

Flexible design and operation of future 4th-generation district heating networks (Heatflex)

Publieke samenvatting / Public summary

Aanleiding

The current energy grids for power (electricity grid) and heat (district heating) need to evolve into a combined flexible structure with many more (sustainable) distributed energy production sources. Intermediate small- and large-scale storage of energy is indispensable. Besides, control of all these energy flows in the system becomes increasingly important. Recently, the number TKI Urban Energy projects related to heat grid systems has increased substantially. Some projects focus on market models, tariffs and legislation (Grid Flex Heeten); gas, heat and electricity integration models (WIM-PICO); and low-temperature heat grids (WINST-Warmte Infrastructuur Nederland met verlaagde Systeem Temperatuur), but the combination of low-temperature heat grids and heat storage was not investigated so far.

Doelstelling

This project aims to develop a reliable modeling tool for a low-temperature district heating network. It can be used for the design of such a network connected to various renewable heat sources including geothermal heat, and can be used for control of an existing district heating network. Obviously there are many commercial tools available that capture the physics of the system and its components (energyPRO, Simulink), but they have the disadvantage of not being open-source and they are also not optimized for transient behaviour. Moreover, modules for geothermal heat (as thermal source) and heat storage (as thermal

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buffer) are not available yet. Note that although the exact physical details of some storage materials are still subject of investigation (in e.g., TKI Urban Energy projects Dope4Heat and Cap4Heat), a lumped parameter approach can still accurately describe the system properties on a higher hierarchical level in terms of reaction time, energy density, power and operational temperature (model reduction approach).

Korte omschrijving

- Development of compact modules for different thermal energy storage components for heating and cooling, based on model reduction techniques.
- Development of optimization models involving the storage components and the conversion of multiple energy carriers (i.e. electricity, thermal energy (heat/cold), gas) within the district heating network.
- Investigation on district heating network topology optimization concerning energy producers, consumers, and energy storage sizing and placement including control.
- Three special reference scenarios will be studied. 1) One in which thermal energy storage in the district heating network is realized through small local thermal storage. 2) One in which thermal energy storage in the district heating network is combined with cooling systems, as is often the case in more extreme climate zones; 3) One in which the performance of a district heating network combined with heat storage is compared to the all-electric case with heat pumps, taking into account the variable availability and pricing of the energy carriers. This will provide realistic urban and district scenarios for local authorities.

Resultaat

This project will develop a reliable modeling tools for a low-temperature (30-60 centigrades) district heating network, which can be used for the optimal design of such a network connected to various renewable energy production sources and can be used for control of such a network.

De data in deze applicatie is afkomstig van de Rijksdienst voor Ondernemend Nederland (RVO) en wordt in samenwerking met de Topsector Energie ontsloten.

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