Component project activity design document form for CDM component project activities

(Version 05.0)

Complete this form in accordance with the Attachment "Instructions for filling out the component project activity design document form for CDM component project activities" at the end of this form.

COMPONENT PROJECT DESIGN DOCUMENT (CPA-DD)	
Title of the CPA	Solar Water Heater Programme in Tunisia – CPA 1
Version number of the CPA-DD	6.1[1]
Completion date of the CPA-DD	29/09/2016[2]
Title of the PoA to which the CPA is included	Solar Water Heater Programme in Tunisia
Host Party	Tunisia
Estimated amount of annual average GHG emission reductions	~~7,242~~7,160
Applied methodology(ies) and, where applicable, applied standardized baseline(s)	AMS.I.C version 17
Sectoral scope(s) linked to the applied methodology(ies)	1

[1] CPA-DD has been updated under current version template (05.0), available from 15/04/2016 onwards.

[2] CPA-DD has been updated under current version template (05.0), available from 15/04/2016 onwards.

SECTION A. General description of CPA

A.1. Title of the proposed or registered PoA

>>

Solar Water Heater Programme in Tunisia

A.2. Title of the CPA

>>

Solar Water Heater Programme in Tunisia – CPA 1[3]

A.3. Description of the CPA

>>

The proposed small-scale CDM Programme Activity (SSC CPA) consists of a group of 14,690 solar water heaters (SWH) installed under the Solar Water Heater Programme in Tunisia (hereafter referred to as the PoA) across the 21 Tunisian provinces.

The proposed CPA is a voluntary initiative taken by the coordinating and managing entity of the PoA, the Tunisian National Agency for Energy Conservation (Agence Nationale pour la Maîtrise de l'Energie – ANME).

The PoA is a programme for the installation of domestic SWH in households throughout Tunisia set up by the coordinating and managing entity. The objective of the PoA is to support the development of solar energy for water heating in Tunisia, including for water heating, in line with the 11th Plan set by the Tunisian government[4]. The stated goal of the PoA is to install around 30,000 SWH per year in households in Tunisia, thereby displacing carbon intensive electricity from the grid and fossil fuels currently used to provide hot water in the households and reducing greenhouse gas emissions. The proposed SSC CPA is expected to reduce ~~72,421~~71,598 tCO_2 over 10 years.
In addition, the PoA will provide households with a flexible and in-house supply of hot water. It will also
support the unstable Tunisian SWH sector and promote new investment in renewable energy projects.

A.4. Entity/individual responsible for the operation of CPA

>>

The entity responsible of the proposed CPA is the ANME. The ANME is also the coordinating and managing entity of the PoA, as indicated in the PoA-DD.

A.5. Technical description of the CPA

>>

3 In accordance with EB47 paragraph 72 , during validation CPA1 was revised from SWH installed between 23/01/2007 and 31/12/2007 to SWH installed between 01/01/2008 and 30/06/2008.

4 Ministère du Développement et de la Coopération Internationale (Ministry of Development and International Cooperation) – March 2006 - Note d'orientation du XIème Plan et de la décennie 2007-2016

The proposed SSC CPA employs state-of-the art and recognised solar water heating technology, which converts solar radiation into thermal energy for the heating of domestic water.

All SWH in the proposed SSC CPA are produced either by domestic companies or by foreign companies and imported by Tunisian companies. They are installed by Tunisian companies experienced in handling and operating this kind of equipment.

Several types of systems (including thermosiphon and forced circulation systems) and collectors (including flat plate and evacuated tube collectors) are used in the SSC CPA.

SWH installed in the SSC CPA consist of the following main parts:

- solar collector(s) that capture solar radiation
- circulating fluids that absorb the energy collected [5]
- a storage tank where the energy from the fluid is transferred to the water and where the heated water is stored until use.

The typical capacity of the storage tank ranges from 200 to 300 litres and the typical surface of the collector between 2 and 4 m^2. The capacity and surface vary according to the household's choice and demand. SWH installed in the SSC-CPA are certified by the ANME and must meet certain requirements, as defined in the latest version of the Prosol 2 Specifications[6]. These requirements deal with:

- compliance with relevant Tunisian and international standards
- minimal energy performance
- specific technical characteristics of the SWH
- modalities for the installation of the SWH.

SWH suppliers and installers as well as the SWH themselves are certified by the ANME according to best practice criteria[7]. This ensures that only high quality equipment and service are provided to households taking part in the SSC CPA.

5 This is mostly glycol (see Annex 2, p5 of the Prosol - Specifications for the eligibility of suppliers to the programme), which is commonly used as coolant fluid all over the world. It is also used as antifreeze in the cooling fluids used in engines. According to the Decree number 2005-1991, regarding the environmental impact assessment and specifying the categories of units subject to the specifications (Ministry of Environment and Sustainable Development), SWH do not require an environmental impact assessment, which shows that these fluids are considered not to have any significant impact on the environment.

6 See the Programme de Promotion de l'Utilisation du Chauffe-eau Solaire en Tunisie – Prosol Tunisie- Cahier des charges relatif à l'éligibilité des fournisseurs au programme (Prosol - Specifications for the eligibility of suppliers to the programme) – latest version.

7 Programme de Promotion de l'Utilisation du Chauffe-eau Solaire en Tunisie – Prosol Tunisie- Cahier des charges relatif à l'éligibilité des fournisseurs au programme (Prosol - Specifications for the eligibility of suppliers to the programme) – latest version

A.6. Party(ies)

Name of Party involved (host) indicates host Party	Private and/or public entity(ies) CPA implementer(s) (as applicable)	Indicate if the Party involved wishes to be considered as CPA implementer (Yes/No)
Tunisia	Agence Nationale pour la Maîtrise de l'Energie (ANME)	No
France	Solvay Energy Services SAS[8]	No

A.7. Geographic reference or other means of identification

>>

Each of the 14,690 SWH is uniquely identified by its serial number. The set of 14,690 serial numbers in the SSC CPA allows the unique identification of the SSC CPA. This information will be made available during verification. The following information is also recorded in a database (hereafter referred to as “Prosol 2 database”) for each SWH, along with the serial number:

- Name of the SWH owner
- Geographical location of the installation
- Installation date
- Supplier and type

A.8. Duration of the CPA

A.8.1. Start date of the CPA

>>

The starting date of the SSC CPA is 01/01/2008, which is the date when the first SWH of the proposed CPA was installed.

A.8.2. Expected operational lifetime of the CPA

>>

15 years[9]

A.9. Choice of the crediting period and related information

>>

Fixed Crediting period

A.9.1. Start date of the crediting period

>>

The starting date of the crediting period is 13/05/2011 or when the SSC PoA is registered, whichever is later.

8 Solvay Energy Services was included as Project Participant after the registration but is listed in this chapter in order to be in line with the current version of the MOCs

9 See BIOME Solar Industry – Lifetime of SWH in Tunisia

A.9.2. Length of the crediting period

>>
N/A

A.10. Estimated amount of GHG emission reductions

Emission reductions during the crediting period	
Years	**Annual GHG emission reductions (in tonnes of CO_2e) for each year**
2011	7,160~~7,242~~
2012	7,160~~7,242~~
2013	7,160~~7,242~~
2014	7,160~~7,242~~
2015	7,160~~7,242~~
2016	7,160~~7,242~~
2017	7,160~~7,242~~
2018	7,160~~7,242~~
2019	7,160~~7,242~~
2020	7,160~~7,242~~
Total number of crediting years	10
Annual average GHG emission reductions over the crediting period	7,160~~7,242~~
Total estimated reductions (tonnes of CO_2e)	71,598~~72,421~~

A.11. Public funding of the CPA

>>
The proposed CPA will not receive any public funding from Parties included in Annex I of the UNFCCC.

A.12. Confirmation for CPA

>>
The SSC CPA is neither registered as an individual CDM project activity nor is it part of another registered PoA.
Information about each SWH compiled in the database set up for the PoA ensures that all SWH in the proposed SSC CPA are uniquely defined and are included in the proposed SSC CPA only, thereby avoiding double counting of emissions reductions generated by the SSC CPA.

A.13. Contact information of responsible persons/ entities for completing the CDM-CPA-DD-FORM

>>
- ANME (Agence Nationale pour la Maîtrise de l'Energie) Ms Afef Jaafar, afef.jaafar@anme.nat.tn
- Solvay Energy Services : Mr Philippe Chevallier, philippe.chevallier@solvay.com

SECTION B. Environmental analysis

B.1. Analysis of the environmental impacts

>>
In accordance with the CDM-SSC-CPA-DD form, this section is not completed since this information is provided at the PoA level.

B.2. Environmental impact assessment

>>
In accordance with the CDM-SSC-CPA-DD form, this section is not completed since this information is provided at the PoA level.

SECTION C. Local stakeholder consultation

C.1. Solicitation of comments from local stakeholders

>>
In accordance with the CDM-SSC-CPA-DD form, this section is not completed since this information is provided at the PoA level.

C.2. Summary of comments received

>>
In accordance with the CDM-SSC-CPA-DD form, this section is not completed since this information is provided at the PoA level.

C.3. Report on consideration of comments received

>>
In accordance with the CDM-SSC-CPA-DD form, this section is not completed since this information is provided at the PoA level.

SECTION D. Eligibility of CPA and estimation of emissions reductions

D.1. Reference of methodology(ies) and standardized baseline(s)

>>
According to Appendix B of the UNFCCC's Simplified modalities and procedures for small-scale clean development mechanism project activities, the type and category of a SSC-PA included in the PoA are: Type: I - Renewable Energy Project
Category: I.C -Thermal energy production with or without electricity
The approved SSC baseline and monitoring methodology AMS.I.C, Thermal energy production with or without electricity, version 17, approved at EB 54, is thus applied to each SSC-CPA included in the PoA.

D.2. Applicability of methodology(ies) and standardized baseline(s)

>>

AMS.I.C version 17 is applicable to the SSC CPA since it meets the applicable requirements set out in the methodology:

- It comprises renewable energy technologies that supply residential users with thermal energy, namely SWH
- It displaces fossil fuel use, namely electricity from the fossil-fuel intense Tunisian grid,
- Liquefied Petroleum Gas (LPG) and natural gas
- It individually does not exceed the applicable SSC threshold: the total installed thermal energy generation capacity of the SSC-CPA equipment is equal to or less than 45 MW thermal since the total number of installed square meters of a SSC-CPA is below the 64,000 m2[10].
- The heat produced by the SWH in the SSC-CPA is used by the household where the SWH is installed. As such, the heat produced by the SSC-CPA is not delivered to another facility or facilities within the project boundary.

As defined in AMS.I.C, the project boundary is the physical, geographical site of the project equipment producing the renewable energy. Hence the boundary for the SSC CPA is the geographical area over which SWH are installed comprising the physical site of each SWH of the SSC CPA. As SWH displace electricity from the Tunisian grid, the project boundary also includes all the power plants connected to the Tunisian grid.

10 Appendix B of the Simplified modalities and procedures for small-scale clean development mechanism project activities – A. General guidance - version 12.1 - http://cdm.unfccc.int/methodologies/SSCmethodologies/history/guid_ssc_meth/guid_ssc_v12_1.pdf 'For thermal applications of solar energy projects, 'maximum output' shall be calculated using a conversion factor of 700 Wth/m2 of aperture area of glazed flat plate or evacuated tubular collector i.e. eligibility limit in terms of aperture area is 64000 m2 of the collector.', (with 700 Wth/m2 * 64,000 m2 = 44,800,000 Wth = 44.8 MWth).

D.3. Sources and GHGs

Source		GHGs	Included?	Justification/Explanation
Baseline scenario	Fuel consumption of the technologies that would have been used in the absence of the project activity	CO_2	Yes	According to AMS.I.C, only CO2 emissions from fuel consumption should be accounted for.
		CH_4	No	According to AMS.I.C.
		N_2O	No	According to AMS.I.C.
	Tunisian grid electricity production	CO_2	Yes	According to AMS.I.C which refers to AMD.I.D and thus the "Tool to calculate the emission factor for an electricity system", only CO2 emissions from electricity generation should be accounted for.
		CH_4	No	According to AMS.I.C.
		N_2O	No	According to AMS.I.C.
Project scenario	Solar water heaters thermal energy production	CO_2		According to AMS.I.C.
		CH_4		According to AMS.I.C.
		N_2O		According to AMS.I.C.

D.4. Description of the baseline scenario

>>
The baseline is identified as the fuel consumption of the technologies that would have been used in the absence of the project activity.
In Tunisia, domestic hot water is currently provided by[11]:

- water heaters (LPG, natural gas, electric, SWH);
- other means (water heating in pots/pans on the cooker/fire using different fuel sources, such as LPG, natural gas, electricity; public bath houses ("hammam")

For each CPA, the mix of baseline fuels used to heat up water before the SWH is installed is recorded in the Prosol 2 database. From the database it can be seen that from beginning of 2008 to mid 2010, at least around 70% of households purchasing a SWH had a water heater previously. In some of the remaining households, water heating in pots, visits to the public bath houses and other traditional means were used to heat water. However these do not provide an output/service (hot water) with the same quality and properties as traditional and solar water heaters. This lack of water heaters is often caused by income or infrastructure constraints. The energy profile of consumers without a water heater thus does not reflect real demand for hot water. The CDM programme will help to alleviate this unmet demand by facilitating access to domestic hot water through the subsidy and the loan support system part of the programme.
As a result, the baseline for these households is defined as the energy consumption of the technologies that would have been used in the absence of the PoA in order to meet the real demand for hot water. This is calculated as the weighted average of the water heaters replaced in the households previously owning a water heater in the CPA, including SWH (see sectionE.6.2). This approach is considered conservative since it only takes into account technologies chosen by

11 STEG – Direction des Etudes et de la Planification – Département Demande d'Electricité (2005) Enquête auprès des clients résidentiels de la STEG 2004 (Survey of STEG clients from the residential sector 2004)

typical homes that have access to modern and efficient water heaters, and it leads to fewer emissions than the approach that includes traditional water heating means.
Therefore, as defined in AMS.I.C, the baseline scenario is the following:

- For SWH that displace technologies using fossil fuels: the fuel consumption of the technologies that would have been used in the absence of the PoA times an emission factor for the fossil fuel displaced.
- For SWH that displace electricity from the grid: as per AMS-I.D, the amount of grid energy displaced by the SWH expressed inMWh of electricity multiplied by the emission factor for the grid. The emission factor for grid electricity is calculated as per the procedures detailed in AMS.I.D, which refers to the “Tool to calculate the emission factor for an electricity system”.

D.5. Demonstration of eligibility for a CPA

>>
The proposed SSC CPA meets all the eligibility criteria for inclusion of a SSC CPA as listed in section
A.4.2.2. of the PoA-DD, i.e. the proposed SSC CPA only includes SWH that:

- are installed after signature of a Prosol 2 contract between the household installing the SWH and the ANME.
- are eligible and certified systems under Prosol 2, as defined in the latest version of Prosol 2 Specifications[12]
- are provided by suppliers certified under Prosol 2
- are installed by installers affiliated to a supplier certified under Prosol 2
- are installed in households in Tunisia
- are new equipment.

This can be confirmed by the information recorded in the Prosol 2 database for each SWH in the SSC CPA.

D.6. Estimation of emission reductions

D.6.1. Explanation of methodological choices

>>
The approved baseline and monitoring methodology AMS.I.C is applied to a typical SSC-CPA included in the PoA.The baseline scenario is the following:

- For SWH that displace technologies using fossil fuels: the fuel consumption of the technologies that would have been used in the absence of the SSC-CPA times an emission factor for the fossil fuel displaced.
- For SWH that displace electricity imported from the grid: as per AMS-I.D, the amount of grid energy displaced by the SWH expressed in MWh of electricity multiplied by the emission factor for the grid. The emission factor for grid electricity is calculated as per the procedures detailed in AMS.I.D, which refers to “Tool to calculate the emission factor for an electricity system”.

12 Programme de Promotion de l’Utilisation du Chauffe-eau Solaire en Tunisie – Prosol Tunisie- Cahier des charges relatif à l’éligibilité des fournisseurs au programme (Prosol - Specifications for the eligibility of suppliers to the programme) – latest version.

D.6.2. Data and parameters fixed ex-ante

Data / Parameter	**$w_{i,x}$**
Unit	%
Description	Weighting of water heater using energy source i in the baseline scenario for SSC-CPA x
Source of data	STEG
Value(s) applied	LPG fired water heaters: 57.9% Natural gas fired water heaters: 6.9% Electric water heaters: 8.7% Other: 26.5%
Choice of data or Measurement methods and procedures	The data is recorded in the Prosol 2 database and comes from a form filled in by the SWH installer during the installation of the SWH.
Purpose of data	Calculation of Baseline scenario
Additional comment	

Data / Parameter	**eff_i**
Unit	%
Description	Average efficiency of a water heater using energy source i
Source of data	RETScreen
Value(s) applied	LPG fired water heaters: 86% Natural gas fired water heaters: 86% Electric water heaters: 94% Solar water heaters: 94%
Choice of data or Measurement methods and procedures	The values chosen are highest efficiencies for typical residential water heaters given by the RETScreen® Software Online User Manual, Solar Water Heating Project Model (Typical Water Heating System Seasonal Efficiencies). This is published by the RETScreen International Clean Energy Decision Support Centre, which is managed by the Natural Resources Canada's (NRCan) CANMET Energy Technology Centre - Varennes (CETC-Varennes). "RETScreen is developed in collaboration with a number of other government and multilateral organisations, and with technical support from a large network of experts from industry, government and academia." (http://www.retscreen.net/ang/centre.php) This data complies with paragraph 22 c) of AMS.I.C version 17.
Purpose of data	Calculation of Baseline scenario
Additional comment	

Data / Parameter	**O_k**
Unit	MWh/y

Description	Annual energy output of SWH k
Source of data	SOLO software
Value(s) applied	See Appendix 4
Choice of data or Measurement methods and procedures	The values are the output of a SOLO, a recognized model calculating the energy output of a SWH. This model was developed by the Centre Scientifique et Technique du Bâtiment (Scientific and Technical Centre for the Construction Industry). “CSTB collaborates with contracting authorities, architects, research offices, manufacturers and entrepreneurs, and helps the French public authorities to define technical regulations and ensure the quality of buildings. CSTB is a State-owned industrial and commercial corporative, placed under the administrative supervision of the French Ministry of Housing. It is one of Europe's leading research and test laboratory in the area of solar thermal in Europe” (http://international.cstb.fr/frame.asp?URL=o verview/task.asp).
Purpose of data	Calculation of Baseline scenario
Additional comment	

Data / Parameter	**Conversion factor**
Unit	No unit
Description	Conversion factor from GJ to MWh
Source of data	
Value(s) applied	1/3.6
Choice of data or Measurement methods and procedures	
Purpose of data	Calculation of Baseline scenario
Additional comment	

Data / Parameter	$FC_{i,m,y}$
Unit	t, m3
Description	Amount of fossil fuel type i consumed by the group of power units m in year y (mass or volume unit)
Source of data	STEG Electricity Retrospective Statistics 1997-2007
Value(s) applied	See Appendix 4
Choice of data or Measurement methods and procedures	Official released statistics by the national power utility; publicly accessible and reliable data source; latest data available.
Purpose of data	Calculation of Baseline scenario

Additional comment	

Data / Parameter	**$NCV_{i,y}$**
Unit	GJ/mass or volume unit
Description	Net calorific value (energy content) of fossil fuel type i in year y
Source of data	STEG Electricity Retrospective Statistics 1997-2007
Value(s) applied	See Appendix 4
Choice of data or Measurement methods and procedures	Official released statistics by the national power utility; publicly accessible and reliable data source; latest data available.
Purpose of data	Calculation of Baseline scenario
Additional comment	

Data / Parameter	**$EF_{CO2,i,y}$**
Unit	tCO2/TJ
Description	CO2 emission factor of fossil fuel type i in year y
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	See Appendix 4
Choice of data or Measurement methods and procedures	IPCC default value
Purpose of data	Calculation of Baseline scenario
Additional comment	

Data / Parameter	**$EG_{m,y}$**
Unit	MWh
Description	Net electricity generated by power plant / unit m in year y
Source of data	STEG Electricity Retrospective Statistics 1995-2005
Value(s) applied	See Appendix 4
Choice of data or Measurement methods and procedures	Official released statistics by the national power utility; publicly accessible and reliable data source; latest data available.
Purpose of data	Calculation of Baseline scenario
Additional comment	

Data / Parameter	$\eta_{m,y}$
Unit	%
Description	Average net energy conversion efficiency of power unit m in year y
Source of data	Annex I of the "Tool to calculate the emission factor for an electricity system"
Value(s) applied	See Appendix 4
Choice of data or Measurement methods and procedures	Default value given by the EB.
Purpose of data	Calculation of Baseline scenario
Additional comment	

Data / Parameter	U
Unit	%
Description	Usage rate of the SWH
Source of data	"Figures of the Tunisian tourism 2008" ("Le tourisme tunisien en chiffres 2008") published by the National Tourism Bureau of Tunisia
Value(s) applied	99%
Choice of data or Measurement methods and procedures	"Figures of the Tunisian tourism 2008" state that the average length of hotel stays for Tunisian residents was 2.2 nights in 2008. This represents 0.6% of the year. As such, a 99% usage rate was defined for the SWH, which is higher than the statistics and is hence considered conservative.
Purpose of data	Calculation of Baseline scenario
Additional comment	

D.6.3. Ex-ante calculation of emission reductions

>>

Emission reductions calculation

$$ERy = BE_y - PE_y - LE_y \quad (1)$$

Where

ER_y Emission reductions in year y (tCO2)
BEy Baseline emissions in year y (tCO2)
PEy Project emissions in year y (tCO2)
LEy Leakage in year y (tCO2)

Leakage

SWH are not transferred from another activity, so no leakage is to be considered.

Therefore $LE_y = 0\ tCO_2$
And
$ERy = BEy - PEy$ **(2)**

Project emissions
According to AMS.I.C, no project emissions need to be taken into account.

Therefore, PEy = 0 tCO2/MWh.
As a result
$ERy = BEy$ **(3)**

Baseline emissions
As mentioned above and as defined in AMS.I.C, the baseline scenario is the following:

- For SWH that displace technologies using fossil fuels: the fuel consumption of the technologies that would have been used in the absence of the SSC-CPA times an emission factor for the fossil fuel displaced.
- For SWH that displace electricity imported from the grid: as per AMS-I.D, the amount of grid energy displaced by the SWH expressed in MWh of electricity multiplied by the emission factor for the grid. The emission factor for grid electricity is calculated as per the procedures detailed in AMS.I.D, which refers to "Tool to calculate the emission factor for an electricity system".

Therefore, baseline emissions are calculated as follows:

$$BEy = (\sum_k Nk * Ok) * (\sum_i w_i * EFi / eff_i) \qquad \textbf{(4)}$$

Where

$\sum k$	Sum over the SWH k installed in the SSC-CPA x
Nk	Number of SWH k installed in the SSC-CPA x
Ok	Estimated annual energy output of SWH k (MWh/y)
k	SWH type
$\sum i$	Sum over the energy source i used in the baseline scenario
wi,x	Weighting of water heater using energy source i in the baseline scenario for the SSC-CPA x (%)
$effi$	Average efficiency of water heater using energy source i
EFi	Emission factor EFi for energy source i[13] (tCO2/MWh)
i	Energy source: fossil fuels and electricity
U	Usage rate of the SWH (all types) in the SSC-CPA x (%)
Fx,y	Failure rate of the SWH (all types) in the SSC-CPA x in year y (%)

Details of the SWH installed in the SSC CPA (model, number of each model installed in the proposed SSC CPA and annual energy output of each model) are provided in Appendix 4.

13 For reasons of simplicity, energy sources refer to fossil fuels as well as electricity.

The Prosol 2 database records the energy source that was used prior to the installation of the SWH for each SWH included in the SSC-CPA. The following energy sources are used in the baseline:

- LPG
- Natural gas
- Electricity
- Other

The emission factor EF for the energy source i (tCO2/MWh) is obtained as follows:

Emission factors EF for fossil fuels

$$EF_i = EF_{CO2,i} \; x \; conversion \; factor \qquad \textbf{(5)}$$

Where

EF_i	CO2 emission factor of fossil fuel type i (tCO2/MWh)
$EF_{CO2,i}$	CO2 emission factor of fossil fuel type (tCO2/GJ)
conversion factor	Conversion factor GJ into MWh

Table D.6.1. CO2 emission factor of fossil fuels

Fossil fuel type	$EF_{CO2,i,y}$ **(tCO2/GJ)**	EF_i **(tCO2/MWh)**	**Source**
LPG	0.0631	0.227	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Natural gas	0.0561	0.202	2006 IPCC Guidelines for National Greenhouse Gas Inventories

Emission factor EF for grid electricity

AMS.I.C refers to the procedures detailed in AMS.I.D in order to calculate the emission factor for grid electricity.

AMS I.D. (Version 16, EB 51) offers two choices for calculating the emission coefficient:

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the “Tool to calculate the emission factor for an electricity system”.

OR

(b) The weighted average emissions (in tCO2/MWh) of the current generation mix. The data of the year in which project generation occurs must be used.

Option (a) above will be applied for this project, which uses a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the “Tool to calculate the emission factor for an electricity system”.

The description below follows the steps of the latest version of the “Tool to calculate the emission factor for an electricity system” and focuses on the key process of the calculation of the emission factors. The data used is from the Electricity Retrospective Statistics 1997-2007 published in October 2008 by the STEG, which was the most recent data available at the time of submission of

the CDM-PDD to the DOE for validation[14]. Please see Appendix 4 for the baseline data underlying the calculations.

Step 1. Identify the relevant electricity systems

Law number 62-8 (3 April 1962) defines the national utility (STEG) as the entity in charge of the production, transmission and distribution of electricity for the Tunisian grid. The Tunisian grid, comprising the power plants that are physically connected through transmission and distribution lines to the project activity and that can be dispatched without significant transmission constraints, as defined in the Electricity Retrospective Statistics 1997-2007 published by STEG, is identified as the relevant electric power system.

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

The “Tool to calculate the emission factor for an electricity system” offers 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 electrification rate in Tunisia is 99.5%[15]. As such off-grid power generation is not significant and is not likely to be displaced by CDM project activities. Therefore, Option I is applied and 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” offers four methods to calculate the OM emission factor (EFgrid,OM,y):

a) Simple OM, or
b) Simple adjusted OM, or
c) Dispatch data analysis OM, or
d) Average OM.

Of these procedures, Option (a) (Simple OM) is applied. This is because low-cost / must run resources constitute less than 50% of total grid generation in average of the five most recent years (see Table D.6.2. below).

Table D.6.2. Share of low-cost / must run resources in the total grid generation[16]

Low-cost / must run resources	2003	2004	2005	2006	2007
Generation (MWh)	199,400	197,200	208,400	191,100	188,100
Share (%) of total generation	1.82%	1.71%	1.67%	1.47%	1.42%

No power plants registered as CDM project activities are included in the sample group that is used to calculate the OM since there are no such power plants in Tunisia.

14 Data from the STEG Annual Reports 2005 and 2007 was also used in this section, but not in the calculations of the grid EF directly

15 STEG Annual report 2007.

16 STEG - Direction des Etudes et de la Planification - Statistiques Rétrospectives d'Electricité 1995-2005 (Electricity Retrospective Statistics 1995-2005); see Appendix 4 for detailed calculation.

The “Tool to calculate the emission factor for an electricity system” offers the choice between two data vintages calculate the Simple OM emission factor ($EF_{grid,OMsimple,y}$):

- Ex-ante option: If the ex ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PoA-DD to the DOE for validation. For off-grid power plants, use a single calendar year within the 5 most recent calendar years prior to the time of submission of the CDM-PDD for validation.
- Ex-post option: If the ex post option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring.

$EF_{grid,OMsimple,y}$ is calculated ex-ante using the data from 2005 to 2007, available in the Electricity Retrospective Statistics 1997-2007 which is the most recent data available at the time of submission of the CDM-PoA-DD to the DOE for validation. This data vintage remains fixed during the crediting period.

Step 4. Calculate OM emission factor according to the selected method

The “Tool to calculate the emission factor for an electricity system” offers two options to calculate $EF_{grid,OMsimple,y}$:

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

Option A is used.

Option A – Calculation based on average efficiency and electricity generation of each plant $EF_{grid,OMsimple,y}$, is calculated based on the net electricity generation of each power unit and an emissions factor for each power unit, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_{i} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}} \qquad \textbf{(6)}$$

Where

$EF_{grid,OMsimple,y}$	Simple operating margin CO2 emission factor in year y (tCO2/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$	CO2 emission factor of power unit m in year y (tCO2/MWh)
m	All power units serving the grid in year y except low-cost / must-run power units
y	The relevant year as per the data vintage chosen in step 3, i.e. the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation

Determination of EFEL,m,y

For power units m for which data on fuel consumption and electricity generation is available, option A1 is applied and the emission factor of each power unit m (EFEL,m,y) is calculated as follows:

$$EF_{EL,m,y} = \frac{\sum_{i} FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{m,y}} \quad \textbf{(7)}$$

Where

$EF_{EL,m,y}$	CO2 emission factor of power unit m in year y (tCO2/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 relevant year as per the data vintage chosen in Step 3

For power units m for which only data on electricity generation and the fuel types used is available, option A2 is applied and the emission factor of each power unit m (EFEL,m,y) is calculated as follows:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} x3.6}{\eta_{m,y}} \quad \textbf{(8)}$$

Where

$EF_{EL,m,y}$	CO2 emission factor of power unit m in year y (tCO_2/MWh)
$EF_{CO2,m,i,y}$	Average CO2 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 in except low-cost/must-run power units
y	The relevant year as per the data vintage chosen in Step 3

For power units m for which only data on electricity generation is available, option A3 is applied and an emission factor of 0 tCO2/MWh is assumed as a simple and conservative approach.

Determination of EGm,y

Since only grid power plants are included, *EGm,y* is determined once for each crediting period using the most recent three historical years for which data is available at the time of submission of the PDD to the DOE for validation.

Using the above methodological choices, the OM emission factor is calculated as:

$EF_{grid,OMsimple,y}$ = 0. 570 tCO_2/MWh

For detailed information, please see Appendix 4.

Step 5. Identify the group of power plants to be included in the build margin

According to the “Tool to calculate the emission factor for an electricity system”, the sample group of power units m used to calculate the build margin consists of either:

a) The set of five power units that have been built most recently, or
b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

Project participants should use the set of power units that comprises the larger annual generation.

In Tunisia, option a) and option b) comprise the same set of power plants, which account for 32% of the annual generation[17].

Since there is no power plants registered as CDM project activities in Tunisia, they are not taken into account in the build margin.

The “Tool to calculate the emission factor for an electricity system” offers the choice between two data vintages to calculate the BM:

- Option 1. For the first crediting period, the build margin emission factor is calculated 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.
- 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

The BM emission factor ($EF_{grid,BM,y}$) is calculated ex-ante using the data from 2005, available in the Electricity Retrospective Statistics 1997-2007. This data vintage remains fixed during the first crediting period and will be updated for the second crediting period.

Step 6. Calculate the build margin emission factor

According to the “Tool to calculate the emission factor for an electricity system”, $EF_{grid,BM,y}$ is the generation-weighted average emission factor of all power units m during the most recent year y for which power generation data is available, calculated as follows.

17 Electricity Retrospective Statistics 1997-2007; STEG - Annual Report 2005

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

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	Most recent historical year for which power generation data is available

The CO_2 emission factor of each power unit m ($EF_{EL,m,y}$) is to be determined as per the guidance in step 4 (a) for the simple OM, using option A1, with data from year 2007, which is the most recent historical year for which power generation data is available, and using for m the power units included in the build margin.

Using the above methodological choices, the BM emission factor is calculated as:
$EF_{grid,BM,y}$ = 0.531 tCO_2/MWh

For detailed information, please see Appendix 4.

Step 7. Calculate the combined margin emission factor

The combined margin (CM) emissions factor ($EF_{grid,CM,y}$) is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad \textbf{(11)}$$

Where:

$EF_{grid,CM,y}$	Combined margin CO2 emissions factor in year y (tCO2/MWh)
$EF_{grid,BM,y}$	Build margin CO2 emission factor in year y (tCO2/MWh)
$EF_{grid,OM,y}$	Operating margin CO2 emission factor in year y (tCO2/MWh)
w_{OM}	Weighting of operating margin emissions factor, which is 0.5 by default
w_{BM}	Weighting of build margin emissions factor, which is 0.5 by default

The calculated CM emission factor is:

$EF_{grid,CM,y}$ =0.570*0.5+0.531*0.5=0.550 tCO_2/MWh

For detailed information, please see Appendix 4.

Table D.6.3: Key information and data used to calculate the emission factor for grid electricity

Parameter	Value / Unit	Source
Operating Margin Emission Factor	0.570 tCO2/MWh	STEG - Electricity Retrospective Statistics 1997-2007
Build Margin Emission Factor	0.531 tCO2/MWh	STEG - Electricity Retrospective Statistics 1997-2007 and STEG – Annual Report 2005
Combined Margin Emission Factor	0.550 tCO2/MWh	STEG - Electricity Retrospective Statistics 1997-2007 and STEG – Annual Report 2005

Emission factors EF for other

This includes households which did not have a water heater previously as well as households for which no data was entered into the Prosol 2 database. This is calculated as the weighted average of the EF of the other energy sources in the CPA (LPG, natural gas, electricity), adjusted to take into account potential existing SWH installed before the programme in the baseline[18].

Table D.6.4. Emission factor for the category other

	tCO2/MWh
EF_{other}	0.288

Discount factors U and F

U is the usage rate of SWH introduced in order to reflect that households do not use their SWH 100% of the time. “Figures of the Tunisian tourism 2008” state that the average length of hotel stays for Tunisian residents was 2.2 nights in 2008. This represents 0.6% of the year. As such, a 99% usage rate was defined for the SWH, which is higher than the statistics and is hence considered conservative.

F is the failure rate of the SWH. The failure rate is determined by CPA through a yearly verification organized by ANME.

18 A 3% factor is used, which is the % of SWH in the water heater park in Tunisia as per the last “Survey of STEG clients from the residential sector”.

D.6.4. Summary of the ex-ante estimates of emission reductions

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
2011	7,160~~7,242~~	0	0	7,160~~7,242~~
2012	7,160~~7,242~~	0	0	7,160~~7,242~~
2013	7,160~~7,242~~	0	0	7,160~~7,242~~
2014	7,160~~7,242~~	0	0	7,160~~7,242~~
2015	7,160~~7,242~~	0	0	7,160~~7,242~~
2016	7,160~~7,242~~	0	0	7,160~~7,242~~
2017	7,160~~7,242~~	0	0	7,160~~7,242~~
2018	7,160~~7,242~~	0	0	7,160~~7,242~~
2019	7,160~~7,242~~	0	0	7,160~~7,242~~
2020	7,160~~7,242~~	0	0	7,160~~7,242~~
Total	**71,598~~72,421~~**	**0**	**0**	**71,598~~72,421~~**
Total number of crediting years	10			
Annual average over the crediting period	7,160~~7,242~~	0	0	7,160~~7,242~~

D.7. Application of the monitoring methodology and description of the monitoring plan

>>

D.7.1. Data and parameters to be monitored

Data / Parameter	**N_k**
Unit	number
Description	Number of SWH k installed in the SSC-CPA x
Source of data	Database developed by the ANME (Prosol 2 database)
Value(s) applied	14,690
Measurement methods and procedures	Each solar water heating system is covered by a contract between the owner and ANME. The type and serial number, owner, location, supplier and installation date are entered into the Prosol 2 database.
Monitoring frequency	
QA/QC procedures	ANME will carry out spot checks in order to ensure that the systems entered into the database are actually operating (see below Fx,y).
Purpose of data	Calculation of Baseline scenario
Additional comment	

Data / Parameter	**$F_{x,y}$**
Unit	%
Description	Failure rate of the SWH (all types) in the SSC-CPA x in year y
Source of data	Yearly verification done by ANME
Value(s) applied	1% (Based on the historical rate of failure recorded in the Prosol 2 database)
Measurement methods and procedures	The failure rate is determined by CPA through a yearly verification organized by ANME. The sample size of the verification is determined following the criterions given by EB50 Appendix 40 and the choice of the SWH to be verified is made through a randomized system. The failure percentage of the verification is applied to the whole population of the considered CPA.
Monitoring frequency	
QA/QC procedures	
Purpose of data	Calculation of Baseline scenario
Additional comment	

D.7.2. Description of the monitoring plan

>>

AMS.I.C offers four options for monitoring:

(a) Metering the energy produced by a sample of the systems where the simplified baseline is based on the energy produced multiplied by an emission coefficient.

(b) Metering the thermal and/or electrical energy produced:

(i) In the case of heat energy (e.g. hot air, hot water), direct measurement of flow and temperature is required.
(ii) In the case of steam energy, direct measurement of flow, temperature, pressure is required to determine enthalpy of the steam.

(c) If the emissions reduction per system is less than 5 tonnes of CO2 a year:
(i) Recording annually the number of systems operating (evidence of continuing operation, such as on-going rental/lease payments could be a substitute), if necessary using survey methods;
(ii) Estimating the annual hours of operation of an average system, if necessary using survey methods. Annual hours of operation can be estimated from total output (e.g. tonnes of grain dried) and output per hour if an accurate value of output per hour is available

(d) For household or commercial applications/systems, whose maximum output capacity is less than 45 kW thermal and where it can be demonstrated that the metering of thermal energy output is not plausible, as in the case of biomass stoves, gasifiers, driers, water heaters etc, the project output energy shall be estimated based on consumption of the biomass (in terms of energy quantity) times the efficiency of the project equipment.

As the emissions reduction per SWH is less than 5 tonnes of CO2 a year (between 0.2 and 1 tCO2/year), option (c) is applicable and chosen for the monitoring of the SSC-CPA. Therefore, the monitoring requirements are the following:
(i) Recording annually the number of systems operating.
(ii) Estimating the annual hours of operation of an average system.

(i) Recording annually the number of systems operating

Each SWH is covered by a contract between the owner and ANME. The type and serial number of the SWH, owner, location, supplier and installation date are entered into the Prosol 2 database. The database tracks the number of SWH k installed in the SSC-CPA x (Nk,x). The ANME manages the datab ase and is responsible for collecting and archiving the data.

To determine the number of operating SWH, an annual verification is implemented by the ANME. The aim of the verification is to assess whether or not the SWH installed as listed in the database are operating. The verification is done by CPA and not for the whole PoA. The sample size is determined by CPA in order to respect the requirements of Appendix 40 of EB50 (confidence level higher or equal to 90%, precision lower or equal to 10%, minimum sample size 50).
The SWH to be verified for each SSC-CPA are extracted from the Prosol 2 database by a randomized system. The result of the verification is the parameter Fx,y , given as a percentage of non operating SWH in the SSC-CPA x. This percentage is applied to the whole population of the SSC-CPA.
The number of SWH operating is calculated as the number of SWH installed in the SSC-CPA (Nk,x) adjusted to take into account the failure rate of the SWH in the SSC-CPA x, i.e as Nk,x * Fx,y.

The SSC-CPA does not involve the replacement of existing SWH. Therefore there is no leakage and no monitoring of scrapped equipment is required.

(ii) Estimating the annual hours of operation

The annual hours of operation are directly linked to the annual insolation[19] 18 incident on the collectors of the SWH. The annual insolation on the collectors is an input data to SOLO (see Appendix 4 for details). The data used is historical data and as such is considered a representative estimate of the annual hours of operation. The input for annual insolation is from the Tunis region.
Tunis region has less annual insolation than the other regions in Tunisia. . In addition, using the climatic conditions of the different meteorological stations of Tunisia and the actual repartition of the SWH by station would lead to higher emission reductions. As such, using data fixed ex-ante to estimate the annual hours of operation is conservative.

19 Insolation is derived from INcoming SOlar radiATION

SECTION E. Approval and authorization

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At the stage of the registration:

- Agence Nationale pour la Maîtrise de l'Energie (ANME) received the Letter of Approval for the Programme of Activities (PoA) "Solar Water Heater Programme in Tunisia" from the CDM Designated national Authority in Tunisia

At the current stage[20];

- Agence Nationale pour la Maîtrise de l'Energie (ANME) received the Letter of Approval for the Programme of Activities (PoA) "Solar Water Heater Programme in Tunisia" from the CDM Designated national Authority in Tunisia

Solvay Energy Services SAS received the Letter of Approval for the Programme of Activities (PoA) "Solar Water Heater Programme in Tunisia" from the French Designated national Authority

20 Due to the current Post Registration Change, the approval and authorization are indicated as in the current MOCs

Appendix 1. Contact information of CPA implementer(s) and responsible person(s)/ entity(ies) for completing the CDM-CPA-DD-FORM[21]

CPA implementer and/or responsible person/ entity	☒ CPA implementer(s) ☒ Responsible person/ entity for completing the CDM-CPA-DD-FORM
Organization	ANME
Street/P.O. Box	Citée Administrative Montplaisir, Avenue du Japon, BP 213
Building	
City	Tunis
State/Region	
Postcode	
Country	Tunisia
Telephone	(+216) 71 906 900
Fax	(+216) 71 904 624
E-mail	
Website	
Contact person	
Title	
Salutation	Mrs
Last name	Jaafar
Middle name	
First name	Afef
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	afef.jaafar@anme.nat.tn

21 The tables in appendix 1 were updated with the last information available in the MOCs and Annexes.Modifications linked to changes in the organizations

CPA implementer and/or responsible person/ entity	☐ CPA implementer(s) ☒ Responsible person/ entity for completing the CDM-CPA-DD-FORM
Organization	Solvay Energy Services
Street/P.O. Box	25 rue de Clichy
Building	
City	Paris
State/Region	
Postcode	75009
Country	France
Telephone	(+33) 4 37 24 88 69
Fax	(+33) 1 40 75 83 10
E-mail	
Website	
Contact person	
Title	
Salutation	Mr
Last name	Chevallier
Middle name	
First name	Philippe
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	philippe.chevallier@solvay.com

Appendix 2. Affirmation regarding public funding

All information regarding public funding is indicated in the relevant sections of the CPA-DD.

Appendix 3. Applicability of methodology(ies) and standardized baseline(s)

All information regarding applicability of methodology(ies) and standardized baseline(s)is indicated in the relevant sections of the CPA-DD.

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

BASELINE INFORMATION

Composition of the SSC CPA

Table 4.1. SWH installed in the proposed CPA-DD

SWH model (*k*)	Annual energy output (O_k) (MWh/y)	Number ($N_{k,x}$)
0101	1.232	127
0102	1.216	2054
0103	2.484	1635
0104	3.904	11
0105	1.354	96
0106	2.181	66
0108	1.450	1561
0109	2.568	923
0201	1.620	66
0202	2.249	25
0207	1.250	440
0208	2.390	114
0209	0.973	71
0210	2.035	30
0212	1.840	1
0301	0.920	811
0302	1.990	289
0303	2.560	99
0304	1.250	354
0305	~~0.942~~0.924	22
0306	2.071	86
0307	0.902	3
0308	2.020	41
0401	1.480	129
0402	2.340	48
0405	1.150	29
0407	1.107	97
0408	2.102	54
0503	1.010	21
0504	2.030	13
0701	0.920	66
0702	1.990	21
0801	2.380	172
0803	2.302	1
0804	0.955	39
0805	1.980	54
0806	0.852	180
0807	1.947	142

SWH model (*k*)	Annual energy output (O_k) (MWh/y)	Number ($N_{k,x}$)
0808	1.089	37
0903	1.500	148
0904	2.069	525
1102	1.075	4
1201	1.190	341
1202	2.420	549
1203	1.190	216
1204	2.420	178
1401	0.947	3
1402	~~1.008~~1.500	11
1403	~~1.260~~2.064	6
1601	1.118	209
1602	1.112	287
1603	2.314	261
1801	~~1.240~~1.234	2
1803	~~1.181~~0.962	919
1804	~~2.257~~2.069	490
1901	~~2.278~~1.400	84
1902	~~2.000~~2.538	30
1903	1.706	33
1904	2.887	14
2001	3.355	61
2002	1.658	80
2101	1.294	27
2102	1.174	63
2103	2.484	8
2104	2.351	6
2201	1.088	42
2202	2.006	65

Information regarding the values used for the parameter O (annual energy output of SWH k)

The values used for the annual energy output of a SWH k are the output of a recognised SWH model. The model currently used was developed by the Centre Scientifique et Technique du Bâtiment (Scientific and Technical Centre for the Construction Industry – CSTB)[22]19 and is called SOLO. It is used to predict the energy performances of SWH. The calculations of the energy performances of a SWH (yield in MWh produced per year) are based on correlations derived from a detailed physical model. The input data of the model are:

Parameter	**Source**
Type of system	Manufacturer specifications for the SWH *k*
Monthly hot water consumption in litres	Manufacturer specifications for the SWH *k*
Collector area (aperture area) in m^2	Manufacturer specifications for the SWH *k*
Collector orientation and tilt	Prosol specifications for the installation of the SWH
Collector characteristics (2 coefficients – zero loss efficiency and U value)	Manufacturer specifications for the SWH *k*
Location of the storage tank (inside vs. outside)	Prosol specifications for the installation of the SWH
Volume of the storage tank in litres	Manufacturer specifications for the SWH *k*
Number of tanks	Manufacturer specifications for the SWH *k*
Temperature of the hot water supplied	By default SOLO uses 60°C, which is the temperature needed for hygienic purposes. Nevertheless, a conservative value of 45°C is used.
Cooling constant (Wh/L.d.°C)	Manufacturer specifications
Climatic station and data (to be chosen in a list among different climatic stations in Tunisia) - temperature outside and of the water, collector insolation.	SOLO climatic data. The input is from the Tunis region. Tunis region has less annual insolation than the other regions in Tunisia. In addition, using the climatic conditions of the different meteorological stations of Tunisia and the actual repartition of the SWH by station would lead to higher emission reductions. As such this approach is conservative.

Applications of SOLO include:

- certification procedure of SWH, in addition to EN 12976, in countries such as France
- GSR procedure explained below[23]

22 CSTB collaborates with contracting authorities, architects, research offices, manufacturers and entrepreneurs, and helps the French public authorities to define technical regulations and ensure the quality of buildings. CSTB is a State-owned industrial and commercial corporative, placed under the administrative supervision of the French Ministry of Housing. It is one of Europe's leading research and test laboratory in the area of solar thermal in Europe" (http://international.cstb.fr/frame.asp?URL=overview/task.asp)

23 Van Cruchten, G. and Vis, I. (2004) Collection and analysis of RES calculation methods in EP calculation for existing housing."Build-On- RES" Project. This project has been initiated by OTB Research Institute for Housing, Urban and Mobility Studies and is co-financed by the European Commission in the framework of the Altener Programme.

In the PoA, SOLO is used by the technical committee of Prosol 2 when it examines the applications of SWH suppliers and SWH models to be certified under the programme. The manufacturer specifications used as inputs are from technical reports published by either a national (ENIT, INRST, CETIME [24]) or an international laboratory (CSTB, TÜV, European Communities Solar Collector Testing Group, DEMOKRITOS, etc.) and they comply with relevant European standards for SWH tests and from technical specifications provided by the SWH suppliers.

The SOLO model was first developed for a certain scheme and contract (Guaranteed Solar Results – GRS) implemented between SWH professionals and costumers aiming at optimising the estimate of energy supply by a SWH in order to provide the best services. In this contract it is agreed that costumers would be compensated for the loss in case the actual energy supply by the solar water heater installed was below the estimated supply. As a result, it is argued that the assessed performances of the SWH might be conservative[25].

The values used for each SWH are recorded in a database after approval by the Technical Committee of Prosol and will be available during verification.

24 ENIT: Ecole Nationale d'Ingénieurs de Tunis (National Engineering School of Tunis) ; INRST : Institut National de Recherche Scientifique et Technique (National Scientific and Technical Research Institute) ; CETIME: Centre Technique des Industries Mécaniques et Electriques (Technical Centre of Mechanical and Electrical Industries).

25 Sanders, J. (2001) Solar Results Purchasing – ETSU S/P3/00273/REP – DTI/Pub URN 01/1141. Report prepared as part of the UK government's Department of Trade and Industry Sustainable Energy Programmes.

Calculation of the grid electricity emission factor

Data used

Plant and type of fuel	Year of commission	Licensed capacity (MW)	Low-cost / must-run plant	Net electricity generation (MWh) (for OM and BM)			Fuel consumption - $FC_{,m,y}$*$NCV_{i,y}$ (GJ)		
				2005	2006	2007	2005	2006	2007
Grand Total		***3,195***		***12,445,900***	***12,783,600***	***13,242,180***	***95,912,931***	***95,891,704***	***101,201,152***
STEG generation		**2,697**		**9,481,700**	**9,868,500**	**10,132,180**	**95,912,931**	**95,891,704**	**101,201,152**
Steam turbines power plants		1,090		**5,343,900**	**5,173,600**	**5,926,200**	**58,583,506**	**57,516,960**	**64,865,757**
Residual fuel oil		0		2,600	0	0	0	0	0
Goulette II				2,600	0	0	0	0	0
Residual fuel oil (RFO) + natural gas (NG)		1,090		5,341,300	5,173,600	5,926,200	58,583,506	57,516,960	64,865,757
Ghannouch RFO		60		0	0	0	0	0	0
Ghannouch NG				212,900	317,700	332,400	3,035,849	4,605,145	4,737,992
Sousse RFO		320		0	62,800	27,400	0	733,862	305,134
Sousse NG				1,437,900	1,193,400	1,707,600	15,977,457	13,709,718	19,064,384
Radés A RFO		340		0	472,100	897,300	1,256,040	4,951,938	9,080,709
Radés A NG				1,721,100	1,106,000	1,262,200	17,386,231	12,112,999	13,547,815
Radés B RFO		370		0	411,600	466,800	795,492	4,159,586	4,792,169
Radés B NG				1,969,400	1,610,000	1,232,500	20,132,437	17,243,713	13,337,554
Gas turbine power plants		**1,161**		**1,507,100**	**1,680,600**	**1,806,680**	**17,045,133**	**15,072,689**	**17,970,164**
Small gas turbines		459		91,300	*265,400*	32,900	2,654,599	1,125,370	336,493
Tunis sud		66		6,700	6,700	800	10,467	116,770	14,026
Korba		56		42,900	42,900	8,400	2,389,825	699,614	140,383
Kasserine		68		10,900	10,900	3,800	191,923	182,419	62,551
Ghannouch		44		7,200	7,200	7,100	62,383	126,567	119,533
Bouchemma		181	**N**	13,700	13,700	10,300		235,926	174,590
Sfax		44		9,900	9,900	2,500		164,123	43,082
Large gas turbines		590		1,413,500	1,413,500	1,773,600	14,311,906	13,940,369	17,629,568
Bir Mcherga		242		309,700	309,700	367,700		4,079,157	4,803,013
Bouchemma				299,000	299,000	217,100	5,851,053	3,921,650	2,857,030
Thyna	2004	119		368,300	368,300	633,500	5,340,263	4,561,309	7,814,369
Goulette	2005	119		92,800	92,800	76,800	731,183	1,170,839	983,270
Feriana	2005	110		343,700	343,700	478,500	2,389,407	4,286,571	5,974,899
Gas oil turbine stations		112		2,300	*1,700*	180	78,628	6,950	4,103
Sfax				0	0	0	40,110	0	0
M.Bourguiba		44		1,300	400	100	20,934	6,611	2,177
Métlaoui		0		0	0	0	0	0	0
Korba				0	0	0	0	151	251
Kasserine				0	0	0	0	188	0
Robbana		34		1,000	0	40	16,747	0	795
Zarzis		34		0	0	40	837	0	879
Bir Mcherga				0	100	60	0	1,210	1,298
Feriana				0	0	0	0	867	586
Goulette				0	100	100	0	1,210	963
Thyna				0	0	0	0	791	16,873
Combined Cycle power plants		**364**		**2,422,300**	**2,823,200**	**2,211,200**	**20,284,292**	**23,302,054**	**18,365,231**
Sousse		364		2,422,300	2,823,200	2,211,200	20,284,292	23,302,054	18,365,231
Renewable power plants		**82**		***208,400***	***191,100***	***188,100***	**0**	**0**	**0**
Hydropower plants		63		*166,000*	*153,500*	*145,200*	0	0	0
Sidi Salem		33					0	0	0
Fernana		10					0	0	0
Nebeur		13					0	0	0
Aroussia		5	**Y**				0	0	0
Kasseb		1					0	0	0
Bouherthma	2003	2					0	0	0
Sejnene		1					0	0	0
Wind powerplants		19		42,400	37,600	42,900	0	0	0
Centrale éolienne Sidi Daoud		19		42,400	37,600	42,900	0	0	0
IPPs		**498**		**2,904,900**	**2,864,000**	**3,054,400**			
Gas turbine power plants		471		2,765,200	2,864,000	3,054,400	22,650,588	23,265,378	25,429,744
Carthage Power Company (CPC) -Radés	2001	471		2,765,200	2,864,000	3,054,400	22,650,588	23,265,378	25,429,744
Combined Cycle power plants		27	**N**	139,700	0	0			
Société d'Electricité d'El Bibane (SEEB)-ElBibane	2003	27		139,700	0	0			
Autoproduction supplied to the grid				**59,300**	**51,100**	**55,600**			
14 industries				59,300	51,100	55,600			

Source of information
STEG - Direction des Etudes et de la Planification - Statistiques Rétrospectives d'Électricité 1997-2007 STEG - Rapport Annuel 2005 (for the year built)

Given the lack of data on electricity generation, fossil fuel consumption, and commissioning dates for some power plants, some assumptions have to be made for the calculations of both operating and build margin emission factors.

Note on FC and NCV

Emission factors (tCO_2/t fuel) are IPCC default values. The fuel consumption is given in tonnes of oil equivalent (converted to GJ in the calculations) by the national utility. This is equivalent to $FC_{i,m,y}$ x $NCV_{i,y}$ from the Tool[26]. FC and NCV are thus not individualised in the emission factors calculations. This is in line with the Tool since the fuel consumption in toe incorporates the NCV provided by the national utility. The table below summarises the electricity generation and fuel consumption information available.

26 “Tool” in Annex 3 refers to the latest version of the “Tool to calculate the emission factor for an electricity system”

Calculation of the OM emission factor

Plant and type of fuel	Year of commission	Licensed capacity (MW)	Low-cost / must-run plant	$EG_{m,y}$ - Net electricity generated and delivered to the grid (MWh)			Fuel consumption - $FC_{i,m,y}$*$NCV_{i,y}$ (GJ)			$EF_{EL,m,y}$ (tCO_2/MWh)				Emissions OM - tCO_2 ($EG_{m,y}$-$EF_{EL,m,y}$)		
				2005	2006	2007	2005	2006	2007	*EF_{OM} Option*	2005	2006	2007	2005	2006	2007
Grand Total		***3,113***		***12,237,500***	***12,592,500***	***13,054,080***								*6,793,973*	*7,130,485*	*7,670,282*
Total for OM calculation				**12,237,500**	**12,592,500**	**13,054,080**										
STEG generation		**2,615**		**9,273,300**	**9,677,400**	**9,944,080**								**5,478,601**	**5,827,624**	**6,246,216**
Steam turbines power plants		1,090		**5,343,900**	**5,173,600**	**5,926,200**	**58,583,506**	**57,516,960**	**64,865,757**					3,165,791	3,427,703	3,930,221
Residual fuel oil		0		2,600	0	0	0	0						0	0	0
Goulette II				2,600	0	0	0	0	0	A1	0.000	0.000	0.000	0	0	0
Residual fuel oil (RFO) + natural gas (NG)		1,090		5,341,300	5,173,600	5,926,200	58,583,506	57,516,960	64,865,757					3,165,791	3,427,703	3,930,221
Ghannouch RFO		60		0	0	0	0	0	0	A1	0.000	0.000	0.000	0	0	0
Ghannouch NG				212,900	317,700	332,400	3,035,849	4,605,145	4,737,992	A1	0.799	0.812	0.798	170,008	257,888	265,328
Sousse RFO		320		0	62,800	27,400	0	733,862	305,134	A1	0.000	0.900	0.857	0	56,507	23,495
Sousse NG				1,437,900	1,193,400	1,707,600	15,977,457	13,709,718	19,064,384	A1	0.622	0.643	0.625	894,738	767,744	1,067,606
Radés 1A RFO		340		0	472,100	897,300	1,256,040	4,951,938	9,080,709	A1	0.000	0.808	0.779	0	381,299	699,215
Radés 1A NG				1,721,100	1,106,000	1,262,200	17,386,231	12,112,999	13,547,815	A1	0.566	0.613	0.601	973,629	678,328	758,678
Radés 1B RFO		370		0	411,600	466,800	795,492	4,159,586	4,792,169	A1	0.000	0.778	0.790	0	320,288	368,997
Radés 1B NG				1,969,400	1,610,000	1,232,500	20,132,437	17,243,713	13,337,554	A1	0.572	0.600	0.606	1,127,416	965,648	746,903
Gas turbine power plants		**1,161**		**1,507,100**	**1,680,600**	**1,806,680**	**17,045,133**	**15,072,689**	**17,970,164**					1,176,890	1,095,006	1,287,543
Small gas turbines		459		91,300	*265,400*	32,900	*2,654,599*	*1,125,370*	336,493		1.628	0.237	0.573	164,517	85,423	31,033
Tunis sud		66		6,700	6,700	800	10,467	116,770	14,026	A1	0.087	0.976	0.982	586	6,539	785
Korba		56		42,900	42,900	8,400	2,389,825	699,614	140,383	A1	3.120	0.913	0.936	133,830	39,178	7,861
Kass erine		68		10,900	10,900	3,800	191,923	182,419	62,551	A1	0.986	0.937	0.922	10,748	10,215	3,503
Ghannouch		44		7,200	7,200	7,100	62,383	126,567	119,533	A1	0.485	0.984	0.943	3,493	7,088	6,694
Bouchemma		181	**N**	13,700	13,700	10,300		235,926	174,590	A1/A2	0.672	0.964	0.949	9,206	13,212	9,777
Sfax		44		9,900	9,900	2,500		164,123	43,082	A1/A2	0.672	0.928	0.965	6,653	9,191	2,413
Large gas turbines		590		1,413,500	1,413,500	1,773,600	*14,311,906*	*13,940,369*	17,629,568		0.567	0.552	0.557	1,009,585	1,009,093	1,256,225
Bir M'cherga		242		309,700	309,700	367,700		4,079,157	4,803,013	A1/A2	0.672	0.738	0.731	208,118	228,433	268,969
Bouchemma				299,000	299,000	217,100	5,851,053	3,921,650	2,857,030	A1	1.096	0.734	0.737	327,659	219,612	159,994
Thyna	2004	119		368,300	368,300	633,500	5,340,263	4,561,309	7,814,369	A1	0.812	0.694	0.691	299,055	255,433	437,605
Goulette	2005	119		92,800	92,800	76,800	731,183	1,170,839	983,270	A1	0.441	0.707	0.717	40,946	65,567	55,063
Feriana	2005	110		343,700	343,700	478,500	2,389,407	4,286,571	5,974,899	A1	0.389	0.698	0.699	133,807	240,048	334,594
Gas oil turbine stations		112		2,300	*1,700*	180	*78,628*	*6,950*	4,103		2.530	0.303	1.687	2,788	489	285
Sfax				0	0	0	40,110	0	0	A1	0.000	0.000	0.000	0	0	0
M.Bourguiba		44		1,300	400	100	20,934	6,611	2,177	A1	1.192	1.223	1.611	1,549	489	161
Métlaoui				0	0	0	0	0	0	A1	0.000	0.000	0.000	0	0	0
Korba				0	0	0	0	151	251	A1	0.000	0.000	0.000	0	0	0
Kass erine				0	0	0	0	188	0	A1	0.000	0.000	0.000	0	0	0
Robbana		34		1,000	0	40	16,747	0	795	A1	1.239	0.000	1.472	1,239	0	59
Zarzis		34		0	0	40	837	0	879	A1	0.000	0.000	1.627	0	0	65
Combined Cycle power plants		**364**		**2,422,300**	**2,823,200**	**2,211,200**	**20,284,292**	**23,302,054**	**18,365,231**					**1,135,920**	**1,304,915**	**1,028,453**
Sousse		364		2,422,300	2,823,200	2,211,200	20,284,292	23,302,054	18,365,231	A1	0.469	0.462	0.465	1,135,920	1,304,915	1,028,453
IPPs		**498**		**2,904,900**	**2,864,000**	**3,054,400**								**1,315,372**	**1,302,861**	**1,424,066**
Gas turbine power plants		471		2,765,200	2,864,000	3,054,400	22,650,588	23,265,378	25,429,744					**1,268,433**	**1,302,861**	**1,424,066**
Carthage Power Company (CPC) - Radés	2001	471		2,765,200	2,864,000	3,054,400	22,650,588	23,265,378	25,429,744	A1	0.459	0.455	0.466	1,268,433	1,302,861	1,424,066
Combined Cycle power plants		27	**N**	139,700	0	0								**46,939**	**0**	**0**
Société d'Electricité d'El Bibane (SEEB)-ElBibane	2003	27		139,700	0	0				A2	0.336	0.336	0.336	46,939	0	0
Autoproduction supplied to the grid				**59,300**	**51,100**	**55,600**								**0**	**0**	**0**
14 industries				59,300	51,100	55,600				A3	0	0	0	0	0	0

Low-cost must run resources	2003	2004	2005	2006	2007
Generation (MWh)	199,400	197,200	208,400	191,100	188,100
% of total generation	1.82%	1.71%	1.67%	1.49%	1.42%

Results	
OM	**tCO_2/MWh**
2005	0.555
2006	0.566
2007	0.588
Average	**0.570**

Calculation of the BM emission factor

Plant and type of fuel	Year of commission	Licensed capacity (MW)	$EG_{m,y}$ - Net electricity generated and delivered to the grid (MWh)	Fuel consumption - $FC_{i,m,y}*NCV_{i,y}$	*EF_{OM} Option*	$EF_{EL,m,y}$ (tCO /MWh)	Emissions BM - tCO_2 ($EG_{m,y}*EF_{EL,m,y}$)
Total BM (option a = b)		***847.6***	***4,243,200***				*2,251,328*
Grand Total Grid		***3195.1***	***13,242,180***				
Total BM in % of Grand Total Grid			***32.0%***				
STEG generation		**349.6**	**1,188,800**	**14,772,538**			**827,262**
Gas turbine power plants		348	**1,188,800**	**14,772,538**			827,262
Large gas turbines			1,188,800	14,772,538			827,262
Thyna	2004	119	633,500	7,814,369	A1	0.691	437,605
Goulette	2005	119	76,800	983,270		0.717	55,063
Feriana	2005	110	478,500	5,974,899		0.699	334,594
Renewable power plants		2		**0**			
Hydropower plants				0			
Bouherthma	2003	2		0		0	
Sejnene	2005	1		0		0	
IPPs		**498**	**3,054,400**	**25,429,744**			**1,424,066**
Gas turbine power plants		471	3,054,400	25,429,744			**1,424,066**
Carthage Power Company (CPC) - Radés	2001	471	3,054,400	25,429,744	A1	0.466	1,424,066
Combined Cycle power plants		27	0				**0**
Société d'Electricité d'El Bibane (SEEB)-ElBibane	2003	27	0	0	A2	0.336	0

Results	tCO_2 /MWh
BM	**0.531**

Calculation of the CM emission factor

Results	
	tCO_2/MWh
OM	0.570
BM	0.531
CM	**0.550**

Appendix 5. Further background information on monitoring plan

All the monitoring information is indicated in the relevant sections of the CPA-DD.

Appendix 6. Summary of post registration changes

A Post Registration Change was required during the first issuance

By means of desk review and interview during on-site assessment, Applus+LGAI proceeded to raise CAR#1 which implies corrections on already registered CPA-1.

As per VVS and CDM PS requirements and after evaluating current version of CPA form and comparing the same with the already registered one, it is confirmed that CPA-1 version is needed to be updated to the current one.

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Document information

Version	*Date*	*Description*
05.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).
04.0	9 March 2015	Revisions to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Editorial improvement.
03.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the component project activity design document form for CDM component project activities (these instructions supersede the "Guidelines for completing the component project activity design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a CPA implementer and/or responsible person/ entity for completing the CDM-CPA-DD-FORM in A.13. and Appendix 1; • Add general instructions on post-registration changes in paragraph 4 and 5 of general instructions and Appendix 6; • Change the reference number from *F-CDM-CPA-DD* to *CDM-CPA-DD-FORM*; • Editorial improvement.
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the component project activity design document form" (EB 66, Annex 16).
01.0	27 July 2007	EB33, Annex42 Initial adoption.

Decision Class: Regulatory
Document Type: Form
Business Function: Registration
Keywords: component project activity, project design document