Using Dynamic Simulations to Analyze the Control of an Integrated Thermal Energy System for a Building Complex

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The Buildings



Picture from www.vulkanoslo.no



The Energy Supply System

- Covers product cooling, space cooling, space heating and DHW preheating
- District heating used for DHW temperature lift and space heating backup
- Main components
 - Heat pumps
 - Water tanks for short term storage/buffering
 - Boreholes for long term thermal storage
 - Solar collectors



The Energy Supply System

Heat pump 48 boreholes Water tanks

Heat exchange station with district heating connection



Picture from www.vulkanoslo.no

Solar collectors

4 heat pumps 14 boreholes Water tanks



The Energy Supply System



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The System Model

- Modelled with Dymola/Modelica
- Goal: Analyze system performance for one year period
- Component models built based on "Thermal" library
- Inputs
 - Measured demand data
 - Ambient temperature and radiation
 - Variable prices for electricity and district heating



The System Model



Research Case Study

- Improve system design
 - Export to district heating grid
 - Larger solar collector area
 - Bigger water storage tanks
 - → What are good component sizes and how should the system be controlled?



First step

- "Reasonable" component sizes
- Parameter study with buffer tank temperatures
 - Warm side: 45…55°C
 - Cold side: 0...10°C
- Effect on heat pump power, parasitic power, thermal losses, district heating import/export, etc.



Results





Future Work

- Different tank temperatures for each operation mode
- Use tanks for peak shaving
 - Variable temperatures based on demands and prices
- Optimization of component sizes with "smart" control
 - "Flat" optimum important



Questions?

Thank you for your attention!

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