Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 116 (2017) 170–179

Energy Procedia

www.elsevier.com/locate/procedia

The 15th International Symposium on District Heating and Cooling

Status of the Horizon 2020 Storm Project

Dirk Vanhoudt[a,b]*, Bert Claessens[a,b], Johan Desmedt[a,b], Christian Johansson[c]

[a]*EnergyVille, Thor Park 8310, 3600 Genk, Belgium*
[b]*VITO, Boeretang 200, 2400 Mol, Belgium*
[c]*NODA, Biblioteksgatan 4, 374 35 Karlshamn, Sweden*

Abstract

This paper describes the progress of the Horizon 2020 STORM–project, started in March 2015. The objective of this project is to develop and demonstrate a generic district heating and cooling network controller. Generic in this sense means that the controller is applicable to widely spread 3rd generation, but also very innovative 4th generation networks. Therefore, the controller will be tested in a traditional district heating scheme but also in an advanced low-temperature network.

The controller influences the demand of the network to achieve a certain objective. STORM focuses on three objectives: (i) a peak shaving objective used to minimize the use of often polluting peak boilers; (ii) a cell balancing objective striving to balance a cluster of consumers to producers of excess heat or/cold; and (iii) a market interaction objective, applicable for heat/cold producers with a connection to the electrical grid (heat pumps or CHPs), maximizing the profit for the producer by switching these devices based on the electricity price.

To guarantee the generic applicability of the controller, self-learning control techniques are used. These techniques have the advantage that they 'learn' the behavior of the network by themselves without the need to be extensively tuned at the installation (plug-and-play installation).

To date, the focus was on algorithms for a forecast module of the heat/cold consumption of the network. These algorithms are already implemented in the controller platform and were running in real-time in one of the demonstration sites. Also, a tracking module was already developed and is currently tested. This module which will try to match the actual network consumption to this optimal consumption profile by distributing the control signals to the right heat consumers. Next step is the implementation of a planning module, which determines the optimal consumption profile, taken into account the forecasts.

Peer-review under responsibility of the Scientific Committee of The 15th International Symposium on District Heating and Cooling.

* Corresponding author. Tel.: +32 14 33 59 74.
E-mail address: dirk.vanhoudt@vito.be

Peer-review under responsibility of the Scientific Committee of The 15th International Symposium on District Heating and Cooling.
10.1016/j.egypro.2017.05.065

Keywords: district heating and cooling networks; intelligent control; algorithm; digitalisation; demand side management

1. Introduction

Since heating represents 42% of the final energy consumption in the EU in 2011, compared to 21% for electricity, 28% for transport and 9% for non-energy use 0, the heating and cooling sector has the largest potential on greenhouse gas emission reductions. DHC networks are very interesting technologies in this context, since investment in waste energy extraction for industry and in renewable energy sources is often too expensive for a single party. However, these sustainable energy sources have a large drawback. Opposite to traditional energy sources, they are often not controllable: thermal energy from the sun is only available when the sun shines, and since waste heat is per definition a waste product: companies are not willing to adjust their production to suited moments. Therefore, in combination with the addition of thermal storage capacity, demand side management in DHC networks - i.e. adjusting the demand of energy to the actual production - is an enabling technology. Demand side management can also make it possible to deliver more energy from a smaller sustainable energy source by applying a peak shaving control strategy limiting the demand of energy to the capacity of the source. Therefore, by applying demand side management DHC networks become ‘smart’, undergoing the same transition as the transition towards smart electricity grids.

The implementation of smart DHC networks has another large benefit: smart DHC networks can even support smart electrical grids, provided there is a connection between the two, as is the case for heat pumps or CHPs. As a result, smart DHC networks can not only reduce greenhouse gas emissions in the DHC network itself, but also at the production site of the electrical grid. Therefore, intelligent controlled DHC networks are indispensable systems in the transition towards zero carbon solutions.

Demand side management could therefore make existing networks more sustainable. However, to fully maximize the share of renewable energy and waste energy in DHC networks, a next step must be taken, a step towards a new generation of DHC networks: one speaks about the fourth generation 0. This generation of networks is especially designed to deal with the fluctuation character of renewable energy sources and waste energy flows (Fig. 1). Evidently, also in these new networks, an intelligent control framework is essential. Ideally, this controller must control both the demand and production of heat and cold, taking into account the state of charge of the different storage capacities in the network.

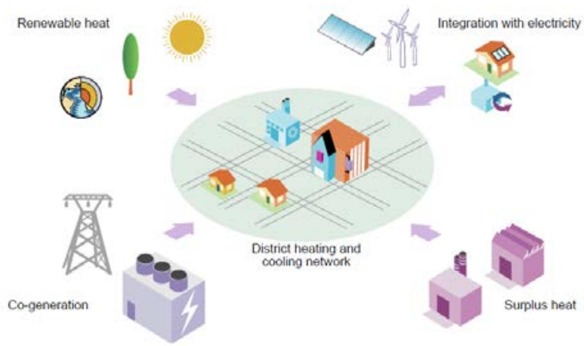

Figure 1: The 4th generation DHC network. (Source: International Energy Agency)

It is in this field that STORM positions itself. Within the STORM project (approved in the H2020 EE13 2014-call, under ID number 649743), a controller is developed starting for state of the art control algorithms suited for both existing and new, 4th generation DHC networks. By harvesting the flexibility in this wide range of networks, the controller will contribute to a more sustainable energy mix of renewable energy and waste heat utilization.