FLEXe

Future Energy System

Aalto University
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Methods for DR response forecasting and optimizing

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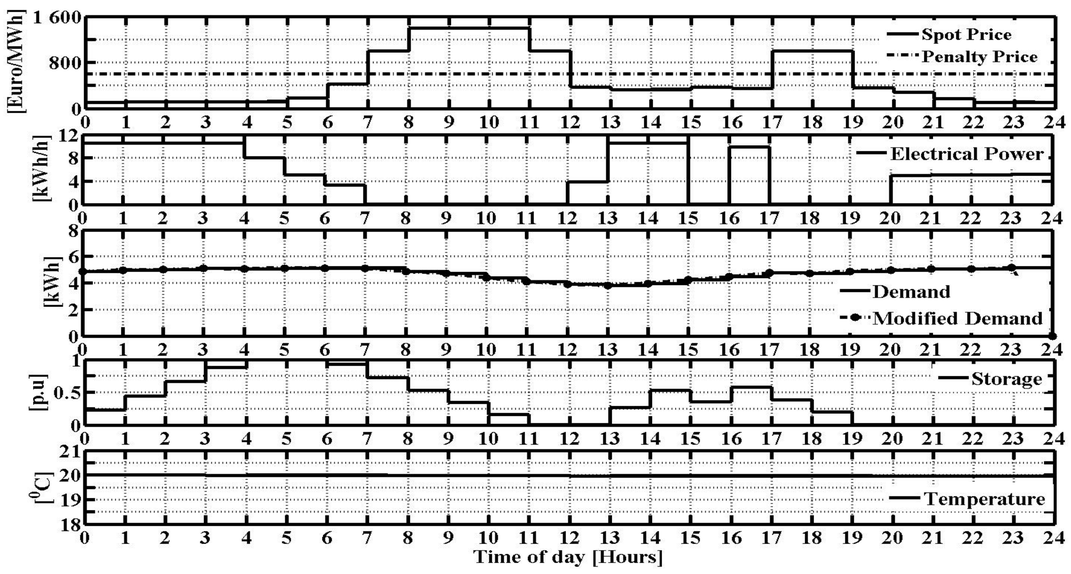
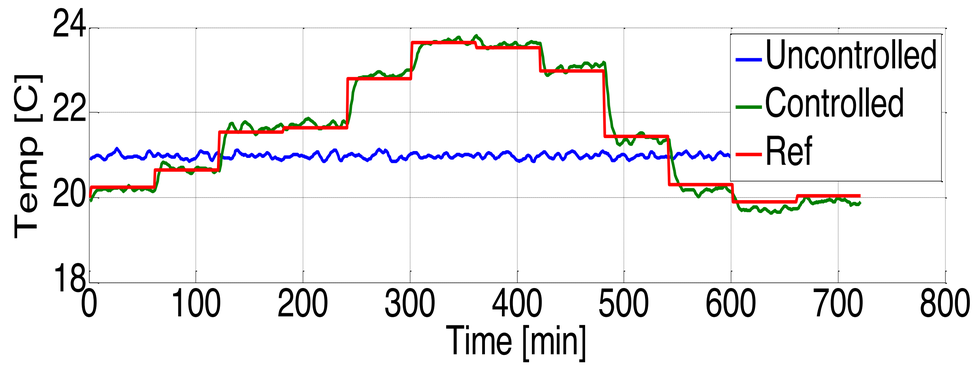
Optimizing the DR of electrical storage heating

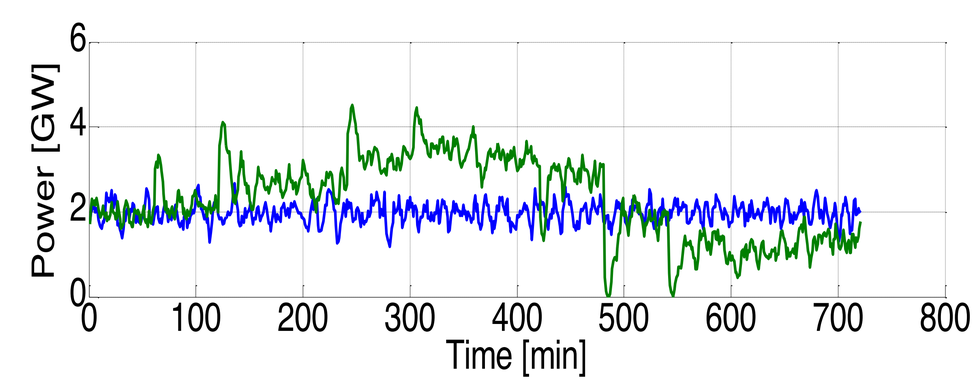
Electrical storage heating ESH offers customers a good opportunity to optimize energy costs utilizing cheap hours of the day ahead Elspot prices. Below is a Figure which depicts the optimal charging of heat storage during one winter day. Top is the power price. Below it is the power taken from grid, next is the heat demand, after which is the storage state of charge and room temperature. Optimization based on linear programming, which is suitable if storage is partial, as in this case, and hence thermal losses are not an issue. For larger storages and if thermal losses should be considered, a better solution is found by MILP, i.e. mixed-integer linear programming.



Optimal DR of direct electrical heating

The potential of direct electrical heating DEH differs from the above since now we have to cope with temperature variations in the building. DEH offers large potential of DR, but for relatively short times, a few hours ahead only.





Hence, DEH is more suitable for shorter term DR, like intraday power balancing, optimizing Elbas trade and balance power, and even as frequency controlled reserves – operational or disturbance.

A problem of DEH and DR has so far been the rebound effect of power demand: If switched off for an hour, for instance, the payback period of the next hour exhibits increased power demand, which manifests itself as a spike.

The Figure above presents one solution to the above problem, and simultaneously offers a possible solution for harnessing DR potential of DEH for short term balance management, either as power sink or as power source. The idea is to broadcast a generic set-point (or changes in the set point) for the DEH thermostats. This enables almost real-time DR together to the management of the rebound power.