



**Monitoring report form for CDM programme of activities  
(version 01.0)**

*Complete this form in accordance with the Attachment "Instructions for filling out the monitoring report form for CDM programme of activities" at the end of this form.*

**MONITORING REPORT**

<b>Title of the programme of activities (PoA)</b>	Solar Water Heater Programme in Tunisia	
<b>UNFCCC reference number of the PoA</b>	4659	
<b>Version number(s) of the PoA-DD(s) applicable to this monitoring report</b>	Version 6	
<b>Coordinating/managing entity (CME)</b>	Agence Nationale pour la Maîtrise de l'Energie (ANME)	
<b>Version number of this monitoring report</b>	4.0	
<b>Completion date of this monitoring report</b>	29/03/2017	
<b>Monitoring period number and dates covered by this monitoring report</b>	MP 1 : 13/05/2011 to 31/12/2014	
<b>Monitoring report number for this monitoring period</b>	1	
<b>Host Party(ies)</b>	Host Party(ies) of the PoA	Is this a host Party to a specific-case CPA covered in this monitoring report?(yes/no)
	Tunisia	Yes
<b>Sectoral scope(s)</b>	Sectoral scope 1 - Energy industries (renewable - / non-renewable sources)	
<b>Selected methodology(ies)</b>	AMS.I.C. Thermal energy production with or without electricity, version 17	
<b>Selected standardized baseline(s)</b>	N/A	
<b>Total amount of GHG emission reductions or net GHG removals by sinks for all specific-case CPAs in the PoA covered in this monitoring report</b>	GHG emission reductions or net GHG removals by sinks reported up to 31 December 2012	GHG emission reductions or net GHG removals by sinks reported from 1 January 2013 onwards
	17,985.0	72,163.0

## PART I - Programme of activities

### SECTION A. Description of PoA

#### A.1. Brief description of the PoA

The small-scale programme of activities (hereafter referred to as “the PoA”) is a programme for the installation of domestic solar water heaters (hereafter referred to as “SWH”) in households throughout Tunisia. The objective of the PoA is to support the development of solar energy for water heating in Tunisia, in line with the 11<sup>th</sup> Plan set by the Tunisian government<sup>1</sup>.

The PoA is a voluntary action, not required by law, launched in January 2007 by the Tunisian National Agency for Energy Conservation (Agence Nationale pour la Maîtrise de l'Energie – ANME) and is undertaken in conjunction with a nation-wide loan support solar programme known as “Prosol 2 – Residential”. The stated goal of the PoA is to install around 30,000 SWH per year in households, thereby displacing carbon intensive electricity from the grid and fossil fuels currently used to provide hot water in the households.

The ANME (Agence Nationale pour la Maîtrise de l'Energie) is the coordinating and managing entity (CME) of the PoA and acts as a coordinator between the different stakeholders involved in the PoA<sup>2</sup>:

- The households willing to install a SWH
- The SWH suppliers and installers certified by the ANME
- The Société Tunisienne de l'Electricité et du Gaz (STEG - Tunisian Electricity and Gas Company), and
- The Tunisian government, granting a subsidy for the purchase of SWH

The ANME signed in 2007 an agreement with the STEG, which plays the role of intermediary between the households and Attijari bank. Attijari bank grants a loan to the households wishing to benefit from the loan support programme and the STEG allows the households to reimburse the loan through its electricity bill over 5 years. This is done through a form part of the application package submitted to the ANME by the suppliers. As such, households only interact with the suppliers and do not need to interact directly with the STEG and the Bank to take part in the programme and enjoy the benefits it offers. The ANME also examines the requests for certification of SWH suppliers as well as SWH models under the PoA, thereby ensuring that high quality equipment is used. After the installation of the SWH, the ANME also deals with maintenance requests and actions for SWH that have a failure.

A typical CPA consists of a group of SWHs installed over a period of six months. The total number of installed square meters of collectors of each individual CPA remains below the small-scale threshold of 64,000m<sup>2</sup> applicable to solar energy projects, as per Appendix B to the decision 21/cp.8 of the document FCCC/CP/2002/7/Add.3.

<sup>1</sup> Ministère du Développement et de la Coopération Internationale (Ministry of Development and International Cooperation) – March 2006 - Note d'orientation du XI<sup>ème</sup> Plan et de la décennie 2007-2016

<sup>2</sup> The exact involvement of each stakeholder might slightly evolve throughout the time but this will not impact the structure and objective of the PoA and the CPAs.

**A.1.1. Generic CPA(s)**

<b>Title, identification/reference number and/or version number of the generic CPA(s) of the PoA</b>	<b>Sectoral scope(s)</b>	<b>Applied methodology(ies) or combination of methodologies and/or standardized baseline(s)</b>
Solar Water Heater Programme in Tunisia – CPA X - Version 5	Sectoral scope 1 - Energy industries (renewable - / non-renewable sources)	AMS.I.C. Thermal energy production with or without electricity, version 17

**A.1.2. Specific-case CPA(s) covered in this monitoring report**

<b>Reference number of the specific-case CPA included in the PoA as of the end of this monitoring period</b>	<b>Title, identification/ reference number and version number of the generic CPA to which the specific-case CPA applies</b>	<b>Crediting period dates of the specific-case CPA</b>	<b>Is this specific-case CPA covered in this monitoring report? (yes/no)</b>
4659-0001	Solar Water Heater Programme in Tunisia – CPA X - Version 6.1 <sup>3</sup>	13/05/2011 – 12/05/2021	yes
4659-0002	Solar Water Heater Programme in Tunisia – CPA X - Version 5	24/08/2012 – 23/08/2022	yes
4659-0003	Solar Water Heater Programme in Tunisia – CPA X - Version 5	24/08/2012 – 23/08/2022	yes
4659-0004	Solar Water Heater Programme in Tunisia – CPA X - Version 5	24/08/2012 – 23/08/2022	yes
4659-0005	Solar Water Heater Programme in Tunisia – CPA X - Version 5	24/08/2012 – 23/08/2022	yes
4659-0006	Solar Water Heater Programme in Tunisia – CPA X - Version 5	24/08/2012 – 23/08/2022	yes
4659-0007	Solar Water Heater Programme in Tunisia – CPA X - Version 5	15/12/2012 – 14/12/2022	yes
4659-0008	Solar Water Heater Programme in Tunisia – CPA X - Version 5	02/01/2013 – 01/01/2023	yes

**A.2. Contact information of the coordinating/managing entity (CME) and/or responsible persons(s)/entity(ies)**

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<sup>3</sup> Version number updated after 1st verification

## **SECTION B. Implementation of PoA**

### **B.1. Implementation of the management system of the PoA**

The program PROSOL is managed by the Prosol unit within the ANME. The Prosol benefits from a series of institutional and financial incentives that intend to leverage the development of SWH in Tunisia. The following steps and procedures are taken to manage this program.

A database was set to include all necessary details of the installed SWH under the frame of PROSOL II residential. All the maintenance of the program PROSOL and its upgrades are guaranteed and performed by a maintenance contract with the service provider. Improvements of the database are made by the service provider whenever it is required, but outside the maintenance contract. This approach guarantees that the database remains reliable, flexible and dynamic.

In addition, all operations planned within the frame of this programme are conducted by suppliers and installers certified by the ANME and using equipments that are also certified, thereby ensuring that high quality equipment is used. The eligibility conditions and all the procedures, for both suppliers and equipments, are defined in pre-established specifications. The Prosol unit with the collaboration of the renewable energies department examines the requests for certification of SWH suppliers as well as SWH models under the PoA. All necessary information regarding the certified suppliers and installers are recorded in the database.

After installation of the SWH, and aside from the sampling performed for CDM purpose as described in the section G3, systematic checks are planned by the Prosol unit to verify whether all the SWH included in the database are really installed. A monthly planning of the list of the SWH to be visited is prepared and coordinated by the head of the service of the Prosol unit. This planning is based on a random sample chosen through an application developed specifically for this purpose and that takes into consideration three parameters: the location, the supplier and the installer in a way that allows the checks to consider a comprehensive and homogenous sample. These checks are made by Prosol technicians who are based in all service regions of the ANME. These technicians are trained by the ANME engineers and participate regularly to training sessions and seminars.

In addition, the Prosol unit deals with maintenance requests and actions for SWH that have a failure. ANME reserves the right on its sole discretion or due to complaints from beneficiaries to carry out any inspection or any other check that ANME considers necessary. In case of non compliance, the ANME reserves the right to penalize the suppliers that commit offenses through suspending temporarily or permanently their eligibility.

The Prosol database presented above ensures that all SWH in a CPA are uniquely defined and are included in one CPA only. In addition, there is no other registered CDM project related to the installation of SWH in Tunisia, thereby avoiding the case of including a new CPA that has been already registered either as a CDM project activity or as a CPA of another PoA .

For the sake of good management of the program, the PoA includes the implementation of activities aimed at strengthening the solar water heating sector in Tunisia, such as technical workshops with professionals of the sector, communication and awareness campaigns in order to intensify the demand for solar water heating in Tunisia and solar certifications such as "Quali-sol" which ensures the good quality of installation of SWH. The ANME thus ensures the smooth running of the PoA as well as its constant improvement.

### **B.2. Implementation of single sampling plan(s)**

The sampling plan procedure is identical for each CPA. Nevertheless, as the implementation dates of the SWH of each CPA are different, the CME considered more accurate to proceed to separate sampling plan for each CPA. See section G.3 of Part II.

**SECTION C. Post-registration changes to the PoA (including the generic CPA(s))**

**C.1. Corrections**

N/A

**C.2. Inclusion of a monitoring plan to the registered PoA-DD (including its generic CPA-DD(s)), if a monitoring plan was not included at the time of registration**

N/A

**C.3. Permanent changes to the monitoring plan as described in the registered PoA-DD, applied methodology, or applied standardized baseline**

N/A

**C.4. Changes to the programme design of the registered PoA-DD (including corresponding changes to project design of the generic CPA-DD(s)) and updates to the eligibility criteria for inclusion of specific-case CPAs in the PoA**

N/A

**C.5. Types of changes specific to afforestation and reforestation activities**

N/A

## PART II - Specific-case component project activity(ies)

### SECTION D. Description of specific-case CPA(s)

#### D.1. Brief description of implemented specific-case CPA(s)

Each specific-case CPA is a voluntary initiative taken by the coordinating and managing entity the ANME. The stated goal of each CPA is to install SWH 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.

All the CPAs of the PoA 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 SWHs 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 CPAs<sup>4</sup>.

SWHs installed in the SSC CPAs consist of the following main parts:

- Solar collector(s) that capture solar radiation,
- Circulating fluids that absorb the energy collected,
- 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 is between 2 and 4 m<sup>2</sup>. The capacity and surface vary according to the household's choice and demand. SWHs installed in the SSC-CPAs are certified by the ANME and must meet certain requirements, as defined in the latest version of the Prosol 2 Specifications. 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. This ensures that only high quality equipment and service are provided to households taking part in the CPAs.

Each specific-case CPA consists of a group SWH installed under the Solar Water Heater Programme in Tunisia across the 21 Tunisian provinces during a certain period of time (see the list below). Each CPA consists of a group of SWH over a period of six months. The total number of installed square meters of collectors of each individual CPA remains below the small-scale threshold of 64,000 m<sup>2</sup> applicable to solar energy projects, as per Appendix B to the decision 21/cp.8 of the document FCCC/CP/2002/7/Add.34.

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<sup>4</sup> Please refer to Appendix 2

Specific-case CPA	Period of installation	Number of SWH
CPA 1	01-01-2008 until 30-06-2008	14,017
CPA 2	01-07-2008 until 31-12-2008	11,149
CPA 3	01-01-2009 until 30-06-2009	12,339
CPA 4	01-07-2009 until 31-12-2009	12,821
CPA 5	01-01-2010 until 30-06-2010	13,978
CPA 6	01-07-2010 until 31-12-2010	12,702
CPA 7	01-01-2011 until 30-06-2011	12,191
CPA 8	01-07-2011 until 31-12-2011	14,230
<b>Sum</b>		<b>103,427</b>

Each SWH included in this specific-case CPA is uniquely identified by its serial number which avoids any double counting.

## D.2. Geographical references or other means of identification of the location of the specific-case CPA(s)

All CPA consist of single SWH installed under the PoA in Tunisia across the 21 Tunisian provinces. The regional distribution of each CPA is shown below.

Provinces					
1	BEJA	8	KASSERINE	15	SFAX
2	BIZERTE	9	KEBILI	16	SIDI BOUZID
3	GABES	10	LE KEF	17	SILIANA
4	GAFSA	11	MAHDIA	18	SOUSSE
5	GRAND TUNIS	12	MEDENINE	19	TATAOUINE
6	JENDOUBA	13	MONASTIR	20	TOZEUR
7	KAIROUAN	14	NABEUL	21	ZAGHOUAN

		CPA1	CPA2	CPA3	CPA4	CPA5	CPA6	CPA7	CPA8	Grand Total
Provinces	Sum of 1	364	335	339	286	311	295	289	237	2,456
	Sum of 2	1,171	962	943	848	921	826	1,100	1,126	7,897
	Sum of 3	189	175	147	169	237	253	153	250	1,573
	Sum of 4	432	298	297	440	566	582	296	512	3,423
	Sum of 5	1,633	1,146	1,404	1,184	1,553	1,323	1,505	1,576	11,324
	Sum of 6	415	336	449	474	450	372	397	453	3,346
	Sum of 7	590	578	620	809	605	605	585	732	5,124
	Sum of 8	166	138	314	417	485	450	434	572	2,976
	Sum of 9	116	171	93	176	227	409	118	327	1,637
	Sum of 10	338	300	440	324	398	334	345	417	2,896
	Sum of 11	697	599	664	700	786	682	682	713	5,523
	Sum of 12	1,150	1,226	1,100	1,250	1,188	1,312	1,005	1,293	9,524
	Sum of 13	1,054	838	814	808	801	650	577	823	6,365
	Sum of 14	1,134	697	810	716	1,226	904	930	837	7,254
	Sum of 15	2,525	1,787	2,232	2,327	2,201	1,821	2,052	2,154	17,099
	Sum of 16	578	447	480	527	502	526	444	689	4,193
	Sum of 17	225	131	128	151	226	244	229	257	1,591
	Sum of 18	748	594	712	728	783	628	635	624	5,452
	Sum of 19	134	178	144	251	224	239	200	351	1,721
	Sum of 20	72	55	54	91	96	80	51	94	593
	Sum of 21	286	158	155	145	192	167	164	193	1,460
		<b>14,017</b>	<b>11,149</b>	<b>12,339</b>	<b>12,821</b>	<b>13,978</b>	<b>12,702</b>	<b>12,191</b>	<b>14,230</b>	<b>103,427</b>

**SECTION E. Post-registration changes to specific-case CPA(s)****E.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline**

The PoA-DD and CPA-DDs state that the number of operating units is to be determined through an annual verification implemented by the ANME. However, the monitoring report and verification report state that the monitoring frequency of the failure rate of the SWH (Fx,y) is once per monitoring period. As a result, a temporary deviation was opened.

This choice was made because, following the sample plan randomly established, the monitoring implies a high number of visits on the field all around Tunisia. Moreover, besides the fact that it's very costly, Tunisia's post revolution context made the access to many region very difficult. All these reasons made the monitoring on an annual basis quite impossible.

The approach taken has been proven to be conservative since the failure rate used for the whole monitoring period is the one related to the year that immediately precede the end of the monitoring period which can only be higher or equal to the failure rate of the first years of the monitoring period following the registration of the PoA and the inclusion of the CPAs.

**E.2. Corrections**

It was identified within CPA-1, some differences regarding the description of SWH's between the documentation which was already registered and the documentation which was submitted for request for issuance. These differences refer to new models of SWH's which were not described within the registered version and to one parameter ( $O_k$  - Annual energy output of SWH k) used for Emission Reduction (ER) calculation

The CPA1-DD was revised to correct all the inconsistencies and a new version of the CPA1-DD was submitted.

**E.3. Changes to the start date of the crediting period of the specific-case CPA(s)**

N/A

**E.4. Inclusion of a monitoring plan into the specific-case CPA(s) that was not included at registration**

N/A

**E.5. Permanent changes to the monitoring plan as described in the registered specific-case CPA-DD(s), applied methodology or standardized baseline**

N/A

**E.6. Changes to project design of the specific-case CPA(s)**

N/A

**E.7. Types of changes specific to afforestation and reforestation specific-case CPA(s)**

N/A



**SECTION F. Description of the monitoring system of specific-case CPA(s)**

ANME is the CME responsible of the monitoring of the SWH installed under the frame of this PoA. Each SWH is recorded in a database (referred to as "Prosol 2 database") along with other details about the SWH.

As per the PoA-DD and CPA-DDs, Option (c) of the AMS.I.C was chosen. Therefore, the monitoring requirements are the following:

- Recording annually the number of systems operating,
- Estimating the annual hours of operation of an average system.

The database tracks the number of SWH installed in the SSC-CPA x. The Prosol unit manages the database and is responsible for collecting and archiving the data. As per the registered PoA-DD following data are collected by the CDM manager from the Prosol Unit:

- Installation date
- Name of the SWH owner
- ID number
- Geographical location of the installation
- Supplier and installer
- Type

Once the above data are collected, the CDM manager compares the number of SWH extracted from the database with those indicated in the included CPAs. Some differences may exist due to the continuous update of the database (from the date of inclusion to the date of the verification) but the number of SWH considered is the one indicated in the included CPA.

In addition, all the suppliers, installers or equipment that have lost their accreditation are excluded. Finally, the  $N_k$  considered is the number of SWH in the  $CPA_x$  minus the number of SWH that have lost their accreditation. As such, considering a number of SWH below the one indicated in CPA-DD is conservative.

For this monitoring period, the monitoring frequency of the failure rate of the SWH ( $F_{x,y}$ ) is only once for the whole monitoring period.

The approach taken is conservative since the failure rate used for the whole monitoring period is the one related to the year that immediately precede the end of the monitoring period which can only be higher or equal to the failure rate of the first years of the monitoring period following the registration of the PoA and the inclusion of the CPAs.

## SECTION G. Data and parameters

## G.1. Data and parameters fixed ex ante, at registration, inclusion or renewal of crediting period

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CPA3	0	0	1	0	1	0	0	1	0	0	1	0	1	1	1	0	0	1	0	0	0	8																																																																																																																																																																																																				
CPA4	0	0	1	0	1	0	0	1	0	0	1	0	1	1	1	0	0	1	0	0	0	8																																																																																																																																																																																																				
CPA5	0	0	1	0	1	0	0	1	0	0	1	0	1	1	1	0	0	1	0	0	1	9																																																																																																																																																																																																				
CPA6	0	0	1	0	1	0	0	1	0	0	1	0	1	1	1	0	0	1	0	0	1	9																																																																																																																																																																																																				
CPA7	0	0	1	0	1	0	1	1	0	0	1	0	1	1	1	0	0	1	0	0	1	10																																																																																																																																																																																																				
CPA8	0	0	1	0	1	0	1	1	0	0	1	0	1	1	1	0	0	1	0	0	1	10																																																																																																																																																																																																				
Choice of data or measurement methods and procedures	<p>For CPA 1: For SWH that displace technologies using fossil fuels or that displace electricity imported from the grid.</p> <p>For CPA 2- CPA 8: For all the SWH installed in a Province where 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. For all the SWH installed in a Province where the natural gas is not provided, it is assumed that LPG was used prior to the installation of the SWH.</p> <p>See also section H.1.</p>																																																																																																																																																																																																																									
Purpose of data	Calculation of baseline emissions																																																																																																																																																																																																																									
Additional comments	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.																																																																																																																																																																																																																									

Data/parameter	$eff_i$
Unit	%
Description	Average efficiency of a water heater using energy source i
Source of data	RETScreen
Value(s) applied	LPG 86% NG 86% ELEC 94% SOLAR 94% OTHERS 100%
Choice of data or measurement methods and procedures	/
Purpose of data	Calculation of baseline emissions

Additional comments	<p>The values chosen are highest efficiencies for typical residential water heaters given by the RETScreen® Software Online User Manual, SWH 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."</p> <p>(<a href="http://www.etscreen.net/ang/centre.php">http://www.etscreen.net/ang/centre.php</a>) This data complies with paragraph 22 c) of AMS.I.C version 17.</p>
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<b>Data/parameter</b>	<b><math>O_k</math></b>
Unit	MWh/y
Description	Annual energy output of SWH k
Source of data	SOLO software
Value(s) applied	See Appendix 2
Choice of data or measurement methods and procedures	The values are the output of a SOLO, a recognized model calculating the energy output of a SWH. This model was developed by the Centre Scientifique et Technique du Bâtiment (Scientific and Technical Centre for the Construction Industry). CSTB is a State-owned industrial and commercial corporative, placed under the administrative supervision of the French Ministry of Housing.
Purpose of data	Calculation of baseline emissions
Additional comments	/

<b>Data/parameter</b>	<b><math>U</math></b>
Unit	%
Description	Usage rate of the SWH
Source of data	"Figures of the Tunisian tourism 2008" ("Le tourisme tunisien en chiffres 2008") published by the National Tourism Bureau of Tunisia
Value(s) applied	99%
Choice of data or measurement methods and procedures	/
Purpose of data	Calculation of baseline emissions
Additional comments	"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.

<b>Data/parameter</b>	<b>Conversion factor</b>
Unit	-
Description	Conversion factor from GJ to MWh
Source of data	/
Value(s) applied	1/3.6
Choice of data or measurement methods and procedures	/
Purpose of data	Calculation of baseline emissions
Additional comments	/

<b>Data/parameter</b>	<b><math>FC_{i,m,y}</math></b>
Unit	t, m <sup>3</sup>
Description	Amount of fossil fuel type i consumed by the group of power units m in year y (mass or volume unit)
Source of data	STEG Electricity Retrospective Statistics 2000-2010
Value(s) applied	See Annex of CPA-DD
Choice of data or measurement methods and procedures	/
Purpose of data	Calculation of baseline emissions
Additional comments	To calculate GEF (for GEF results fixed per CPA see Appendix 2)

<b>Data/parameter</b>	<b><math>NCV_{i,y}</math></b>
Unit	GJ/mass or volume unit
Description	Net calorific value (energy content) of fossil fuel type i in year y
Source of data	STEG Electricity Retrospective Statistics 2000-2010
Value(s) applied	See Annex of CPA-DD
Choice of data or measurement methods and procedures	/
Purpose of data	Calculation of baseline emissions
Additional comments	To calculate GEF (for GEF results fixed per CPA see Appendix 2)

<b>Data/parameter</b>	<b><math>EF_{CO_2,i,y}</math></b>
Unit	tCO <sub>2</sub> /TJ
Description	CO <sub>2</sub> emission factor of fossil fuel type i in year y
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	See Annex of CPA-DD
Choice of data or measurement methods and procedures	/
Purpose of data	Calculation of baseline emissions
Additional comments	To calculate GEF (for GEF results fixed per CPA see Appendix 2)

<b>Data/parameter</b>	<b><math>EG_{m,y}</math></b>
Unit	MWh
Description	Net electricity generated by power plant / unit m in year y
Source of data	STEG Electricity Retrospective Statistics 2000-2010
Value(s) applied	See Annex of CPA-DD
Choice of data or measurement methods and procedures	/
Purpose of data	Calculation of baseline emissions
Additional comments	To calculate GEF (for GEF results fixed per CPA see Appendix 2)

Data/parameter	$\eta_{m,y}$
Unit	%
Description	Average net energy conversion efficiency of power unit m in year y
Source of data	Annex I of the "Tool to calculate the emission factor for an electricity system"
Value(s) applied	See Annex of CPA-DD
Choice of data or measurement methods and procedures	/
Purpose of data	Calculation of baseline emissions
Additional comments	To calculate GEF (for GEF results fixed per CPA see Appendix 2)

## G.2. Data and parameters monitored

Data/parameter	$N_k$																		
Unit	number																		
Description	Number of SWH k installed in the SSC-CPA x																		
Measured/calculated/ default	Measured																		
Source of data	Database developed by the ANME (Prosol 2 database)																		
Value(s) of monitored parameter	<table><tr><th>CPA 1</th><th>CPA 2</th><th>CPA 3</th><th>CPA 4</th><th>CPA 5</th><th>CPA 6</th><th>CPA 7</th><th>CPA 8</th><th></th></tr><tr><td>14,017</td><td>11,149</td><td>12,339</td><td>12,821</td><td>13,978</td><td>12,702</td><td>12,191</td><td>14,230</td><td>103,427</td></tr></table>	CPA 1	CPA 2	CPA 3	CPA 4	CPA 5	CPA 6	CPA 7	CPA 8		14,017	11,149	12,339	12,821	13,978	12,702	12,191	14,230	103,427
CPA 1	CPA 2	CPA 3	CPA 4	CPA 5	CPA 6	CPA 7	CPA 8												
14,017	11,149	12,339	12,821	13,978	12,702	12,191	14,230	103,427											
Monitoring equipment	Prosol 2 database. The type and serial number, owner, location, supplier and installation date are entered into the Prosol 2 database.																		
Measuring/reading/ recording frequency	Included in Prosol Database after installation																		
Calculation method (if applicable)	N/A																		
QA/QC procedures	ANME will carry out spot checks in order to ensure that the systems entered into the database are actually operating (see below $F_{x,y}$ ).																		
Purpose of data	Calculation of baseline emissions																		
Additional comments	the $N_k$ considered is the number of SWH in the CPAx minus the number of SWH that have lost their accreditation. The value is applied to the whole monitoring period even if the loss of the accreditation was later. The approach is then conservative																		

Data/parameter	$F_{x,y}$																
Unit	%																
Description	Failure rate of the SWH (all types) in the SSC-CPA x in year y																
Measured/calculated/default	Measured through sampling (refer to section D.3). To be determined for each CPA																
Source of data	Sampling done by ANME																
Value(s) of monitored parameter	<table><tr><th>CPA 1</th><th>CPA 2</th><th>CPA 3</th><th>CPA 4</th><th>CPA 5</th><th>CPA 6</th><th>CPA 7</th><th>CPA 8</th></tr><tr><td>8.3%</td><td>6.7%</td><td>8.8%</td><td>10.0%</td><td>8.3%</td><td>0.0%</td><td>8.8%</td><td>2.7%</td></tr></table>	CPA 1	CPA 2	CPA 3	CPA 4	CPA 5	CPA 6	CPA 7	CPA 8	8.3%	6.7%	8.8%	10.0%	8.3%	0.0%	8.8%	2.7%
CPA 1	CPA 2	CPA 3	CPA 4	CPA 5	CPA 6	CPA 7	CPA 8										
8.3%	6.7%	8.8%	10.0%	8.3%	0.0%	8.8%	2.7%										
Monitoring equipment	Determined during household visits as of sample list																
Measuring/reading/recording frequency	Once per Monitoring Period																
Calculation method (if applicable)	The failure rate is determined per CPA through a sampling organised by the ANME. The sampling follows the rules and recommendations of the latest versions of the “Standard - Sampling and surveys for CDM PA and PoA” and the “Guideline - Sampling and surveys for CDM PA and PoA”. The failure rate of the sampled SWHs is applied to the whole population of the considered CPA.																
QA/QC procedures	See section G.3																

Purpose of data	Calculation of baseline emissions
Additional comments	For this monitoring period, the monitoring frequency of the failure rate of the SWH ( $F_{x,y}$ ) is only once for the whole monitoring period. The approach taken is conservative since the failure rate used for the whole monitoring period is the one related to the year that immediately precede the end of the monitoring period which can only be higher or equal to the failure rate of the first years of the monitoring period following the registration of the PoA and the inclusion of the CPAs.

### G.3 Implementation of specific-case CPA level sampling plan

As the CPAs are linked to the installation date of the SWH, the CME decided to conduct a separate sampling for each CPA. Therefore the failure rate  $F_{x,y}$  of the SWH installed in the framework of the PoA is determined by sampling of SWH of each CPA.

The methodology described below is applicable to all CPAs independently. This sampling is in conformity with the registered PoA-DD and the 8 included CPA-DD and to the latest UNFCCC recommendations.

#### Description of implemented single sampling design

The objective of the sampling is to determine for each CPA and for each verification until the end of the crediting period the failure rate of the installed SWH. A precision level of 10% associated to a confidence interval of 90% must be considered to define the sample size. The sampling follows the recommendations of the following documents :

- “Standard - Sampling and surveys for CDM PA and PoA” (v4.1, EB74 Annex 6, modified by EB 80, Annex 7)
- “Guideline - Sampling and surveys for CDM PA and PoA” (v3.0, EB75, Annex 8)

The sampled population is the total amount of SWH installed for the specific CPA. This population is homogeneous as all these SWH have been installed during the same time interval.

The **Prosol Database** is the main database for the project and contains all detailed information for each SWH installed (installation date, location of the beneficiary, National Identity Card number of the beneficiary, SWH model etc.).

#### Sample size :

The equation to give the required sample size is<sup>5</sup>:

$$n \geq \frac{1.645^2 N \times p(1-p)}{(N-1) \times 0.1^2 \times p^2 + 1.645^2 p(1-p)}$$

Where:

n	Sample size. If the calculated value for n is lower than 30, n will be equal to 30 (see EB74, Annex 6, par. 12).
N	Total number of SWH installed in the framework of the specific CPA. N is obtained by extraction of the Prosol Database. In the CPA-DD, this parameter is called $N_{k,x}$
p	The expected proportion of SWH operating. In order to determine n for the first verification, a conservative value of 90% is used for p..
1.645	Represents the 90% confidence required
0.1	Represents the 10% relative precision required

<sup>5</sup> Source: EB75, Annex 8, (Appendix 1, par.12)

In order to consider the risk of the non-answers and of the erroneous answers (e.g. beneficiary not available, data sheet not correctly filled in) the number of SWH to be sampled was increased following the formula below :

$$n_{\text{increased}} \geq \frac{n}{\% \text{ valid responses}}$$

For the first round of sampling, a valid response rate of 80% was considered.

### **Sampling frame :**

The list of all SWH installed for a specific CPA is used as population for the sampling. For each CPA this list is obtained by extraction from the Prosol Database to an Excel file. In each CPA list:

- SWH are classified by National Identity Card Numbers of the beneficiaries (increasing order)
- SWH are then numbered chronologically from 1 to N (N being the total number of SWH in the CPA)
- Geographical localisation and other characteristics of each SWH are indicated.

### **Choice of SWH to be sampled :**

The used method is a sampling per interval which is also called systematic sampling. To determine the SWH to be sampled per CPA, the CME proceeded as following:

1. To obtain the population per CPA
2. To determine the parameter  $n_{\text{increased}}$
3. To calculate the sampling interval  $k = N / n_{\text{increased}}$
4. To select randomly a number between 1 and k by using the Excel formula  $1 + \text{ENT}(\text{ALEA}()) * k$ . The number obtained « e1 » corresponds to the number of the first SWH of the sample.
5. To determine successively the other SWH to be sampled according to the equations:  $e2 = e1 + k$ ,  $e3 = e2 + k$  etc.

The sample list of all randomly selected SWH per CPA is kept. All steps are described in the respective CPA workbook excel files.

### **Data collection**

Once the CPA sample lists are determined by the CME CDM Manager, CME technicians visit the households where the selected SWH are installed. For each visit the technicians fill in a dedicated form. The CME technicians in charge of the household visits are located in all regional divisions of CME. They are the same technicians who make the usual SWH control visits. They are trained in the SWH technology and therefore have all the necessary competencies to conduct the sampling in the field. Every technician had received a detailed procedure instructing them how to correctly conduct the visits and to fill in the form. Explanations were in addition given by phone to the technicians.

### **Data analysis**

The data collected on each control form are the basis for the CME CDM Manager to determine if the SWH is operating or not. First, the CME CDM Manager checks the quality of the data reported on the forms. Each form illegible, incoherent or not completely filled is excluded from the sample and considered as invalid. The mention "Invalid result" is reported in the CPA workbook excel file for the respective SWH. All the sampled SWH are splitted in two categories:

#### **1. Tested SWH**

- The technicians could test the SWH and fill in the form
- The technicians could test the SWH and confirm that the SWH isn't operating

#### **2. Not tested SWH [Invalid results]**

- The technicians could not test the SWH and could not fill in the form, mainly because the beneficiary wasn't available at the time of the visit

- The technicians could test the SWH and fill in the form but the SWH was not operating at the time of the visit for external reasons (water shutdown for example). These SWH were considered as not tested

The main parameters indicated in the form are the temperature of the cold water and the temperature of the warm water. They are the basis for the analysis of the operation of the SWH. The analysis consists of a comparison of the SWH operation with a theoretical situation. This analysis is based on the comparison of the actual  $\Delta t$  (warm water temperature – cold water temperature) obtained during the visits and the theoretical temperature difference which is determined for the SWH (e.g. depending of SWH model, volume, date of the visit, weather, etc.). The different steps are:

1. To calculate the actual  $\Delta t$
2. To determine the theoretical  $\Delta t$  the SWH
3. To compare the actual  $\Delta t$  with the theoretical  $\Delta t$
4. To verify the results obtained

Furthermore, other information is raised during the visits, in particular the hour of control, the weather of the day, the schedule of the last use of hot water, etc. This information contributes to the evaluation of the general operation of the SWH.

### **Verification of required confidence/ precision**

Once the results of the sampling are compiled and the failure rates are determined, the CME CDM Manager verifies that:

1. the interval of 10 % confidence is well respected and,
2. the minimum number  $n$  of SWH to sample as calculated above is reached.

If one of the conditions is not met for a specific CPA, the CME determines randomly a second sample list for this CPA and organizes a second visit. The results of this second visit are added to CPA workbook excel file. The number of additional SWH to be sampled is determined by the formula:

$$n_{\text{additional}} = \frac{n - \text{Number of SWH sampled and with valid result}}{\% \text{ valid answers}}$$

Once  $n_{\text{additional}}$  is known, additional SWH to be sampled are chosen in a random way by the same method than described above. Finally, the results are internally validated by the management of the CME on a specific form. All results are reported in the CPA workbooks and used to finally calculate the failure rate of the sample per CPA.

$$\text{Sample failure rate} = \frac{\text{Number of non – operating SWH}}{\text{Number of sampled SWH with valid result}}$$

If the confidence/ precision is respected, then the failure rate of the specific CPA is equal to the failure rate of the sample.

### **Results of the sampling procedure for the calculation of the failure rate**

	CPA1	CPA2	CPA3	CPA4	CPA5	CPA6	CPA7	CPA8
Number of SWH in the CPA	14,017	11,149	12,339	12,821	13,978	12,702	12,191	14,230
SWHs operating	33	28	31	36	33	33	31	36
SWHs not operating	3	2	3	4	3	0	3	1
Valid results	36	30	34	40	36	33	34	37
Invalid results	27	30	26	20	27	27	26	26
Number of CES sampled	63	60	60	60	63	60	60	63
Sample size requirement met ?	yes	yes	yes	yes	yes	yes	yes	yes



Response rate	57.1%	50.0%	56.7%	66.7%	57.1%	55.0%	56.7%	58.7%
<b>Operating rate</b>	<b>91.7%</b>	<b>93.3%</b>	<b>91.2%</b>	<b>90.0%</b>	<b>91.7%</b>	<b>100.0%</b>	<b>91.2%</b>	<b>97.3%</b>
<b>Failure rate</b>	<b>8.3%</b>	<b>6.7%</b>	<b>8.8%</b>	<b>10.0%</b>	<b>8.3%</b>	<b>0.0%</b>	<b>8.8%</b>	<b>2.7%</b>

### **Roles and responsibilities of the persons involved in the sampling process**

The main persons involved in the sampling campaign are:

**CME CDM Manager:** Knowledge of CDM projects, of the Prosol program and of the internal organisation of the CME. Supervision of the sampling campaign. Collect of the forms filled in by the CME technicians. Analysis of the collected data. Preparation of the Monitoring Report and associated documents.

**CME technicians:** Knowledge of the Prosol program and of the SWH characteristics. Visit of the households. Data collection on the forms.

**Manager of the Prosol unit:** Knowledge of the Prosol program, of the SWH characteristics and the Prosol Database. Maintenance of the Database. Extraction of the required information for the determination of the sampling plan.

<b>Task</b>	<b>Responsible</b>
Management of Prosol Database	Prosol unit
Implementation of sampling plan	CME CDM Manager
Extraction of information Prosol database (list of SWH per CPA)	Prosol unit
Preparation of sample lists	CME CDM Manager
Sampling campaign organisation and information of technicians	CME CDM Manager, Prosol unit and Supervision unit of the regional divisions
Coordination and schedule of visits	CME CDM Manager, Prosol unit and Supervision unit of the regional divisions
Visits in households and completion of forms	CME technicians
Data consolidation	CME CDM Manager
Validation of results of sampling	CME CDM Manager, CME management (Director of Studies and Schedule)

## SECTION H. Calculation of GHG emission reductions or net GHG removals by sinks

### H.1. Calculation of baseline emissions or baseline net GHG removals by sinks

Emission reductions calculation :

$$ER_y = BE_y - PE_y - LE_y$$

Where

$ER_y$  Emission reductions in year  $y$  (tCO<sub>2</sub>)

$BE_y$  Baseline emissions in year  $y$  (tCO<sub>2</sub>)

$PE_y$  Project emissions in year  $y$  (tCO<sub>2</sub>)

$LE_y$  Leakage in year  $y$  (tCO<sub>2</sub>)

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

Therefore  $LE_y = 0$  tCO<sub>2</sub>.

$$ER_y = BE_y - PE_y$$

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

Therefore,  $PE_y = 0$  tCO<sub>2</sub>/MWh. As a result :

$$ER_y = BE_y$$

For CPA 1, 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 was calculated as per the procedures detailed in AMS.I.D, which refers to "Tool to calculate the emission factor for an electricity system".

$$BE_y = \left( \sum_k N_k * O_k \right) * \left( \sum_i w_i * EFi / eff_i \right) * U * (1 - F_{x,y})$$

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 $i$ 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 <sub>2</sub> /MWh), see table below
$i$	Energy source
$U$	Usage rate of the SWH (all types) in the SSC-CPA $x$ (%). It reflects that households do not use their SWH 100% of the time. A 99% usage rate was defined ex-ante.
$F_{x,y}$	Failure rate of the SWH (all types) in the SSC-CPA $x$ in year $y$ (%). The failure rate is determined by CPA through a sampling approach (see section G.3 above)

Fossil fuel type	$EF_{CO_2,i,y}$ (tCO <sub>2</sub> /GJ)	$EF_i$ (tCO <sub>2</sub> /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
Combined margin EF for grid electricity		0.550	STEG - Electricity Retrospective Statistics 1997-2007 and STEG – Annual Report 2005
EF for other		0.288	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

Applying actual values on a yearly basis, baseline emissions are as follows:

	$(\sum_k Nk * Ok) * (\sum_i w_i * EFi / eff_i)$	$U$	$1 - F_{x,y}$	$BEy$
CPA 1	7,010	99%	91.7%	6,362

For CPA 2 to CPA 8, the baseline scenario is the following:

The approach to calculate the baseline emissions as explained above for CPA1 was modified. In order to be more conservative and to avoid risk of incomplete answer on the technology which was replaced by the installation of the SWH, the following assumptions were used:

1. For all SWH installed in a Province where 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 Provinces where natural gas is provided.
2. For all SWH installed in a Province where 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).

Fossil fuel type	$EF_{CO_2,i,y}$ (tCO <sub>2</sub> /GJ)	$EF_i$ (tCO <sub>2</sub> /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

Applying actual values on a yearly basis, baseline emissions are as follows:

	$(\sum_k Nk * Ok) * (\sum_i w_i * EFi / eff_i)$	$U$	$1 - F_{x,y}$	$BEy$
CPA 2	4,145	99%	93,3%	3,830
CPA 3	4,557		91,2%	4,113
CPA 4	4,696		90,0%	4,184
CPA 5	5,019		91,7%	4,555
CPA 6	4,504		100,0%	4,459
CPA 7	4,329		91,2%	3,907
CPA 8	4,963		97,3%	4,780

**H.2. Calculation of project emissions or actual net GHG removals by sinks**

According to AMS.I.C, no project emissions need to be taken into account.  
Therefore,  $PE_y = 0 \text{ tCO}_2$

**H.3. Calculation of leakage**

SWH are not transferred from another activity, so no leakage is to be considered.  
Therefore  $LE_y = 0 \text{ tCO}_2$

**H.4. Summary of calculation of GHG emission reductions or net GHG removals by sinks**

Specific-case CPA reference number	Baseline emissions or baseline net GHG removals by sinks (tCO <sub>2</sub> e)	Project emissions or actual net GHG removals by sinks (tCO <sub>2</sub> e)	Leakage (tCO <sub>2</sub> e)	GHG emission reductions or net GHG removals by sinks (tCO <sub>2</sub> e) achieved in the monitoring period		
				Up to 31/12/2012	From 01/01/2013	Total amount
4659-0001	22,800.0	-	-	10,276.0	12,524.0	22,800.0
4659-0002	9,022.0	-	-	1,363.0	7,659.0	9,022.0
4659-0003	9,691.0	-	-	1,465.0	8,226.0	9,691.0
4659-0004	9,857.0	-	-	1,490.0	8,367.0	9,857.0
4659-0005	10,731.0	-	-	1,622.0	9,109.0	10,731.0
4659-0006	10,505.0	-	-	1,588.0	8,917.0	10,505.0
4659-0007	7,995.0	-	-	181.0	7,814.0	7,995.0
4659-0008	9,547.0	-	-	-	9,547.0	9,547.0
<b>Total</b>	<b>90,148.0</b>	<b>-</b>	<b>-</b>	<b>17,985.0</b>	<b>72,163.0</b>	<b>90,148.0</b>

**H.5. Comparison of GHG emission reductions or net GHG removals by sinks with estimates in the included CPA-DD(s)**

Specific-case CPA reference number	Value estimated in ex ante calculation in the included CPA-DD(s)	Actual values achieved by the specific-case CPA(s) during this monitoring period
4659-0001	26,368.0	22,800.0
4659-0002	10,126.0	9,022.0
4659-0003	11,879.0	9,691.0
4659-0004	12,621.0	9,857.0
4659-0005	13,152.0	10,731.0
4659-0006	11,750.0	10,505.0
4659-0007	8,984.0	7,995.0
4659-0008	9,716.0	9,547.0
<b>Total</b>	<b>104,596.0</b>	<b>90,148.0</b>

**H.6. Remarks on difference from the estimated value in the included CPA-DD(s)**

The actual Emission Reductions achieved during this monitoring period are less than those estimated in the included CPAs –DD. The difference comes from two main reasons : 1) Removal of SWH provided by 2 suppliers (due to loss of accreditation, Shamsy & SIAME) and 2) Failure rate applied to CPA population.

# Appendix 1. Contact information of coordinating/managing entity and/or responsible persons/entities

<b>Coordinating/managing entity and/or responsible person/entity</b>	<input checked="" type="checkbox"/> Coordinating/managing entity <input checked="" type="checkbox"/> Person/entity responsible for completing the CDM-MR-FORM
<b>Organization name</b>	Agence Nationale pour la Maîtrise de l'Energie (ANME)
<b>Street/P.O. Box</b>	Cité administrative Montplaisir, Avenue du Japon B.P 213
<b>Building</b>	
<b>City</b>	Tunis
<b>State/Region</b>	
<b>Postcode</b>	1073
<b>Country</b>	Tunisia
<b>Telephone</b>	+ 216 71 906 900
<b>Fax</b>	+216 71 904 624
<b>E-mail</b>	
<b>Website</b>	
<b>Contact person</b>	Afef Jaafar
<b>Title</b>	
<b>Salutation</b>	Ms
<b>Last name</b>	Jaafar
<b>Middle name</b>	
<b>First name</b>	Afef
<b>Department</b>	
<b>Mobile</b>	
<b>Direct fax</b>	
<b>Direct tel.</b>	+ 216 71 906 900 [4152]
<b>Personal e-mail</b>	afef.jaafar@anme.nat.tn

<b>Coordinating/managing entity and/or responsible person/entity</b>	<input type="checkbox"/> Coordinating/managing entity <input checked="" type="checkbox"/> Person/entity responsible for completing the CDM-MR-FORM
<b>Organization name</b>	Solvay Energy Services SAS
<b>Street/P.O. Box</b>	25 rue de Clichy
<b>Building</b>	
<b>City</b>	Paris
<b>State/Region</b>	
<b>Postcode</b>	75009
<b>Country</b>	France
<b>Telephone</b>	(+33) 4 37 24 88 69
<b>Fax</b>	(+33) 1 40 75 83 10
<b>E-mail</b>	
<b>Website</b>	
<b>Contact person</b>	Philippe Chevallier
<b>Title</b>	
<b>Salutation</b>	Mr
<b>Last name</b>	Chevallier
<b>Middle name</b>	
<b>First name</b>	Philippe
<b>Department</b>	CO2 Operations
<b>Mobile</b>	
<b>Direct fax</b>	
<b>Direct tel.</b>	+33 4 37248869
<b>Personal e-mail</b>	philippe.chevallier@solvay.com

## Appendix 2. Information regarding data and parameters fixed ex ante, at registration, inclusion or renewal of crediting period

### 1) 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)<sup>6</sup> 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 <i>k</i>
Monthly hot water consumption in litres	Manufacturer specifications for the SWH <i>k</i>
Collector area (aperture area) in m <sup>2</sup>	Manufacturer specifications for the SWH <i>k</i>
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 <i>k</i>
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 <i>k</i>
Number of tanks	Manufacturer specifications for the SWH <i>k</i>
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<sup>7</sup>

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,

<sup>6</sup> 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>)

<sup>7</sup> 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.

INRST, CETIME<sup>8</sup>) 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 SWH installed was below the estimated supply. As a result, it is argued that the assessed performances of the SWH might be conservative<sup>9</sup>. The values used for each SWH are recorded in a database after approval by the Technical Committee of Prosol:

SWH Model	Ok (MWh/y)	SWH Model	Ok (MWh/y)	SWH Model	Ok (MWh/y)	SWH Model	Ok (MWh/y)	SWH Model	Ok (MWh/y)	SWH Model	Ok (MWh/y)	SWH Model	Ok (MWh/y)
101	1.232	306	2.071	514	2.041	1203	1.190	1806	2.765	2603	0.902	3604	1.136
102	1.216	307	0.902	601	1.044	1204	2.420	1809	1.064	2604	2.094	3701	1.768
103	2.484	308	2.020	602	2.232	1301	0.900	1810	2.257	2605	0.969	3901	1.016
104	3.904	309	2.024	701	0.920	1302	2.692	1811	1.051	2606	2.089	3902	2.041
105	1.354	310	2.292	702	1.990	1303	1.194	1812	2.245	2702	1.017	3903	1.160
106	2.181	401	1.480	703	2.560	1304	2.146	1901	1.400	2703	2.043	3904	2.292
107	3.395	402	2.340	801	2.380	1401	0.947	1902	2.538	2704	1.147	3905	1.124
108	1.450	403	1.360	802	1.307	1402	1.500	1903	1.706	2705	1.162	3906	2.333
109	2.568	404	2.140	803	2.302	1403	2.064	1904	2.887	2801	1.206	3907	1.283
201	1.620	405	1.150	804	0.955	1404	0.720	1905	1.256	2802	2.043	3908	2.510
202	2.249	406	2.380	805	1.980	1405	0.960	1906	3.372	2901	0.949	4001	1.112
203	1.100	407	1.107	806	0.852	1406	1.200	2001	3.355	3001	1.027	4002	2.368
204	2.170	408	2.102	807	1.947	1407	2.739	2002	1.658	3002	2.118	4201	1.196
205	1.240	409	1.266	808	1.089	1501	1.070	2003	1.026	3101	0.941	4202	1.294
206	2.400	410	1.974	809	0.944	1502	2.160	2004	2.217	3102	2.068	4203	2.202
207	1.250	411	0.926	810	2.042	1601	1.118	2101	1.294	3201	0.991	4204	2.323
208	2.390	412	2.048	811	1.130	1602	1.112	2102	1.174	3202	0.992	4301	1.206
209	0.973	413	0.935	812	2.192	1603	2.314	2103	2.484	3203	2.102	4302	2.043
210	2.035	414	2.120	901	2.053	1604	0.932	2104	2.351	3204	1.129	4402	1.205
211	0.918	415	1.071	902	2.069	1605	1.025	2201	1.088	3301	1.369	4403	2.339
212	1.840	416	2.191	903	1.500	1606	2.159	2202	2.006	3302	2.523	4501	1.010
213	2.123	501	1.070	904	2.069	1701	1.069	2301	1.044	3403	1.500	4601	1.054
214	1.203	502	2.050	1001	1.500	1702	1.178	2302	2.232	3404	2.069	4602	2.232
301	0.920	503	1.010	1002	2.500	1801	1.234	2401	0.966	3501	1.236	4701	1.026
302	1.990	504	2.030	1101	2.670	1802	2.535	2402	1.843	3502	2.454	4702	2.217
303	2.560	505	1.160	1102	1.075	1803	0.962	2403	2.409	3601	1.091		
304	1.250	506	2.310	1201	1.190	1804	2.069	2601	0.915	3602	0.935		
305	0.924	513	1.016	1202	2.420	1805	1.334	2602	1.811	3603	2.233		

<sup>8</sup> 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).

<sup>9</sup> 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.



**2) Emission factor as of registered CPA-DD:**

CPA 1	Combined Margin EF	0.550 tCO <sub>2</sub> /MWh	STEG - Electricity Retrospective Statistics 1997-2007, STEG – Annual Report 2005	Used
	EF other	0.288	CPA-DD	

CPA 2 – 8	Combined Margin EF	0.54228	STEG - Electricity Retrospective Statistics 2000-2010 and , STEG – Annual Report 2010	Not used
CPA 2	EF other	0.306	CPA-DD	
CPA 3		0.303		
CPA 4		0.311		
CPA 5		0.308		
CPA 6		0.317		
CPA 7		0.307		
CPA 8		0.313		

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