CLEAN DEVELOPMENT MECHANISM
SMALL-SCALE PROGRAM ACTIVITY DESIGN DOCUMENT FORM (CDM-SSC-CPA-DD)
Version 01

CONTENTS

Annexes

NOTE:

(i) This form is for submission of CPAs that apply a small scale approved methodology using the provision of the proposed small scale CDM PoA.

(ii) The coordinating/managing entity shall prepare a CDM Small Scale Programme Activity Design Document (CDM-SSC-CPA-DD)[1,2] that is specified to the proposed PoA by using the provisions stated in the SSC PoA DD. At the time of requesting registration the SSC PoA DD must be accompanied by a CDM-SSC CPA-DD form that has been specified for the proposed SSC PoA, as well as by one completed CDM-SSC CPA-DD (using a real case). After the first CPA, every CPA that is added over time to the SSC PoA must submit a completed CDM-SSC CPA-DD.

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1 The latest version of the template form CDM-CPA-DD is available on the UNFCCC CDM web site in the reference/document section.

2 At the time of requesting validation/registration, the coordinating managing entity is required to submit a completed CDM-POA-DD, the PoA specific CDM-CPA-DD, as well as one of such CDM-CPA-DD completed (using a real case).

SECTION A. General description of small scale CDM programme activity (CPA)

A.1. Title of the small-scale CPA:

>>
Solar Water Heater Programme in Tunisia – CPA 3
Version 3
16/07/2012

Version	Date	Comment
Version 1	20/12/2011	Submitted to the DOE for inclusion
Version 2	22/06/2012	PDD amended by ANME and Orbeo
Version 3	16/07/2012	PDD amended by ANME and Orbeo

A.2. Description of the small-scale CPA:

>>
The proposed small-scale CDM Programme Activity (SSC CPA) consists of a group of 13,729 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[3]. 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 50,420 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.3. Entity/individual responsible for the small-scale 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.4. Technical description of the small-scale CPA:

[3] 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[4]
- 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[5]. 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[6]. This ensures that only high quality equipment and service are provided to households taking part in the SSC CPA.

A.4.1. Identification of the small-scale CPA:

>>
Solar Water Heater Programme in Tunisia – CPA 3

A.4.1.1. Host Party:

[4] 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.

[5] 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.

[6] 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.

>>
Tunisia

A.4.1.2. Geographic reference or other means of identification allowing the unique identification of the small-scale CPA (maximum one page):

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Each of the 13,729 SWH is uniquely identified by its serial number. The set of 13,729 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.4.2. Duration of the small-scale CPA:

A.4.2.1. Starting date of the small-scale CPA:

>>
The starting date of the SSC CPA is 01/01/2009, which is the date when the first SWH of the proposed CPA was installed.

A.4.2.2. Expected operational lifetime of the small-scale CPA:

>>
15 years[7]

A.4.3. Choice of the crediting period and related information:

Fixed Crediting period

A.4.3.1. Starting date of the crediting period:

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The starting date of the crediting period is 24/08/2012 or when the SSC CPA is included, whichever is later.

A.4.3.2. Length of the crediting period, first crediting period if the choice is renewable CP:

>>
N/A

[7] See BIOME Solar Industry – Lifetime of SWH in Tunisia

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

>>

Year	Estimation of annual emission reductions in tonnes of CO_2e
24/08/2012 => 31/12/2012	1,796
2013	5,042
2014	5,042
2015	5,042
2016	5,042
2017	5,042
2018	5,042
2019	5,042
2020	5,042
2021	5,042
01/01/2022 => 23/08/2022	3,246
Total estimated reductions (tonnes of CO2e)	50,420
Total number of crediting years	10
Annual average of the estimated reductions over the crediting period (tCO2e)	5,042

A.4.5. Public funding of the CPA:

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

A.4.6. Information to confirm that the proposed small-scale CPA is not a de-bundled component

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The Guidelines on assessment of de-bundling for SSC project activities (version 3 – EB54) is used to demonstrate that the SSC CPA included in the PoA is not a de-bundled component of another CDM programme activity (CPA) or CDM project activity.

The maximum surface of each of the SWH collectors included in the SSC-CPA is below 10 m^2, which is less than 1% of the small scale threshold defined by AMS.I.C (1% of 64,000m2 = 640 m^2 > 10m^2).
In accordance with the Guidelines on assessment of de-bundling for SSC project activities, since each of the independent subsystems (i.e. SWH collectors) included in the CPA of the PoA is no greater than 1% of the small scale thresholds defined by the methodology applied, the SSC-CPA is exempted from performing de-bundling check, i.e. the SSC-CPA is considered as being not a de-bundled component of a large scale activity.

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A.4.7. Confirmation that small-scale CPA is neither registered as an individual CDM project activity or is part of another Registered PoA:

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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.

SECTION B. Eligibility of small-scale CPA and Estimation of emissions reductions

B.1. Title and reference of the Registered PoA to which small-scale CPA is added:

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Solar Water Heater Programme in Tunisia

B.2. Justification of the why the small-scale CPA is eligible to be included in the Registered PoA :

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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[8]
- 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.

B.3. Assessment and demonstration of additionality of the small-scale CPA , as per eligibility criteria listed in the Registered PoA:

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All the SWH under the SSC-CPA:

- 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[9]
- 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.

As a result, all the SWH under the SSC CPA meet the key criteria and data for assessing additionality of a SSC CPA listed in section E.5.2 of the PoA-DD of the registered PoA. This can be confirmed by the

[8] 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.

[9] 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.

information recorded in the Prosol 2 database for each SWH in the SSC CPA. Therefore, the SSC CPA is deemed to be additional.

B.4. Description of the sources and gases included in the project boundary and proof that the small-scale CPA is located within the geographical boundary of the registered PoA.

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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.

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 m^2 [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.

Table B.4.1 below summarises the emissions sources and gas included in the SSC CPA boundary.

Table B.4.1. Emission sources and gases included in the SSC CPA boundary

	Source	Gas	Included?	Justification / Explanation
Baseline	Fuel consumption of the technologies that would have been used in the absence of the	CO_2	Yes	According to AMS.I.C, only CO_2 emissions from fuel consumption should be accounted for.
		CH_4	No	According to AMS.I.C.

[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/m^2 of aperture area of glazed flat plate or evacuated tubular collector i.e. eligibility limit in terms of aperture area is 64000 m^2 of the collector.', (with 700 Wth/m^2 * 64,000 m^2 = 44,800,000 Wth = 44.8 MWth).

	project activity	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 CO_2 emissions from electricity generation should be accounted for.
		CH_4	No	According to AMS.I.C.
		N_2O	No	According to AMS.I.C.
SSC CPA	Solar water heaters thermal energy production	CO_2	No	According to AMS.I.C.
		CH_4	No	According to AMS.I.C.
		N_2O	No	According to AMS.I.C.

All the SWH in the proposed SSC CPA are installed in Tunisia, which is defined as the geographical boundary of the registered PoA in section A.4.1.2. of the PoA-DD of the registered PoA. Therefore, the SSC CPA is located within the geographical boundary of the registered PoA.

B.5. Emission reductions:

B.5.1. Data and parameters that are available at validation:

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Data / Parameter:	$w_{i,x}$
Data unit:	%
Description:	Weighting of water heater using energy source *i* in the baseline scenario for SSC-CPA *3*
Source of data used:	STEG
Value applied:	LPG fired water heaters: 49.1% Natural gas fired water heaters: 5.3% Electric water heaters: 11.7% Other: 33.9%
Justification of the choice of data or description of measurement methods and procedures actually applied :	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.
Any comment:	

Data / Parameter:	eff_i
Data unit:	%
Description:	Average efficiency of a water heater using energy source *i*
Source of data used:	RETScreen
Value applied:	LPG fired water heaters: 86% Natural gas fired water heaters: 86%

	Electric water heaters: 94% Solar water heaters: 94%
Justification of the choice of data or description of measurement methods and procedures actually applied :	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.
Any comment:	

Data / Parameter:	***O_k***
Data unit:	MWh/y
Description:	Annual energy output of SWH *k*
Source of data used:	SOLO software
Value applied:	See Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	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=overview/task.asp).
Any comment:	

Data / Parameter:	***Conversion factor***
Data unit:	No unit
Description:	Conversion factor from GJ to MWh
Source of data used:	
Value applied:	1/3.6
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	***$FC_{i,m,y}$***
Data unit:	t, m^3

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 used:	STEG Electricity Retrospective Statistics 2000-2010
Value applied:	See Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official released statistics by the national power utility; publicly accessible and reliable data source; latest data available.
Any comment:	

Data / Parameter:	$NCV_{i,y}$
Data unit:	GJ/mass or volume unit
Description:	Net calorific value (energy content) of fossil fuel type *i* in year *y*
Source of data used:	STEG Electricity Retrospective Statistics 2000-2010
Value applied:	See Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official released statistics by the national power utility; publicly accessible and reliable data source; latest data available.
Any comment:	

Data / Parameter:	$EF_{CO2,i,y}$
Data unit:	tCO_2/TJ
Description:	CO_2 emission factor of fossil fuel type *i* in year *y*
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	See Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default value
Any comment:	

Data / Parameter:	$EG_{m,y}$
Data unit:	MWh
Description:	Net electricity generated by power plant / unit *m* in year *y*
Source of data used:	STEG Electricity Retrospective Statistics 2000-2010
Value applied:	See Annex 3

Justification of the choice of data or description of measurement methods and procedures actually applied :	Official released statistics by the national power utility; publicly accessible and reliable data source; latest data available.
Any comment:	

Data / Parameter:	$\eta_{m,y}$
Data unit:	%
Description:	Average net energy conversion efficiency of power unit *m* in year *y*
Source of data used:	Annex I of the “Tool to calculate the emission factor for an electricity system”
Value applied:	See Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value given by the EB.
Any comment:	

Data / Parameter:	***U***
Data unit:	%
Description:	Usage rate of the SWH
Source of data used:	“Figures of the Tunisian tourism 2008” (“Le tourisme tunisien en chiffres 2008”) published by the National Tourism Bureau of Tunisia
Value applied:	99%
Justification of the choice of data or description of measurement methods and procedures actually applied :	“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.
Any comment:	

B.5.2. Ex-ante calculation of emission reductions:

>>

Emission reductions calculation

$$ER_y = BE_y - PE_y - LEy \quad (1)$$

Where

ER_y Emission reductions in year *y* (tCO_2)

BE_y Baseline emissions in year *y* (tCO_2)

PE_y Project emissions in year *y* (tCO_2)

LE_y Leakage in year *y* (tCO_2)

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

Therefore $LE_y = 0$ tCO_2
And
$$ER_y = BE_y - PE_y \quad \textbf{(2)}$$

Project emissions
According to AMS.I.C, no project emissions need to be taken into account.
Therefore, $PE_y = 0$ tCO_2/MWh.

As a result
$$ER_y = BE_y \quad \textbf{(3)}$$

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:

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

Where

$\sum k$	Sum over the SWH k installed in the SSC-CPA x
N_k	Number of SWH k installed in the SSC-CPA x
O_k	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
$w_{i,x}$	Weighting of water heater using energy source i[11] in the baseline scenario for the SSC-CPA x (%)
eff_i	Average efficiency of water heater using energy source i
EF_i	Emission factor EFi for energy source i (tCO_2/MWh)
i	Energy source: fossil fuels and electricity
U	Usage rate of the SWH (all types) in the SSC-CPA x (%)
$F_{x,y}$	Failure rate of the SWH (all types) in the SSC-CPA x in year y (%)

[11] For reasons of simplicity, energy sources refer to fossil fuels as well as electricity.

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 Annex 3.

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* (tCO_2/MWh) is obtained as follows:

Emission factors *EF* for fossil fuels

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

Where

EF_i	CO_2 emission factor of fossil fuel type *i* (tCO_2/MWh)
$EF_{CO2,i,}$	CO_2 emission factor of fossil fuel type (tCO_2/GJ)
conversion factor	Conversion factor GJ into MWh

Table B.5.1. CO_2 emission factor of fossil fuels

Fossil fuel type	$EF_{CO2,i,y}$ **(tCO_2/GJ)**	EF_i **(tCO_2/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 2000-2010* 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[12].. Please see Annex 3 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 2000-2010 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%[13]. 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 ($EF_{grid,OM,y}$):

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 E.6.1. below).

Table B.5.2. Share of low-cost / must run resources in the total grid generation[14]

[12] 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.

[13] *STEG Annual report 2007*.

Low-cost / must run resources	2006	2007	2008	2009	2010
Generation (MWh)	129,300	91,500	77,400	176,400	188,700
Share (%) of total generation	0.96%	0.66%	0.53%	1.18%	1.20%

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.

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 2008 to 2010, available in the *Electricity Retrospective Statistics 2000-2010* 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 CO_2 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:

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

Where

[14] STEG - Direction des Etudes et de la Planification - Statistiques Rétrospectives d'Electricité 2000-2010 (*Electricity Retrospective Statistics 2000-2010)*; see Annex 3 for detailed calculation.

$EF_{grid,OMsimple,y}$	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 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 $EF_{EL,m,y}$

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* ($EF_{EL,m,y}$) is calculated as follows:

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

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 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* ($EF_{EL,m,y}$) is calculated as follows:

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

Where

$EF_{EL,m,y}$	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$EF_{CO2m,,i,y}$	Average CO_2 emission factor of fuel type *i* used in power unit *m* in year *y* (tCO_2/GJ)
$\eta_{m,y}$	Average net energy conversion efficiency of power unit *m* in year *y* (ratio)
m	All power units serving the grid in year y 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 tCO_2/MWh is assumed as a simple and conservative approach.

Determination of $EG_{m,y}$

Since only grid power plants are included, $EG_{m,y}$ 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. 56256 tCO_2/MWh

For detailed information, please see Annex 3.

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 [15].

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 2010, available in the *Electricity Retrospective Statistics 2000-2010*. 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.

[15] *Electricity Retrospective Statistics 2000-2010; STEG - Annual Report 2010*

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad \textbf{(10)}$$

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 be determined as per the guidance in step 4 (a) for the simple OM, using option A1, with data from year 2010, 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:

$EF_{grid,BM,y}$ = 0.52199 tCO_2/MWh

For detailed information, please see Annex 3.

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 CO_2 emissions factor in year y (tCO_2/MWh)
$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$	Operating margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM}	Weighting of operating margin emissions factor, 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:

$EF_{grid,CM,y}$=0.56252*0.5+0.52199*0.5=0.54228 tCO_2/MWh

For detailed information, please see Annex 3.

Table B.5.3: Key information and data used to calculate the emission factor for grid electricity

Parameter	**Value / Unit**	**Source**
Operating Margin Emission Factor	0.56256 tCO_2/MWh	STEG - Electricity Retrospective Statistics 2000-2010
Build Margin Emission Factor	0.52199 tCO_2/MWh	STEG - Electricity Retrospective Statistics 2000-2010 and STEG – Annual Report 2010

Combined Margin Emission Factor	0.54228 tCO_2/MWh	STEG - Electricity Retrospective Statistics 2000-2010 and STEG – Annual Report 2010

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[16].

Table B.5.4. Emission factor for the category other

	tCO_2/MWh
EF_{other}	0.303

The approach to calculate the baseline emissions as explained above is the approach described in the generic CPA-DD that has been listed with the registration of the PoA. Due to inconsistencies found in the Prosol 2 database during the on-site visit, it was decided to move away from this approach in order to enhance conservativeness. Therefore, for CPA-3, the following assumptions were used to determine the baseline emissions:
1. For all the SWH installed in a Governorate where the natural gas is provided (even if it's only in some cities), it is assumed that natural gas was used prior to the installation of the SWH, therefore the emission factor of natural gas is used in the baseline emissions. The information provided by STEG (Société Tunisienne de l'Electricité et du Gaz), who is in charge of the Natural Gas distribution in Tunisia, was used to determine the Governorates where the natural gas is provided.

2. For all the SWH installed in a Governorate where the natural gas is not provided, it is assumed that LPG was used prior to the installation of the SWH. Therefore the emission factor of LPG is used in the baseline emissions. LPG is considered since it has the lowest emissions factor amongst the three remaining options (electricity, LPG, other).

Discount factors *U* and *F*

U and *F* are discount factors discussed at the end of section E.6.2.

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. See section E.7.2.

[16] 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".

B.5.3. Summary of the ex-ante estimation of emission reductions:

>>

Year	Estimation of project activity emissions (tonnes of CO2 e)	Estimation of baseline emissions (tonnes of CO2 e)	Estimation of leakage (tonnes of CO2 e)	Estimation of overall emission reductions (tonnes of CO2 e)
24/08/2012 => 31/12/2012	0	1,796	0	1,796
2013	0	5,042	0	5,042
2014	0	5,042	0	5,042
2015	0	5,042	0	5,042
2016	0	5,042	0	5,042
2017	0	5,042	0	5,042
2018	0	5,042	0	5,042
2019	0	5,042	0	5,042
2020	0	5,042	0	5,042
2021	0	5,042	0	5,042
01/01/2022 => 23/08/2022	0	3,246	0	3,246
Total (tonnes of CO2 e)	**0**	**50,420**	**0**	**50,420**

B.6. Application of the monitoring methodology and description of the monitoring plan:

B.6.1. Description of the monitoring plan:

>>

Data / Parameter:	N_k
Data unit:	number
Description:	Number of SWH *k* installed in the SSC-CPA *x*
Source of data to be used:	Database developed by the ANME (Prosol 2 database)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	13,729
Description of measurement methods and procedures to be applied:	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.
QA/QC procedures to be applied:	ANME will carry out spot checks in order to ensure that the systems entered into the database are actually operating (see below $F_{x,y}$).

Any comment:	

Data / Parameter:	$F_{x,y}$
Data unit:	%
Description:	Failure rate of the SWH (all types) in the SSC-CPA *x* in year *y*
Source of data to be used:	Yearly verification done by ANME
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1% (Based on the historical rate of failure recorded in the Prosol 2 database)
Description of measurement methods and procedures to be applied:	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 Annex 30 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.
QA/QC procedures to be applied:	

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 CO_2 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 CO_2 a year (between 0.2 and 1tCO_2/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* ($N_{k,x}$). The ANME manages the database 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 Annex 30 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 $\boldsymbol{F_{x,y}}$, 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 ($N_{k,x}$) adjusted to take into account the failure rate of the SWH in the SSC-CPA x, i.e as $N_{k,x} * F_{x,y}$.

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[17] incident on the collectors of the SWH. The annual insolation on the collectors is an input data to SOLO (see Annex 3 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.

[17] Insolation is derived from INcoming SOlar radiATION

SECTION C. Environmental analysis

C.1. Please indicate the level at which environmental analysis as per requirements of the CDM modalities and procedures is undertaken. Justify the choice of level at which the environmental analysis is undertaken:

✕
In accordance with the CDM-SSC-CPA-DD form, this section is ticked since this information is provided at the PoA level. In this case sections C.2. and C.3. need not be completed in this form.

C.2. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>
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. Please state whether an environmental impact assessment is required for a typical CPA, included in the programme of activities (PoA), in accordance with the host Party laws/regulations:

>>
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. Stakeholders' comments

>>

D.1. Please indicate the level at which local stakeholder comments are invited. Justify the choice:

✕
In accordance with the CDM-SSC-CPA-DD form, this section is ticked since this information is provided at the PoA level. In this case sections D.2. to D.4. need not be completed in this form.

D.2. Brief description how comments by local stakeholders have been invited and compiled:

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

D.3. Summary of the 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.

D.4. Report on how due account was taken of any 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.

Annex 1

CONTACT INFORMATION ON ENTITY/INDIVIDUAL RESPONSIBLE FOR THE SMALL-SCALE CPA

Organization:	ANME
Street/P.O.Box:	3 rue Chott Mariem Montplaisir, BP 213
Building:	
City:	Tunis
State/Region:	
Postfix/ZIP:	1073
Country:	Tunisie
Telephone:	(+216) 71 906 900
FAX:	(+216) 71 904 624
E-Mail:	
URL:	
Represented by:	
Title:	Director
Salutation:	Mrs
Last Name:	Osman
Middle Name:	
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

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

Annex 3

BASELINE INFORMATION

Composition of the SSC CPA

Table 3.1. SWH installed in the proposed CPA-DD

SWH model (*k*)	Annual energy output (O_k) (MWh/y)	Number ($N_{k,x}$)
101	1.232	1
102	1.216	2285
103	2.484	805
104	3.904	4
105	1.354	178
106	2.181	58
108	1.45	1386
109	2.568	649
201	1.62	73
202	2.249	45
205	1.24	3
207	1.25	69
208	2.39	28
209	0.973	625
210	2.035	68
211	0.918	1
212	1.84	31
213	2.123	15
214	1.203	14
301	0.92	308
302	1.99	161
303	2.56	1
304	1.25	166
305	0.924	80
306	2.071	120
307	0.902	37
308	2.02	1
403	1.36	1
405	1.15	67
406	2.38	1
407	1.107	3
408	2.102	10
409	1.266	111
410	1.974	49
411	0.926	72
412	2.048	10
501	1.07	1

SWH model (k)	Annual energy output (O_k) (MWh/y)	Number ($N_{k,x}$)
502	2.05	1
503	1.01	4
504	2.03	6
701	0.92	7
702	1.99	3
801	2.38	75
804	0.955	21
805	1.98	19
806	0.852	17
807	1.947	6
808	1.089	15
901	2.053	4
903	1.5	912
904	2.069	465
1201	1.19	387
1202	2.42	306
1203	1.19	118
1204	2.42	95
1303	1.194	8
1304	2.146	14
1401	0.947	9
1402	1.5	12
1403	2.064	5
1601	1.118	144
1602	1.112	183
1603	2.314	142
1801	1.234	1
1803	0.962	1352
1804	2.069	479
1905	1.256	327
1906	3.372	42
2001	3.355	4
2002	1.658	77
2101	1.294	29
2102	1.174	221
2103	2.484	13
2104	2.351	5
2201	1.088	143
2202	2.006	83
2301	1.044	67
2302	2.232	41
2401	0.966	182
2402	1.843	34
2601	0.915	10
2602	1.811	14
2605	0.969	1

SWH model (*k*)	Annual energy output (O_k) (MWh/y)	Number ($N_{k,x}$)
2702	1.017	12
2703	2.043	13
2801	1.206	17
2802	2.043	10
2901	0.949	18
3001	1.027	2
3002	2.118	1
3102	2.068	7
3403	1.5	5
3404	2.069	4

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)[18] 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[19]

[18] 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)

[19] 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[20]) 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[21].

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.

[20] 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).

[21] 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

Installed power capacities (MW)						
	Fuel	2006	2007	2008	2009	2010
COMBINED CYCLE PLANTS		**835**	**835**	**835**	**835**	**835**
CC-STEG/Sousse	Nat. Gas	364	364	364	364	364
CC-CPC/Radès	Nat. Gas	471	471	471	471	471
STEAM TURBINES		**1090**	**1090**	**1090**	**1090**	**1090**
Ghannouch	Bi-fuel (Nat. Gas and Fuel-oil)	60	60	60	60	60
Sousse		320	320	320	320	320
Radès A		340	340	340	340	340
Radès B		370	370	370	370	370
Goulette II						
GAS TURBINES		**1188**	**1308**	**1308**	**1434**	**1560**
Tunis-Sud	Nat. Gas	66	66	66	66	66
Korba	Nat. Gas	56	56	56	56	56
Kasserine	Nat. Gas	68	68	68	68	68
Ghannouch	Nat. Gas	44	44	44	44	44
Bouchemma	Nat. Gas	181	181	181	181	181
Sfax	Nat. Gas	44	44	44	44	44
M. Bourguiba	Gas-oil	44	44	44	44	44
Robbana	Gas-oil	34	34	34	34	34
Bir M'cherga	Nat. Gas	242	242	242	242	242
Zarzis	Gas-oil	34	34	34	34	34
Thyna	Nat. Gas	119	119	119	119	119
Thyna2	Nat. Gas		120	120	120	120
Thyna3	Nat. Gas					126
Goulette	Nat. Gas	119	119	119	119	119
Feriana	Nat. Gas	110	110	110	110	110
Feriana2	Nat. Gas				126	126
SEEB-El Bibane	Nat. Gas	27	27	27	27	27
HYDRO-POWER PLANTS		**66.1**	**66.1**	**66.1**	**66.1**	**66.1**
Sidi salem	Low-cost/must-run	36	36	36	36	36
Fernana		9.7	9.7	9.7	9.7	9.7
Nebeur		13	13	13	13	13
Aroussia		4.8	4.8	4.8	4.8	4.8
Kasseb		0.7	0.7	0.7	0.7	0.7
Bouhertma		1.3	1.3	1.3	1.3	1.3
Sejnene		0.6	0.6	0.6	0.6	0.6
WIND-POWER PLANTS		**19.3**	**19.3**	**19.3**	**55**	**55**
Sidi-Daoud I+II	Low-cost/ must-run	19.3	19.3	19.3	55	55
TOTAL INTERCONNECTED GRID		**3 198.4**	**3 318.4**	**3 318.4**	**3 480.1**	**3 606.1**

Source: Statistiques rétrospectives 2000-2010, pp. 30, Table 1

Production (GWh)					
Fuel type	**Plant**	**Technology**	**2008**	**2009**	**2010**
NATUREL GAS	Sousse	CC	1 642	2 229	2 786
	Radès CPC	CC	3 338	3 155	3 224
	Ghannouch	ST	365	302	257
	Sousse	ST	1 920	1 643	1 417
	Radès A	ST	1 677	1 718	2 023
	Radès B	ST	1 767	1 854	2 101
	Goulette	ST	0	0	0
	Tunis-Sud	GT	2	4	2
	Korba	GT	48	29	20
	Kasserine	GT	8	10	4
	Ghannouch	GT	6	3	3
	Bouchemma	GT	7	17	5
	Sfax	GT	3	4	2
	Bir M'cherga	GT	376	488	525
	Bouchemma	GT3	380	450	422
	Thyna	GT	778	724	940
	Thyna2	GT			
	Thyna3	GT			
	Goulette	GT	80	138	134
	Feriana	GT	433	522	735
	Feriana2	GT			
	SEEB	GT	102	114	2
FUEL OIL	Ghannouch	ST	0	0	0
	Sousse	ST	0	0	0
	Radès A	ST	346	343	2
	Radès B	ST	336	158	0
	Goulette II	ST	0	0	0
DIESEL	Sfax	GT			0
	M. Bourguiba	GT	0	0	1
	Metlaoui	GT			
	Korba	GT	0	0	0
	Kasserine	GT	0	0	0
	Robbana	GT	0	0	0
	Zarzis	GT	0	0	0
	Bir M'cherga	GT	0	0	0
	Radès A et B	ST			
	Bouchemma	GT			
	Feriana	GT			
	Goulette	GT	0	0	0
	Thyna	GT	0	0	0
Total production (GWh)			**13 613**	**13 906**	**14 606**

Source: Statistiques rétrospectives 2000-2010, p. 37, Table 12 and p. 36, table 9 for Radès CPC and SEEB

Fuel consumption (toe)					
Fuel type	**Plant**	**Technology**	**2008**	**2009**	**2010**
NATURAL GAS	Sousse	CC	334 139	442 839	547 590
	Radès CPC	CC	659 857	625 522	635 763
	Ghannouch	ST	124 002	103 361	88 679
	Sousse	ST	505 722	436 834	375 070
	Radès A	ST	431 957	452 986	529 418
	Radès B	ST	438 898	468 494	527 418
	Goulette	ST	0	0	0
	Tunis-Sud	GT	811	1 842	800
	Korba	GT	18 483	11 103	7 880
	Kasserine	GT	3 354	4 241	1 788
	Ghannouch	GT	2 215	1 252	1 199
	Bouchemma	GT	2 917	7 178	2 242
	Sfax	GT	1 258	1 676	818
	Bir M'cherga	GT	116 522	150 121	162 818
	Bouchemma	GT3	116 120	138 070	128 962
	Thyna	GT	229 724	211 990	280 211
	Thyna2	GT			
	Thyna3	GT			
	Goulette	GT	24 587	41 474	41 129
	Feriana	GT	128 937	155 954	219 513
	Feriana2	GT			
	SEEB	GT	39 863	37 371	719
FUEL OIL	Ghannouch	ST	0	0	0
	Sousse	ST	0	0	0
	Radès A	ST	83 297	83 333	513
	Radès B	ST	80 552	38 196	0
	Goulette II	ST	0	0	0
DIESEL	Sfax	GT	0	0	0
	M. Bourguiba	GT	77	77	195
	Metlaoui	GT			
	Korba	GT	1	3	0
	Kasserine	GT	1	0	0
	Robbana	GT	68	62	134
	Zarzis	GT	50	27	329
	Bir M'cherga	GT	33	24	33
	Radès A et B	ST			
	Bouchemma	GT	22	18	31
	Feriana	GT	15	125	112
	Goulette	GT	19	20	23
	Thyna	GT	79	55	329
TOTAL CONSUMPTION			**3 343 580**	**3 414 248**	**3 553 716**

Source: Statistiques rétrospectives 2000-2010, pp. 38, Table 13

Source of information
STEG - Direction des Etudes et de la Planification - Statistiques Rétrospectives d'Électricité 2000-2010
STEG - Rapport Annuel 2010 (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[22]. 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.

[22] "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

CO2 emissions (tCO2e)					
Fuel type	Plant	Technology	2008	2009	2010
NATUREL GAS	Sousse	CC	759 642	1 006 765	1 244 909
	Radès CPC	CC	1 500 140	1 422 082	1 445 364
	Ghannouch	ST	281 910	234 984	201 606
	Sousse	ST	1 149 725	993 113	852 696
	Radès A	ST	982 025	1 029 833	1 203 596
	Radès B	ST	997 805	1 065 089	1 199 049
	Goulette	ST	0	0	0
	Tunis-Sud	GT	1 844	4 188	1 819
	Korba	GT	42 020	25 242	17 915
	Kasserine	GT	7 625	9 642	4 065
	Ghannouch	GT	5 036	2 846	2 726
	Bouchemma	GT	6 632	16 319	5 097
	Sfax	GT	2 860	3 810	1 860
	Bir M'cherga	GT	264 905	341 290	370 156
	Bouchemma	GT3	263 991	313 893	293 186
	Thyna	GT	522 262	481 945	637 041
	Thyna2	GT	0	0	0
	Thyna3	GT	0	0	0
	Goulette	GT	55 897	94 288	93 504
	Feriana	GT	293 130	354 551	499 048
	Feriana2	GT	0	0	0
	SEEB	GT	90 626	84 960	1 635
FUEL OIL	Ghannouch	ST	0	0	0
	Sousse	ST	0	0	0
	Radès A	ST	263 305	263 418	1 622
	Radès B	ST	254 628	120 739	0
	Goulette II	ST	0	0	0
DIESEL	Sfax	GT	0	0	0
	M. Bourguiba	GT	234	234	593
	Metlaoui	GT	0	0	0
	Korba	GT	3	9	0
	Kasserine	GT	3	0	0
	Robbana	GT	207	188	407
	Zarzis	GT	152	82	1 000
	Bir M'cherga	GT	100	73	100
	Radès A et B	ST	0	0	0
	Bouchemma	GT	67	55	94
	Feriana	GT	46	380	340
	Goulette	GT	58	61	70
	Thyna	GT	240	167	1 000
Total CO2 emissions (tCO2e)			**7 747 115**	**7 870 246**	**8 080 498**

	2008	2009	2010
Average emission factor (tCO2/GWh)	569.1	566.0	553.2

$EF_{OM,2008-2010}$	0.56256	tCO2/MWh

Calculation of the BM emission factor

Designation	Technology	Energy used	Commissioning date	Installed power (MW)	Production in 2010 (GWh)	CO2 emission factor (tCO2/TJ)	Fuel consumption (toe)	CO2 emissions (tCO2e)
CPC	Combined cycle	Natural Gas	2001	471	3 223.9	54 300	635 763	1 445 364
Thyna	Gas turbine	Natural Gas	2004	119	940.2	54 300	280 211	637 041
Thyna2	Gas turbine	Natural Gas	2007	120	0.0	54 300	0	0
Thyna3	Gas turbine	Natural Gas	2007	120	0.0	54 300	0	0
Goulette	Gas turbine	Natural Gas	2005	119	134.3	54 300	41 129	93 504
Feriana	Gas turbine	Natural Gas	2005	110	734.9	54 300	219 513	499 048
Feriana2	Gas turbine	Natural Gas	2009	126	0.0	54 300	0	0
SEEB	Gas turbine	Natural Gas	2003	27	2.2	54 300	791	1 798
Sejnane*	Hydro	Hydro power	2005	0.6	0.5	0	0	0
Bouhartma*	Hydro	Hydro power	2003	1.3	1.0	0	0	0
Sidi Daoud II	Wind	Wind power	2009	34.7	91.0	0	0	0
TOTAL				**1212**	**5 127.9**			**2 676 755**
Share of total electricity Production (%)					32.5%			

**The actual power generation data for Sejnane and Bouhartma are not available, hence the generation is assumed to be proportional to the power rate.*

EF_{BM}	0.52199	tCO2/MWh

Calculation of the CM emission factor

Operating Margin (weighted average 2008-2010)	**0.56256**	**tCO2/MWh**	W_{OM}	0.5
Build Margin (b)	**0.52199**	**tCO2/MWh**	W_{BM}	0.5

Combined Margin (tCO2/MWh)	**0.54228**	**tCO2/MWh**

Annex 4

MONITORING INFORMATION

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

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