



CITIES

Centre for IT Intelligent Energy Systems

Building Energy Demand Modelling

Objective

The objective of this CITIES demonstration project is to develop methodologies for the modelling of energy demand and flexibility potentials for whole districts and cities. Basically this can be done along two ways, top-down where generic models are used, or bottom-up by modelling the individual buildings and accumulate them up to the aggregated level.

In the current work, we apply the bottom up approach in the short run, but top-down will be investigated and added, if doable. The idea is to classify the buildings in a given area into types and sum up according to the number of each type within the area. For this purposes types of buildings are modelled. To validate these, we need measured data from real buildings. In Sønderborg, we collect these measurements for the main energy carriers, which are heat, cooling, electricity and gas. (Other datasets will be applied also.)

A second motivation for the current work is to contribute to the CO₂ emission estimation for Sønderborg. We step up on the methodology applied in Sønderborg for years. The idea here could be to apply a combination of measurements and a model that is validated by actual measurements. This way, the accuracy of the model is improved with increased number of measurements and experience. Also the methodology will be researched.

Partners

- Project Zero, Sønderborg
- SE
- Sønderborg Fjernvarme
- DTU
- AAU

Background

Project Zero does estimate the emission of CO₂ for Sønderborg for years. This task turns out to be rather demanding and the accuracy is limited. E.g. the usage of oil is rather unpredictable. Any form for improvement is welcome and other cities requesting such methods that can be automated and based on measurements.

CITIES is developing a data management and analysis platform that is one of the efforts in the current demonstration case. The platform is applied to collect all available data sources and build up a “database” for the analysis of all these data.

Connection with CITIES WP's

WP1: Data management platform development. Appliances modelling.

WP2: Evt. Fluid and gashouse energy resource modelling.

WP3: Models for heat dynamics of buildings generating flexibility and aggregation models. Data infrastructure development.

Description

The data available at the current time is very limited. The sampling rate that is stored is hourly data for 140 buildings in Sønderborg. The data is collected since Nov. 2014. The data basis will be increased as e-meters are introduced in Sønderborg and connectivity enabled. This is a time consuming effort and therefore additional data sources will be applied, if available.

Note: There is a dataset from 2009-2010, collected by DTU Compute and shared with CITIES. These data were applied in research publication by Peder Bacher.

The methodology applied is, a) to analyse measured data from buildings and b) classify them into types. The resulting building types will then be modelled in dynamic building simulation tools. With these building type models, the area for all buildings will be modelled by aggregating the actual number of buildings in each type and compare the result with the overall energy demand for the area.

In a second step, the thermal dynamics of the buildings will be studied to find the flexibility. There will be investigation on the thermal capacities of the buildings, thermal storage tanks and similar storage capacities. The above model will then be adjusted accordingly and the aggregated flexibility determined.

Expected outcomes

The main outcome would be a methodology to model building stock at aggregate level in terms of energy demand and flexibility. There will be a number of scientific publications and Sønderborg will get an improved modelling tool for their work. The methodology will be applied in other cases. The data management platform will be improved to a widely applicable tool. The tools will be able to be applied in the optimization of building designs towards energy flexibility that will generate innovative developments in the building sector.

Time schedule

June 2015 to Dec 2016