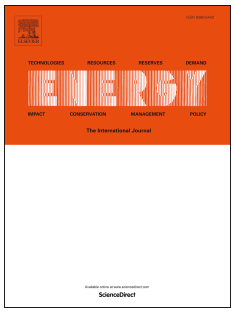
Accepted Manuscript



District heating systems - Framework for Modelica-based simulation and dynamic optimization

Gerald Schweiger, Per-Ola Larsson, Fredrik Magnusson, Patrick Lauenburg, Stephane Velut

PII: S0360-5442(17)30869-1

DOI: 10.1016/j.energy.2017.05.115

Reference: EGY 10923

To appear in: *Energy*

Received Date: 4 November 2016

Revised Date: 24 April 2017

Accepted Date: 17 May 2017

Please cite this article as: Schweiger G, Larsson P-O, Magnusson F, Lauenburg P, Velut S, District heating systems - Framework for Modelica-based simulation and dynamic optimization, *Energy* (2017), doi: 10.1016/j.energy.2017.05.115.

District heating systems - Framework for Modelica-based simulation and dynamic optimization

Gerald Schweiger[a,*], Per-Ola Larsson[b], Fredrik Magnusson[b], Patrick Lauenburg[c], Stephane Velut[b]

[a] *AEE - Institute for Sustainable Technologies, 8200 Gleisdorf, Austria*
[b] *Modelon AB, SE-223 70 Lund, Sweden,*
[c] *Department of Energy Sciences, Lund University, SE-221 00 Lund, Sweden*

Abstract

Future district heating systems (so called 4th generation district heating (4GDH) systems) have to address challenges such as integration of (de)centralized renewable energy sources and storage, low system temperatures and high fluctuation of the supply temperature. This paper presents a novel framework for representing and simplifying on-grid energy systems as well as for dynamic thermo-hydraulic simulation and optimization of district heating systems. We describe physically precise and numerically robust models for simulation and continuous optimization. Furthermore, we propose a novel method to decompose a mixed-integer-optimal control problem into two sub-problems, separating the discrete part from the continuous. Two use cases show the applicability of the framework. An existing district heating system with more than 100 consumers is adapted to test the framework based on simulation requirements of 4GDH systems. The second case presents the continuous optimization of a district heating system in a virtual city district. A main advantage of combining equation-based modelling and nonlinear optimization is the possibility of including model coherences based on physical laws into the optimization formulation. Results show that the framework is well-suited for simulating larger scale 4GDH systems and that the solution time of the continuous optimization problem is sufficiently low

*Corresponding author
Email address: g.schweiger@aee.at (Gerald Schweiger)