Case Studies

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ANNEX 57 — Flexibility by implementation of heat pumps in multi-vector energy systems and thermal networks

Demo No.: D-005	**Location/City: Stockholm**	**Country: Sweden**
Project name (short and full title): Large heat pumps in Stockholm		
Quotation: Stockholm Exergi has some large heat pumps in the district heating system. The operation of the heat pumps is optimised together with other heat generation resources depending on heat demand, electricity and other fuel prices.		
Schedule of the demo project (research study): 1986 –		**Year of realisation:** 1986
Leader organisation (owner, constructor, solution developer, research inst., etc.): Stockholm Exergi (former Fortum Värme, Birka Energi, Stockholm Energi)		
Participating organisations – demonstration project part (involved other organisations): Stockholm Exergi (In the Stockholm district heating system there are two other large heat producers connected; NorrEnergi and Söderenergi. NorrEnergi has some large heat pumps.)		
Budget of the demo (invest/monitoring etc.):		

Summary of the project:
The Stockholm district heating system is large with over 12 TWh of heat demand annually. Since the 1970s the system has been operated with both combined heat and power (CHP) and heat pumps (HP). About 660 MW of heat pumps and 300 MW of electric boilers are currently operational in this system.

The operation of the district heating system is optimized taking into account the heat demand, electricity and fuel prices and congestions in the district heating network. In figure 1 a normal yearly duration curve for the Stockholm district heating system can be seen. CHP with different kinds of waste as fuel (blue area) is the bas load production together with CHP with wood chips as fuel (dark green area). The coal fired CHP (black area in middle) is today (2022) replaced with bio CHP. Normally HP is the next generation source (white area). Above HP comes CHP with pellets as fuel and solid bio heat only boilers (HOB) and turbine bypass (light green area). On top is bio oil and then fossil oil HOB (black area on top). On daily basis depending on electricity prices and bio fuel prices HP can replace bio fuel CHP or be replaced by pellets bio fuel CHP. When the electricity prices are extremely high HP can be replaced by solid HOB and turbine bypass. And also the other extreme with very low or negative electricity prices can result that HP replace wood chip CHP.

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In the daily (hourly) optimization all variable cost are taking into account. When it comes to HP the electricity price includes power price, variable components in network tariffs and electricity tax.

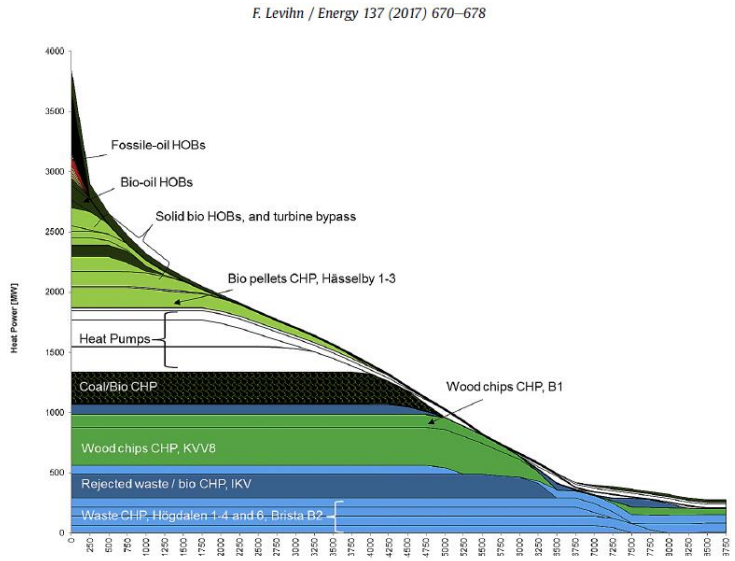

Fig. 1. Annual load duration and merit order at average prices. Due to variations in power prices, less turbine bypass is utilized in real operation.

Expected results

- Optimized operation of heat pumps in district heating system
- That the operation of heat pumps will differ depending on electricity and fuel prices

Published articles (paper, article etc.):

- Levihn F. CHP and heat pumps to balance renewable power production: Lessons from the district heating network in Stockholm, Energy 137 (2017) 670-678

Contact information [Name, company, telephone, and mail address]

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