Heat Roadmap Europe 2050
A low-carbon heating and cooling strategy

4DH
4th Generation District Heating Technologies and Systems

reINVEST

3RD INTERNATIONAL CONFERENCE ON

SMART ENERGY SYSTEMS AND 4TH GENERATION DISTRICT HEATING

COPENHAGEN, 12–13 SEPTEMBER 2017

AALBORG UNIVERSITY
DENMARK

Personal introduction Johan Dalgren

johan.dalgren@fortum.com

- **first year industrial PhD student 50% at KTH Stockholm**
- **employed at Fortum Värme (DH/DC in Stockholm) since 2007. Working with production and distribution optimization of DH.**
- **Need for a more complete supply temperature strategy that will be part of the production planning and optimization, which is the aim of my research.**

Classic supply temp strategy

- **Normally distribution pipes are being dimensioned with an optimal velocity given by cost for pumping vs cost of pipe dimension. A temperature difference between supply and return at DOT of 55°C gives its heat capacity.**
- **The supply temp curve is then set to keep the flow constant with rising outdoor temp (compensating reduced load and return temp) down to a breakpoint where it's kept constant, minimum temp for hot tap water prod.**
- **Bottlenecks preventing the optimum starting order of plants and social variations in load and return temp forces the supply temp upwards.**
- **Strategies to dynamically even out and maximize the flow are popular to minimize the supply temp. It must be secured of course that the increased pumping power doesn't cost more than what is gained from less heat losses. This way of using the supply and return as an accumulator reduces the possibility to increase the flow to compensate an unexpected peak in the load or change in production (start of unit impossible if not in the end of the system).**

New pipes

- **When dimensioning new pipes consideration should be taken to future temperature levels, available differential pressure, length to customer furthest away and area of supply so that also the cost for heat losses could be included as a parameter. Furthermore the impact of varying electricity price and marginal production cost should also be of interest.**
- **To increase the flow capacity with a booster pump could be a good idea on an existing pipe since the flow often can be increased more than 40%. But if the pipe is being changed and the pump needs to lift the entire flow, a step up in dimension could come cheaper and even give a higher capacity.**

As-is supply temp strategy

- **Stockholm DH network (7,4TWh, 3GW), 2 networks, 1413 km pipes, 19 sites, 4 production partners (>1GW).**
- **Simulated and calculated flow capacities (PFC and Termis) together with the ideal production plan is the base for a manually calculated supply temp curve. Resulting in heat capacities as boundary conditions for the production optimization (BoFiT). Meaning the starting order always comes first.**
- **To get the benefit of lower supply temp some plants with big system impact have a floating curve and others whose effect on the system is small an individual to optimize its local performance.**
- **Still a lot of the network capacity is not utilized due to unavailability and the dynamics in the network (load and return temp).**
- **The contribution of low temperature heat recovery also adds challenges.**

Idea of to-be supply temp strategy

- **To get free from some of these boundary conditions the idea is to divide the network in different temperature levels using shunts (preferably with heat recovery). Creating motorways, "normal" and low temperature networks.**
- **The motorways secure the right starting order by eliminating bottlenecks and creates opportunities for blending in heat recovery.**
- **In the low temperature networks the local conditions are in focus, meaning cost of pumping power vs heat loss and performance of heat recovery.**
- **The "normal" temperature network is still subject for classic supply temp optimization, but now with less boundaries.**
- **Final goal is to calculate the flow capacities in critical sections and heat loss as a function of supply temp (Termis) and feed them to the production opt tool (BoFiT) to optimize prod cost incl. supply temp.**