



Aalborg Forsyning Living Lab: Combined control of a common mixing loop and central space and hot-water heating

ABOUT THE LIVING LAB:

The main part of the Aalborg living lab consists of 12 residential buildings with BMS supplied with low temperature district heating via a common mixing loop established out on the street at the point of coupling to the main district heating network. Establishment of the mixing loop was carried out by Aalborg Forsyning, while Neogrid provided the control layer and Xtel the indoor climate sensors (temperature, humidity and CO₂) to the apartments. A couple of single-family houses were also part of the demonstrator.

The aim of this living lab is to demonstrate the feasibility of integration of local controllers in buildings with a central controller for low temperature district heating to an area. This integrated control ensures that the quality of service of space heating and hot-water production is maintained, while reducing the supply temperature dynamically to minimize losses and improve the return temperature.

On top of this, a second part of the demonstrator (Ravnkildevej) consists of 2 single family houses supplied by district heating, with a substation controller for space and water heating. Those houses are equipped with controllable smart thermostats.

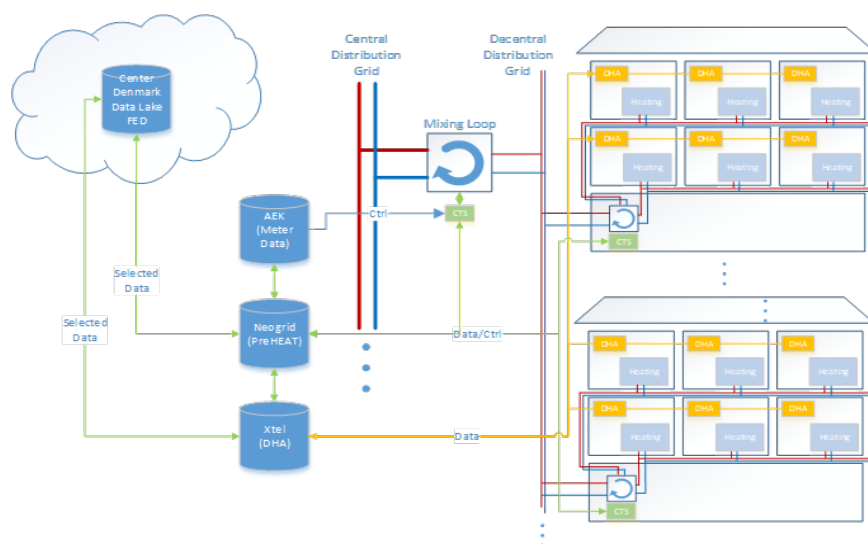
FACTS:

Fyrkildevej (main demonstrator)

- ✓ Type of living lab: Building (apartment blocks).
- ✓ 12 buildings, 157 households.
- ✓ Heated area: 14,079 m².

Ravnkildevej

- ✓ Type of living lab: Building (single-family houses).
- ✓ 2 households.





RESULTS:

The living lab succeeded in the following points:

- ✓ Implementation of the common mixing loop
- ✓ Dynamical control of the common supply temperature to the buildings
- ✓ Integration to the local BMS in the buildings
- ✓ Data-driven control of space heating using weather forecasts
- ✓ Data integration across tools from Neogrid Technologies, Xtel, and Center Denmark
- ✓ Development of a digital twin of single-family houses by Aalborg University
- ✓ Flexibility experiments on single family houses with user surveys by Aarhus University

In the period from December 2022 to February 2023, the supply temperature to the area was reduced by 21°C (+/- 4°C - down to temperatures ranging 55-60°C) compared to the temperature supplied by the grid, highlighting a significant reduction potential.

Aalborg Forsyning estimated that the mixing loop provided a yearly net reduction of the heat loss in the local area of 20% (corresponding to a net reduction of energy demand of 17% when considering the extra electricity demand from the mixing loop pump, amounting to 8.5 MWh per year of saved energy).

Most apartment blocks controlled by Neogrid got a reduced return temperature on their space heating production by 0-10°C.

Flexibility deployment on the Fyrkildevej living lab was not achieved at full scale, as full-scale operation of the mixing loop control was delayed and the final stable regulation of the supply temperature turned out to be challenging. Nevertheless, control structures for peak shaving of a pool of buildings were developed during the project and demonstrated on other buildings.

PERSPECTIVES FOR THE FUTURE:

- ✓ Transition to low-temperature district heating is calling for a scale-up of local controllers for areas within the network that integrate with buildings.
- ✓ Aalborg Forsyning is looking into implementing similar solutions at other residential areas within their supply area.
- ✓ Neogrid Technologies will implement technology and knowledge achieved in the living lab in their commercial products and solutions.

TECHNICAL SETUP

Neogrid established a two-way communication between the buildings' BMS systems and its cloud, as well as between the common mixing loop and its cloud. Indoor climate data was collected by sensors from Xtel communicating with its cloud, which were then transmitted cloud-to-cloud to Neogrid's cloud where they were used in control. Neogrid has also demonstrated export capabilities to Center Denmark.

The control operated by Neogrid relies upon weather forecasts, operational requirements from the district heating as well as comfort requirements for hot-water and space heating. It integrates optimized control out in the buildings with the common mixing loop controller to ensure that requirements are satisfiable.

FED is a Danish digitization project, funded by Innovation Fund Denmark, aimed at turning Danish power consumption flexible to enable utilization of excess power from wind turbines and solar cells.

The project brings together Denmark's foremost researchers, organizations, supply companies, software companies and a number of living labs that provide data for the project.

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