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Efficient Energy Use

Optimization of regional energy system

When existing district heating systems require updating, which technologies to invest in, and when? Optimization tool gives new insights to this dilemma.

Introduction

Predictions of technology and commodity prices affect the choice of district heating supply technology in a commercial DH grid. In order to precisely evaluate the effects and sensitivities of this variation and to investigate feasibility of intermittent supply and storage technologies, a model is constructed.

Methods

Hourly data of heat demand, solar irradiance and wind is used. District heating demand must be met, lowest total costs for the whole system are searched, by optimising heat portfolio on hourly resolution over 20 year total span, taking into account long-term changes.

Results & discussion

First WP1 case represents the actual situation in Keski-Uusimaa case: it is cost-optimal to use the already existing CHP plant. Approximately 30 GW of heat pumps are built immediately, which cover most of the heat demand. No electricity generating plants are built until after 15 years, when 5 MW wind turbines are commissioned. Most of the consumed electricity is imported.

Results indicate that existing CHP can and should be utilized. However, the CHP plant is only used for 1300 peak load hours in the first period, declining to 940 peak load hours in the fourth period. The heat pumps, however, are used for 5200 to 4800 peak load hours, at an average 3.2 coefficient of performance. Mean cost for produced energy over the whole 20-year period is 21 EUR/MWh.

A cost-optimal generation portfolio is solved with the model within some hours to days. Presented tool allows energy companies to input their own boundary conditions and to come up with lowest achievable total costs over long period of time and to investigate key affecting factors and risks.

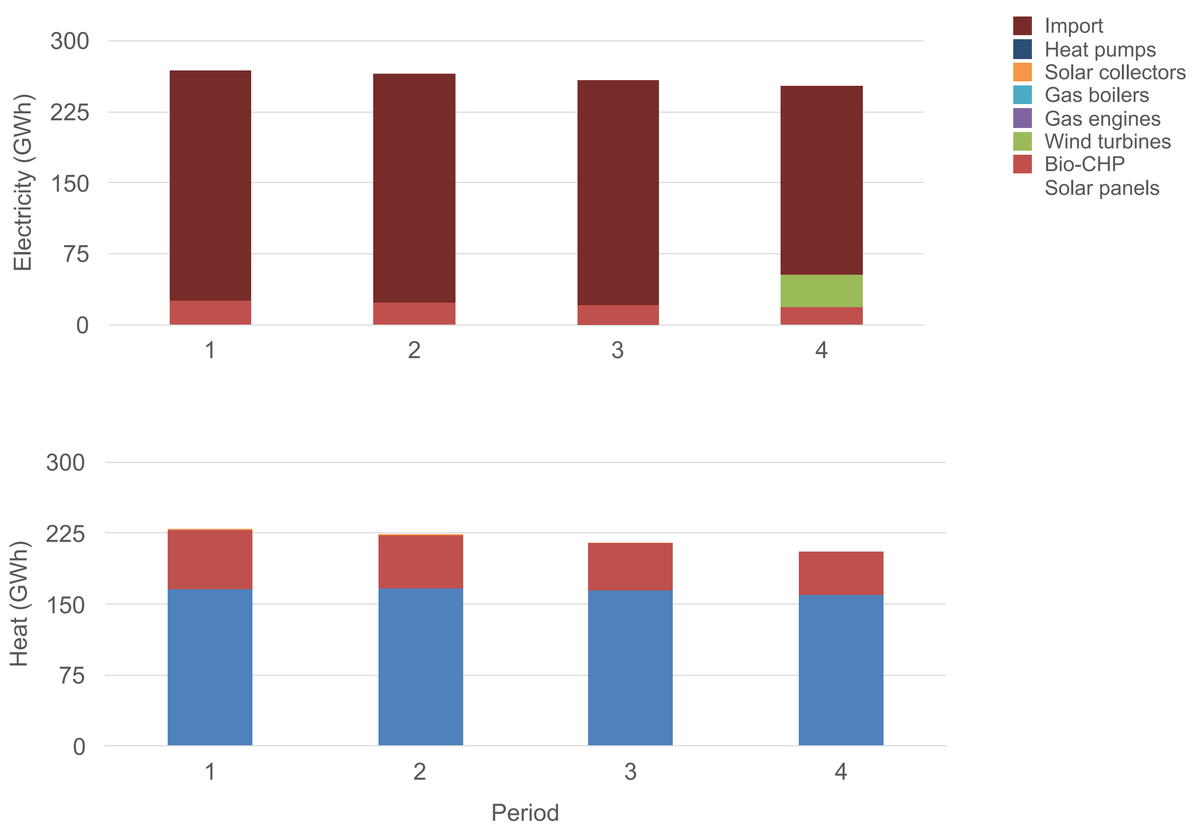

Figure 1: Electricity and heat production over four five-year periods.