil fuel	See above “soils and geology”
Air	No impact, except possible pollution from exhaust fumes and dust from vehicles especially during construction	Use of vehicles meeting the required emission standard Watering of the road to decrease dust
Natural environment	Construction – risk of wildlife disturbance Construction and operation – possible impact on some species of interest Operation – risk of fire due to the presence of oil at high temperature	Avoid use of pesticides, careful choice of location for disposal of excavated soil Site located outside any protected natural area, most of the biodiversity considered as having a low patrimonial value. Measures will be implemented to protect species of interest. Regular maintenance of the equipment, management of vegetation around the site, fire prevention procedure
Socio-economic impacts		
Local population	Site located away from major populated areas No displacement of population or economic	No negative impact expected, so no mitigation measure required

[16] Burgeap – Phenixa (2011)

	activity is expected No destruction of habitats	
Local economy	Creation of jobs for the construction and operation phases. Local workforce will benefit from these opportunities to the extent they have the required skills. Very low resource-usage conflict levels as the site is a pastoral land with low fodder resources No negative impact on local economic activities	No negative impact expected, so no mitigation measure required
Tourism	Positive impact on tourism and media cover for the project Educational role of the project Site located outside any protected natural area or touristic area No impact on the local cultural heritage	No negative impact expected, so no mitigation measure required
Health	Construction – noise due to traffic Operation – noise due to the rotation of the turbine and condensers	Limit traffic, limit speed Locate turbines and condensers far away from houses, install noise attenuation features on equipment Limit noise to permissible levels defined according to relevant standards

D.2. Environmental impact assessment

Mitigation measures described in section D.1 will ensure that significant negative impacts are avoided. As highlighted in the FESIA, the project has several significant positive impacts, especially on the local economy and development.

SECTION E. Local stakeholder consultation
E.1. Solicitation of comments from local stakeholders

Masen has been consulting stakeholders throughout the planning phase of the project. They organised two public consultations, the first one in November 2010 during the preparation of the FESIA to present the project and its implications to local stakeholders and to respond to their comments, and the second one organised in March 2012 to present the environmental and social impacts of the common infrastructures.
In addition, Masen organised a public meeting on 24/04/2012 to present the proposed project and its development under the CDM and to collect comments and recommendations from local stakeholders. Stakeholders were informed about the meeting via announcements published on 06/04/2012 in three newspapers (Le Matin, Assabah and Almassae) and via invitation letters sent to key stakeholders, including representatives of the central and local government (various ministries, technical directorates and offices), the DNA, ONE, the local villages, communities and NGOs.

More than 50 people attended the meeting, including:
- local NGOs;
- inhabitants of Ghessate, the nearest community to the project;
- representatives of the local government;
- representatives of national governmental services such as the Office National de l'Eau Potable (National Drinking Water Office) and the Direction Provinciale de l'Equipement et des Transports, Eaux et Forets (Provincial Directorate for Infrastructure and Transport, Water and Forest Services); and
- representatives of the regional directorates of ONE and Masen.

Four presentations were followed by a Q&A session. The speakers (in italics) and the topics they covered were as follows:
- *Masen*: Morocco Solar Plan & Masen's pipeline of projects. Presentation of the proposed project, including the results of the FESIA, recommended mitigation measures and the plan for the implementation of these measures.
- *Climatekos (PDD consultant)*: climate change challenges at the local and global level, contribution of the CDM to the sustainable development of developing countries, eligibility criteria for the CDM, main steps of the CDM cycle, and plan for the development of the proposed project as a CDM project.
- *Moroccan DNA*: CDM background and procedures, presentation of the Moroccan DNA, and sustainable development criteria for the approval of CDM projects by the Moroccan DNA.
- *ONE*: status of rural electrification in Ouarzazate Province, contribution of the proposed project to the increase of the generation capacity on the Morrocan grid and to the improvement of the grid in the Ouarzazate Province.

A summary of the Q&A session that followed is provided in section E.2 below. Comprehensive minutes of the meetings as well as attendance sheets were provided to the DOE.

E.2. Summary of comments received

Questions raised and their answers are summarised below. Various stakeholders raised questions, including representatives of local communities and NGOs.
Q: The project has a strategic importance for the Ouarzazate Province. People expect the project to have a significant impact on local employment. However, to date companies which have been involved in the project have used very little local workforce. What are you doing to change this situation?

A: Masen has, through the specifications for the bidding process, required that companies use local skills as much as possible and Masen will monitor the compliance with this requirement. Nevertheless the project is at a very early stage and little workforce has been required so far.

Q: What is the status of the project?
A: Only preliminary works for the construction of a road to the site and to Tasselmante village have started. The initial schedule will be followed for the next steps.

Q: What is Masen doing to promote local development? Why are projects to be financed by funds coming from the sale of the land for the project being delayed?
A: In addition to the road to Tasselmante village, Masen is working with local government bodies to ensure access for local population to basic infrastructures such as roads, electricity, drinking water, communication and sewage systems. Besides, Masen is responsible for purchasing the land but is not involved in managing the funds. Representatives of the local government explained that the first projects planned with the supervisory ministry will start very soon.

Q: We have noticed and greatly appreciated the participation of Masen in a youth holiday camp in the province. We would like this involvement in cultural and socio-economic matters to be greater.
A: We are happy to support projects in the province, provided they promote sustainable development of the region. Masen does not want to provide funding only. In the holiday camp mentioned, Masen organised educational activities on sustainable energy. You can send your suggestions for other activities to ouarzazate@masen.ma .

Q: What is the status of the support programmes you announced about education and green tourism?
A: They are still in our pipeline. Some of them, such as the Institute of Education on Renewable Energies, are on their way. The objective is to give local population the capacity to understand and be part of the proposed project.

Q: What are Masen's procurement procedures, and why have Ouarzazate companies not been consulted for the construction of the roads yet?
A: Calls for tenders are public and open to all Moroccan companies, in compliance with Masen's procurement procedures. Calls for tenders are published in newspapers and one of the assessment criteria is the company's ability to meet deadlines.

Q: Some rumours suggest that the power plant will emit radiations that have a negative impact on the health of the population surrounding the project site. Could you please tell us more about that? People are worried and seek experts' opinion.
A: The proposed project will not emit any radiation that has a negative impact on people. The project will use the natural solar radiation to produce steam, which is used to generate electricity.

Q: We highly appreciate Masen's approach to involve local population throughout the project. However, we would like Masen to get closer to the local population and especially provide clear and specific answers to their questions. For that purpose we recommend Masen to:
- Set-up an office in Ouarzazate;
- Give more subsidies for the implementation of cultural activities; and
- Involve Ouarzazate local associations in projects planned in the region.

A: We thank you for these recommendations and will work on implementing them. A local office is planned and will open in the next few months.

Q: Is it possible to have preferential electricity prices for the inhabitants of the province?
A: Electricity prices in Morocco are set by the government through a Decree and are applicable to all regions in the country.

E.3. Report on consideration of comments received

Comments were addressed during the meeting, as shown in section E.2. Local stakeholders showed high interest and expectations in the project and in the positive impacts it will have.

SECTION F. Approval and authorization

A Letter of Approval from the Ministry of Energy, Mines, Water and Environment (Morocco DNA) was issued on the 3rd of August 2012.

The Letter of Approval has been provided to the DOE as part of the validation process.

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Appendix 1: Contact information of project participants

Organization name	Moroccan Agency for Solar Energy (Masen)
Street/P.O. Box	Avenue Al Araar
Building	Immeuble extension CMR, 3ème étage
City	Rabat
State/Region	
Postcode	Hay Riad
Country	Morocco
Telephone	+212 (0)5 37 57 46 22
Fax	+212 (0)5 37 57 14 74
E-mail	masen@masen.ma
Website	
Contact person	Mrs. TAOBANE Nadia
Title	
Salutation	Mrs
Last name	Taobane
Middle name	
First name	Nadia
Department	
Mobile	+212 (0)6 61 98 23 37
Direct fax	
Direct tel.	
Personal e-mail	taobane@masen.ma

Appendix 2: Affirmation regarding public funding

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Appendix 3: Applicability of selected methodology

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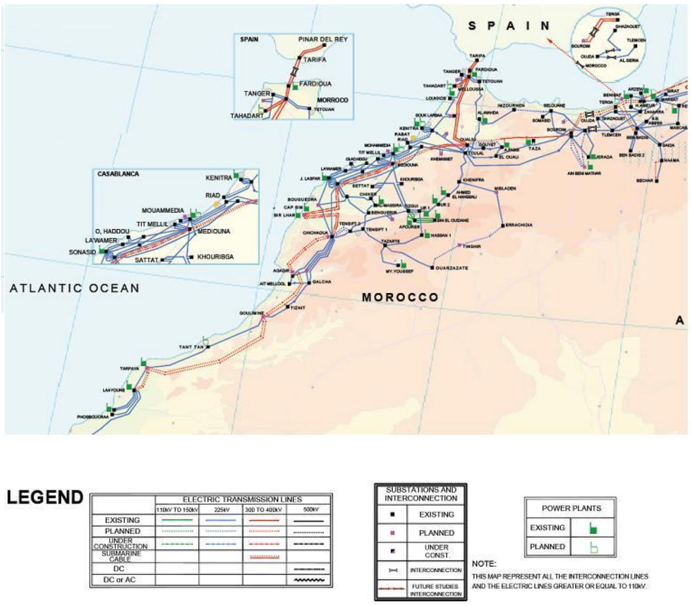
Appendix 4: Further background information on ex ante calculation of emission reductions

Data for the calculation of the operating margin emission factor

perspectives climate change

STEP 1: Identify the relevant electricity systems

The transmission grid is owned by the state power utility ONE and consisted of 18 920 km of 400 kV, 225 kV, 150 kV and 60 kV lines (2006). It covers the entire country and is connected to the Algerian and Spanish power grids via regional links. The capacity of the connection between Morocco and Spain is 1 400 MW via two 400 kV subsea cables, between Algeria and Morocco there is a 1 200 MW connection via three 400 kV lines. Up-to-date figures published by ONE display an ambitious expansion of its distribution network. According to ONE, said network currently consists of 20.877 km of high voltage lines, 68.310 km of medium voltage lines and 162.385 km of low voltage lines, summing up to a total amount of 251.572 km. (Source: https://energypedia.info/index.php/Morocco_Energy_Situation#cite_note-9; http://www.one.org.ma/FR/pages/interne.asp?esp=2&id1=4&id2=52&id3=161&t2=1&t3=1)



Source: Euro-Mediterranean Energy Market Integration Project (MED-EMIP) - (http://www.medemip.eu/Calc/FM/MED-EMIP/AUPTDE/Electicity_Interconnection_Maps/Arab

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

Option I: Only grid power plants are included in the calculation.

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

The "Tool to calculate the emission factor for an electricity system" provides four methods to calculate the operating margin.
Option (a) “Simple OM” has been chosen because:

i) low-cost/must-run resources in Morocco constitute less than 50% of total grid generation in average of the five most recent years, so the Simple OM method can be used. (See worksheet "LC-MR")

Since the *ex ante* option has been chosen, the emission factor is determined using a 3-year generation-weighted average, based on the most recent data available. Therefore, the data vintage chosen is 2009, 2010 and 2011.

Calculation for Year 2009			Main fuel source		Secondary fuel					
Plant *m*	**Fueltype** *i*	**Annual Generation** $EG_{m,y}$ (MWh)	**Fuel Consumption** $FC_{i,my}$ (10^3t)	**Fuel EF** $EF_{CO2,i,y}$ x $NCV_{i,y}$ (tCO2/t)	**Fuel Consumption** $FC_{i,my}$ (10^3t)	**Fuel EF** $EF_{CO2,i,y}$ x $NCV_{i,y}$ (tCO2/t)	**CO_2 Emissions** (tCO2) FC x NCV x EF_{CO2}	**Baseline** $EF_{EL,my}$ (tCO_2/MWh)	**Low cost / must run**	**CDM registered**
AFOURER	Hydro	401,936							yes	no
BINE EL OUIDANE	Hydro	293,111							yes	no
STEP AFOURER TURBINAGE (pump storage)	Hydro	383,805							yes	no
AL MASSIRA	Hydro	87,113							yes	no
IMFOUT	Hydro	14,082							yes	no
DAOURAT	Hydro	2,287							yes	no
SIDI SAID MAACHOU	Hydro	-							yes	no
KASBA ZIDANIA	Hydro	-							yes	no
MOHAMED EL KHAMIS	Hydro	101,126							yes	no
BOU AREG	Hydro	10,007							yes	no
HASSAN 1er	Hydro	115,631							yes	no
AHMED EL HANSALI	Hydro	185,168							yes	no
MOULAY YOUSSEF	Hydro	62,684							yes	no
MANSOUR EDDAHBI	Hydro	35,703							yes	no
EL KANSERA	Hydro	33,689							yes	no
IDRISS 1	Hydro	160,139							yes	no
AL WAHDA	Hydro	599,109							yes	no
ALLAL EL FASSI	Hydro	297,367							yes	no
OUED EL MAKHAZINE	Hydro	84,628							yes	no
LALLA TAKERKOUST	Hydro	20,365							yes	no
LAU	Hydro	27,588							yes	no
TAURART	Hydro	1,059							yes	no
AÏT MESSAOUD	Hydro	30,440							yes	no
FES AMONT	Hydro	-							yes	no
FES AVAL	Hydro	-							yes	no
MEKNES	Hydro	-							yes	no
TAZA	Hydro	1,517							yes	no
SEFROU	Hydro	226							yes	no
TANAFNIT	Hydro	3,579							yes	no
EL BORJ	Hydro	-							yes	no
JLEC (concession)	coal	9,771,604	3,526,183	2.267			7,994,024	**0.82**	no	no
Tahaddart (EET) (concession)	Natural gas	2,843,608	484,086	1.828			884,782	**0.31**	no	no
AIN BENI MATHAR	Natural gas	209,852	63,168	1.828			115,454	**0.55**	no	no
MOHAMMEDIA	coal	490,904	223,427	2.400			536,241	**1.09**	no	no
MOHAMMEDIA	fuel oil	1,485,168	386,920	3.005			1,162,656	**0.78**	no	no
KENITRA	fuel oil	1,166,485	329,469	3.005			990,021	**0.85**	no	no
JERADA	coal, petcoke	600,803	289,033	2.277	40,382	2.673	848,184.67	**1.41**	no	no
JERADA	Anthracite, fuel oil		37,544	2.043	1,823	3.005	82,194		no	no
MOHAMMEDIA TG (100MW)	Fuel oil, gas-oil	143,769	49,967	3.005	1,630	3	155,045	**1.08**	no	no
MOHAMMEDIA TG (33MW)	Fuel oil, gas-oil	23,585	8,769	3.005	196	3.006	26,939	**1.14**	no	no
TAN TAN(33MW)	Fuel oil, gas-oil	354,373	73,322	3.005	156.00	3.006	220,794.16	**0.62**	no	no
TIT MELLIL(33MW)	Fuel oil, gas-oil	75,027	26,284	3.005	59	3.006	79,158	**1.06**	no	no
TETOUAN(33MW)	Fuel oil, gas-oil	42,006	14,971	3.005	120	3.006	45,347	**1.08**	no	no
AGADIR(20 MW)	Fuel oil, gas-oil	1,144	429	3.005	40	3.006	1,409	**1.23**	no	no
TANGER(20 MW)	Fuel oil, gas-oil	5,038	1,915	3.005	78	3.006	5,989	**1.19**	no	no
TETOUAN(20 MW)	Fuel oil, gas-oil	3,152	1,234	3.005	86	3.006	3,967	**1.26**	no	no
LAAYOUNE	Fuel oil, gas-oil	3,542	768	3.005	119.0	3.006	2,665	**0.75**	no	no
TAG LAAYOUNE	Fuel oil, gas-oil	193,887	62,609	3.005	10,161	3.006	218,675	**1.13**	no	no
BOU ARFA	Diesel	-							no	no
FIGUIG	Diesel	-							no	no
AOUSSERD	Diesel	143							no	no
SMARA	Diesel	105	566	3.006			1,701	**0.84**	no	no
TATA	Diesel	-							no	no
TENDRARA	Diesel	-							no	no
BOUJDOUR	Diesel	115							no	no
TARFAYA	Diesel	1,651							no	no
Wind (CED - Compagnie Eolienne du Détroit	Wind	157,826								
parc A. Torres (3,5MW)	Wind	0	-	0	0	0	-	**0**	yes	no
Parc Tanger (140MW)	Wind	110,253	-	0	0	0	-	**0**	yes	yes
AMOUGDOUL	Wind	123,157							yes	yes
Imports		4,748,644					-	**0**		
Total		**25,508,200**								
Total LC/MR		3,343,595								
Total excluding LC/MR		**22,164,605**					13,375,248	**0.603**		

Calculation for Year 2010			Main fuel source		Secondary fuel					
Plant *m*	**Fueltype** *i*	**Annual Generation** ***EG*** $_{m,y}$ (MWh)	**Fuel Consumption** $FC_{i,my}$ (t or 10³m³ for natural gas)	**Fuel EF** $EF_{CO2,i,y}$ x $NCV_{i,y}$ (tCO2/t)	**Fuel Consumption** $FC_{i,my}$ (t)	**Fuel EF** $EF_{CO2,i,y}$ x $NCV_{i,y}$ (tCO2/t)	**CO_2 Emissions** (tCO2) FC x NCV x EF_{CO2}	**Baseline** $EF_{EL,my}$ (tCO_2/MWh)	**Low cost / must run**	**CDM registered**
AFOURER	Hydro	373,268							yes	no
BINE EL OUIDANE	Hydro	295,507							yes	no
STEP AFOURER TURBINAGE (pump storage)	Hydro	163,032							yes	no
AL MASSIRA	Hydro	270,099							yes	no
IMFOUT	Hydro	65,041							yes	no
DAOURAT	Hydro	28,729							yes	no
SIDI SAID MAACHOU	Hydro	-							yes	no
KASBA ZIDANIA	Hydro	-							yes	no
MOHAMED EL KHAMIS	Hydro	109,132							yes	no
BOU AREG	Hydro	12,633							yes	no
HASSAN 1er	Hydro	151,080							yes	no
AHMED EL HANSALI	Hydro	309,924							yes	no
MOULAY YOUSSEF	Hydro	44,321							yes	no
MANSOUR EDDAHBI	Hydro	35,663							yes	no
EL KANSERA	Hydro	44,715							yes	no
IDRISS 1	Hydro	221,172							yes	no
AL WAHDA	Hydro	947,506							yes	no
ALLAL EL FASSI	Hydro	281,328							yes	no
OUED EL MAKHAZINE	Hydro	115,078							yes	no
LALLA TAKERKOUST	Hydro	29,152							yes	no
LAU	Hydro	17,446							yes	no
TAURART	Hydro	-							yes	no
AÏT MESSAOUD	Hydro	29,086							yes	no
FES AMONT	Hydro	-							yes	no
FES AVAL	Hydro	-							yes	no
MEKNES	Hydro	-							yes	no
TAZA	Hydro	1,339							yes	no
SEFROU	Hydro	0							yes	no
TANAFNIT	Hydro	79,839							yes	no
EL BORJ	Hydro	5,616							yes	no
JLEC (concession)	coal	9,847,176	3,632,455	2.268			8,237,670	**0.84**	no	no
Tahaddart (EET) (concession)	Natural gas	2,152,963	373,268	1.828			682,237	**0.32**	no	no
AIN BENI MATHAR	Natural gas	810,321	209,975	1.828			383,778	**0.47**	no	no
MOHAMMEDIA	coal	323,992	144,500	2.244			324,285	**1.00**	no	no
MOHAMMEDIA	fuel oil	1,633,684	422,610	3.005			1,269,901	**0.78**	no	no
KENITRA	fuel oil	1,440,049	406,879	3.005			1,222,631	**0.85**	no	no
JERADA	coal, petcoke	695,064	420,536	2.349	-	2.673	992,752.31	**1.43**	no	no
JERADA	Anthracite, fuel oil		-	-	1,672	3.005	5,024		no	no
MOHAMMEDIA TG (100MW)	Fuel oil, gas-oil	577,060	176,397	3	2,392	3	537,245	**0.93**	no	no
MOHAMMEDIA TG (33MW)	Fuel oil, gas-oil	73,098	28,654	3.005	154	3.006	86,565	**1.18**	no	no
TAN TAN(33MW)	Fuel oil, gas-oil	261,352	49,898	3.005	3,153	3.006	159,415.28	**0.61**	no	no
TIT MELLIL(33MW)	Fuel oil, gas-oil	140,527	50,205	3.005	29	3.006	150,948	**1.07**	no	no
TETOUAN(33MW)	Fuel oil, gas-oil	52,238	18,664	3.005	125	3.006	56,459	**1.08**	no	no
AGADIR(20 MW)	Fuel oil, gas-oil	32,431	12,002	3.005	1,224	3.006	39,744	**1.23**	no	no
TANGER(20 MW)	Fuel oil, gas-oil	41,085	17,992	3.005	320	3.006	55,026	**1.34**	no	no
TETOUAN(20 MW)	Fuel oil, gas-oil	9,555	4,258	3.005	22	3.006	12,861	**1.35**	no	no
LAAYOUNE	Fuel oil, gas-oil	14,576	3,249	3.005	691	3.006	11,840	**0.81**	no	no
TAG LAAYOUNE	Fuel oil, gas-oil	244,997	73,443	3.005	24,537	3.006	294,438	**1.20**	no	no
BOU ARFA	Diesel	-							no	no
FIGUIG	Diesel	-							no	no
AOUSSERD	Diesel	134							no	no
SMARA	Diesel	152	143	3.006			430	**0.93**	no	no
TATA	Diesel	-							no	no
TENDRARA	Diesel	-							no	no
BOUJDOUR	Diesel	178							no	no
TARFAYA	Diesel	-							no	no
Wind (CED - Compagnie Eolienne du Détroit	Wind	165,574								
parc A. Torres (3,5MW)	Wind	0						**0**	yes	no
Parc Tanger (140MW)	Wind	365,553					-	**0**	yes	yes
AMOUGDOUL	Wind	127,688						**0**	yes	yes
Imports		4,091,300					-	**0**		
Total		**26,731,453**								
Total LC/MR		4,289,521								
Total excluding LC/MR		**22,441,932**					14,523,250	**0.647**		

Calculation for Year 2011			Main fuel source		Secondary fuel					
Plant *m*	**Fueltype** *i*	**Annual Generation** $EG_{m,y}$ (MWh)	**Fuel Consumption** $FC_{i,m,y}$ (t or 10³m³ for natural gas)	**Fuel EF** $EF_{CO2,i,y}$ x $NCV_{i,y}$ (tCO2/t)	**Fuel Consumption** $FC_{i,m,y}$ (t)	**Fuel EF** $EF_{CO2,i,y}$ x $NCV_{i,y}$ (tCO2/t)	**CO_2 Emissions** (tCO2) FC x NCV x EF_{CO2}	**Baseline** $EF_{EL,m,y}$ (tCO_2/MWh)	**Low cost / must run**	**CDM registered**
AFOURER	Hydro	304,861							yes	no
BINE EL OUIDANE	Hydro	151,689							yes	no
STEP AFOURER TURBINAGE (pump storage)	Hydro	133,311							yes	no
AL MASSIRA	Hydro	155,617							yes	no
IMFOUT	Hydro	47,629							yes	no
DAOURAT	Hydro	20,731							yes	no
SIDI SAID MAACHOU	Hydro	-							yes	no
KASBA ZIDANIA	Hydro	-							yes	no
MOHAMED EL KHAMIS	Hydro	59,900							yes	no
BOU AREG	Hydro	1,904							yes	no
HASSAN 1er	Hydro	94,525							yes	no
AHMED EL HANSALI	Hydro	177,771							yes	no
MOULAY YOUSSEF	Hydro	29,529							yes	no
MANSOUR EDDAHBI	Hydro	32,031							yes	no
EL KANSERA	Hydro	31,269							yes	no
IDRISS 1	Hydro	107,388							yes	no
AL WAHDA	Hydro	256,422							yes	no
ALLAL EL FASSI	Hydro	218,244							yes	no
OUED EL MAKHAZINE	Hydro	65,504							yes	no
LALLA TAKERKOUST	Hydro	33,553							yes	no
LAU	Hydro	27,136							yes	no
TAURART	Hydro	-							yes	no
AÏT MESSAOUD	Hydro	32,679							yes	no
FES AMONT	Hydro								yes	no
FES AVAL	Hydro								yes	no
MEKNES	Hydro	866							yes	no
TAZA	Hydro	1,751							yes	no
SEFROU	Hydro	51							yes	no
TANAFNIT	Hydro	68,429							yes	no
EL BORJ	Hydro	85,876							yes	no
JLEC (concession)	coal	10,133,957	3,763,683	2.268			8,536,033	**0.84**	no	no
Tahaddart (EET) (concession)	Natural gas	2,329,144	402,536	1.828			735,836	**0.32**	no	no
AIN BENI MATHAR	Natural gas	1,721,765	342,672	1.828			626,405	**0.36**	no	no
MOHAMMEDIA	coal	702,396	290,148	2.244			651,092	**0.93**	no	no
MOHAMMEDIA	fuel oil	1,532,546	391,926	3.005			1,177,738	**0.77**	no	no
KENITRA	fuel oil	1,685,647	481,039	3.005			1,445,522	**0.86**	no	no
JERADA	coal, petcoke	842,430	499,458	2.349	-	2.673	1,177,160.26	**1.40**	no	no
JERADA	Anthracite, fuel oil	-	-		1,309	3.005	3,933		no	no
MOHAMMEDIA TG (100MW)	Fuel oil, gas-oil	970,673	294,534	3.000	3,478	3.006	894,056	**0.92**	no	no
MOHAMMEDIA TG (33MW)	Fuel oil, gas-oil	29,869	11,420	3.005	517	3.006	35,871	**1.20**	no	no
TAN TAN(33MW)	Fuel oil, gas-oil	377,548	68,865	3.005	9,765	3.006	236,289	**0.63**	no	no
TIT MELLIL(33MW)	Fuel oil, gas-oil	345,905	127,035	3.005	3,297	3.006	391,650	**1.13**	no	no
TETOUAN(33MW)	Fuel oil, gas-oil	116,159	40,729	3.005	2,129	3.006	128,790	**1.11**	no	no
AGADIR(20 MW)	Fuel oil, gas-oil	79,524	32,445	3.005	3,151	3.006	106,968	**1.35**	no	no
TANGER(20 MW)	Fuel oil, gas-oil	31,386	13,397	3.005	270	3.006	41,070	**1.31**	no	no
TETOUAN(20 MW)	Fuel oil, gas-oil	29,507	12,902	3.005	11	3.006	38,804	**1.32**	no	no
LAAYOUNE	Fuel oil, gas-oil	26,596	6,033	3.005	-	3.006	18,129	**0.68**	no	no
TAG LAAYOUNE	Fuel oil, gas-oil	289,278	108,739	3.005	12,235	3.006	363,535	**1.26**	no	no
BOU ARFA	Diesel	564	2,478	3.006			7,448	**1.32**	no	no
FIGUIG	Diesel								no	no
AOUSSERD	Diesel								no	no
SMARA	Diesel								no	no
TATA	Diesel								no	no
TENDRARA	Diesel								no	no
BOUJDOUR	Diesel								no	no
TARFAYA	Diesel								no	no
Wind (CED - Compagnie Eolienne du Détroit	Wind	156,845								
parc A. Torres (3,5MW)	Wind	0						**0**	yes	no
Parc Tanger (140MW)	Wind	416,256					-	**0**	yes	yes
AMOUGDOUL	Wind	119,073						**0**	yes	yes
Imports		4,824,124					-	**0**		
Total		**28,899,858**								
Total LC/MR		2,830,840								
Total excluding LC/MR		**26,069,018**					16,616,328	**0.637**		

Data for the calculation of the build margin emission factor

STEP 5: Calculate the build margin emission factor								
		BM						
		Plant *m* *SET*	Start year	Generation 2011 (accumulated MWh) AEG_{SET}	% of AEG_{total}	Accumulative % of AEG_{total}	CO2 Emissions (accumulated tCO2)	Baseline $EF_{EL,my}$ (tCO_2/MWh)
$SET_{\geq 20\%} = SET_{sample}$	$SET_{5\text{-units}}$	EL BORJ	2010	85,876	0.36%	0.36%	-	0.000
		Ain beni mathar	2009	1,721,765	7.31%	7.68%	626,405	0.364
		TANAFNIT	2009	68,429	0.29%	7.97%	-	0.000
		Mohammedia (100 MW)	2009	970,673	4.12%	12.09%	894,056	0.921
		Tan Tan	2009	377,548	1.60%	13.70%	236,289	0.626
		TAG LAAYOUNE	2007	26,596	0.11%	13.81%	18,129	0.682
		Tahaddart	2005	2,329,144	9.89%	23.70%	735,836	0.316
		STEP Afourer	2004/2005	133,311	0.57%	24.27%	-	0.000
		AHMED EL HANSALI	2003	177,771	0.76%	25.03%	-	0.000
		AÏT MESSAOUD	2003	32,679	0.14%	25.16%	-	0.000
			$AEG_{SET\text{-}5\text{-}units}$	3,224,291				
			$AEG_{SET\text{-}\geq 20\%}$	5,580,031				
			AEG_{total}	23,540,405				
							2011 $EF_{grid,BM,y}$ (tCO_2/MWh)	0.450

Calculation of the combined margin emission factor

Step 6: Baseline Grid Emission Factor, Morocco	
Year 1 (2009)	
EF_{OM} (tCO_2/MWh)	0.603
Annual generation (MWh)	22,164,605
Year 2 (2010)	
EF_{OM} (tCO_2/MWh)	0.647
Annual generation (MWh)	22,441,932
Year 3 (2011)	
EF_{OM} (tCO_2/MWh)	0.637
EF_{BM} (tCO_2/MWh)	0.450
Annual generation (MWh)	26,069,018
Generation weighted $EF_{OM,y1\text{-}y3}$	0.630
$EF_{CM} = 0.75 * EF_{OM,y1\text{-}y3} + 0.25 * EF_{BM,y3}$ =	**0.585**

Low-cost must-run resources

	Power generation (GWh)			
Year	Hydro	Wind	Total	Average share of LC/MR
2011	2,139	692	28,900	10%
2010	3,631	659	26,731	16%
2009	2,952	391	25,508	13%
2008	1,360	298	24,563	7%
2007	1,318	279	23,177	7%
			Average over 5 years:	**10.5%**

Emission factors and NCVs

Specific Moroccan fuel emission factors available

Natural gas

Natural gas fuel emission factor (for the Tahaddart Plant)
Source: ONE; 2006 IPCC Guidelines for National Greenhouse Gas Inventories: TABLE 1.2
DEFAULT NET CALORIFIC VALUES (NCVs) AND LOWER AND UPPER LIMITS OF THE 95% CONFIDENCE INTERVALS; TABLE 1.4
DEFAULT CO2 EMISSION FACTORS FOR COMBUSTION

Fuel Type	Year	Density	Net Calorific Values		Emission factor		
		t/m3	GJ/1000m3	GJ/t	kgCO2/TJ	t CO2/t	tCO2/m3
Source >		ONE	ONE		IPCC		
Natural gas	2008	0.6289	33.660	53.522	54,300	**2.906**	1.828

Coal

	Net Calorific value		Effective CO2 emission factor		Fuel emission factor
	Mcal/t	GJ/t	kgCO2/TJ		(tCO2/t fuel)
			95% confidence interval		
Coal Plant			Lower	Upper	
Source: ONE, personal Email, 24.04.2012	Specification of imported coal for specific coal fired plants		IPCC	IPCC	
2008					
Jerada	6219	26.0	89,500	99 700	**2.330**
Mohamedia	6162	25.8	89,500	99 700	**2.309**
JLEC	6025	25.2	89,500	99 700	**2.258**
2009					
Jerada	6076	25.4	89,500	99 700	**2.277**
Mohamedia	6405	26.8	89,500	99 700	**2.400**
JLEC	6050	25.3	89,500	99 700	**2.267**
2010					
Jerada	6268	26.2	89,500	99 700	**2.349**
Mohamedia	5989	25.1	89,500	99 700	**2.244**
JLEC	6052	25.3	89,500	99 700	**2.268**

Petcoke and local coal

	Net Calorific value				Effective CO2 emission factor		Fuel emission factor
	Mcal/t			GJ/t	kgCO2/TJ		(tCO2/t fuel)
				95% confidence interval			
	Lower	Typical	Upper	Selected	Lower	Upper	
Source: ONE	Specification of imported petcoke for the JLEC (Jorf Lasfar) plant				IPCC	IPCC	
Petcoke	7000	7700	8000	32.2	82,900	115 000	**2.673**
Anthracite (local coal)				21.6	94,600	101 000	**2.043**

IPCC standard fuel emission factors

IPCC default net calorific values (NCVs)
2006 IPCC Guidelines for National Greenhouse Gas Inventories
Volume 2: Energy, Chpt. 1, Page 1.18

Table 1.2 Default net calorific values (NCVs) and lower and upper Limits of the 95% confidence intervals[1]

Fuel type English description	Net calorific value (GJ/t	Lower	Upper
Gas/Diesel Oil	43	41.4	43.3
Residual Fuel Oil	40.4	39.8	41.7
Petroleum Coke	32.5	29.7	41.9
Anthracite	26.7	21.6	32.2
Coking Coal	28.2	24	31
Other Bituminous Coal	25.8	19.9	30.5
Natural Gas	48	46.5	50.4

IPCC default CO_2 Emission Factors for combustion
2006 IPCC Guidelines for National Greenhouse Gas Inventories
Volume 2: Energy, Chpt. 1, Page 1.23

Table 1.4 default co2 emission factors for combustion [1]

Fuel type	Default carbon content (kg/GJ)	Default carbon oxidation factor	Effective CO2 emission factor **(kg/TJ)**[2]		
			Default value[3]	**95% confidence interval**	
	A	**B**	**C=A*B*44/12*1000**	**Lower**	**Upper**
Gas/Diesel Oil	20.2	1	74,100	72,600	74 800
Residual Fuel Oil	21.1	1	77,400	75,500	78 800
Petroleum Coke	26.6	1	97 500	82,900	115 000
Anthracite	26.8	1	98 300	94,600	101 000
Coking Coal	25.8	1	94 600	87,300	101 000
Other Bituminous Coal	25.8	1	94 600	89,500	99 700
Natural Gas	15.3	1	56 100	54,300	58 300

Calculated emission factors - according to IPCC

Fuel Type	net calorific values (NCVs) lower limit of the 95% confidence intervals	Effective CO2 emission factor	Fuel emission factor
	(GJ/t fuel)	(kgCO2/TJ)	(tCO2/t fuel)
Gas/Diesel Oil	41.4	72,600	3.006
Residual Fuel Oil	39.8	75,500	3.005
Petroleum Coke	29.7	82,900	2.462
Anthracite	21.6	94,600	2.043
Coking Coal	24	87,300	2.095
Other Bituminous Coal	19.9	89,500	1.781
Natural Gas	46.5	54,300	2.525

Appendix 5: Further background information on monitoring plan

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Appendix 6: Summary of post registration changes

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History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03	EB 25, Annex 15 26 July 2006	
02	EB 14, Annex 06b 14 June 2004	
01	EB 05, Paragraph 12 03 August 2002	Initial adoption.
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