# ADVANCED STORAGE CONCEPTS FOR SOLAR HOUSES AND LOW ENERGY BUILDINGS
# IEA-SHC TASK 32 (www.iea-shc.org)


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INTERNATIONAL ENERGY AGENCY
Solar Heating & Cooling Programme

## Objectives

1. To investigate advanced solutions for storing heat in systems providing heating or cooling for solar and low energy buildings.
2. To contribute to the development of advanced storage solutions in thermal solar systems for buildings that lead to high solar fraction.
3. To propose advanced storage solutions for the benefit of other heating or cooling technologies than solar (heat pump, boiler).


*A low energy house with active solar, F*


*Spheres of zeolite 5 mm, SPF CH*

## Why high density thermal storage ?

- to increase the thermal mass of building components
- to reduce the solar store volume for a given solar fraction
- to reduce the heat losses of the store
- to increase the solar fraction for a given available volume
- to reduce the number of on/off cycles of boilers
- to produce heat and cold with the same machine.

## Focus

Main focus of Task 32 is detached houses with storage units sized to achieve a significant solar fraction of heating or both heating and cooling load. Standard current solutions make use of insulated water tanks in the range of 400 to 1 000 liters and achieve 25 to 50% solar fraction. The goal of Task 32 is to investigate new solutions to improve the storage efficiency and capacity and the fractional energy savings by solar.

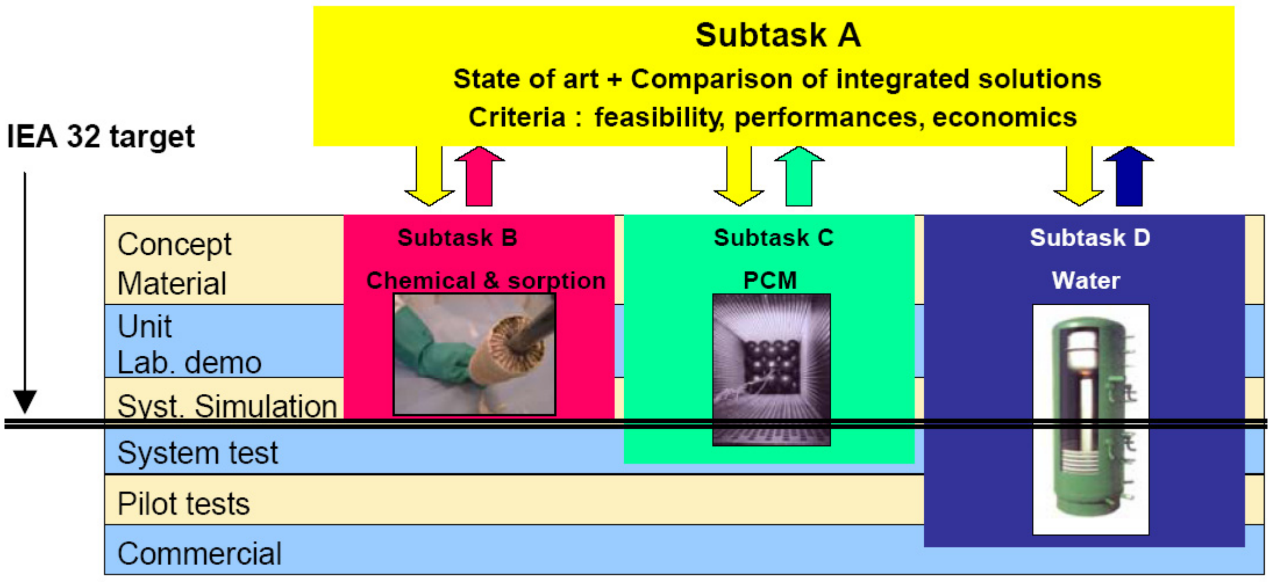

*Storing summer energy to winter is still a challenge, CH*

| Option | Advantages | Disadvantages |
|---|---|---|
| **Chemical and sorption** | • High energy density resulting in small volume of material.<br>• Many systems act as heat pumps making cooling as well as heating possible | • Greater complexity in the system (closed systems).<br>• Many compounds are relatively expensive.<br>• Relatively high temperatures required.<br>• Limited experience with long-term operation (after many thousand cycles). |
| **Phase Change Materials (PCM)** | • Higher thermal energy storage capacity (smaller storages) than sensible energy storage, at least if only small useful temperature differences are used.<br>• Relatively constant temperature during charging and discharging. | • Higher investment cost, in most cases, compared to water storage.<br>• In many cases, the peak power during discharge is limited due to limited heat conduction in the solid state of PCM. This is the main limit determining the acceptable size for the storage modules.<br>• Limited experience with long-term operation (after many thousand cycles).<br>• Risks of loss of stability of the solution and deterioration of the encapsulation material. |
| **Water** | • Environmentally friendly.<br>• Inexpensive and easy to handle.<br>• High thermal capacity.<br>• Decreasing density with increasing temperature and low thermal conductivity. This offers the possibility of stable thermal stratification.<br>• Long term experience available. | • Large volumes required<br>• Relatively large heat losses |

## Temperature range: 0 to 150 °C

The technologies are at different stages of development. It is accepted that the delivery of a participating team can be either:

- a system design evaluated by simulation
- a system prototype evaluated in a laboratory
- a tested installed system.




## ONGOING AND COMPLETED PROJECTS

| Subtask A | Chemical and Sorption | PCM | Water |
|---|---|---|---|
| • "State of the Art" handbook covering thermal storage for solar buildings. Published July 2005.<br>• Comparison and evaluation criteria for Task 32 systems | • Monosorp (ITW, Univ. Stuttgart, Germany). Test and simulations of open zeolite store working with ventilation heat recovery system.<br>• Thermochemical Accumulator (SERC, Högskolan Dalarna, Sweden). Tests and simulations of three phase closed absorption system with integral heat storage<br>• Adsorption store (SPF, Hochschule für Technik Rapperswil, Switzerland). Test of closed adsorption store with detailed property measurements.<br>• Modestore (AEE-Intech, Austria). Tests and simulations of closed adsorption heat storage.<br>• Compact Chemical Heat Store (ECN, Holland). Completed feasibility study for solar seasonal storage for single-family houses. | • Enhanced heat transfer (Univ. Lleida, Spain). Tests and simulation of graphite matrix with PCM in bottles for free cooling and DHW stores.<br>• PCM in solar combistores (Applied Univ. Yverdon. Switzerland). Parametric study of PCM in stores for solar combisystems.<br>• PCM for reduced boiler emissions (IWT, Univ. Graz, Austria). Tests and simulations of PCM storage for reducing starts/stops for boilers.<br>• Supercooling PCM for long term storage (Danish Univ. of Technology). Simulation feasibility study of supercooled PCM store for long term storage.<br>• PCM slurries (IWT, Univ. Graz, Austria). Tests and simulations of PCM slurries for increasing cycle time of boilers. | • Laboratory tests of stratifiers (Danish Univ. of Technology). Tests using particle image velocimitry and CFD simulations.<br>• Solar goes CFD (ITW, Univ. Stuttgart, Germany). Development of methodology for store optimisation and design using CFD tools.<br>• Insulation materials for stores (Danish Univ. of Technology). Completed literature survey of insulation materials available for stores.<br>• Advanced storage concepts for solar combisystems (ITW, Univ. Stuttgart, Germany). Completed simulation study of different storage concepts and comparison with water stores. |