SMART BUILDINGS USE ENERGY WHEN THE WIND BLOWS

It is the official objective of the Danish government, that renewable energy sources must constitute 100% of the gross energy consumption in 2050. Already in 2020, this number will be 35% and wind power must represent 50% of the total electricity consumption.

We have not designed today´s energy system for such large amounts of renewables so to accomplish the goal we must redesign the infrastructure of the system and transform it into a so-called Smart Grid.

The Challenge of Renewable Energy

The electricity system must always have an instantaneous balance between demand and supply. This is particularly difficult to obtain in a system with large amounts of renewables such as wind power, because they supply energy when the wind blows rather than when there is a demand. It is therefore necessary either to store large amounts of energy or to shift demands to whenever the renewables supply energy.

It is costly to store energy, which makes it attractive to shift demands as much as possible. It is however not an easy task to shift demand and to make it feasible we need a smarter energy system - often termed as “Smart Grid”. Such a system will have an increased amount of sensing and communication devices as well as intelligent software to utilize this additional flow of data. In such a system, the consumers will be more flexible and help the system maintain balance and in return get a more economic, sustainable and reliable supply of energy.

Smart Buildings in the Smart Grid

This PhD investigates how we can make heating and ventilation systems in buildings more flexible. The approach is to use model-based control to optimize the building operation by

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taking into account weather forecasts, energy prices, CO2 emissions, system contingencies and comfort constraints. The end-goal is to achieve a smart building suited for a system with a large share of renewables and at the same time save money for the consumer and respects comfort.

More is sometimes less

For many decades there have been invested a lot of effort in reducing energy consumption. This one-sided focus on conservation is justified in the traditional energy system, but as the share of renewables increase, we also need to focus on *when* consumption takes place. Preliminary results indicates that it can make sense to use more energy if this energy is utilized to shift consumption from periods with high prices and a low share of renewables to periods with low prices and large share of renewables. Then we use more, but at a lower cost and with less environmental impact.

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