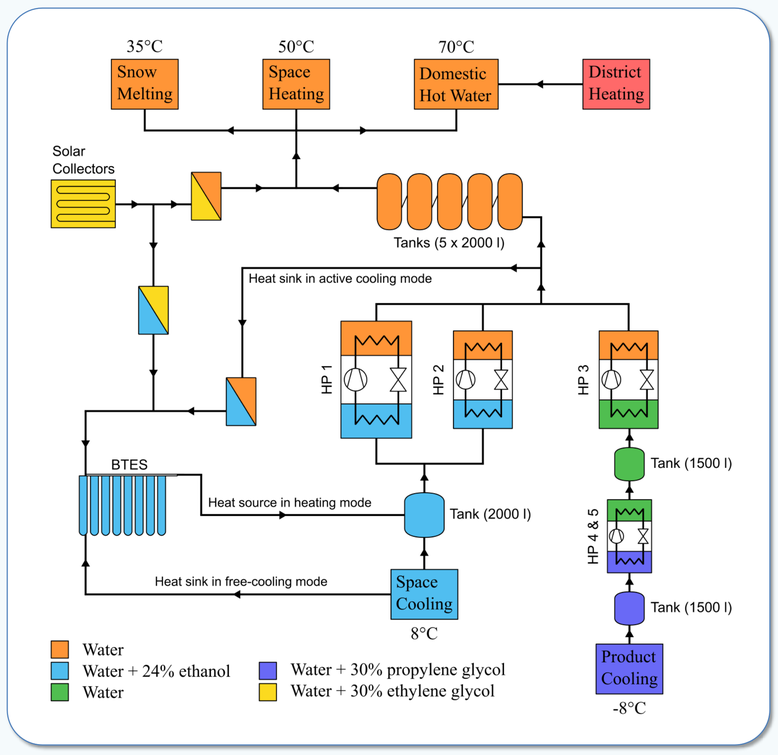
Integrated Thermal Energy Systems

Case definition

Integrated thermal energy systems: complex and interdependent

Large buildings and building complexes have varying demands for space heating and cooling as well as domestic hot water production. Interaction between these heating and cooling demands is possible with the employment of heat pumps and thermal energy storage. Both short term storage (hourly) and long term storage (seasonal) is required.

Designing such systems is difficult due to the interdependence of the components and the uncertainty of the expected demands. To ensure efficient interaction, smart design and control are needed. A connection to a district heating network enables even more control options as heat can not only be purchased, but also sold. A simplified diagram is shown to the right.

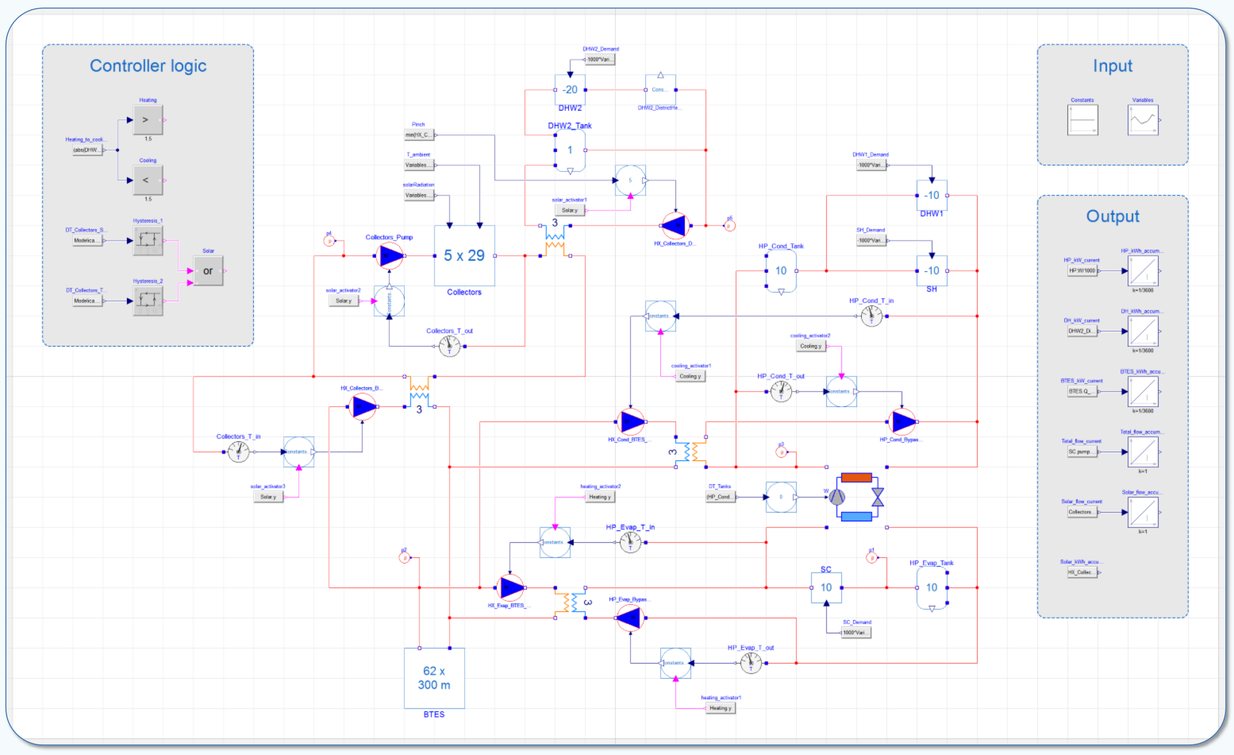


System modeling

Objective: increase energy efficiency

To increase the energy efficiency of such integrated systems, component design and control strategy need to be combined. As the components depend on each other, they should not be designed individually, but as a whole to ensure feasible operation.

Dynamic system simulations were performed to analyze system performance. Finding a good trade-off between accuracy and simulation speed is an important consideration.



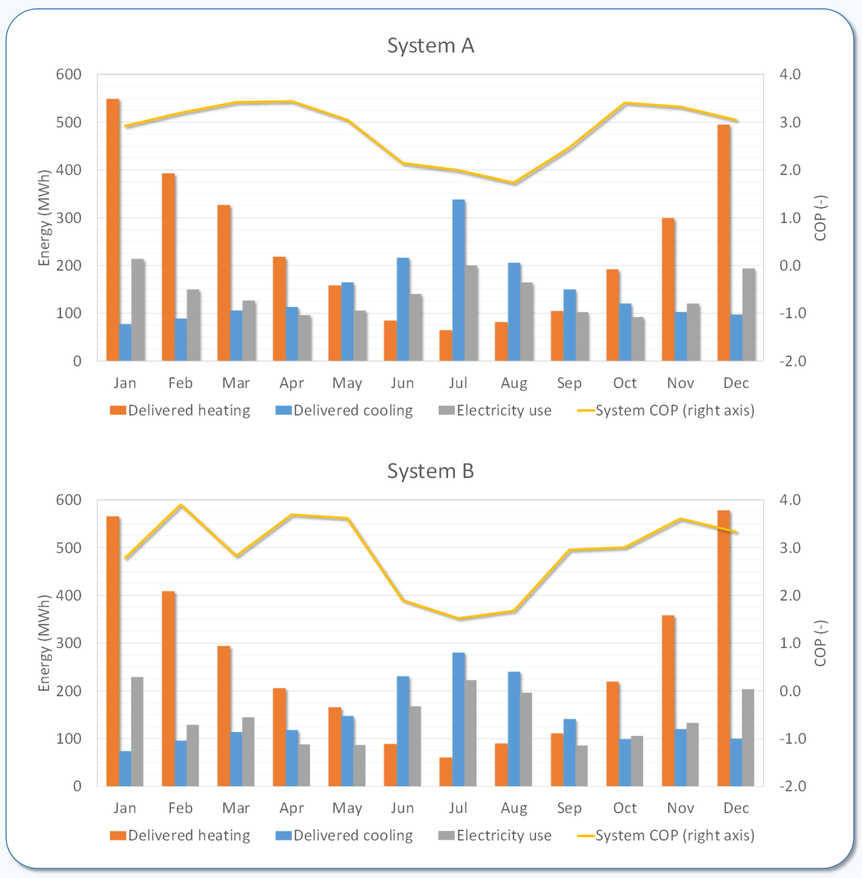
Status 2015

Close collaboration between WP3 (SINTEF) and PhD student (NTNU). Component models were developed for

- Heat pump
- Heat exchanger
- Solar collector
- Borehole thermal energy storage

Together with simple models for tanks, pumps, and pipes, these were combined into a representative system model. A simple control strategy using current measurements was implemented. The simulation of one year with detailed dynamics is possible, using weather data and actual demands as inputs.

Future work will include the implementation of a smart control strategy using forecasts and the optimization of system performance (considering the uncertainty of the inputs).



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