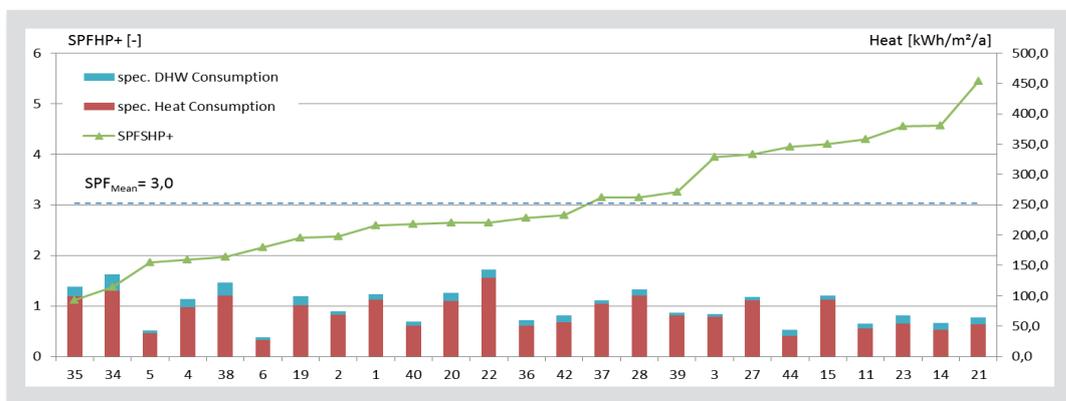


# Solar and Heat Pump Systems



Monitored results on 25 SHP systems. The SPF can range from bad systems to excellent ones [Source: Fraunhofer ISE]



SOLAR + HEAT PUMP

Solar and heat pump systems will be part of the future energy technologies for space heating and cooling, as well as DHW production, in many countries. If such systems are combined with PV (in parallel or through PVT collectors), they can fulfil the request of a net zero yearly energy balance.

Annex 38 has produced the engineering tools to further support the combined SHP technologies (simulation, monitoring, laboratory testing, performance figure definitions) for systems with solar and heat pumps on air source, ground source or ice storage.

HPP Annex 38 started in January 2010 and ended in December 2013. Its scope considered solar thermal collectors and storage in combination with heat pumps, for the supply of domestic hot water and heating in family houses.

The Annex was a joint effort of the Solar Heating and Cooling Programme (SHC) and the Heat Pump Programme (HPP) of the International Energy Agency. It was called Task 44 for SHC and Annex 38 for HPP.

## Results and Conclusions

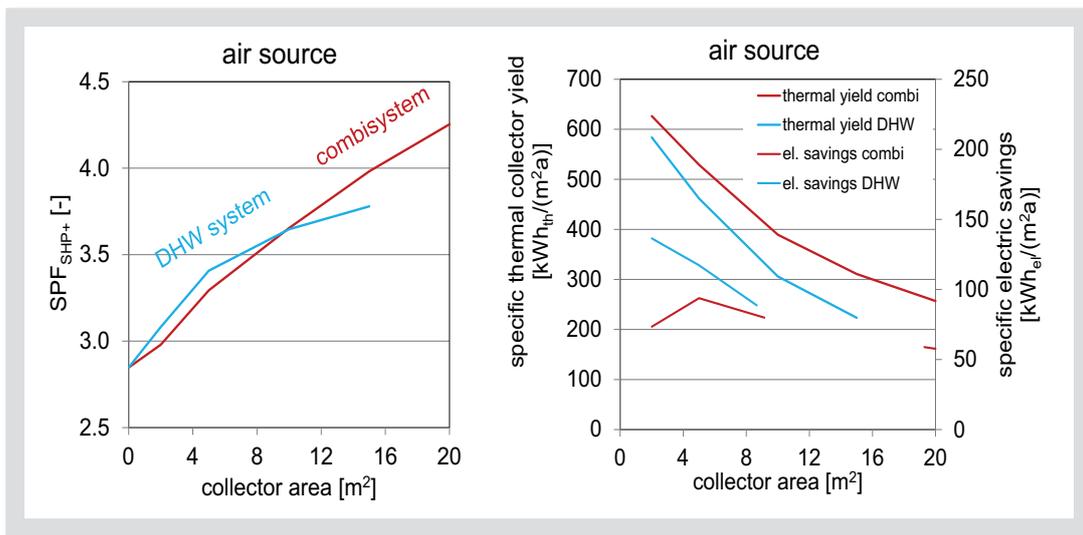
... A survey of the global market showed the trend of more solar in air and ground source heat pump installations.

... Definitions of SPF have been given in detail and the influence of the boundaries clearly depicted. The storage losses influences have been shown.

... More than 30 systems have been monitored over 1 or 2 years and results reported.

... It could be observed that high SPFs can be reached in well integrated systems. Solar heat is a valid source for the heat pump and can bring substantial advantages in terms of economic and energetic considerations.

... Simulation tools have been developed for solar collectors under dew point operation, heat pumps, and ice storage and sensitivity analysis have been made based on validated model on field tests in several countries.



What does solar heating add to the whole? Performance of air-source solar and heat pump systems, where solar heating is used for DHW only (DHW) or for a combined system with combined storage (combi). (Simulations of SPF in reference conditions.) For more results see the handbook *Solar and Heat Pump Systems for Residential Buildings*.

## Methodology and objectives

The Annex was organized in four Subtasks each lead by an expert and the choice of topics for each sub-task proved to be adequate:

**Subtask A:** Solutions and generic systems (Lead Country: Germany, Fraunhofer ISE, Sebastian Herkel). The objective of Subtask A was to collect, create and disseminate information about the current and future solutions for combining solar thermal and heat pump to meet heat requirements of a one family house. Subtask A dealt with pre-manufactured systems and systems installed and monitored during 1 or 2 years.

**Subtask B:** Performance assessment (Lead Country: Austria, AIT, Ivan Malenkovic 2010-2012 and Michael Hartl in 2013). The objective of this subtask was to reach a common definition of the figures of merits of solar + heat pump systems and how to assess them. This work lead to prenormative definition on how to test and report the performance of a combined solar and heat pump systems.

**Subtask C:** Modeling and simulation (Lead Country: Switzerland, SPF, Michel Haller). The objective was here to provide modeling tools of all generic solar and heat pump systems and to report sensitivity analysis on most of the systems such as being able to pinpoint important features and marginal ones in a given system configuration. Sizing of systems and optimizing their control are also possible using the output of this Subtask, with the computing tools and the framework developed.

**Subtask D:** Dissemination and market support (Lead Country: Italy, EURAC, Wolfram Sparber). The objective was to provide information during the course of T44A38 so that value added created by the participants could be transferred as fast as possible to a growing market. A second objective was to deliver the final book of T44A38 aimed as a reference document in the field of solar heat and heat pumps.

## Further information

- Contact person:** Operating Agent was Swiss Federal Office of Energy, Switzerland, represented by Jean-Christophe Hadorn, jchadorn@baseconsultants.com
- Participating countries:** From HPP: Finland, Germany, and Switzerland (Operating Agent)  
 From SHC: Austria, Belgium, Canada, Denmark, France, Germany, Italy, Spain, Sweden, Switzerland (Operating Agent), and USA
- Publications:** Final report of Annex 38 and Executive Summary of Annex 38, available at [www.heatpumpcentre.org](http://www.heatpumpcentre.org), and the handbook *Solar and Heat Pump Systems for Residential Buildings* (ISBN: 978-3-433-03040-0).
- Internet:** <http://task44.iea-shc.org/net> and information regarding Annex 38 at [www.heatpumpcentre.org](http://www.heatpumpcentre.org)

