Catalogue of Selected Systems

IEA SHC TASK 53 | NEW GENERATION SOLAR COOLING & HEATING SYSTEMS (PV OR THERMALLY DRIVEN)

Catalogue of Selected Systems

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Contents

1 Executive Summary

IEA SHC Task 53 continues the work of earlier IEA SHC Tasks (Tasks 38, 48) to find solutions to make solar heating and cooling systems interesting and more cost competitive. The general objective of Subtask C is to stimulate, monitor and analyze performance of field test systems and demonstration projects of new generation solar cooling & heating systems.

The specific objectives of Subtask C are:

- To create a monitoring procedure for field tests or demo projects.
- To select identified projects and organize a complete field test monitoring campaign.
- To analyze potential technical issues on the monitored systems.
- To compare solar thermal and PV-driven SHC systems based on technical and economical key figures.

The activities to reach these objectives are:

- C1: Monitoring procedure and monitoring system selection criteria
- C2: System description for field test and demo project
- C3: Monitoring data analysis on technical issues & on performances
- C4: Best practices / feedback

Once the Monitoring Procedure was established in Subtask C1, activities in Subtask C2 work focused on the selection and description of field test and demo projects. Two surveys were completed by partners. Sixteen realized systems were selected as demo projects, which were analyzed in more detail on their technical and economic performance in Subtask C3.

This document describes the main characteristics of 16 new generation (NG) solar cooling and heating systems:

- 7 NG photovoltaic driven systems
- 11 NG thermally driven systems

2 Definition of the field test and demo projects

Solar heating and cooling (SHC) systems can be very complex and are characterized by a huge variety of different system configurations. SHC systems can include a solar or other heat source, a cold source and different types of heat rejection units as well as thermal storages. According to the monitoring procedure (defined in activity C1), the possible energy flows of the New Generation Solar Cooling and Heating Systems are represented in a simplified energy flow diagram in Figure 1.

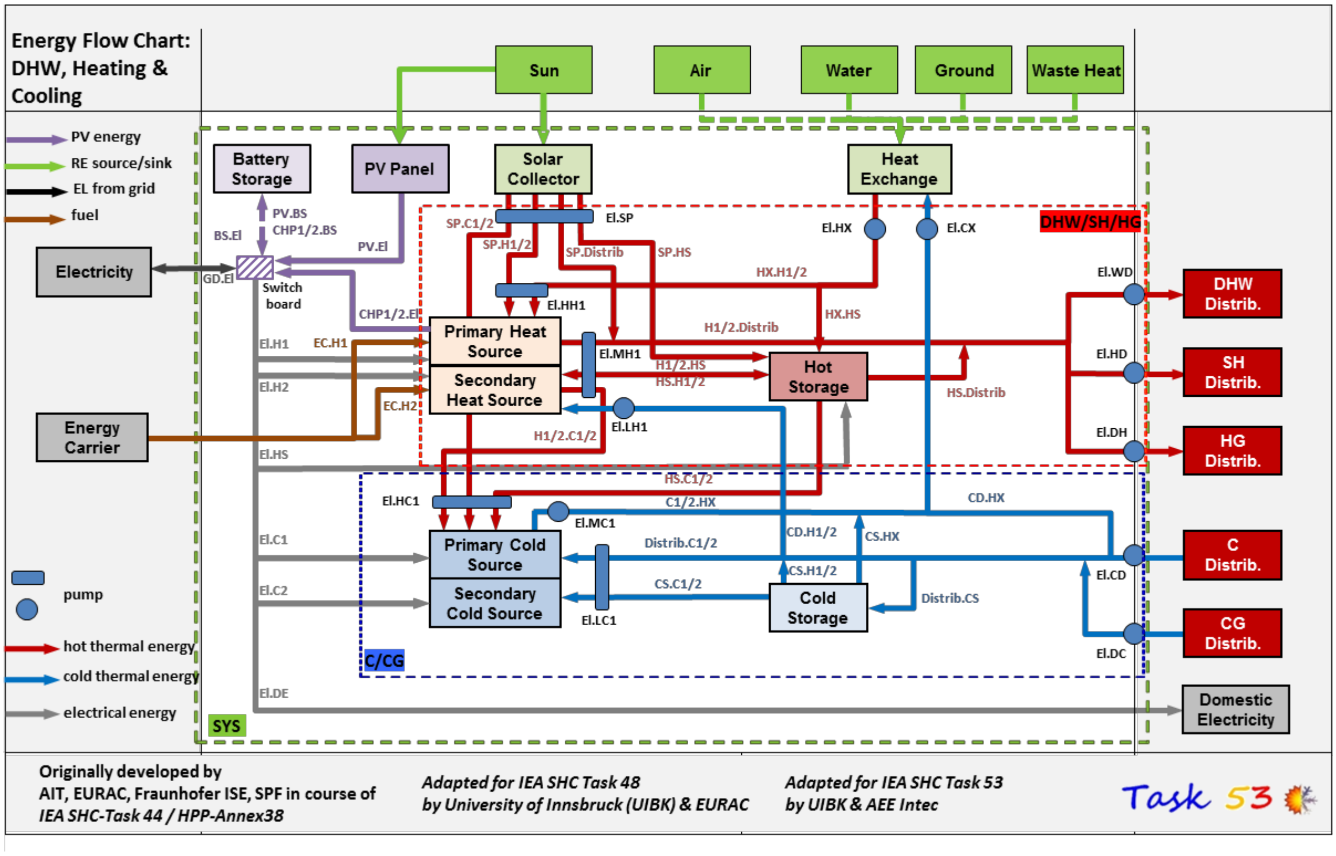


Figure 1. Simplified energy flow chart of the total SHC system within SHC Task 53.

The energy flows are used for technical and economic assessment (activity C3) and is performed in the T53E4-Tool. The Tool allows a wide range of new generation solar heating and cooling systems for all kind of applications (space heating (SH), domestic hot water (DHW), cooling (C), etc.) to be analyzed and assessed. Solar includes solar thermal and solar electric (photovoltaic) driven systems. The key performance indicators are used to compare the entire SHC system with the Task 53 reference (Ref) system as well as with an individual chosen (specific) reference system.

To represent the entire Solar Cooling and Heating system and to create the assessment the following components have are included and predefined in the T53E4 Tool.

- Solar sources:
  - Flat plate collector
  - Evacuated tube collector
  - Photovoltaic

- Heat sources:
  - Natural gas
  - Combined heat and power plant
  - Heat pump and reversible heat pump
  - Absorption heat pump and reversible absorption heat pump
  - District heating
  - Natural gas boiler
  - Condensing natural gas boiler
  - Electrical heater
  - Oil boiler
  - Pellet boiler

- Cold source:
  - Air or water cooled vapor compression chiller
  - Single effect absorption chiller
  - Double effect absorption chiller

  - Adsorption chiller
  - District cooling

- Cooling tower:
  - Wet cooling tower
  - Dry cooling
  - Hybrid cooling

- Storage:
  - Hot water storage
  - Cold water storage
  - Battery storage

Any combination of these components can be represented. If more than two heat/cold sources are included they need to merged and defined as individual component accordingly.

Two templates (one for electrical, one for solar thermal driven systems) were sent to all participants of Task 53 in order to collect the different systems that are currently working or have been simulated for future developments.

The idea of the templates is to break down the main characteristics of the systems, allowing to cluster results afterwards. Therefore (i) general information (location, operator, type of application,…), (ii) solar technology used (photovoltaic or solar thermal), (iii) heat/cold sources (type, capacity, etc.), (iv) energy storage (type, size), (v) heat rejection units (type, capacity) and (vi) backup solutions (hot/cold, type, capacity) were collected. Suitable systems for detailed technical and economic analysis were selected and are described in chapter 3.

The templates with its main questions about characteristics are shown in the following two figures.

General data	
Country:	Specifiy in which country the plant is located
City / region:	Specify in which city and region the plant is located
Company:	Specifiy the owner company
Year of completion:	Specify the year of completion or planned year
Type of application:	Specify the application, eg. cooling/heating of offices, residentials, food preservation etc.
Photovoltaic energy technology	
PV modules:	Specify PV installed peak power and type
Orientation/inclin:	Specify PV orientation (east=-90) and inclination (horizontal= 0)
Voltage:	Specify system voltage and if and inversor to a.c. is employed
Compressor driven heating/cooling	
Characteristics	Specify the number of units and the system (air/air, air/water, ...)
Heating	Nominal capacity, electrical consumption and COP
Cooling	Nominal capacity, electrical consumption and EER
Manufacturer	Nominal capacity, electrical consumption and COP
Energy storage systems	
Heat storage tank	Specify number of storage tanks and their corresponding volume
Electric storage	Specify number of storage units and their corresponding capacity (Ah or kWh))
Other technologies	Specifiy type of technology and storage capacity
Heat rejection technology	
Dry cooling:	Specify the dry system heat rejection capacity [kW]
Wet cooling:	Specify the wet system heat rejection capacity [kW]
Other technology:	Specify the type of technology and the heat rejection capacity [kW]
Main and/or back-up heating /cooling system technology	
Boiler	Specify the number of units and their corresponding nominal heating /cooling power
District heating	Specify the number of units and their corresponding nominal heating /cooling power
Heat pump (heating or	Specify the number of units and their corresponding nominal heating /cooling power
Other	Specify the number of units and their corresponding nominal heating /cooling power

Figure 2. Template for PV electrical driven SHC systems

General data	
Country:	Specifiy in which country the plant is located
City / region:	Specify in which city and region the plant is located
Company:	Specifiy the owner company
Year of completion:	Specify the year of completion or planned year
Type of application:	Specify the application, eg. cooling/heating of offices, residentials, food preservation etc.

Solar energy technology	
Solar themal coll.:	specify type of emploteyd collectors: flat plates, evacuated tubes, parabolic, air collectors, …
Area:	Specify gross area of the installed thermal coll. Type
Orientation/inclin:	Specify PV orientation (east=-90) and inclination (horizontal= 0)

Thermally driven technology	
Technology	Specify number of units and technology: absortion, adsorption, DEC (solid sorption matl.) DEC (liquid sorption matl.)
Heating	Nominal capacity and efficiency
Cooling	Nominal capacity and efficiency
Manufacturer	Nominal capacity, electrical consumption and COP

Energy storage systems	
Heat storage tank	Specify number of storage tanks and their corresponding volume
Electric storage	Specify number of storage units and their corresponding capacity (Ah or kWh))
Other technologies	Specifiy type of technology and storage capacity

Heat rejection technology	
Dry cooling:	Specify the dry system heat rejection capacity [kW]
Wet cooling:	Specify the wet system heat rejection capacity [kW]
Other technology:	Specify the type of technology and the heat rejection capacity [kW]

Main and/or back-up heating /cooling system technology	
Boiler	Specify the number of units and their corresponding nominal heating /cooling power
District heating	Specify the number of units and their corresponding nominal heating /cooling power
Heat pump (heating o	Specify the number of units and their corresponding nominal heating /cooling power
Other	Specify the number of units and their corresponding nominal heating /cooling power

Figure 3. Template for thermal driven SHC systems

3 Description of selected field test and demo projects

Feedback of 18 entities was collected, describing more than 30 plants and configurations. C2 is focusing on built systems, thus only built and monitored examples were selected. Figure 4 is showing the subdivision in simulated and monitored configurations of the overall survey.

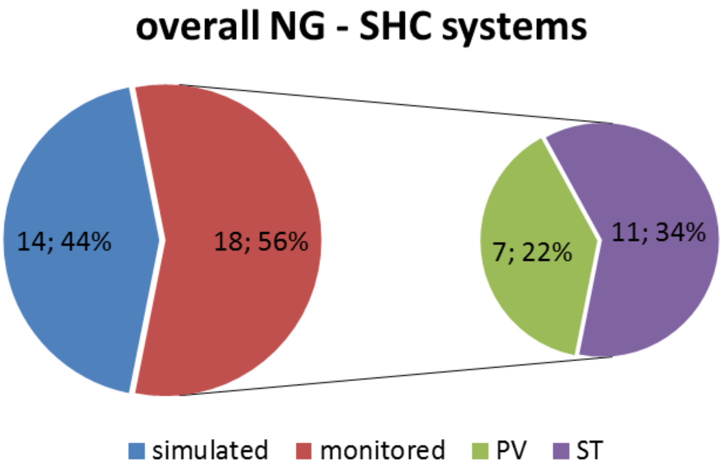


Figure 4. Overall number of collected new generation solar heating and cooling systems, subdivided in simulated and monitored examples.

The following 18 systems have been selected to be included in C2 activity about field test and demo projects. Out of the 18 selected examples 7 systems are driven by Photovoltaic, 11 systems are driven by solar thermal. In Table 1 the systems are listed including information of the located country and the responsible person with the corresponding e-mail address.

Table 1. Selected photovoltaic and solar thermal driven systems.

Photovoltaic driven Systems		
PV1 - France	Daniel Mugnier	daniel.mugnier@tecsol.fr
PV2 - Germany	Felix Loistl	felix.loistl@hm.edu
PV3 - Switzerland	Lukas Omlin	lukas.Omlin@spf.ch
PV4 - Egypt	Christoph Banhardt	christoph.banhardt@tu-berlin.de
PV5 - Spain	Pedro Vicente	pedro.vicente@umh.es
PV6 - Spain	Francisco Aguilar	faguilar@umh.es
PV 7 - Austria	Tim Selke	tim.selke@ait.ac.at
Thermal driven Systems		
TH1 - Morocco	Pietro Finocchiaro	pietro.finocchiaro@solarinvent.com
TH2 - Finland	Richard Schex	richard.Schex@zae-bayern.de
TH3 - Sweden	Corey Blackman	corey.Blackman@climatewell.com
TH4 - Austria	Rebekka Koell	r.koell@aee.at
TH5 - Italy	Salvatore Vasta	salvatore.vasta@itae.cnr.it
TH6 - France	Daniel Mugnier	daniel.mugnier@tecsol.fr
TH7 - China	Wei Zheng	wei.zheng@cn.yazaki.com
TH8 - Australia	Subbu.Sethuvenkatraman	subbu.Sethuvenkatraman@csiro.au
TH9 - Australia	Subbu.Sethuvenkatraman	subbu.Sethuvenkatraman@csiro.au
TH10 - Italy	Pietro Finocchiaro	pietro.finocchiaro@solarinvent.com
TH11 - Austria	Alexander Thür	Alexander.thuer@uibk.ac.at

The majority of the examples (60%, 11plants) are located in southern climates, 40% (7 plants) in northern climates. This subdivision is used in C3 activity to separate roughly between different solar yields (southern higher than northern) and the dominant demands (cooling in southern, heating in northern) and thus different non-renewable primary energy savings, economics and efficiencies.

Figure 5 shows further the distribution of PV and ST driven system in the two categories and in more detail country wise. Most of the examples (13 out of 18) are placed in Europe. The systems in Africa, Asia and Australia are all located in warmer climates; the systems in Europe are in different climates.

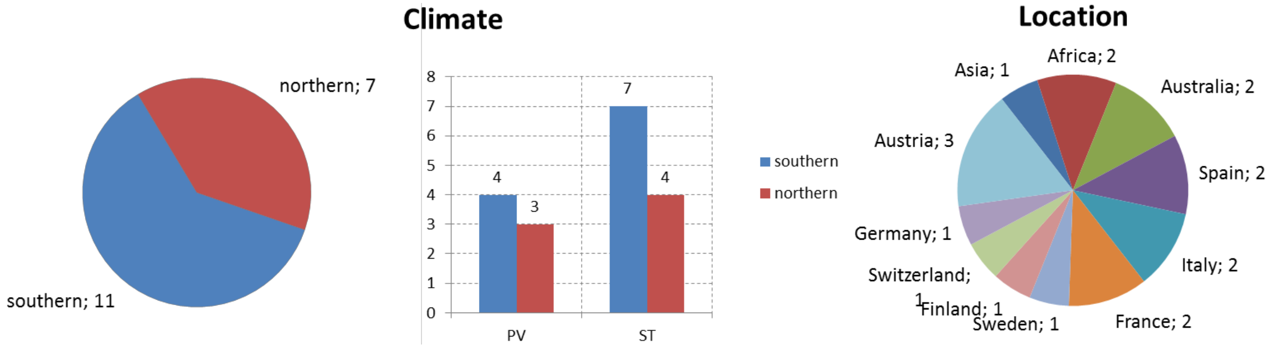


Figure 5. Climate and location of the demonstration systems

The SHC systems are built for a wired range of applications, dominated by combined cooling and heating (C+SH; 8) and cooling only (C – 6 plants) applications. The remaining 4 built to satisfy domestic hot water only (DHW – 1 plant), space heating + DHW (SH+DHW – 1 plant), cooling + space heating + DHW (C+SH+DHW – 1 plant) and cooling + DHW (C+DHW – 1 plant).

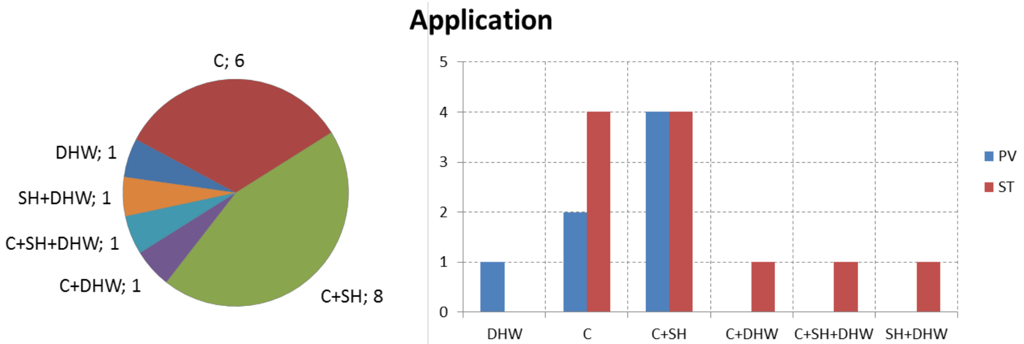


Figure 6. Application of the demonstration systems

In Figure 6 (right side) the subdivision is carried out for PV and ST separately. Most applications are for cooling + space heating (PV - 4 plants; ST – 4 plants) but the rest is distributed differently. PV driven systems are more built for single usage (C – 2 plants; DHW – 1 plant), whereas solar thermal driven systems have more than one demand (7 out of 11). Moreover the ST examples include DHW applications more often than the PV systems (ST – 3 plants; ST – 1 plant).

In view of economic assessment the nominal capacity is from high interest. On the one hand the ratio of investment to consumption based costs is influenced (but also depending on the yearly demands) significantly and on the other hand the economy of scale can be advantageous for large scale systems. Figure 7 shows an overview of the nominal capacities for the OPV and ST driven systems. PV systems are mainly present in small scale (<10 kW; PV – 5 plants; ST – 2 plants). ST systems are mainly built for medium scale applications (10-100 kW; PV – 2 plants; ST - 7 plants) but also for large scale (>100 kW; ST – 2 plants).

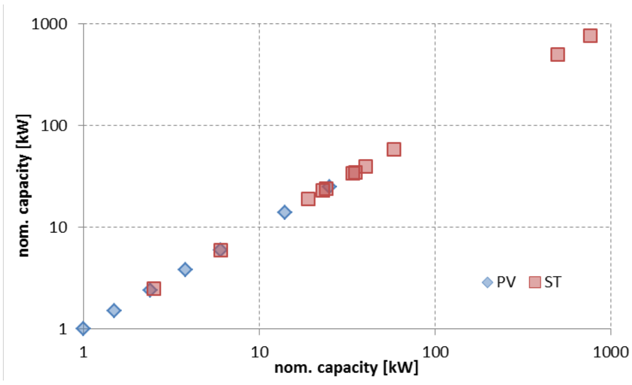


Figure 7. Capacities of the demonstration systems

The main technologies used for the PV and ST driven systems shows a wide range of different solutions. The PV systems with their heat pumps / vapour compression chillers are often used in combination with water distributions systems (x/water – 4 plants) but also for air applications (x/air – 3 plants). The ST driven systems are clearly dominated by H_2O/LiBr absorption chillers (6 plants), further two desiccant cooling systems, one NH_3/H_2O, one collector with integrated absorption and one system does not include a chiller at all are installed.

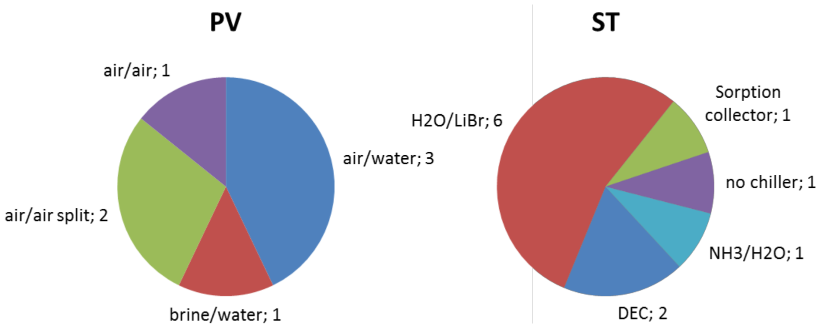
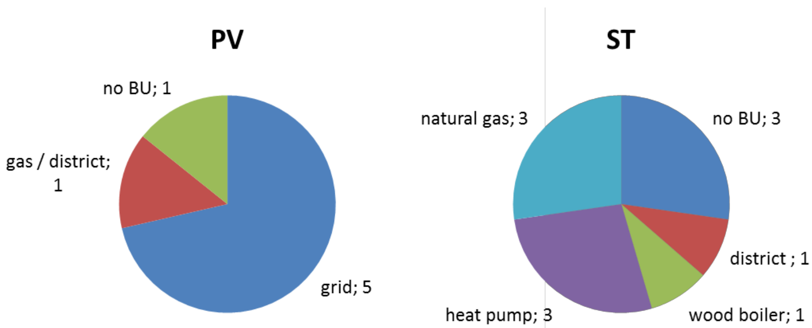


Figure 8. Heat pump types and chiller types used for the demonstration systems

Regarding the backup systems the picture shows also a wide variation but by nature ST systems include a wider range of backup solutions. The type of backup in combination with the solar fraction is the main key or bottleneck for high non-renewable primary energy savings.

The PV systems are dominated by grid connection, one system includes backups by natural and district cooling and one system is working solar autonomous without a backup. The majority is using backup natural gas boilers (3 plants); heat pumps (3 plants) or is even working solar autonomous (3 plants). Less systems use district heating (1 plant) or wood chip boiler (1 plant)

as



backups.

Figure 9. Backup types installed at the demonstration systems

Last but not least the storage solution is influencing the non-renewable primary effectiveness, but mainly the economics. By nature this picture shows higher variation within the PV system and less within the ST driven systems. Almost half of the PV systems are including a battery (el) as single solution (1 plant) or in combination with water (1 plant) or the building mass (1 plant). The other half is using ordinary water tanks (2 plants) or latent storages (1 plant); one system resigns to use storages at all. As expected the majority of the ST is using water storages (8 plants) but also a reasonable number is including latent storages (3 plants).

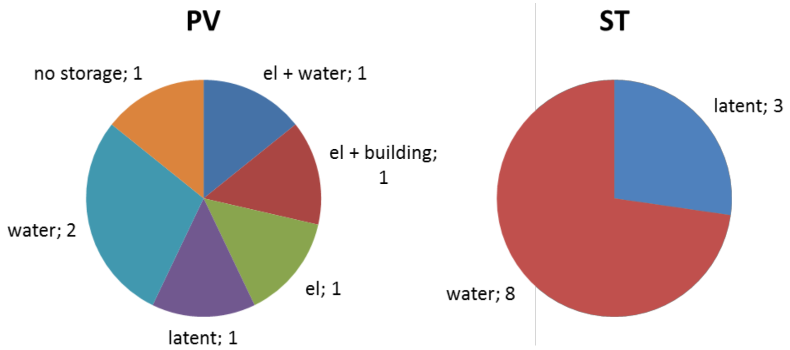


Figure 10. Storage types integrated in the demonstration systems

3.1 Details of the PV driven systems

The following tables show detailed information about the photovoltaic driven NG-SHC systems.

General data			
Number - Country:	PV1 - France	PV2 - Germany	PV3 - Switzerland
City / region:	Toulon	Garching/Bavaria	6415 Arth
Company:	Atisys - Neotherm - EED - Tecsol	ZAE Bayern	Aurelius Waldispühl (Private Person)
Year of completion:	2017	2017	2015
Type of application:	Cooling for tertiary & industrial sector	Cooling and heating of an office building with laboraties	Space cooling and heating, 3-4 person household
Photovoltaic energy technology			
PV modules:	5040 Wp, 18 PV modules	10000 Wp (estimated)	11055 Wp, 33 PV Modules,
Orientation/inclin:	Southwest / 15 deg	Southest / 30 deg	East (-95) / 15 deg
Voltage:		System runs at 400 Vac. 3 phase grid-connected inverter	Unit works at 400 Vac and PV is sypplyed at 656 Vcc
Compressor driven heating/cooling			
Characteristics	Heat Pump. Refriger: propane, R290	Air to air, 1 outdoor, 6-8 indoor units	brine water heatpump (heating)
Heating	-	NomCap = 25.0 kW ElecCon= 5.70 kW, COP = 4.39	NomCap = 14.1 kW ElecCon= 2.27 kW, COP = 6,2
Cooling	Cap=2.38-0.76 kW (using a variable frequency drive)	NomCap = 22.4 kW, ElecCon = 5.45 kW, EER = 4.11	Freecooling with groundwater
Manufacturer	Prototipe. Compressors GEA	Fujitsu	Zehnder; Comfobox10, Serie 5
Energy storage systems			
Heat storage tank	1000 liters water/glycol mixture	Latent heat storage, to be defined	500 liters (DHW) and Building mass
Electric storage	4*150Ah, 12 V Gel	No Electric Storage	No Electric Storage
Heat rejection technology			
Technology	Air-cooled condenser, microchannel type 10.2 kW	Dry cooling heat rejection by direct condenstation, about 25 kW	Ground water cooling
Main and/or back-up heating /cooling system technology			
System and control	Power compressors and auxiliary components heat pump when not PV production or elec. storage	Gas Boiler supplying hot water for heated and chilled ceilings / District Cooling: Well water (15°C/20°C)	Electrical heater, grid connected
	Daniel Mugnier daniel.mugnier@tecsol.fr	Felix Loistl felix.loistl@hm.edu	Lukas Omlin Lukas.Omlin@spf.ch

General data			
Number - Country:	PV4 - Egypt	PV5 - Spain	PV6 - Spain
City / region:	Hurghada, El Gouna	Elche, Alicante	Elche, Alicante
Company:	Berlin Institute of Technology	Prointer / Universidad Miguel Hernández	Prointer / Universidad Miguel Hernández
Year of completion:	2018	2014	2015
Type of application:	Space cooling of apartments	Space heating and cooling	Domestic Hot Water for dwellings
Photovoltaic energy technology			
PV modules:	400Wp (Planed to increase to 1600Wp	705 Wp, 3 Modules	490 Wp, 2 Modules
Orientation/inclin:	Horizontal / 0 deg	South (-20) / 35 deg	South / 45 deg
Voltage:	12V (might be changed) and AC 220V	Unit works at PV (24 Vcc) and grid (230 Vac)	Unit works at 230 Vac, PV is converted 24 Vcc to 230 Vac
Compressor driven heating/cooling			
Characteristics	air/air (split)	air/air (split)	air to water. A pipe surrounds the tank
Heating	-	NomCap = 3.81 kW ElecCon= 0.79 kW, COP = 4,82	NomCap = 1.51 kW ElecCon= 0.45 kW, COP = 3,35
Cooling	NomCap = 6.0 kW, ElecCon = 2.35 kW, EER = 2.55	NomCap = 3.66 kW, ElecCon =0.98 kW, EER=3.73	-
Manufacturer	Carrier	KAYSUN / MIDEA	Prototipe from a MIDEA Heat pump
Energy storage systems			
Heat storage tank	Only simulated. Building Mass	No Thermal Storage	190 liters (DHW)
Electric storage	1*200Ah, 12 V	No Electric Storage	No Electric Storage
Heat rejection technology			
Technology	Split-Unit system. Increased nightly radiation exchange by vaulted ceiling	The unit increases PV voltage. Electrity that is not needed is not generated	An electronic device derivers the excess of electricity to the tank electrical heater
Main and/or back-up heating /cooling system technology			
System and control	Grid connected	Grid connected. Hybrid Airconditioner	Grid connected.
	Christoph Banhardt christoph.banhardt@tu-berlin.de	Pedro Vicente pedro.vicente@umh.es	Francisco Aguilar faguilar@umh.es

General data	
Number - Country:	PV7 - Austria
City / region:	Graz, Austria
Company:	Institute of Thermal Engineering, Graz University of Technology
Year of completion:	2017
Type of application:	self- sufficient cooling and heating
Photovoltaic energy technology	
PV modules:	1200 Wp; 4 Glas-Glas modules with monocrystalin cells
Orientation/inclin:	South / 90 deg (Fassade)
Voltage:	2 Strings; 1x64 V 1x45 V; Battery 24V; Inverter output 230 V ac
Compressor driven heating/cooling	
Characteristics	R134a to Water (indirect cooling) or R134a to Air (direct
Heating	-
Cooling	Nominal capacity = 1033 W, electrical consumption = 373 W and EER = 2.77
Manufacturer	SECOP
Energy storage systems	
Heat storage tank	-
Electric storage	2 LiFePo4 -Batterys, á 1,15 kWh
Heat rejection technology	
Technology	-
Main and/or back-up heating /cooling system technology	
System and control	-

Tim Selke
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3.2 Details of the ST driven systems

The following tables show detailed information about the thermal driven NG-SHC systems.

General data			
Number - Country:	TH1 - Morocco	TH2 - Finland	TH3 - Sweden
City / region:	Marrakech	Mikkeli, ○61°42'N, 27°16'O	Karlstad
Company:	Agence Marocaine pour l'Efficacité Energétique	Savo Solar Oy	ClimateWell
Year of completion:	2016	2016	2014 (Renovation Ongoing)
Type of application:	Ventilation of a library	Solar Cooling and Heating of an office building	Cooling & Heating of Offices/Industrial Facility
Solar energy technology			
Solar themal collectors	Evacuated tube collectors	Flat: 9 x 2m² of Savosolar Standard + 9 x 2m² of improved foil insulated	Flat Plate Sorption Integrated Collectors
Area:	8.81 m2	36 m² (aperture area)	180 m^2 (aperture area)
Orientation/inclin:	South (0º) / 25º	East (-90°) / 50°	Southeast (-40º) / 40º
Thermally driven technology			
Technology	Nr 1 DEC (solid sorption material) HVAC	1 unit of Li/Br absorption chiller with heat pump mode	Triple-state absorption module into collectors
Heating	Nominal capacity 4.0 kW COP=18	24 kW @ 30/40°C COP ~ 1.72	N/A
Cooling	Nominal capacity 6.2 kW COP=20	10 kW @ 15/10°C COP ~ 0.72	40 kW
Manufacturer	SOLARINVENT	ZAE Bayern	ClimateWell & Hewalex
Energy storage systems			
Heat storage tank	Internal latent storage (desiccant beds)	2000 liters with improved stratification device	Heat Water: 1000 liters; Cold Storage = 12.6 m^3
Heat rejection technology			
System	Integrated wet cooling system	Dry cooling. P=24 kW at design point	Dry cooling. P=50 kW
Main and/or back-up heating /cooling system technology			
System	No auxiliary, the system is solar autonomous	1 unit with max. 14 kW @ 85°C in summertime and 95°C in wintertime serve as backup: heat for the absorption chiller and HP	-
	Pietro Finocchiaro pietro.finocchiaro@solarinvent.com	Richard Schex Richard.Schex@zae-bayern.de	Chris Bales cba@du.se

General data			
Number - Country:	TH4 - Austria	TH5 - Italy	TH6 - France
City / region:	Graz	Palermo	Montpellier, Occitanie
Company:	AEE INTEC (accompanying research)	Consorzio ARCA	SERM
Year of completion:	2014	2016	2013
Type of application:	Cooling and heating for house + process heat/cold	Poligenerative CSP Plant to drive a 23kW Absorption	DHW/cooling of offices & residentials
Solar energy technology			
Solar themal collectors	Flat plate collector (Ökotech HT 16,7)	Linear Fresnel Reflector, with Archimede Solar Energy absorber pipe	Double glasse flat plate collectors
Area:	100 m²	110m² to SHC (total 730 m²)	240 m²
Orientation/inclin:	South (0º) /45º	South (0°) / 0°	Southwest (30º) / 30°
Thermally driven technology			
Technology	Absorption cooling machine (ammonia/water)	Double effect Water/LiBr Absorption Chiller	Single effect absorption LiBr
Heating	-	23 kW COP= 1.1; Integrated Cooling Tower	
Cooling	19 kW	23 kW COP= 1.1; Integrated Cooling Tower	35 kW COP = 0.6
Manufacturer	PINK (Pink Chiller PC 19)	Systema (Italy);	YAZAKI WFC-SC10
Energy storage systems			
Heat storage tank	Hot storage: 20 m³ Cold storage: 1 m³	Ternary Molten Salt Themocline Storage (400 kWh)	1500 liters (+10 m³ for DHW separated)
Heat rejection technology			
System	Dry cooling. Table top cooler (P=50 kW)	The absorption chiller is equipped with a cooling tower, in the same cabinet	JACIR SH08-3C26 - 86 kW (hybrid dry/adiabatic)
Main and/or back-up heating /cooling system technology			
System	Wood chip boiler (100 kW)	SCH System works using as back-up and integration system a preinstalled HP, that provide hot/cold water to the ARCA's HVAC system	Gas burners (700 kW) Compression chiller (scroll) : 900 kW
	Rebekka Koell r.koell@aee.at	Salvatore Vasta salvatore.vasta@itae.cnr.it	Daniel Mugnier daniel.mugnier@tecsol.fr

General data			
Number - Country:	TH7 - China	TH8 - Australia	TH9 - Australia
City / region:	Jinan City, Shandong	Echuca Victoria	Echuca Victoria
Company:	Jinan Quancheng Park Emergency Center	Echuca Regional Health	Echuca Regional Health
Year of completion:	2016, completion	2010	2017
Type of application:	Solar heating and cooling	Cooling of Building	Cooling of Building
Solar energy technology			
Solar themal collectors	Evacuated tube collector (heat pipe, horizontal type & gravity type)	144 Greenland Systems GLX100-16	242 Number of Chromasun MCT micro Concentrator Fresnel
Area:	160 m^2 (146 m^2 Horizontal type; 14 m^2 Gravity type:)	406 m² 144 collectors, 2.82 m²/coll	820.4 m^2
Orientation/inclin:	Hz: 0º/19º; Gr: West(90)/?	North / 36.5º (Australia) Approx 320kW @	North / 23º (Australia)
Thermally driven technology			
Technology	Water fired absorption chiller, 1 unit	Broad BYDH43 Single Stage Absorption Chiller	Thermax 2-Stage Vapour Abs. Chiller HDG.40B.TCU
Heating	None	No Heating	No Heating
Cooling	35.2 kW COP = 0.7	Cooling 500kW. Chiller power Input 2.7kW	1500 kW, Max Heat 767kW. Chiller power input
Manufacturer	YAZAKI	Broad	Thermax
Energy storage systems			
Heat storage tank	Hot Water Storage: 5000 L; Cold storage: 1500 L	Hot Water Storage 2 x 5000 liters (Tank @ 90°C)	Storage Tanks for Fire Water - 150kL x 2 - Chilled Water @ approx 6°C
Heat rejection technology			
System	Wet cooling: P=93.3 kW	Dry cooling: P=1170 kW Wet cooling: P=3527 kW	Dry cooling: P=1170 kW Wet cooling: P=3527 kW
Main and/or back-up heating /cooling system technology			
System	Air-water heatpump, 1 unit, cooling 29.3 kW, heating 41 kW. Pre-cooling and pre-heating for ventilation system	Gas Boiler (steam to water) Broad HW Boost	Riello RS130 - 1600kW
	Wei Zheng wei.zheng@cn.yazaki.com	Subbu.Sethuvenkatraman Subbu.Sethuvenkatraman@csiro.au	Subbu.Sethuvenkatraman Subbu.Sethuvenkatraman@csiro.au

General data		
Number - Country:	TH10 - Italy	TH11-Austria
City / region:	Palermo	Innsbruck, Austria
Company:	University of Palermo/ENEA	NHT
Year of completion:	2014	2015
Type of application:	Ventilation of an office	heating, DHW + free cooling
Solar energy technology		
Solar themal collectors	PVT (ventilated PV+air collector)	flat plate & PV
Area:	2.4 m^2	75 m^2 & 25 kWp
Orientation/inclin:	South (0º) / 25º	20° / 40° & +20/-20° / 40°
Thermally driven technology		
Technology	Nr 1 DEC (solid sorption material) HVAC	-
Heating	Nominal capacity 2.5 kW COP=16.7	-
Cooling	Nominal capacity 1.5 kW COP=25	-
Manufacturer	SOLARINVENT	-
Energy storage systems		
Heat storage tank	Internal latent storage (desiccant beds)	1 tank, 6m^3
Heat rejection technology		
System	Integrated wet cooling system	-
Main and/or back-up heating /cooling system technology		
System	No auxiliary, the system is solar autonomous	1 ground water heat pump (CTA: Optiheat 1-44e Duo) just for heating and DHW; no cooling mode! P_th=58 kW, P_el=9.8kW, COP=6.0 at W10/W35
	Pietro Finocchiaro pietro.finocchiaro@solarinvent.com	Alexander Thür alexander.thuer@uibk.a.cat

4 Conclusions

This document describes the characteristics of 18 new generation solar cooling and heating systems – 7 New Generation (NG) photovoltaic driven systems and 11 New Generation (NG) thermally driven systems.

These systems were selected to be examples of field test and demo projects. The systems are fully monitored and will provide the needed data to calculate the performances of the systems (Subtask C3).

5 IEA SHC Technology Collaboration Programme

The Solar Heating and Cooling Technology Collaboration Programme was founded in 1977 as one of the first multilateral technology initiatives ("Implementing Agreements") of the International Energy Agency. Its mission is *"to enhance collective knowledge and application of solar heating and cooling through international collaboration to reach the goal set in the vision of solar thermal energy meeting 50% of low temperature heating and cooling demand by 2050.*

The members of the IEA SHC collaborate on projects (referred to as "Tasks") in the field of research, development, demonstration (RD&D), and test methods for solar thermal energy and solar buildings.

Research topics and the associated Tasks in parenthesis include:

Solar Space Heating and Water Heating (Tasks 14, 19, 26, 44, 54)
Solar Cooling (Tasks 25, 38, 48, 53)
Solar Heat for Industrial or Agricultural Processes (Tasks 29, 33, 49, 62)
Solar District Heating (Tasks 7, 45, 55)
Solar Buildings/Architecture/Urban Planning (Tasks 8, 11, 12, 13, 20, 22, 23, 28, 37, 40, 41, 47, 51, 52, 56, 59)
Solar Thermal & PV (Tasks 16, 35, 60)
Daylighting/Lighting (Tasks 21, 31, 50, 61)
Materials/Components for Solar Heating and Cooling (Tasks 2, 3, 6, 10, 18, 27, 39)
Standards, Certification, and Test Methods (Tasks 14, 24, 34, 43, 57)
Resource Assessment (Tasks 1, 4, 5, 9, 17, 36, 46)
Storage of Solar Heat (Tasks 7, 32, 42, 58)

In addition to our Task work, other activities of the IEA SHC include our:

- International Conference on Solar Heating and Cooling for Buildings and Industry
- Solar Heat Worldwide report – annual statistics publication
- Memorandum of Understanding – working agreement with solar thermal trade organizations
- Workshops and seminars

Country Members
Australia, Austria, Belgium, Canada, China, Denmark, European Commission, France, Germany, Italy, Mexico, Netherlands, Norway, Portugal, Slovakia, South Africa, Spain, Sweden, Switzerland, Turkey, and United Kingdom

Sponsor Members
European Copper Institute, ECREEE, RCREEE, International Solar Energy Society