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Transforming cities for a smart, sustainable Europe

OPEN DISTRICT HEATING

Heat recovery model in Stockholm

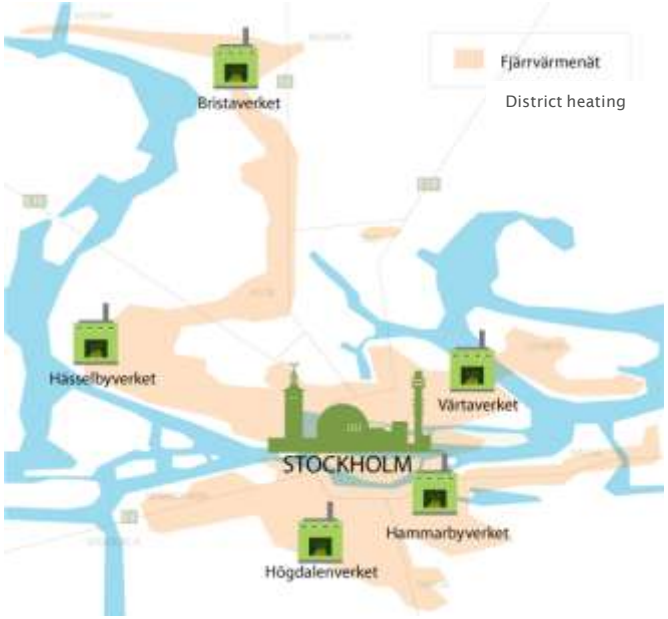
Martin Brolin, Fortum Värme



Fortum Värme in brief

District heating in Stockholm will be entirely produced from renewable and recovered energy no later than 2030

- Fortum Värme produces district heating, district cooling and electricity
- The vast district heating network consists of 2.800 km of pipes (Stockholm – Barcelona)
- Fortum Värme has 9.500 district heating and cooling customers and supply 90% of the total heat demand in the Stockholm area
- Fortum Värme is equally jointly owned by Fortum and City of Stockholm.
- The company has contributed to Stockholm being counted among the world's cleanest capital cities and that Stockholm was designated by the EU in 2010 as the world's first environmental capital – Green Capital
- District heating in Stockholm will be entirely produced from renewable and recovered energy no later than 2030.



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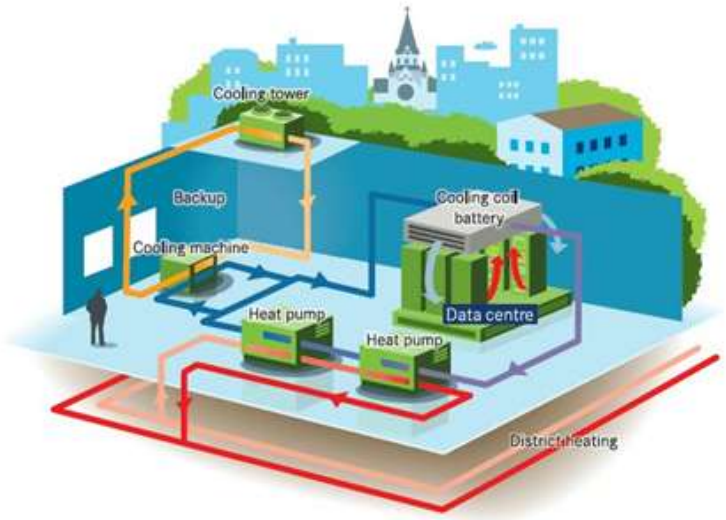
From decentralized production to a sustainable and integrated energy system

Open District Heating enables customers to be a part of the energy supply by recover its excess heat

- Huge amount of energy is wasted daily around the world, only in Stockholm around 500 GWh heat p.a.
- Open District Heating enables customers to deliver its excess heat into the district heating network and at the same time turn cooling cost to a revenue
- Main segments for heat recovery in Stockholm is data centers, supermarkets, switchgear stations and other industries with excess heat
- Customers act as small scale production units scattered on the district heating network
- District heating network works as an energy carrier where energy can be moved from places with surplus to places with demand
- Heat supply from the customers compete with our own production and enable avoidance of other less environmental and economical friendly production
- Heat can be supplied both on forward line (68 degrees C as general) as well as on the return line depending on local conditions



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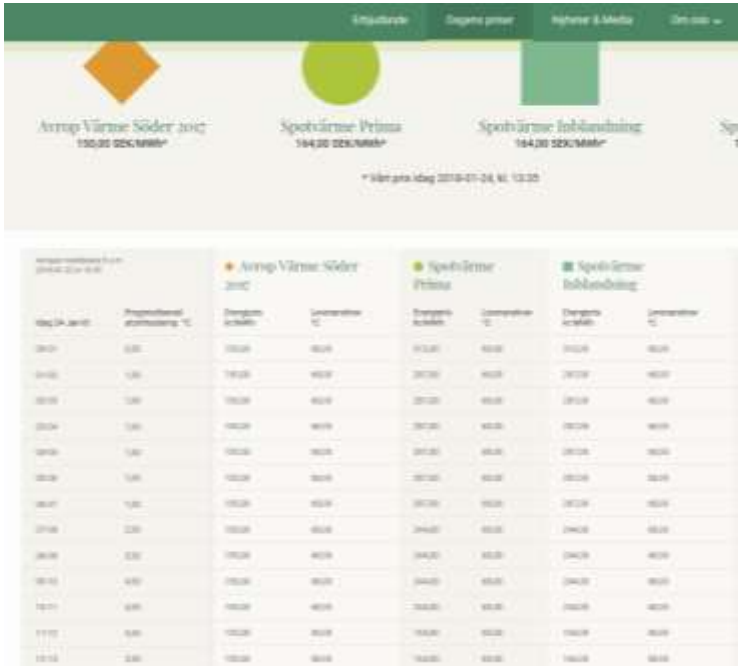
World's first spot market for recovered heat

Open District Heating customers contributed to heating of 25.000 apartments in Stockholm during 2017

- Open District Heating was launched to market 2014
- Energy prices are published at 4 pm each day for the coming day
- Prices are based on the outdoor temperature and projected district heating production cost
- During 2017 a total amount of 85 GWh heat was recovered, corresponding heating of 25.000 apartments or 1% of the total supplied district heating
- Today there are 27 Open District Heating customers within heat capacity range of 100 kW to 10 MW
- Two main types of agreements, Spot and Call
- Customer invests in production unit usually heat pumps and Fortum Värme invests in connecting pipes to network



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Our vision and coming steps

10% of the total district heating demand in Stockholm will come from recovered heat by 2035

- Data centers account for 3% of global electricity consumption today, a figure that is expected to increase to 10% in 2025
- Sweden and Stockholm hold unique benefits for large scale data center establishments
- During 2017 a cooperation – Stockholm Data Parks - was launched between several of partners
- Stockholm Data Parks offers attractive, short time-to-market and cost efficient data center establishments in Stockholm with heat recovery
- Our vision is that 10% of the total district heating demand in Stockholm will come from recovered heat by 2035

Possibilities to replicate

District heating and heat recovery at different levels

- One the basics for the model in Stockholm has been the existing vast district heating network, which has been gradually built up since 1950-60´s
- The business model and technical solutions has been carried out and piloted together with customers, learning by doing
- Key is to establish a two-sided beneficiary model where the partnership contribute to more sustainable energy solutions
- Same setup and model can successfully be carried for local solutions in smaller scale within limited parts of cities or campus