



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

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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.

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:

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Solar Water Heater Programme in Tunisia – CPA X

Version 5

16/02/2011

Version	Date	Comment
Version 1	22/04/2008	Submitted to the Tunisian DNA for approval
Version 2	16/01/2009	Submitted to the DOE for validation
Version 3	21/06/2010	Modified to address validation findings
Version 4	30/09/2010	Modified to address validation findings
Version 5	16/02/2011	Modified to address findings from the DOE's Certification Body

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

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

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 government³. 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. 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:

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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 collected⁴
- 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 m². 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 Specifications⁵. 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 criteria⁶. 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:

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Solar Water Heater Programme in Tunisia – CPA X

A.4.1.1. Host Party:

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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 SWH in the SSC CPA is uniquely identified by its serial number. The set of serial numbers of all SWH in the SSC CPA will allow the unique identification of the SSC CPA. This information will be made available during verification. The following information will also be 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:

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The starting date of the SSC CPA is the date when the first SWH of the proposed CPA is installed.

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

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15 years⁷

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 whenever the CPA is added to the corresponding registered SSC PoA.

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

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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:

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Year	Estimation of annual emission reductions in tonnes of CO ₂ e
20XX	
20XX	
20XX	
20XX	
20XX	
20XX	
20XX	
20XX	
20XX	
20XX	
Total estimated reductions (tonnes of CO₂e)	
Total number of crediting years	10
Annual average of the estimated reductions over the crediting period (tCO₂e)	

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) are 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 m², which is less than 1% of the small scale threshold defined by AMS.I.C (1% of 64,000m² = 640 m² > 10m²).

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.



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 Specifications⁸
- 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 Specifications⁹
- 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.

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..



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 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: for each SSC-CPA 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 equal or less to the 64,000 m²¹⁰:
- 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
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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).



Baseline	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 CO ₂ emissions from fuel consumption should be accounted for.
		CH ₄	No	According to AMS.I.C.
		N ₂ O	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 ₂ O	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 ₂ O	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 x
Source of data used:	Prosol 2 database
Value applied:	LPG fired water heaters: XX Natural gas fired water heaters: XX Electric water heaters: XX Other: XX
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 the 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.etscreen.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 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:	<i>Conversion factor</i>
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 1997-2007
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 1997-2007
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:	$EF_{CO_2,i,y}$
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 1997-2007



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

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

Where

ER_y Emission reductions in year y (tCO₂)
 BE_y Baseline emissions in year y (tCO₂)
 PE_y Project emissions in year y (tCO₂)



LE_y Leakage in year y (tCO₂)

Leakage

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

Therefore $LE_y = 0$ tCO₂

and

$$ER_y = BE_y - PE_y \quad (2)$$

Project emissions

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

Therefore, $PE_y = 0$ tCO₂/MWh.

As a result

$$ER_y = BE_y \quad (3)$$

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:

$$BE_y = \left(\sum_k N_{k,x} * O_k \right) * \left(\sum_i w_{i,x} * EF_i / eff_i \right) * U * F_{x,y} \quad (4)$$

Where

\sum_k	Sum over the SWH k installed in the SSC-CPA x
$N_{k,x}$	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 EF_i 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.



A table such as the one below will be provided in Annex 3 for each SSC CPA.

Table 3.1. SWH installed in the proposed CPA-DD

SWH model (<i>k</i>)	Annual energy output (<i>O_k</i>) (MWh/y)	Number (<i>N_{k,x}</i>) ¹²
<i>k1</i>		
<i>k2</i>		
...		

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

$$EF_i = EF_{CO_2,i} \times \text{conversion factor} \quad (5)$$

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

¹² This information will be provided during verification for SSC CPAs for which the exact composition is not known at the start of the CPA. An estimation will be used for the purpose of calculating *ex-ante* the emissions reductions.



Table B.5.1. CO₂ emission factor of fossil fuels

Fossil fuel type	$EF_{CO_2,i,y}$ (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 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 validation¹³. 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 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)

¹³ 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.



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%¹⁴. 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 generation¹⁵

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.

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.

¹⁴ STEG Annual report 2007.

¹⁵ STEG - Direction des Etudes et de la Planification - Statistiques Rétrospectives d'Electricité 1995-2005 (*Electricity Retrospective Statistics 1995-2005*); see Annex 3 for detailed calculation.



- *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:

$$EF_{grid,OMsimple,y} = \frac{\sum_i EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (6)$$

Where

$EF_{grid,OMsimple,y}$	Simple operating margin CO ₂ emission factor in year y (tCO ₂ /MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$	CO ₂ emission factor of power unit m in year y (tCO ₂ /MWh)
m	All power units serving the grid in year y except low-cost / must-run power units
y	The 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:

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

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)
$EF_{CO_2,i,y}$	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:

$$EF_{EL,m,y} = \frac{EF_{CO_2,m,i,y} \times 3.6}{\eta_{m,y}} \quad (8)$$

Where

$EF_{EL,m,y}$	CO ₂ emission factor of power unit m in year y (tCO ₂ /MWh)
$EF_{CO_2,m,i,y}$	Average CO ₂ emission factor of fuel type i used in power unit m in year y (tCO ₂ /GJ)
$\eta_{m,y}$	Average net energy conversion efficiency of power unit m in year y (ratio)
m	All power units serving the grid in year y 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 $EG_{m,y}$

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:

$EF_{grid,OMsimple,y} = 0.570 \text{ tCO}_2/\text{MWh}$

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:

- The set of five power units that have been built most recently, or
- 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 generation¹⁶.

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 2007, 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.

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

Where

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

The CO₂ emission factor of each power unit *m* ($EF_{EL,m,y}$) is determined as per the guidance in step 4 (a) for the simple OM, 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:

$EF_{grid,BM,y} = 0.531 \text{ tCO}_2/\text{MWh}$

For detailed information, please see Annex 3.

¹⁶ STEG Electricity Retrospective Statistics 1997-2007; STEG - Annual Report 2005



Step 7. Calculate the combined margin emission factor

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

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

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:

$$EF_{grid,CM,y} = 0.570 \times 0.5 + 0.531 \times 0.5 = 0.550 \text{ tCO}_2/\text{MWh}$$

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	0.570 tCO ₂ /MWh	STEG - Electricity Retrospective Statistics 1997-2007
Build Margin Emission Factor	0.531 tCO ₂ /MWh	STEG - Electricity Retrospective Statistics 1997-2007 and STEG – Annual Report 2005
Combined Margin Emission Factor	0.550 tCO ₂ /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 baseline¹⁷.

The EF for the category “other” is specific to each CPA.

Table B.5.4. Emission factor for the category other

	tCO ₂ /MWh
EF_{other}	XX (specific to each CPA)

¹⁷ 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”.



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.

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

>>

Year	Estimation of project activity emissions (tonnes of CO ₂ e)	Estimation of baseline emissions (tonnes of CO ₂ e)	Estimation of leakage (tonnes of CO ₂ e)	Estimation of overall emission reductions (tonnes of CO ₂ e)
Year A				
Year B				
Year C				
Year ...				
Total (tonnes of CO ₂ e)				

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

B.6.1. Description of the monitoring plan:

>>

Data / Parameter:	$N_{k,x}$
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
Value of data applied for the purpose of calculating expected emission reductions in section B.5	To be determined in each SSC-CPA-DD (Prosol 2 database)
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	To be determined in each SSC-CPA-DD
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 criteria 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 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 1tCO₂/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 CPA are extracted from the Prosol 2 database by a randomized system. The result of the verification is the parameter $F_{x,y}$, given as a percentage of non operating SWH in the SSC-CPA x . This percentage is applied to the whole population of the 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 insolation¹⁸ 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.

¹⁸ 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:	
First Name:	Néjib
Department:	Studies and Planning & Prosol
Mobile:	
Direct FAX:	(+216) 71 906 900
Direct tel:	(+216) 71 908 997
Personal E-Mail:	Osman.nejib@anme.nat.tn





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 ($N_{k,x}$)
k1	annual energy output k1	number of SWH k1 in the SSC CPA x
k2	annual energy output k12	number of SWH k2 in the SSC CPA x
...
Total		Total number of SWH in the SSC CPA

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)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

¹⁹ 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>)



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 for the SWH <i>k</i>
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 below²⁰

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, CETIME²¹) 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

²⁰ 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.

²¹ 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).



was below the estimated supply. As a result, it is argued that the assessed performances of the SWH might be conservative²².

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.

²² 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.



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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 _v (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		13,700	13,700	10,300	235,926	235,926	174,590
Sfax		44		9,900	9,900	2,500	164,123	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	5,851,053	4,079,157	4,803,013
Bouchemma				299,000	299,000	217,100	3,921,650	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	383,270
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.Bourouiba		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	537	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					0	0	0
Kasseb		1					0	0	0
Bouherthma	2003	2					0	0	0
Sejhene		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		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 (tCO₂/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 $FC_{i,m,y} \times NCV_{i,y}$ from the Tool²³. 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.

²³ “Tool” in Annex 3 refers to the latest version of the “Tool to calculate the emission factor for an electricity system”



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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 _{L,m,y} *NCV _{L,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	N	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	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				0	0	0	0	0	0	A1	0.000	0.000	0.000	0	0	0	
Ghannouch NG		60		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				0	62,800	27,400	0	733,862	305,134	A1	0.000	0.900	0.857	0	56,507	23,495	
Sousse NG		320		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	
Radès 1A RFO				0	472,100	897,300	0	4,951,938	9,080,709	A1	0.000	0.808	0.779	0	381,299	699,215	
Radès 1A NG		340		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	
Radès 1B RFO				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	
Radès 1B NG		370		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	
Kasserine		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		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	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		
MBourguiba		44	1,300	400	100	20,934	6,611	2,177	A1	1.192	1.223	1.611	1,549	489	161		
Mélaoui			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		
Kasserine			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) - Radès	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	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	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%

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Results	
OM	tCO ₂ /MWh
2005	0.555
2006	0.566
2007	0.588
Average	0.570



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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 ₂ /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

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Calculation of the CM emission factor

Results	
	tCO ₂ /MWh
OM	0.570
BM	0.531
CM	0.550

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NAME /TITLE OF THE PoA: Solar Water Heater Programme in Tunisia



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Annex 4

MONITORING INFORMATION

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