Feed-in from distributed heat sources in district heating systems
A way to develop DH by including not only heat delivery, but also decentralised heat supply

Prosumers – consumers that act both as heat users and producers of heat

Boilers and other heat sources that is owned by the DH-company or by a third part
A part of
Fjärrsynsprojekt: Små värmekällor – kunden som prosument
Small heat resources – the customer as prosumer

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Final report, in Swedish, in summer 2016
http://www.energiforsk.se/program/fjarrsyn/rapporter/sma-varmekallor-kunden-som-prosument-2016-289/
Central connection – distributed connection

4 different way for distributed connection
R/R, R/S, S/S and S/R (do not show combinations in this presentation)

R/S – two different connection and control principles;
• flow controlled and
• temperature controlled
<table>
<thead>
<tr>
<th>Distributed heat generation</th>
<th>R/R</th>
<th>R/S</th>
<th>S/R</th>
<th>S/S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most common</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Can create a flow in the DH network</td>
<td></td>
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<tr>
<td>Need a feed-in pump (in brackets, can function without a pump)</td>
<td>(X)</td>
<td>X</td>
<td></td>
<td>(X)</td>
</tr>
<tr>
<td>Increase DH return temperature</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Simple control strategy</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Must produce a temperature above a certain level</td>
<td></td>
<td>X</td>
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<tr>
<td>Can be used as an over-heat protection system at a common DH substation without an extra pipe (the 3rd pipe)</td>
<td>X</td>
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<tr>
<td>An extra pipe is needed when connected to a common DH substation (the 3rd pipe)</td>
<td>X</td>
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<td>X</td>
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<tr>
<td>Useful in most applications</td>
<td></td>
<td>X</td>
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</table>
Two different kinds of feed in system (in R/S mode)

**Temperature controlled (TC)**
- There must always be a flow through the shunt pipe – SV4 may never close completely
- The feed-in pump, P2, shall only have enough pressure head to exceed the differential pressure, set point curve for speed is given by a value on $\Delta p_1$
- Feed in flow is completely controlled by the valve in the shunt, SV4. SV2 may in some circumstances need to help.
- The cold temperature on the hot side of the HX is higher than it need to be.
Two different kinds of feed in system (in R/S mode)

Flow controlled (FC)

- No flow through the shunt pipe – SV4 shut or the shunt do not exist

- The flow is controlled by the feed in pump, P2, or SV2 with a fixed speed on P2, speed set point by $\Delta p_1$.

- P2 the feed-in pump will work with a to low flow for a too long time, guarantee problems??

- There are control and pump problems if the feed-in flow is small and the differential pressure is high
### Decentralized heat sources;

- **Solar thermal**
- **Excess heat from cooling machines,** (data centres, shopping centres and sports arenas).
- **Excess heat from industrial processes,** (casting, moulding or excess steam).
- **Old boiler that no longer is in permanent use but could be used temporarily**
- **Waste dump with methane aggregation and burning**
- **Crematorium**
- **Heat pumps** (when cheap electricity)
- **And a lot more**

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<tr>
<th>Heat Source</th>
<th>FC or TC or both</th>
<th>TC (single machines)</th>
<th>FC (in series)</th>
<th>FC (maximum $\Delta t$)</th>
<th>TC</th>
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<th>TC/FC</th>
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OK flow control

Not a good choice

OK temperature control

System layout 1
System layout 2A
System layout 3A
Thank you for your attention