

An aerial photograph of the KTH Royal Institute of Technology campus in Stockholm. The image shows a large, historic red-brick building with a prominent central tower and a green dome. The building is surrounded by a well-maintained green lawn, several tall, slender trees, and a central courtyard with a small pond and a fountain. The sky is blue with scattered white clouds.

Heat re-use in Stockholm

Gert Svensson
Dep. Director PDC
KTH Royal Institute of Technology
November 17, 2013

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

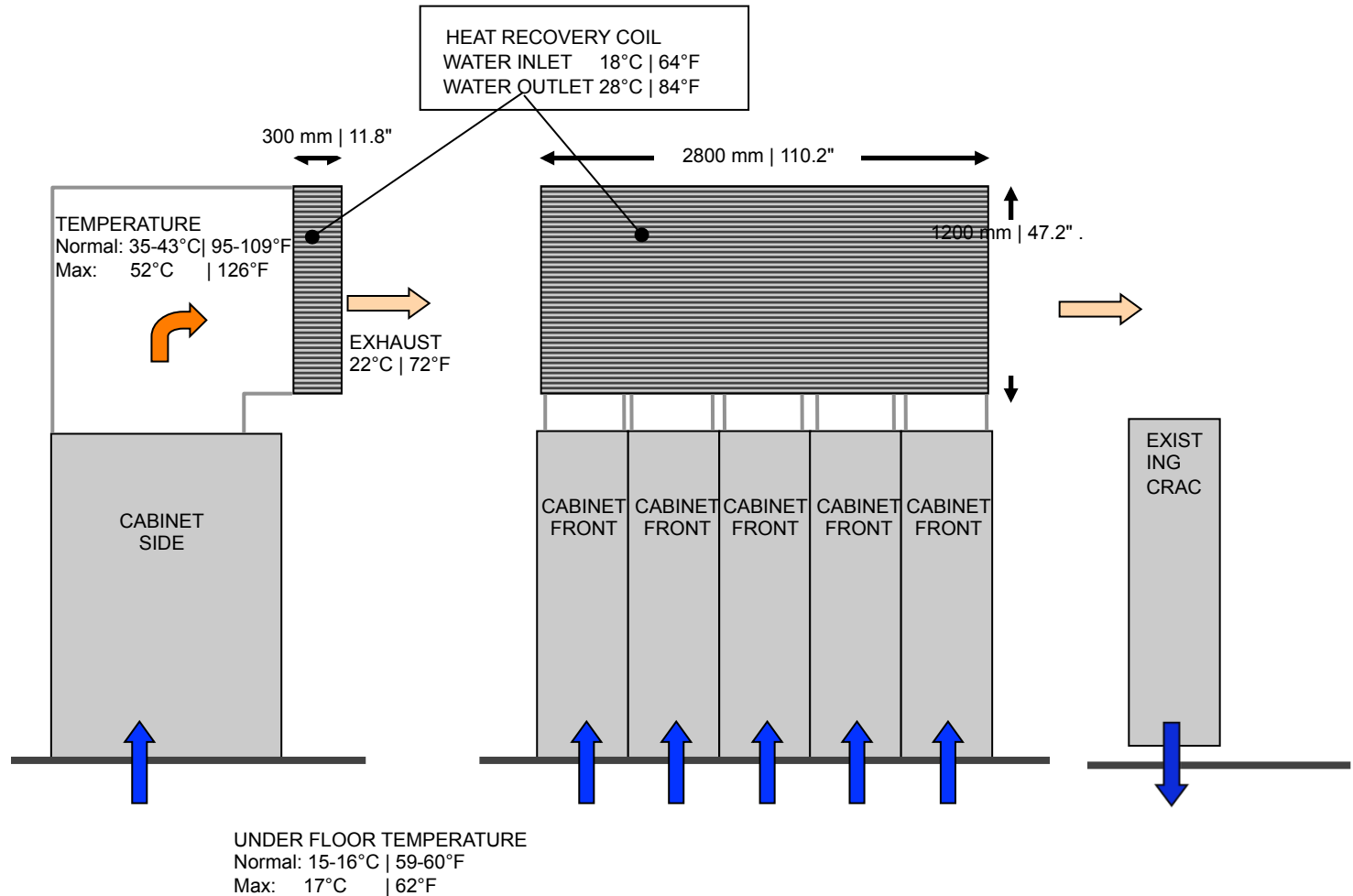
- **Cray could not provide what we wanted**
- **Own design**
- **Industrial components**



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



Fortum's distrikt heating



PDC Center for
High Performance Computing



Källa:

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

Fortum's district cooling

Fjärrkyla i Storstockholm



**PDC Center for
High Performance Computing**



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



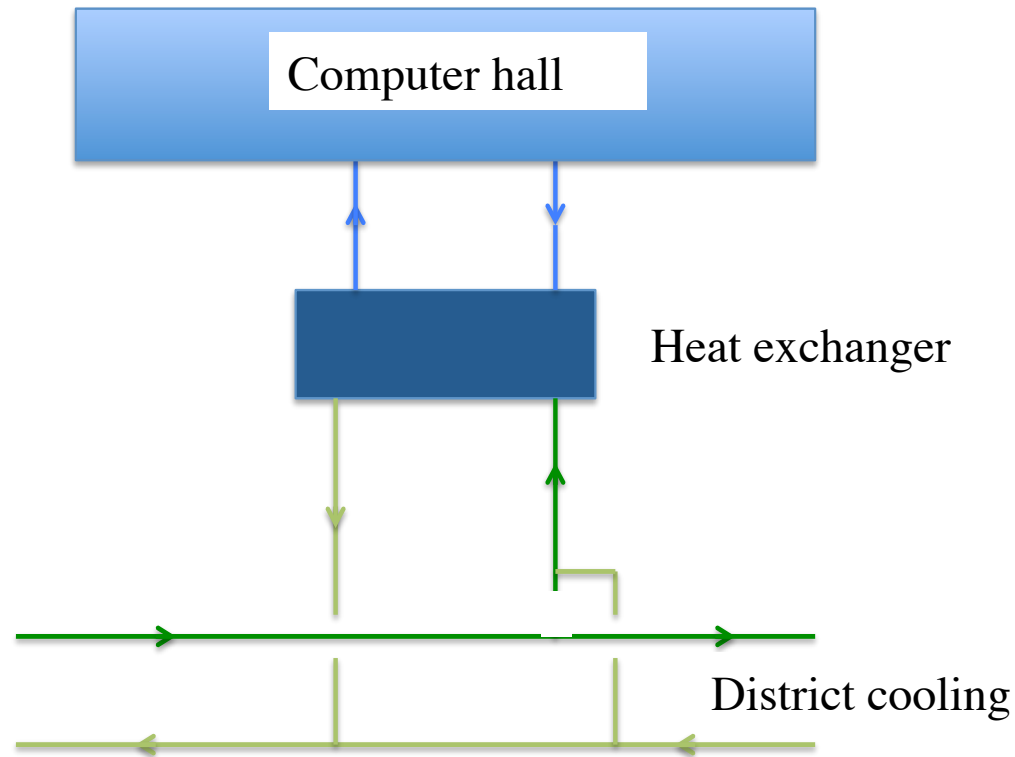
**PDC Center for
High Performance Computing**

- 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



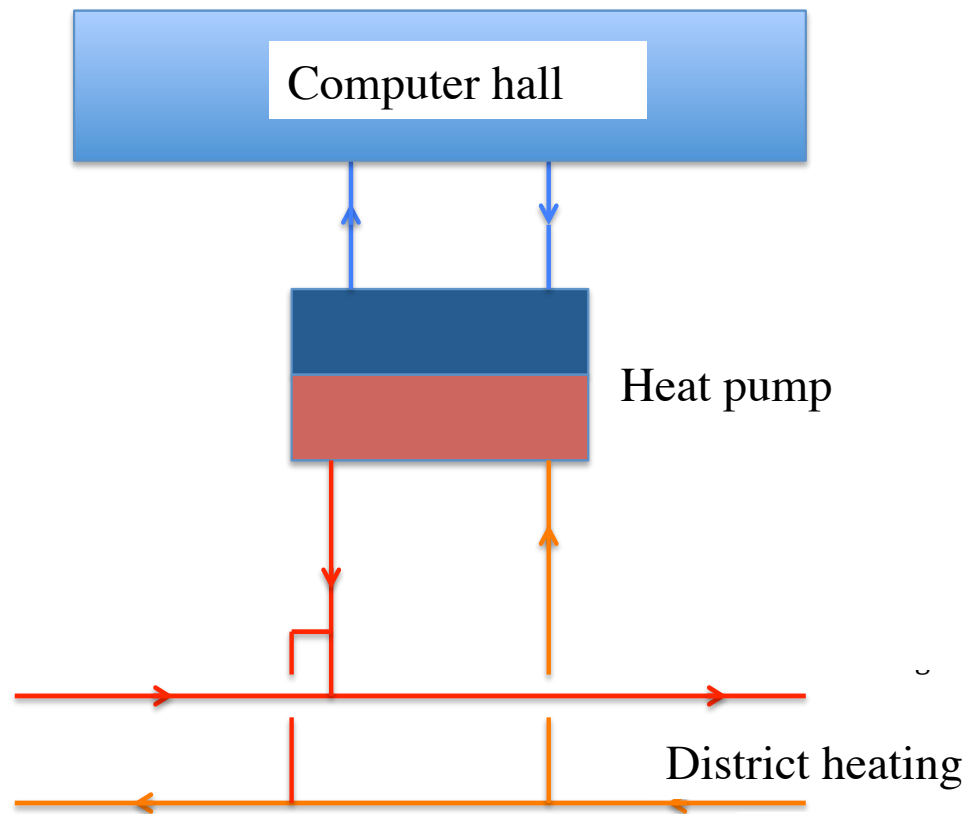
**PDC Center for
High Performance Computing**



2. Re-use to the district heating



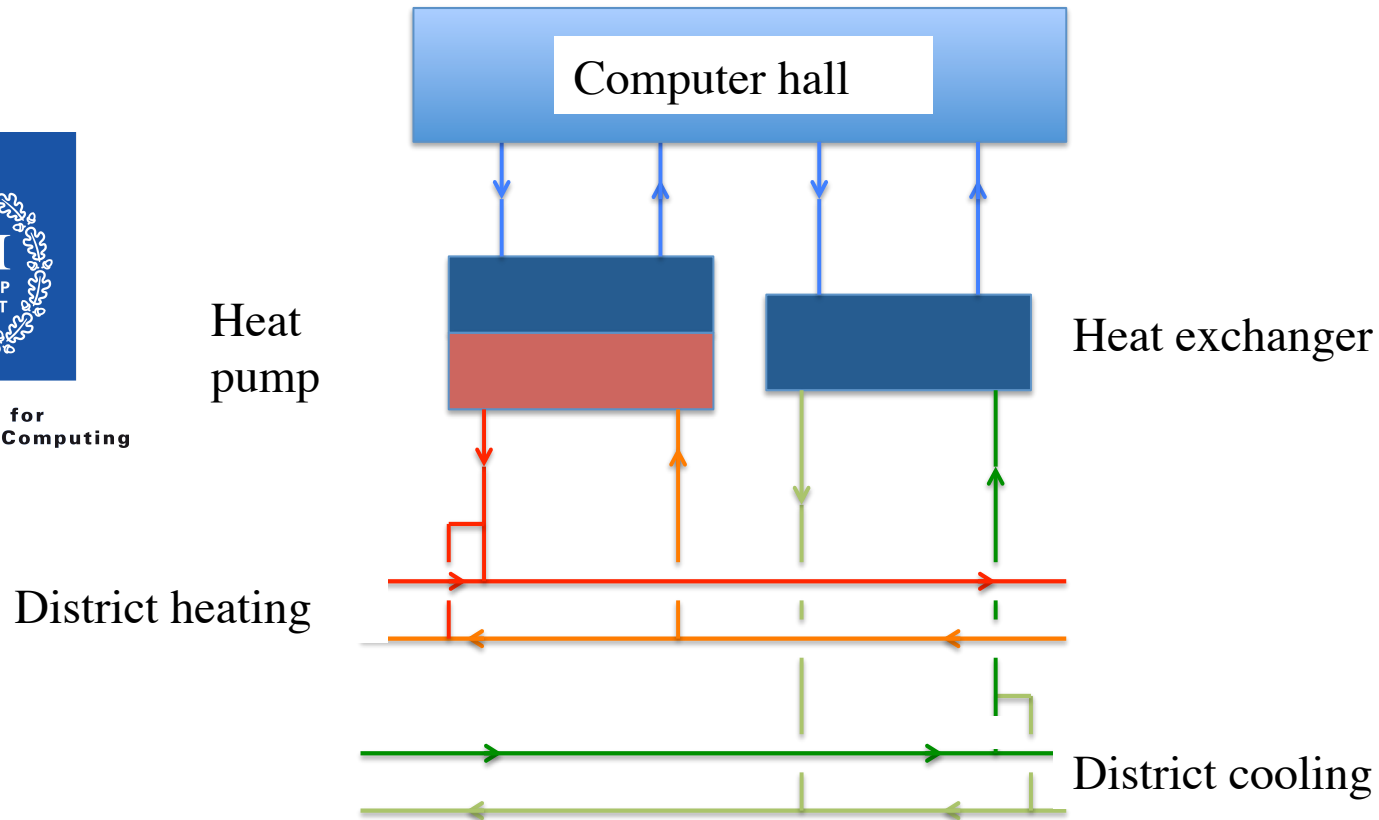
PDC Center for
High Performance Computing



3. District cooling and heating combined



PDC Center for
High Performance Computing





**PDC Center for
High Performance Computing**

Questions?

gert@kth.se