

An aerial photograph of a large, historic red brick building complex, likely a university campus. The building features a prominent central tower with a green dome and a clock face. The courtyard is lush with green lawns, several tall, slender trees, and a central fountain. A wide, light-colored gravel path winds through the courtyard. The sky is blue with scattered white clouds.

# Heat re-use in Stockholm

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# Agenda



**PDC Center for  
High Performance Computing**

- **Introduction**
- **Experience from heat re-use at PDC**
- **Plans for heat re-use in Stockholm**

# PDC – Introduction



**PDC Center for  
High Performance Computing**



- **PDC the largest of six national centers in Sweden**
- **Located at KTH Royal Institute of Technology in Stockholm**
- **Main system Cray XE6 with 36,384 cores, 305 TFLOPS**

# Stockholm



**PDC Center for  
High Performance Computing**



- **Cold climate – we need heating in the winter**
- **Unique district heating AND district cooling network**

# Heat re-use project



PDC Center for  
High Performance Computing

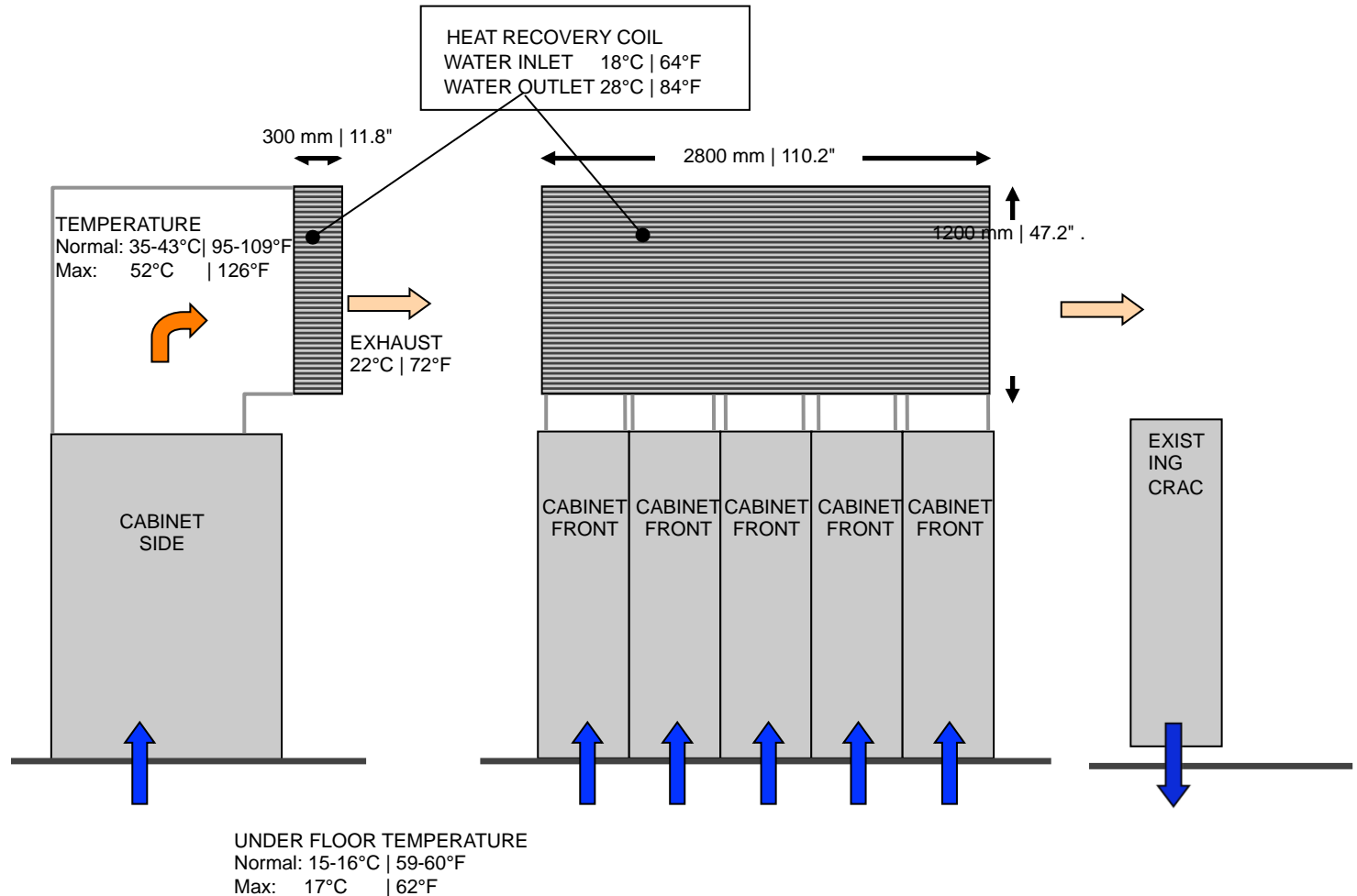
- Cray could not provide what we wanted
- Own design
- Industrial components



# In the computer room



PDC Center for High Performance Computing



# Heat re-use facts



**PDC Center for  
High Performance Computing**

- **Input water 20 °C (68 °F)**
- **Output water 28 °C (82 °F)**  
– good enough to heat incoming air to a building
- **We could use existing pipes**
- **Still pay-off time of 8 years**
- **Using district cooling in the summer**
- **Around 300 kW is captured of 500 kW total**
- **Last winter 820 MWh**

# Experiences



**PDC Center for  
High Performance Computing**

- **Fun but much work**
- **Working with custom design is hard**
- **Controlling the cooling was really hard**
- **Works really well – no failures**
- **Next generation we will use a liquid cooled system and use heat pumps.**



# Open District Heating A Stockholm Initiative



Next generation  
energy company



# Fortum's distrikt heating



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Källa:

Fortum Värme "Här finns vi" <http://www.fortum.com/countries/se/foretag/fjarrvarme/har-finns-vi/pages/default.aspx>

# Fortum's district cooling



PDC Center for  
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Fjärrkyla i Storstockholm



Källa:

Fortum Värme "Fjärrkyla i Stockholm" <http://www.fortum.com/countries/se/foretag/fjarrkyla/fjarrkyla-i-stockholm/pages/default.aspx>

# Idea



**PDC Center for  
High Performance Computing**

- **District Heating and Cooling network exists today**
- **127 computer halls in Stockholm with constant heat production**
- **Total 132 MW**
- **Reimburse computer halls for produced energy**

# Possibilities



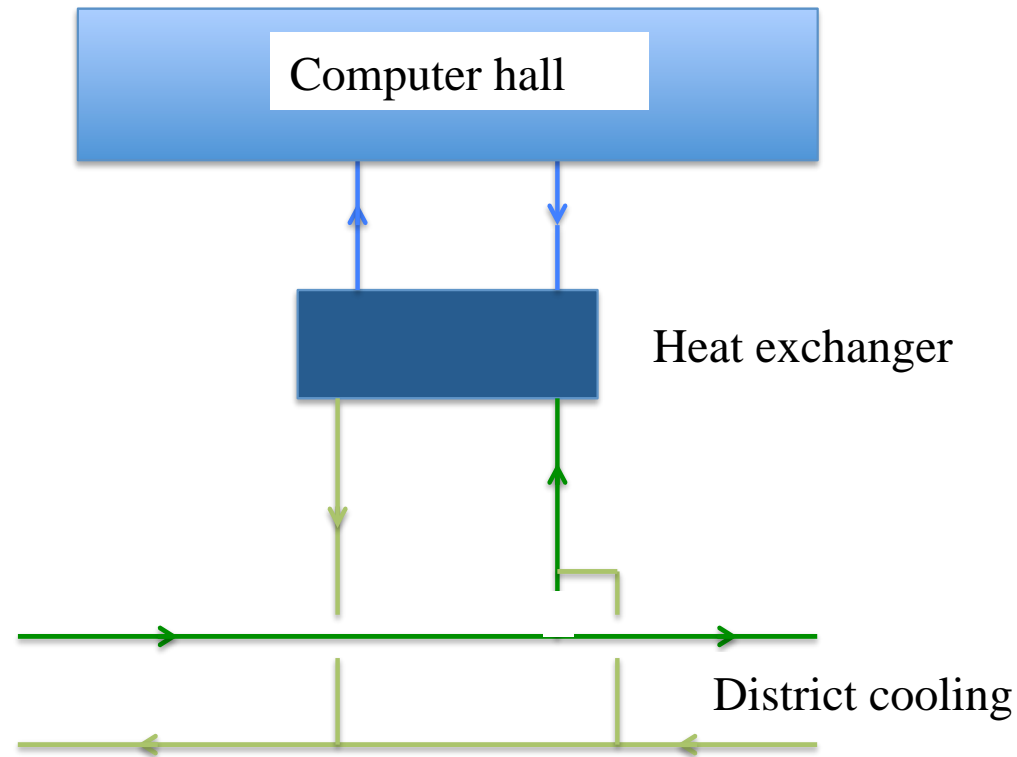
**PDC Center for  
High Performance Computing**

- 1) Direct district cooling**
- 2) Use district heating for cooling via heat pump**
- 3) Use both district cooling and heating via heat pump**
- 4) Cool village: co-location close to the production sites**

# 1. Re-use to the district cooling



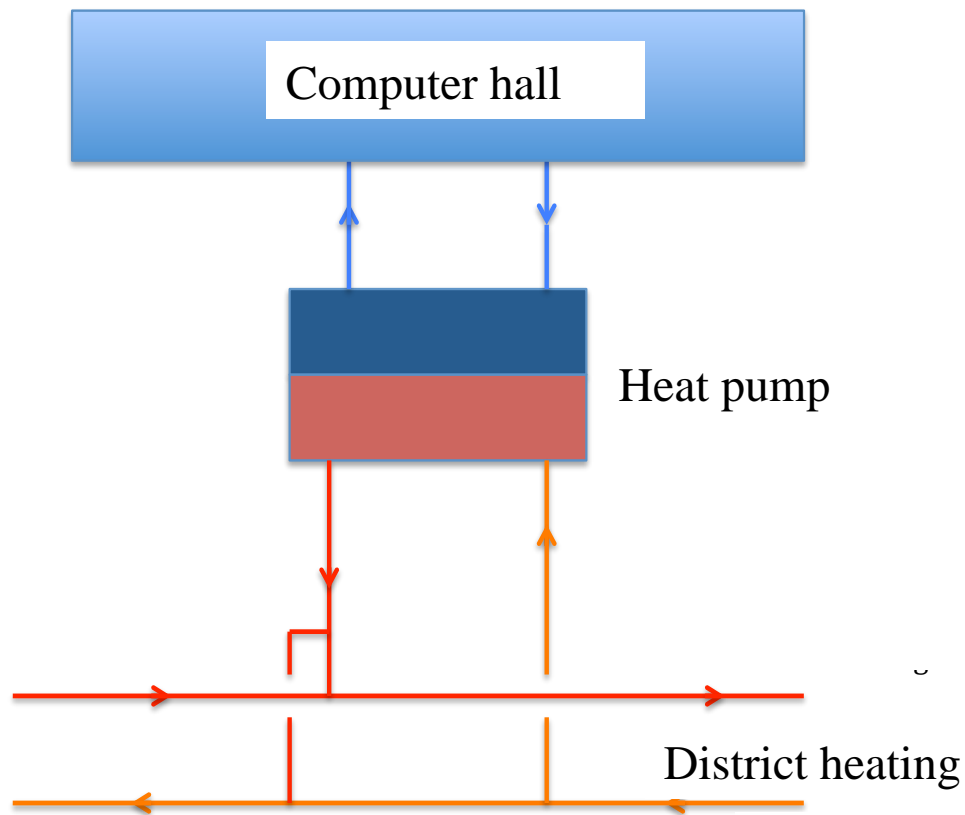
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## 2. Re-use to the district heating



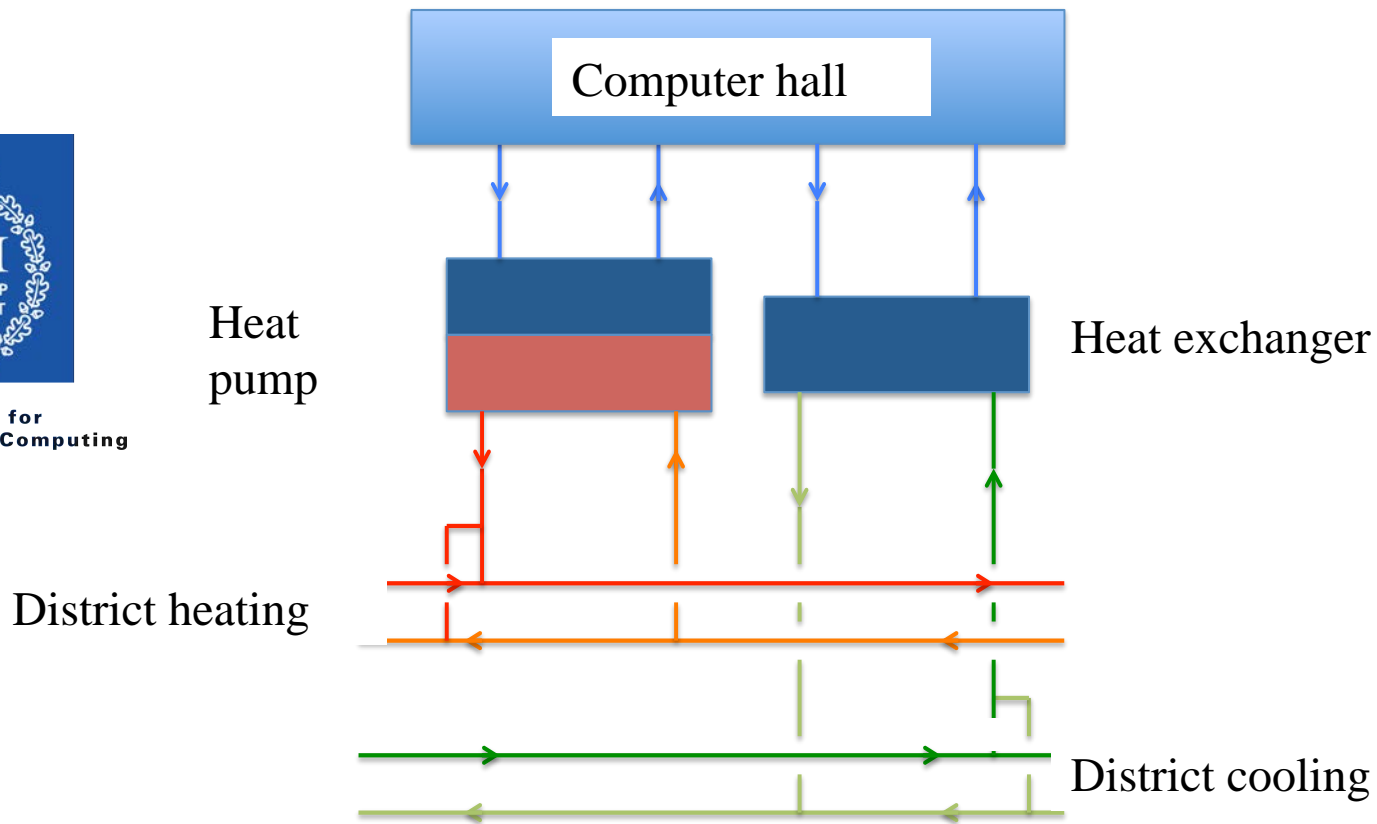
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# 3. District cooling and heating combined



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Questions?

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