SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

# 2017 HIGHLIGHTS

## Task 53 – New Generation Solar Cooling & Heating Systems (PV or solar thermal driven systems)

## THE ISSUE

A tremendous increase in the market for air-conditioning can be observed worldwide especially in developing countries. The results of the past IEA SHC Tasks and work on solar cooling in *SHC Task 38: Solar Air-Conditioning and Refrigeration* show the large potential of this technology for building air-conditioning, particularly in sunny regions. However, solar thermal cooling faces barriers to emerge as an economically competitive solution. Thus there is a strong need to stimulate the solar cooling sector for small and medium sized systems.

## OUR WORK

SHC Task 53, building upon earlier IEA SHC work in this field, is working to find solutions to make solar driven heating and cooling systems cost competitive and to help build a strong and sustainable market for new innovative thermal cooling systems and solar PV. These objectives are being tackled through five activities:

1. Investigation of new small to medium size PV & solar thermal driven cooling and heating systems and development of best suited cooling and heating systems technology with a focus on reliability, adaptability and quality.
2. Proof of cost effectiveness of the above mentioned solar cooling and heating systems.
3. Investigation on life cycle performances on energy and environmental terms (LCA) of different options.
4. Assistance with the market deployment of new solar cooling and heating systems for buildings worldwide.
5. Increasing energy supply safety and influencing the virtuous demand side management behaviors.

The Task's scope is technologies for the production of cold/hot water or conditioned air by means of solar heat or solar electricity. That is, the Task starts with the solar radiation reaching the collectors or the PV modules and ends with the chilled/hot water and/or conditioned air transferring to the application. It is focused on solar driven systems for both cooling (ambient and food conservation) and heating (ambient and domestic hot water).

**Participating Countries**

*Australia*
*Austria*
*China*
*France*
*Germany*
*Italy*
*Netherlands*
*Spain*
*Sweden*
*Switzerland*


**Task Period** 2014 - 2018
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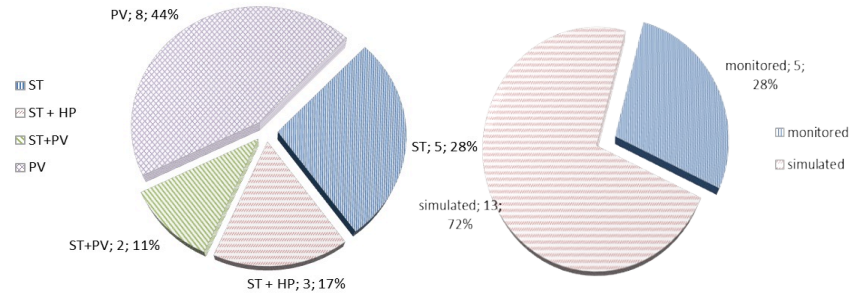
Task 53

# KEY RESULTS IN 2017

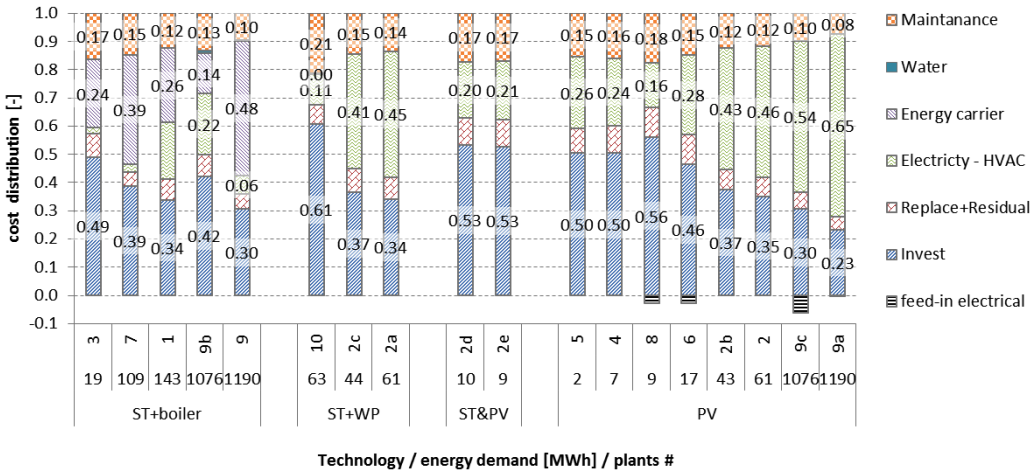
SHC Task 53 started in March 2014. The first results have been presented at numerous events, which can be found on the Task 53 webpage.

## Sensitivity analysis on the technical and economic performance of thermal and PV driven solar heating and cooling systems

Solar heating and cooling is projected to be an environmentally sound alternative to conventional systems. Both solar electrical and solar thermal driven systems can provide a suitable solution. Therefore, the comparison of technical and economic performance of Solar Heating and Cooling (SHC) systems becomes a major issue, and one that is not simple as the assessment requires a common comparable format, which is complicated by the numerous alternative energy sources and design possibilities.




A generalized technical and economic assessment methodology has been developed and tested in SHC Task 53. Ten case studies and best practice plants were analyzed and compared.




All systems can achieve non-renewable primary energy savings greater than 40%, and some show a cost ratio lower than 1. The PV and ST system are compared for southern and northern locations and although the differences are rather small, solar thermal seems to have advantages against PV driven systems. But in certain cases, the situation is reversed and PV is advantageous.

A comprehensive sensitivity analysis on boundary conditions shows the technical and economic performance in the same range for solar thermal and PV. Finally, the analysis points out that both technologies - solar thermal and PV driven systems - can be an economic solution.

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## Life Cycle Analysis for Solar Cooling Systems


The on-going work on developing a specific tool for assessing Life Cycle Analysis for solar cooling has led to the development of the ELISA (Environmental Life Cycle Impacts of Solar Air-conditioning Systems) tool.

The ELISA tool, which was in beta test in 2017, is a user-friendly Life Cycle Assessment (LCA) tool that aims to support researchers, designers and decision-makers in evaluating the life cycle energy and environmental advantages related to the use of solar heating and cooling (SHC) systems in substitution of conventional ones. The tool takes into consideration specific climatic conditions and building loads. It should be used only for educational and research activities.

The tool was developed in Microsoft Excel with the following characteristics:

- Easy-to-use: it can be used both by LCA practitioners and non-professional users
- Applicable to different geographic contexts
- Possibility to compare 4 typologies of systems:
  1. SHC system
  2. SHC system with photovoltaic panels (PVs)
  3. Conventional systems
  4. Conventional systems with PVs

ELISA is a tool developed by University of Palermo for creating life cycle energy and environmental balances of the SHC system, for carrying out simplified LCAs, and for comparing the SHC systems with conventional ones.

Data on specific energy and environmental impacts of different components of SHC and conventional systems are provided with the tool. The tool allows for calculating the following indices:

- Global warming potential (GWP)
- Global energy requirement (GER)
- Energy payback time (EPT)
- GWP payback time (GWP-PT)
- Energy return ratio (ERR)

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