

# Final report

## 1.1 Project details

<b>Project title</b>	IEA-SHC Task 43 and 45 - prolongation
<b>Project identification (program abbrev. and file)</b>	EUDP 13-II, 64013-0519
<b>Name of the programme which has funded the project</b>	EUDP
<b>Project managing company/institution (name and address)</b>	SolarKey Int.
<b>Project partners</b>	PlanEnergi, DTU
<b>CVR</b> (central business register)	26959276
<b>Date for submission</b>	2015-07-01

## 1.2 Short description of project objective and results

The project supported the coordination of - and participation in:

- Extended period of IEA-SHC Task 43 "Solar Rating & Certification".
- Extended period of IEA-SHC Task 45 "Large Solar Heating and Cooling Systems with Heat Pumps and Seasonal Storage"

Task 43: Final evaluation report and final management report will be delivered for the IEA SHC ExCo meeting in December 2015. Final report on results will be given at the SHC2015 Conference in Turkey December 2015. The main outcomes of the Task 43 are:

- New ISO standard for solar collector testing
- Organisation of the "Global Solar Certification Network", now ready to operate a system of mutual recognition of test and inspection reports – so manufacturers can avoid re-testing and re-inspection when they enter new markets

Task 45: Final evaluation report and final management report have been approved at the IEA SHC ExCo meeting June 2015. Final report on results will be given at the SHC2015 Conference in Turkey December 2015. The main outcomes of the Task 45 are:

- Substantial information given in the fact sheet section of the Task 45 web site
- Network of international experts in largescale solar heating and cooling established – including now Chinese experts

## 1.3 Executive summary

Two issues within the IEA SHC are dealt with in this project supported by EUDP:

- Task 43 "Solar Rating and Certification"
- Task 45 "Large Solar Heating/Cooling Systems"

### Conc. Task 43 "Solar Rating and Certification" - extension

The overall aim is to increase quality and remove trade barriers and hence assist/accelerate the trend towards a bigger market for better and cheaper solar thermal products collectors world wide.

The main objective in the extension period was to establish a global certification scheme for solar collectors. This was not achieved fully, but a system making it possible for the manufacturers to re-use test and inspection reports in the different certification schemes around the world has been organized within the "Global Solar Certification Network".

Furthermore work was done on "harmonised" ISO standards for solar thermal systems and components.

#### Conc. Task 45 "Large Solar Heating/Cooling Systems" - prolongation

Focus from Danish side in the extended period was on elaborating and finalizing guidelines and facts sheet for large collector fields and seasonal storages. A set of fact sheets with substantial information are now available from the IEA SHC Task 45 web. The main overall objectives in the prolonged period was still to promote use of large solar systems with seasonal storage and heat pumps in connection with district heating and enhanced international cooperation was achieved – especial Chinese experts have shown very keen interest in cooperation in this field.

#### **1.4 Project objectives**

Two issues within the IEA SHC are dealt with in this project:

- Task 43 "Solar Rating and Certification"
- Task 45 "Large Solar Heating/Cooling Systems"

#### Conc. Task 43 "Solar Rating and Certification" - extension

The overall aim was to increase quality and remove trade barriers and hence assist/accelerate the trend towards a bigger market for better and cheaper solar thermal products collectors world wide.

The main objective in the extension period was to establish a global certification scheme for solar collectors based on international ISO standard.

#### Conc. Task 45 "Large Solar Heating/Cooling Systems" - prolongation

The main overall objective of this Task was to assist in a strong and sustainable market development of large solar heating and cooling systems. The systems can include seasonal storages and/or heat pumps/chillers.

The more specific objectives were

- to elaborate and finalize guidelines and facts sheet for large collector fields and seasonal storages
- continue promotion of large scale solar systems with seasonal storage and heat pumps in connection with district heating and to further extend international cooperation in this field.

#### **1.5 Project results and dissemination of results**

##### *1.5.1 Task 43 accomplishments*

The following is a brief report on the accomplishments of each single work activity within the Subtasks A to C. The deliverable numbering correspond to the latest workplan: TASK 43 - extension: Solar Rating and Certification Procedures - From International Standardization to Global Certification Work Plan – version 3.01, October 2013, Jan Erik Nielsen, 2013-10-25

##### **1.5.1.1 Subtask A: Harmonization of standards for solar thermal products**

D-A1.EN ISO 9806 "Solar energy - Solar thermal collectors - Test methods" + inputs on further improvements / ISO TC 180

The work is accomplished - the standard has been published and - based on analysis of answer to a questionnaire - work on improvement/revision has already started (under CEN lead).

D-A2.Draft ISO 22975 series on "Solar Energy - Collector components and materials"

- i. Part 1: Evacuated tubes -- Durability and performance
- ii. Part 2: Heat-pipe for evacuated tubes -- Durability and performance
- iii. Part 3: Absorber surface durability

Accomplished. i and ii are now available as ISO/DIS 22975 1 & 2. iii has been published as a final ISO standard: 22975-2.

D-A3. Proposal for plan for further harmonization of ISO 9459-4 and the EN 12977 series - and inputs for first draft of a common standard. Documented differences between Compo-

nent test system simulation (CTSS) standards worldwide (particularly ISO 9459-4 and EN 12977

Not accomplished. It was decided to use the limited resources on collector standards. Work on this topic will be proposed in new task.

D-A4. Inputs to first draft of ISO Standards for test methods for reliability/durability and safety of solar heating systems inspired by European, American, Asian, Australian and other standards (e.g.: EN 12976, EN 12977, ...).

Not accomplished. It was decided to use the limited resources on collector standards. Work on this topic will be proposed in new task.

D-A5. Inputs to revised draft of ISO 9488 "Solar Energy - Vocabulary"

Not accomplished. Several attempt were made to start the revision, but so far without big success. Work on this topic will be proposed in new task.

D-A6. Pre-normative documents related to other standardization opportunities for solar thermal products/systems including a draft of an ISO Technical Report on 'Certification Requirements)

Not accomplished. It was decided to use the limited resources on collector standards. Work on this topic will be proposed in new task.

#### **1.5.1.2 Subtask B: Harmonization of certification schemes for solar collectors**

D-B1. First draft set of requirements (Kick-off meeting, September 2013)

Accomplished.

D-B2. 2<sup>nd</sup> draft set of requirements (Web meetings 14/11 – 12/12 2013)

Accomplished.

D-B3. Final draft set of requirements (Web meetings 16/1 – 13/2 2014)

Accomplished.

D-B4. Approved version of harmonized requirements for certification schemes for collectors (Gran Canarias meeting, Meeting 2014)

Work accomplished as harmonized requirements for operators participating in the Global Solar Certification Network have been defined in the annexes to the Global Solar Certification Network Working Rules.

#### **1.5.1.3 Subtask C: Organizational framework for global collector certification**

D-C1. First draft set of rules for the organizational framework

Accomplished

D-C2. 2<sup>nd</sup> draft set of rules for the organizational framework

Accomplished

D-C3. Final draft set of rules for the organizational framework

Accomplished

D-C4. Approved version of organizational framework for global solar collector certification

Accomplished. Final version of the Working Rules for the Global Solar Certification Network is available (June 2014)

D-C5. Template for a licence agreement between the individual certification body and the GSC-NW related to empowerment including the acceptance of the global certification rules

Accomplished. Available as annex G of the working rules.

#### 1.5.1.4 Reports & Publications

##### Task reports

Report No.	Report Title	Publication Date	Access (Public, REstricted)	Web or Print
-	Utilisation of ISO9806:2013 in Global Solar Certification	November 2014	PU	Web
N0001	Network Working Rules. Main part	June 2015	PU	Web
N0002.A1	Annex A1. Requirements for Certification Bodies	June 2015	PU	Web
N0001.A2	Annex A2 Procedures for Peer Assessment of Certification Bodies	February 2015	PU	Web
N0001.A3	Annex A3. Peer Assessment Report for Certification Bodies	October 2014	PU	Web
N0001.A4	Annex A4. Agreement on the Mutual Acceptance of Test Reports	June 2015	PU	Web
N0001.B1	Annex B1. Requirements for Testing Laboratories	March 2015	PU	Web
N0001.B2	Annex B2. Procedures for Peer Assessment of Testing Laboratories	February 2015	PU	Web
N0001.B3	Annex B3. Peer Assessment Report for Testing Laboratories	October 2014	PU	Web
N0001.C1	Annex C1. Requirements for Inspections Bodies	March 2015	PU	Web
N0001.C2	Annex C2. Procedures for Peer Assessment of Inspections Bodies	November 2014	PU	Web
N0001.C3	Annex C3. Peer Assessment Report for Inspection Bodies	October 2014	PU	Web
N0001.D1	Annex D1. Test report template (data sheet)	April 2015	PU	Web
N0001.D2	Annex D2. Inspection report template	June 2015	PU	Web
N0001.E1	Annex E1. Factory production control	March 2015	PU	Web
N0001.F	Annex F. Fees for the Global Solar Certification Network	May 2015	PU	Web

N0001.G	Annex G. Template for signing up for the Global Solar Certification Network	March 2015	PU	Web
N0002	Example Scheme Rules for Certification – N0002	September 2014	RE	Web(RE)
N0002.A1	Annex A1. Requirements – Collectors	August 2014	RE	Web(RE)
N0002.B1	Annex B1. Factory Production Control – Collectors	August 2014	RE	Web(RE)
N0002.C1	Annex C1. Procedure for Surveillance Test – Collectors	August 2014	RE	Web(RE)
N0002.D1	Annex D1. Inspection Report Template – Collectors	August 2014	RE	Web(RE)
N0002.E1	Annex E1. Template for Certificate and Data Sheet – Collectors - Version with GSC number	August 2014	RE	Web(RE)
N0002.F1	Annex F1. Declaration of Tested Values on Label	August 2014	RE	Web(RE)
N0002.G	Annex G. Certificates and Sub-licenses for other Brands ...	August 2014	RE	Web(RE)
N0002.H	Annex H. Fees – initial draft for discussion	September 2014	RE	Web(RE)
N0002.I	Annex I. Comparison of Requirements on Different Certification Schemes	September 2014	PU	Web
N0004	GSC – Introduction	September 2014	PU	Web
N0005	List of GSCN Members	-	RE	Web(RE)
N0006-N0033	Agendas and reports from Network meetings and board meetings	February 2014 - June 2015	RE	Web(RE)
N0034	How to join the Global Solar Certification Network	June 2015	PU	Web
N0035-N0038	Agendas and reports from board meetings	June 2015	RE	Web(RE)

\* Restricted: available only to Task participants via internal Task website

### Journal, magazine articles

ReportNo.	Report Title	Publication Date	Access (Public, REstricted)	Web or Print
	Proceedings of SHC 2013: From International Standardization to Global Certification, Freiburg, J.E.Nielsen	September 2013	PU	Web
	Proceedings of SHC 2014: Global Solar Certification, Beijing, Les Nelson (Key-	October 2014	PU	Web

	note) Global Solar Certification based on new international collector testing standard ISO 9806:2013, J.E. Nielsen, H. Drück et al			
	To come: Proceedings of SHC 2013: Special session within "Industry Track" on Global Solar Certification Network	December 2015	PU	Web

### 1.5.1.5 Workshops and Conferences

The following are workshops and conferences Task participants contributed to with results of their work achieved within the frame of the Task or with results of the Task work.

Workshop/Conference	Place	Date
SHC2013	Freiburg, Germany	September 2013
SHC2014	Beijing, China	October 2014
SHC2015	Istanbul, Turkey	December 2015

### 1.5.2 Task 45 accomplishments

The following is a brief report on the accomplishments of each single work activity within the Subtasks A to C. The deliverable numbering correspond to the latest workplan: "Work Plan, revision 5 (incl. prolonged period), October 20, 2013, Jan Erik Nielsen"

#### 1.5.2.1 Subtask A: Collectors and collector loop

A-D1: Models for correction of collector efficiency parameters depending on collector type, flow rate, tilt and fluid type

The work is accomplished and reported in fact sheets 45.A.1

A-D2: If possible: Proposal for an informal annex to be included in EN 12975 / ISO 9806-1 describing how to make the above mentioned corrections

The results from A-D1 has been disseminated to the convenor Andreas Bohren (SPF, CH) of CEN TC 312 WG1 in order to be taken into consideration in the now on-going revision of the ISO 9806.

A-D3: Proposal for requirements and test methods for collector loop pipes (safety, durability, heat loss, thermal expansion) - pre-normative work - to be proposed to the relevant ISO/CEN TC's

This deliverable has not been accomplished due to lack of resources. However, there is interest from industry to elaborate fact sheets on the subject. Could be done in a follow-up task.

A-D4 Guidelines for requirements for collector loop installation, hydraulic scheme including precautions for safety and expansion including check list for checking installation accordingly  
The work is accomplished and reported in fact sheets 45.A.2.

A-D5 Detailed simulation models for solar collector fields (thermal performance)

The work is accomplished and reported in fact sheets 45.A.4.

A-D6 Control and operation strategies for solar collector fields

This deliverable has not been accomplished due to lack of resources.

A-D7 Procedure for guaranteeing performance of collector field installation - including how to check the guarantee - and including validation on existing fields

The work is accomplished - except for the validation (due to lack of resources). Reported in fact sheets 45.A.3.1 and fact sheets 45.A.3.2. Guarantee procedures for both thermal power output and annual energy output have been elaborated.

A-D8 Procedure for guaranteeing performance of solar loop heat exchanger - including how to check the guarantee - and including validation on existing fields

The work is accomplished - except for the validation (due to lack of resources). Reported in fact sheets 45.A.3.1.

A-D9 Input to task website

The work is accomplished: <http://task45.iea-shc.org/>.

A-D10 Input to "Fact sheets"

The work is accomplished: <http://task45.iea-shc.org/fact-sheets>.

### **1.5.2.2 Subtask B: Storages**

B1 State of the art report with best practice examples

Work accomplished with respect to bore hole heat storage and water pit storage - reported in fact sheets 45.B.3.1 and 45.B.3.2.

Draft general report made, final general report delayed.

B2 Identification of necessary R+D

Draft report made, final report delayed.

B3 Procedure for checking the performance of the storage and definition of characteristic parameters for comparison of storages --> simple tool

Work not accomplished.

B4 Design guidelines for seasonal storages and review of design/ simulation tools. Internet-database in cooperation of IEA ECES --> English version of [www.saisonalspeicher.de](http://www.saisonalspeicher.de)

Work not accomplished.

### **1.5.2.3 Subtask C: Systems**

C-D1: Overview system categories

The work is accomplished and reported in fact sheets 45.C.1

C-D2: Updated database large systems >0.5MW

The work is accomplished, database available from: <http://task45.iea-shc.org/system-database>.

C-D3: Guidelines and tools for feasibility incl. sensitivity analysis

The work on C-D3.1 (Does a large solar system fit into the surrounding regional/national energy system) was not accomplished due to lack of resources.

C-D3.2 and C-D3.3 were accomplished. Deliverables are:

- C-D3.2 Report on analysis of questionnaire on feasibility tools: "Subtask C-D3 status report": [http://task45.iea-shc.org/data/sites/1/publications/P-Task45C-D3\\_FeasToolsQuestResults.pdf](http://task45.iea-shc.org/data/sites/1/publications/P-Task45C-D3_FeasToolsQuestResults.pdf)
- C-D3.3 Simple calculation tool for large solar systems with seasonal storage: <http://task45.iea-shc.org/simple-tools>

C-D4: Models for ESCo services

The work is accomplished and reported in fact sheets 45.C.2.1, 45.C.2.2A, 45.C.2.2B and 45.C.2.3

C-D5: Procedures for performance check/monitoring/surveillance  
 The work is partly accomplished in cooperation with subtask A and reported in fact sheets 45.A.3.1 and 45.A.3.2.

C-D6: Guidelines for planning, installation, commissioning, operation  
 The work was not accomplished due to lack of resources.

C-D7 Input to "Fact sheets"  
 The work is accomplished: <http://task45.iea-shc.org/fact-sheets>.

C-D8 Input to task website  
 The work is accomplished: <http://task45.iea-shc.org/>.

#### 1.5.2.4 Reports and publications

ReportNo.	Report Title	Publication Date	Access (Public, REstricted)	Web or Print
INFO sheet 45.0	IEA SHC Task 45 FACT SHEETS - overview	May 2015	PU	Web
INFO sheet 45.A.1	Correction of collector efficiency parameters depending on variations in collector type, fluid type, collector flow rate and collector tilt.	February 2015	PU	Web
TECH sheet 45.A.1	Correction of collector efficiency parameters depending on variations in collector type, fluid type, collector flow rate and collector tilt.	December 2014	PU	Web
INFO sheet 45.A.2	Requirements & guidelines for collector loop installation	December 2014	PU	Web
TECH sheet 45.A.2	Requirements & guidelines for collector loop installation	December 2014	PU	Web
INFO sheet 45.A.3.1	Performance guarantee - Collector field power output	April 2014	PU	Web
TECH sheet 45.A.3.1	Performance guarantee - Collector field power output	April 2014	PU	Web
INFO sheet 45.A.3.2	Performance guarantee - Collector field annual output	July 2014	PU	Web
TECH sheet 45.A.3.2	Performance guarantee - Collector field annual output	April 2014	PU	Web
INFO sheet 45.A.4	Simulation of large collector fields	December 2014	PU	Web
TECH sheet 45.A.4	Simulation of large collector fields	December 2014	PU	Web
INFO sheet 45.B.1	Seasonal storages - Best practise examples	Delayed	NA	NA
TECH sheet 45.B.1	Seasonal storages - Best practise examples	Delayed	NA	NA



INFO sheet 45.B.2	Seasonal storages - Monitoring	Delayed	NA	NA
TECH sheet 45.B.2	Seasonal storages - Monitoring	Delayed	NA	NA
INFO sheet 45.B.3.1	Seasonal storages – Bore hole heat storage – Guidelines for materials & construction	February 2015	PU	Web
TECH sheet 45. B.3.1	Seasonal storages – Bore hole heat storage – Guidelines for materials & construction	October 2014	PU	Web
INFO sheet 45. B.3.2	Seasonal storages – Water pit heat storage – Guidelines for materials & construction	December 2014	PU	Web
TECH sheet 45. B.3.2	Seasonal storages – Water pit heat storage – Guidelines for materials & construction	December 2014	PU	Web
INFO sheet 45.C.1	Categorization of large solar heating and cooling systems	December 2014	PU	Web
TECH sheet 45.C.1	Categorization of large solar heating and cooling systems	December 2014	PU	Web
INFO sheet 45.C.2.1	ESCo models - General description	April 2015	PU	Web
TECH sheet 45.C.2.1	ESCo models - General description	April 2015	PU	Web
TECH sheet 45.C.2.2A	ESCo models - Best practice ex: Lisbon	April 2015	PU	Web
TECH sheet 45.C.2.2B	ESCo models - Best practice ex: Graz	April 2015	PU	Web
INFO sheet 45.C.3	ESCo models - Energy performance contracts - Simple model	December 2014	PU	Web
TECH sheet 45.C.3	ESCo models - general description	December 2014	PU	Web

### 1.5.2.5 Workshops and conferences

Workshop/Conference	Place	Date
Common Workshop with Task 44	Barcelona, Spain	April 2011
EU RHC platform workshop: Smart Cities / Smart District Heating	Bruxelles, Belgium	February 2011
EU RHC platform workshop: Combined systems	Bruxelles, Belgium	April 2011
Polish national workshop in Warsaw: Smart District Heating	Warsaw, Poland	May 2011
ISES 2011, Kassel: IEA-SHC Task 45	Kassel, Germany	August 2011
IEA-SHC/ESTIF meeting: Large solar systems	Kassel, Germany	August 2011
Solar Summit Freiburg: Smart District Heating. J.E. Nielsen	Freiburg, Germany	November 2011
Common Workshop with IEA DHC	Braedstrup, Denmark	May 2012
MIICS2012	Mikkeli, Finland	March 2012
Gleisdorf Solar 2012	Gleisdorf, Austria	September 2012
Common Workshop with Task 48 and 49	Graz, Austria	September 2012
ASTTP (Austrian solar thermal technology platform)	Austria	April 2012
SHC2012	San Francisco, USA	July 2012
KlimaEnergy Congress	Bolzano/Bozen, Italy	September 2012
OTTI, 23. Symposium - Thermische Solarenergi,	Kloster Banz, Bad Staffelstein, Germany	April 2013
InterSolar Conference	Munich, Germany	June 2013
International Energy Conference	DTU Copenhagen, Denmark	September 2013
SHC2013	Freiburg, Germany	September 2013
SEL SYMPHOSIUM "Heizen und Kühlen mit Fernwärme"	Bolzano/bozen, Italy	November 2013,
Energy Systems in the Alps - storage and distribution ... Energy Platform Workshop 3	Zurich, Switzerland	February 2014
SHC2014	Beijing, China	October 2014

## 1.6 Utilization of project results

### 1.6.1 Task 43

The "Global Solar Certification Network" has now been established and is ready to operate. Using the system of the "Global Solar Certification Network", manufacturers can re-use test and inspection reports from one certification scheme in one part of the world for obtaining certification in another part of the world. Significant amounts of money and resources can be spared – and enhanced competition can be expected - leading to cheaper quality products on the world market. And hence more wide spread use of solar thermal collectors and systems.

### 1.6.2 Task 45

The project results can be utilized by manufacturers, systems designers, system installers, project developers and Energy Service Companies (ESCOs) when they develop, construct, design, and finance large scale solar heating and cooling systems. Dissemination of information about the good development in Denmark concerning solar district heating systems has inspired other parts of the world – including China – to have a closer look at the possibilities for using these kind of systems in the national energy supply. If China starts deploying the market for solar district heating this could make a major impact on the world's emissions of CO<sub>2</sub>.

## 1.7 Project conclusion and perspective

### 1.7.1 Task 43

The aim of the extended period of Task 43 (Global Solar Certification) was to facilitate cross-border trading for manufacturers and other suppliers of solar thermal products; its objective is to minimize the need for re-testing and re-certification in each new country where products are to be marketed and sold.

"Global Solar Certification" is now being implemented for solar thermal collectors and is based on the test procedures given ISO 9086. Other components as well as complete solar water heaters and solar heating/cooling systems could be included at a later stage.

"Global Solar Certification" is a cooperation between solar certification bodies/schemes around the world. When a product has been certified by one of the participating certification bodies/schemes, the product can obtain certification from all other participating certification schemes without re-testing of the product and without re-inspection of production facilities. The "Global Solar Certification Network" (GSCN) has been established. The GSCN is made up by industry representatives and representatives from participating certification bodies and test labs. The GSCN is governed by a board of directors and managed by a manager; the Network operates under the "Network Working Rules".

How does it work for manufacturers: A manufacturer having already a certificate accepted within the GSC, simply apply directly to a certification body issuing the wanted certificate (also accepted within the GSC), showing his existing certificate and related documentation. The "new" certification body will then tell the manufacturer if any additional testing will be needed. If no additional testing is required - or when such additional testing has been completed - the manufacturer is granted the license to mark his product with the "new" certificate too.

### 1.7.2 Task 45

The main deliverables are the set of FACT SHEETS and the comprehensive detailed database of worldwide large solar heating and cooling systems.

The main outcome is the comprehensive information given in the fact sheets and the establishment of a global network of experts dealing with large solar heating and cooling systems. Especially the connection between the Chinese experts and experts from other parts of the world is expected to have good impact on future large systems in China and in elsewhere. The task has brought knowledge about large solar systems out to new countries and inspired people to consider the benefit of large central solar thermal solutions e.g. for district heating. Especially it seems that China has very good opportunities for implementing potentially a very large amount of huge solar district heating systems.

A follow-up task has been proposed from the Austrian side – to continue the good international cooperation and the very good momentum seen just now with respect to the interest of large scale solar heating and cooling systems.

## **Annex - Relevant links**

Task 43

<http://task43.iea-shc.org/>

<http://www.gsc-nw.org/>

Task 45

<http://task45.iea-shc.org/>