



Combined short- and long-term heat storage with Sodium Acetate Trihydrate for solar heat supply in buildings

Englmair, Gerald; Moser, Christoph; Furbo, Simon; Schranzhofer, Hermann; Fan, Jianhua

Publication date:
2018

Document Version
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):

Englmair, G., Moser, C., Furbo, S., Schranzhofer, H., & Fan, J. (2018). *Combined short- and long-term heat storage with Sodium Acetate Trihydrate for solar heat supply in buildings*. Poster session presented at International Sustainable Energy Conference 2018, Graz, Austria.

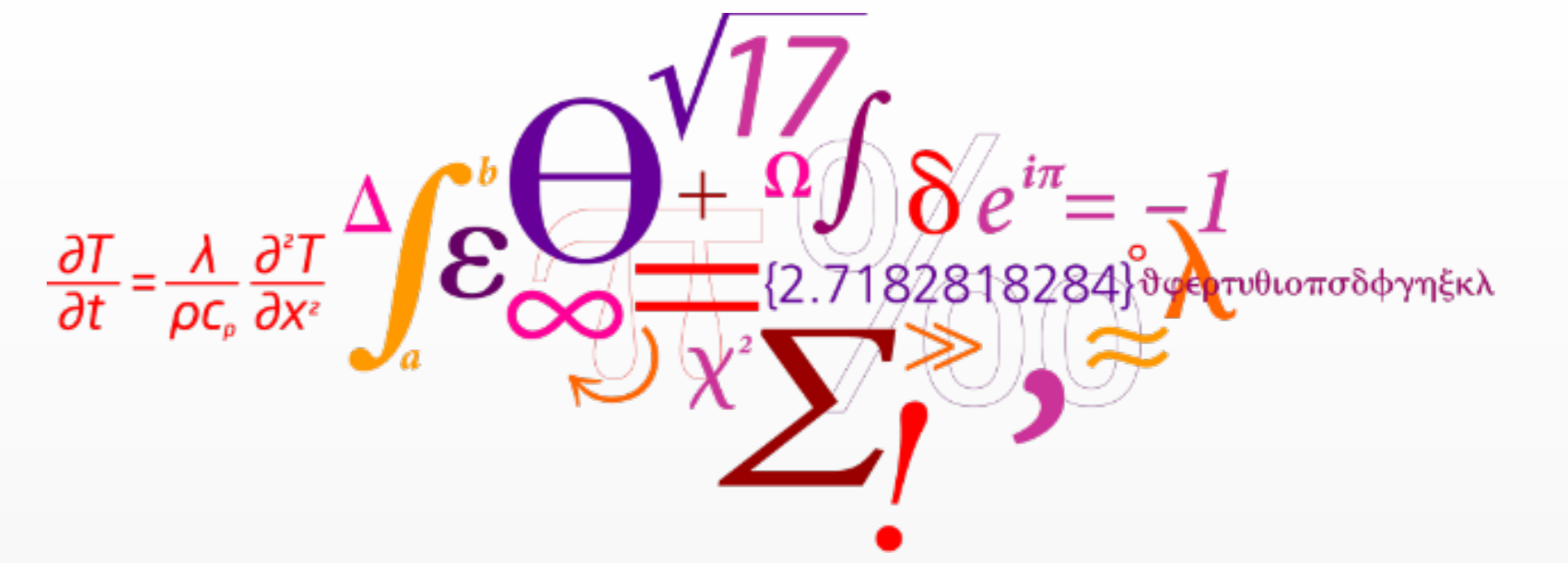
General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

COMBINED SHORT- AND LONG-TERM HEAT STORAGE WITH SODIUM ACETATE TRIHYDRATE FOR SOLAR HEAT SUPPLY IN BUILDINGS



Gerald Englmaier¹, Christoph Moser², Simon Furbo¹, Hermann Schranzhofer², Jianhua Fan¹

¹ Department of Civil Engineering, Technical University of Denmark; gereng@byg.dtu.dk

² Institute of Thermal Engineering, Graz University of Technology

Background:

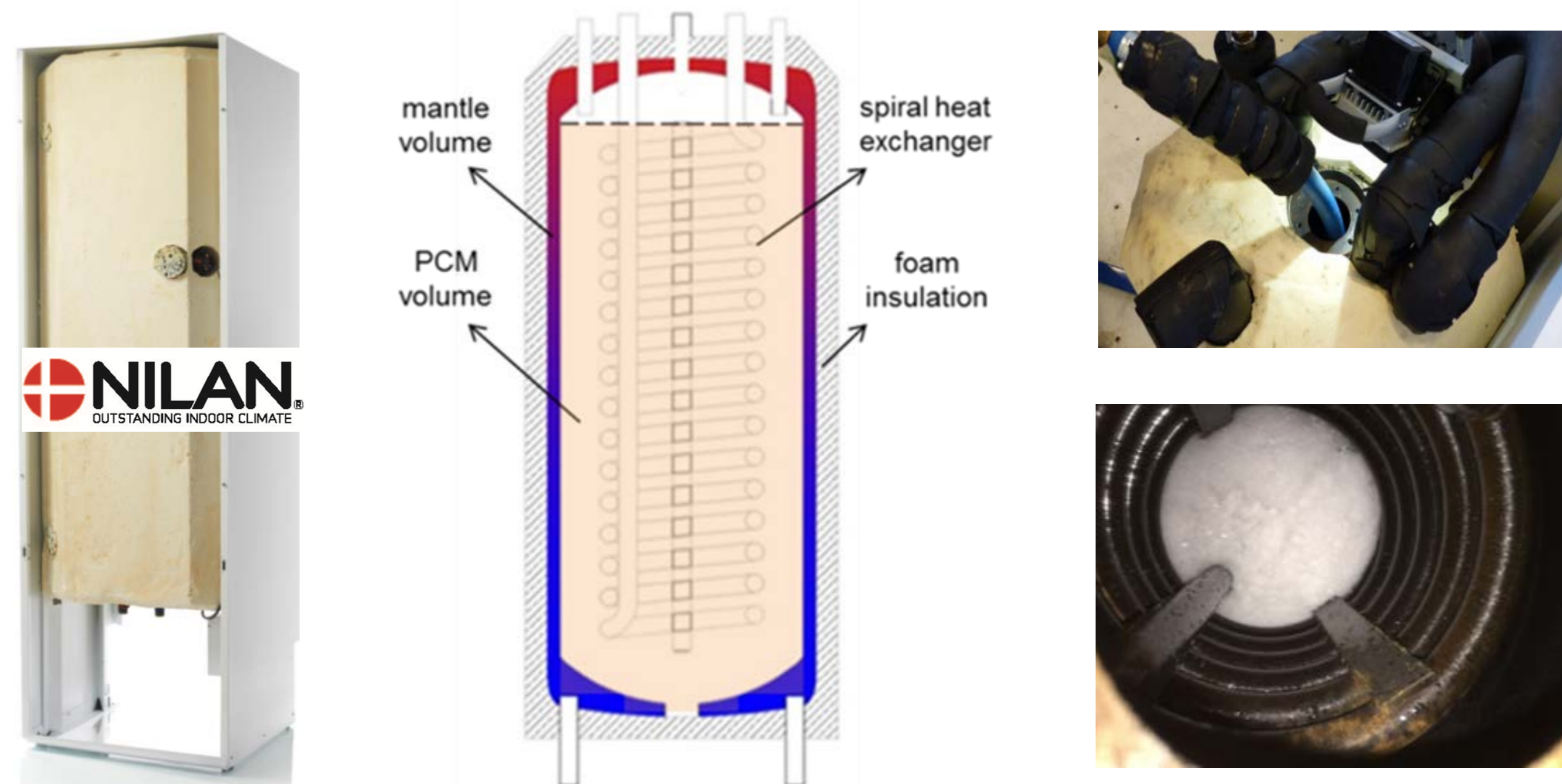
Due to the mismatch of solar energy resources and domestic heat demand, long-term storage of heat is essential for an innovative system with a high solar fraction in the range of 70%-100%. Therefore a concept based on stable supercooling of a sodium acetate trihydrate (SAT) has been investigated.

Material properties:

- Melting temperature: 58 °C
- Latent heat of fusion: 264 kJ kg⁻¹
- Market prices (food grade): typically below 0.5 € kg⁻¹
- Thickening agents and liquid polymers are used to stabilize SAT
- SAT can supercool to ambient temperature while heat of fusion is preserved

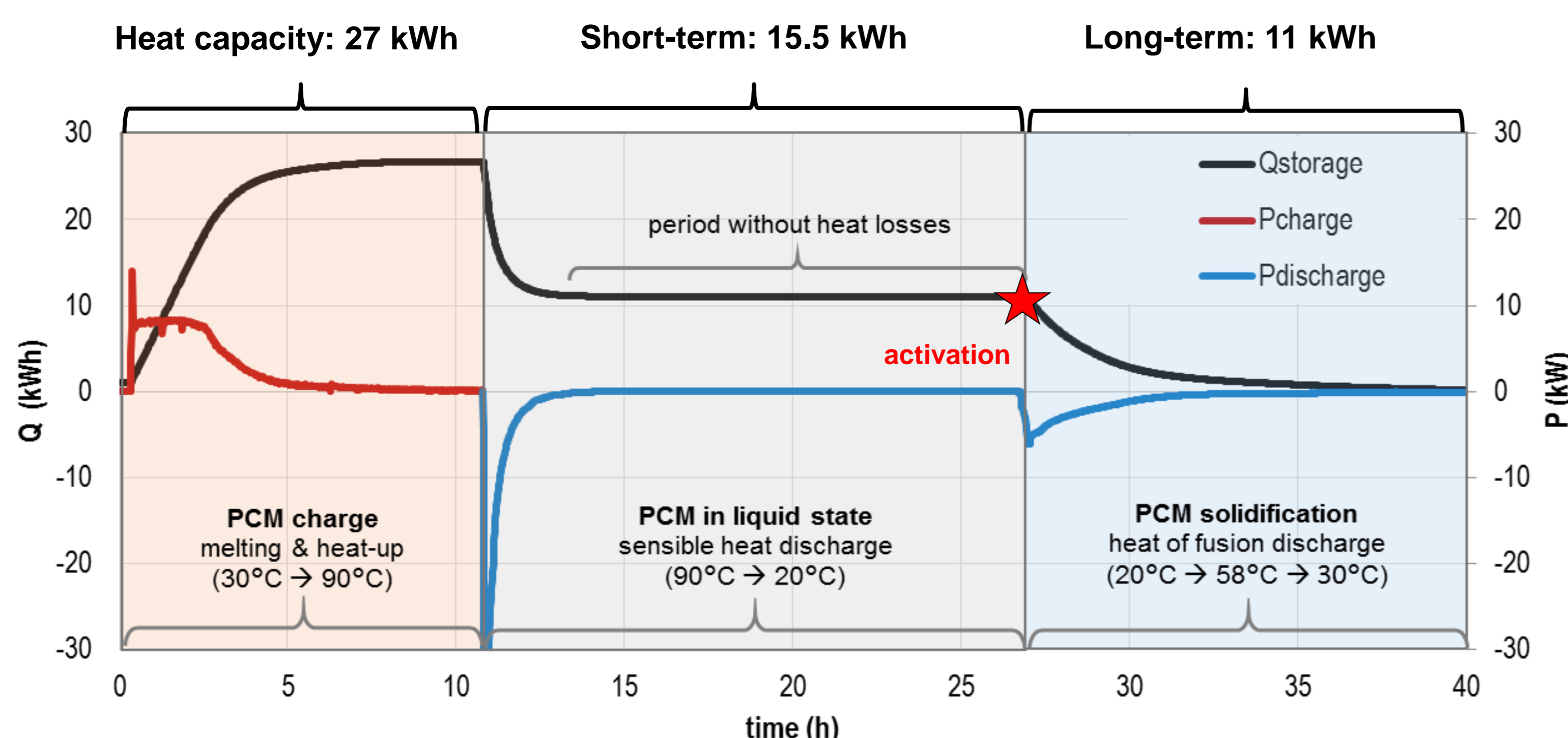
Heat storage units:

Supercooling of SAT composites can be achieved in flat container of 150 L with an internal height of 5 cm. Later, a cylindrical container (Ø 0.4 m) of similar volume was built with an internal spiral heat exchanger. It was situated in a water tank (Ø 0.46 m) so that heat transfer via its outer surface was possible. The total heat exchange surface was 3 m². Units of both design were constructed by Nilan A/S.



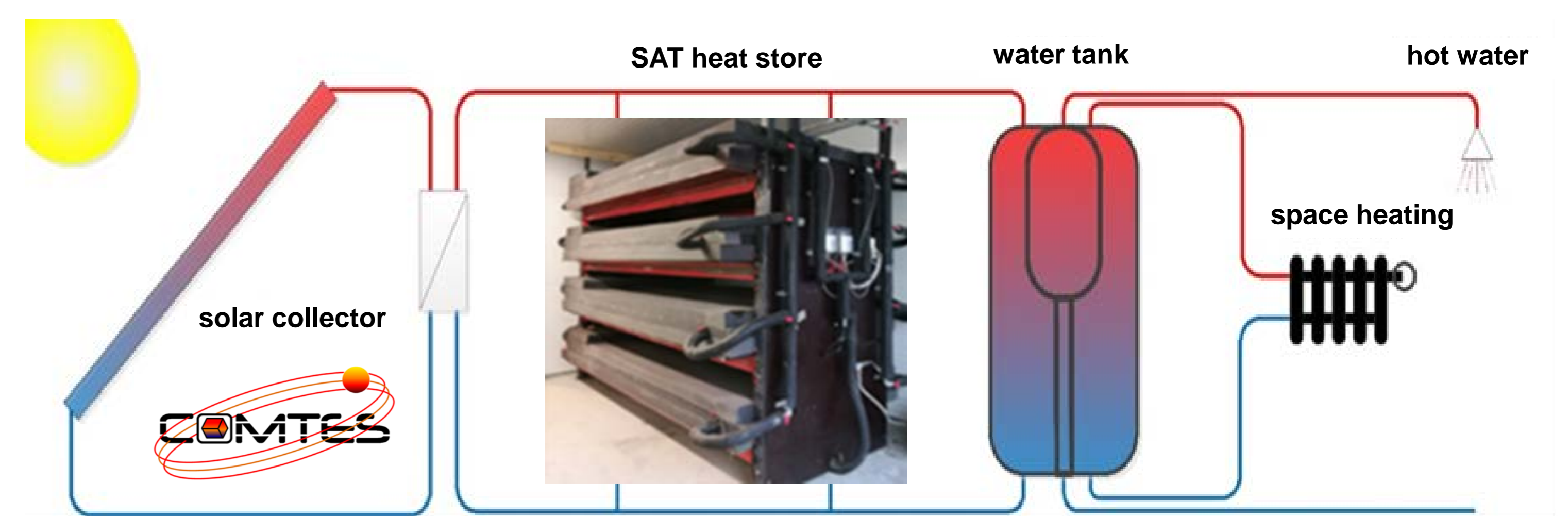
Potentially inexpensive heat storage design

Prototype units were tested for their short- and long-term heat storage potential after heating to 90 °C. Controlled activation of SAT crystallization was achieved by either seed crystal injection or local cooling (CO₂ evaporation, Peltier elements).



Test results of cylindrical heat storage unit

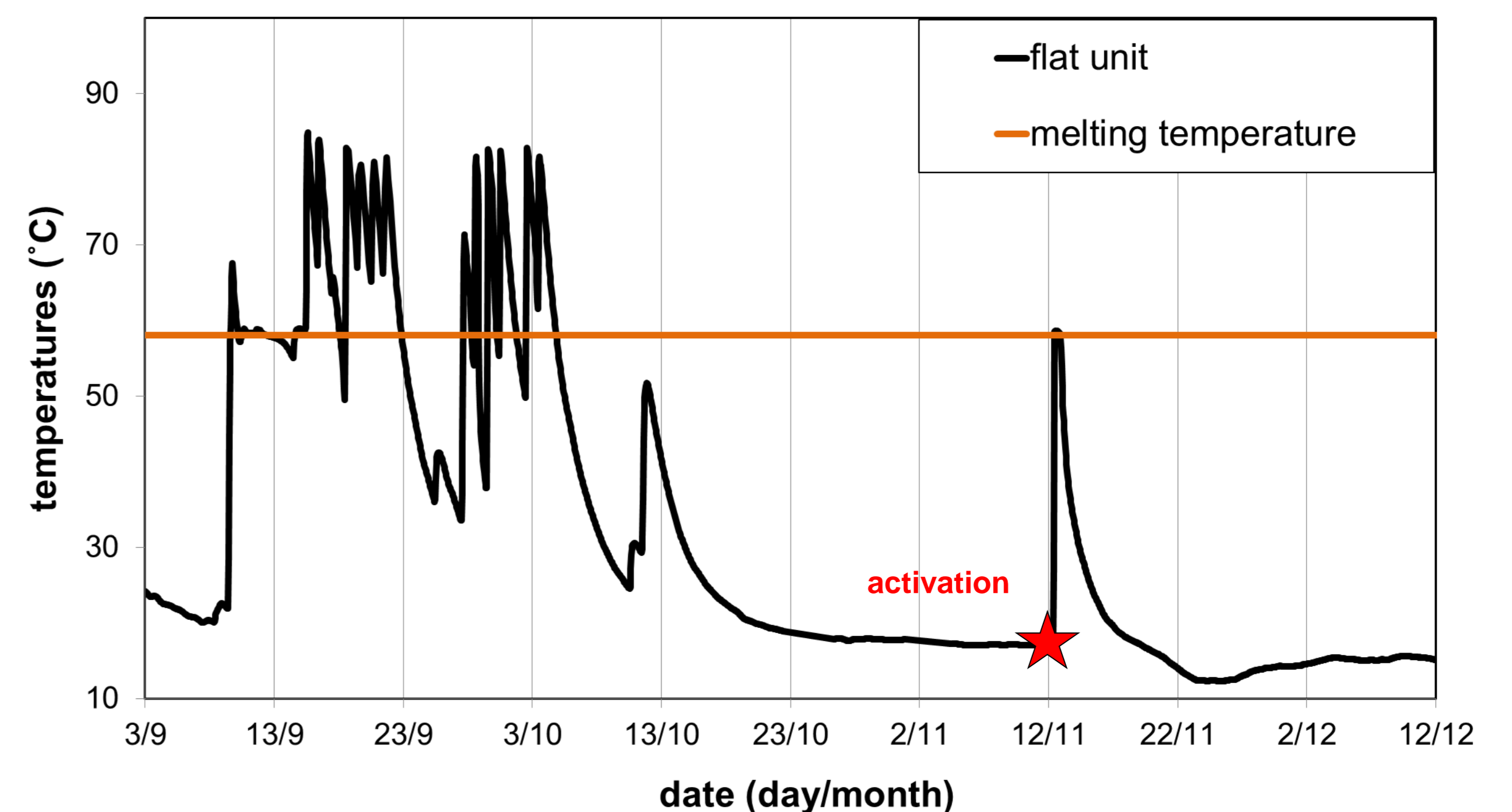
Demonstration system:



Solar combi-system with segmented SAT heat store

A segmented SAT heat store was formed by 4 flat units. 22.4 m² of evacuated tubular collectors were installed. Hot water and space heating demand was drawn-off at the 750 l water tank. Flat units were charged after the water tank was heated up. Heat transfer from the SAT units to the water storage in periods with shortage of solar energy.

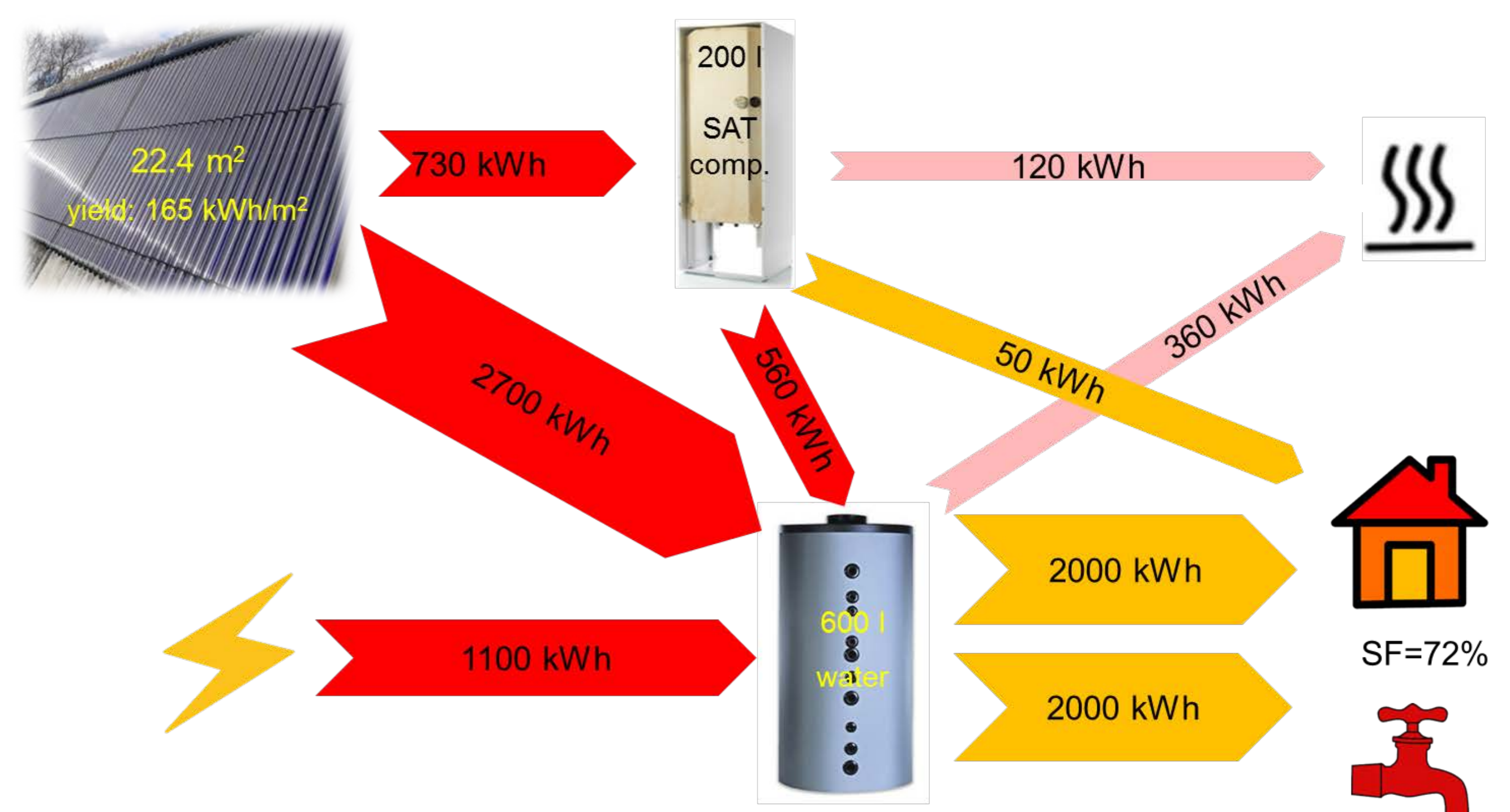
In autumn SAT composite remained up to 2 months in supercooled state:



Proof of concept

System simulation:

- Component models were developed and experimentally validated
- Daily hot water demand: 126 L at 45 °C (3 persons)
- High Solar Fractions (SF) for a Passive house in Danish climate



Yearly heat flux (supply, demand, loss) in the solar combi-system

Acknowledgement:

This research is funded by the PhD program of the Sino Danish Center for Education and Research (SDC). The work was also supported by the European Commission (Grant Agreement N_295568). We would like to thank our industrial partner NILAN A/S for the good collaboration.

Conclusions:

- Proof of combined short- and long term heat storage
- Improved cylindrical units are potentially economic
- Application of segmented heat stores in novel energy systems:
 - Power to heat (PV, wind power) → Solar combi-system 2.0