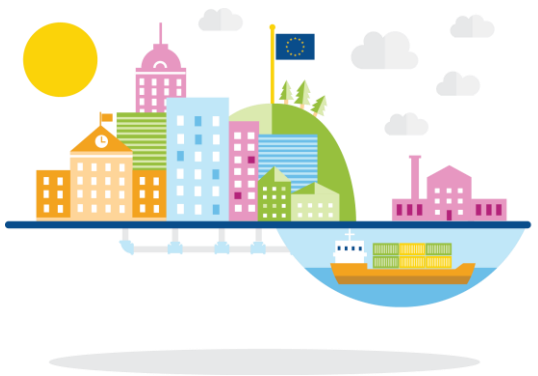
Celsius Talk:

“Heat-pumping the future of district energy”

Thursday March 28, 2019



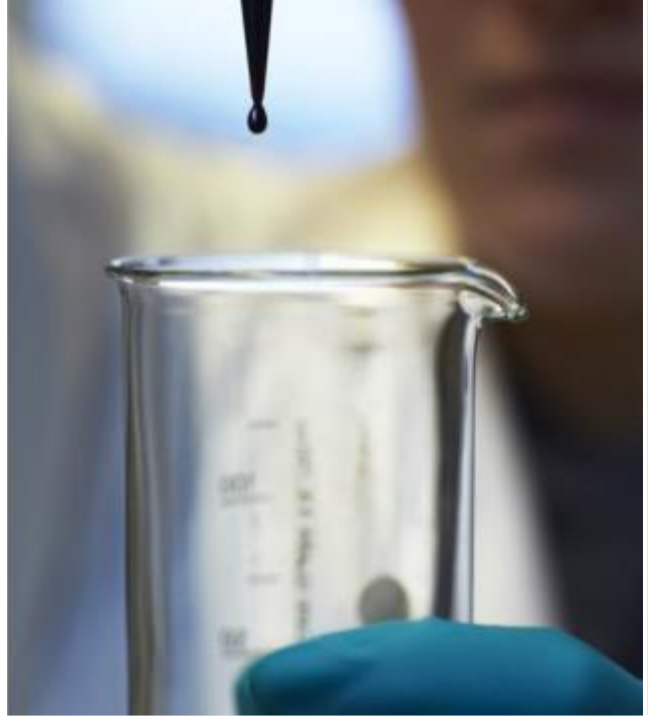
HEAT PUMPS IN DISTRICT HEATING SYSTEMS

Markus Lindahl

2019-03-28

RISE Research Institutes of Sweden

BUILT ENVIRONMENT
ENERGY AND CIRKULAR ECONOMY



Background

- Heat pumps in district heating systems

- Swedish national project 2015-2018
  - Financed by the Swedish Energy Agency

- Aim:
  - To investigate new possibilities for HP in combination with DH systems
  - Show combinations of heat pumps (HP) and district heating (DH) where both systems benefits

- Three independet subprojects:
  - HP in combination with DH in the manufacturing industry
  - DHW production in combination with low-temperature DH
  - **Optimized combination of HP and DH in facilities and multi-family houses**

Background

- Optimized combination of HP and DH

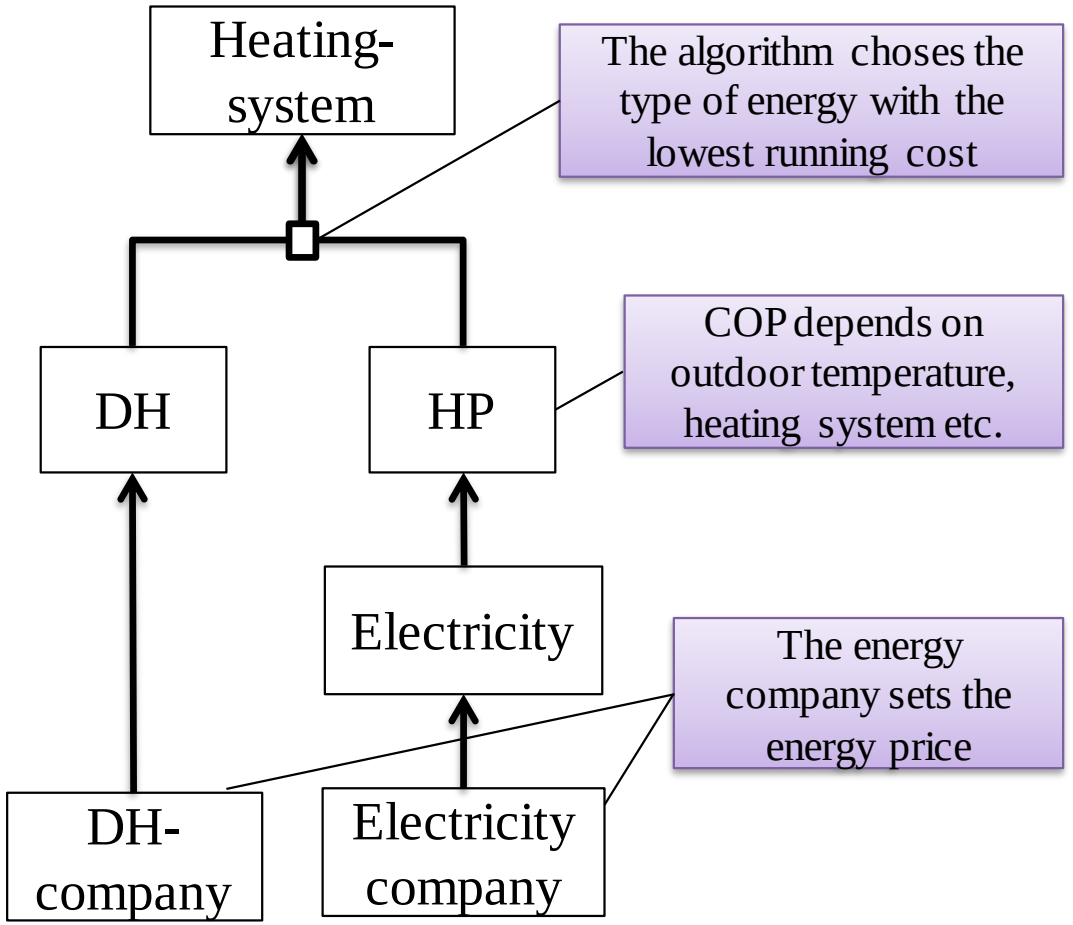
- Swedish heating market
  - District heating (DH) dominates in multi-family houses
  - Heat Pumps (HP) in single-family houses
- In facilities and multi-family houses with an installed heat pump there are many times also a connections to district heating
  - DH is often used as auxiliary heat when needed
- Future smart grids would benefit if it is possible to alter the heat production based on the demand and supply
- Hybrid heat pumps exist on the European market
  - With the possibility to alter between heat pump and gas/oil boiler

Main activites

- Develop an algorithm:
  - Best according to price to use district heating and when to use a heat pump
  - Lowest variable cost
- Calculate the life cycle costs (LCC)
  - Evaluate costs related to double systems
- Case study:
  - Evaluating the model
  - LCC

The algoritm

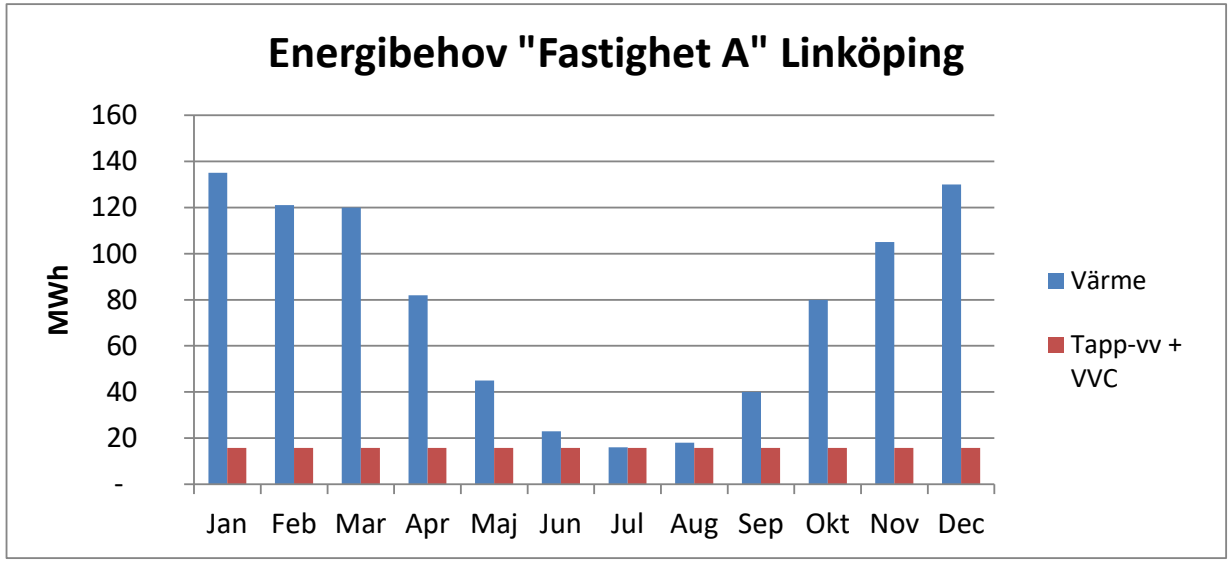
- The algorithm makes an update of the current situation once every hour
  - Outdoor temperature => COP
  - Energy prices
- Every hour the heating alternative with the lowest variable cost is chosen
- Production of:
  - Space heating
  - Domestic hot water (DHW)



Background case study

Model house

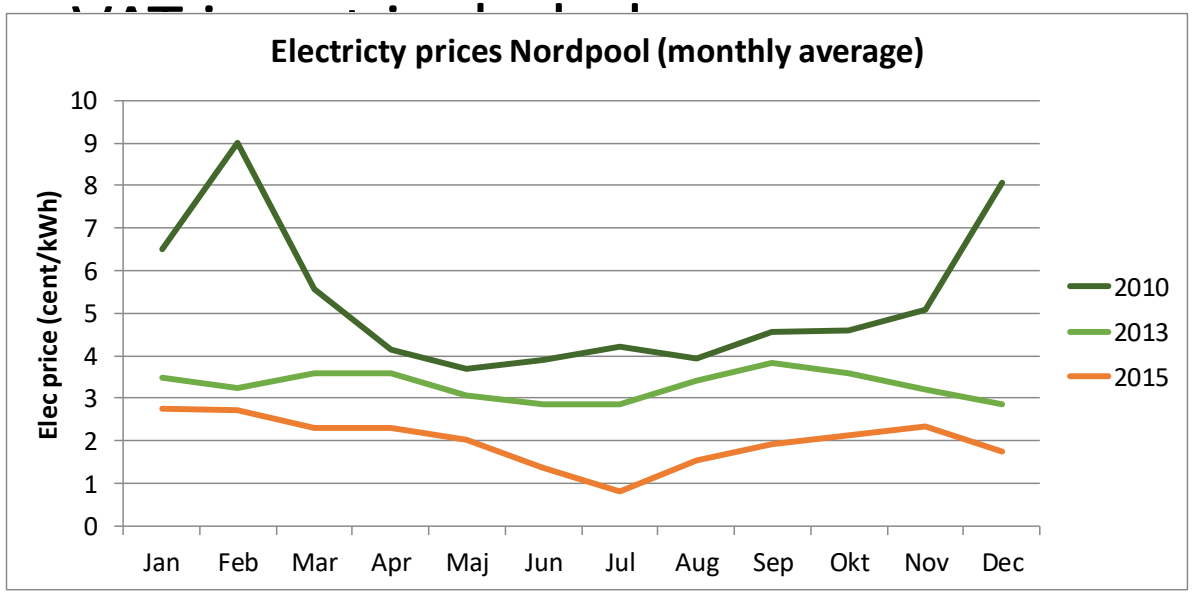
- Linköping
- Multi-family house
  - 11 floors
  - 93 apartments
  - Built: 1961
- DH + Exhaust air HP
  - Assumed: Typical COP values for an new exhaust air HP
  - HP covers 60% of the annual heating demand



Energy prices Linköping (variable cost)

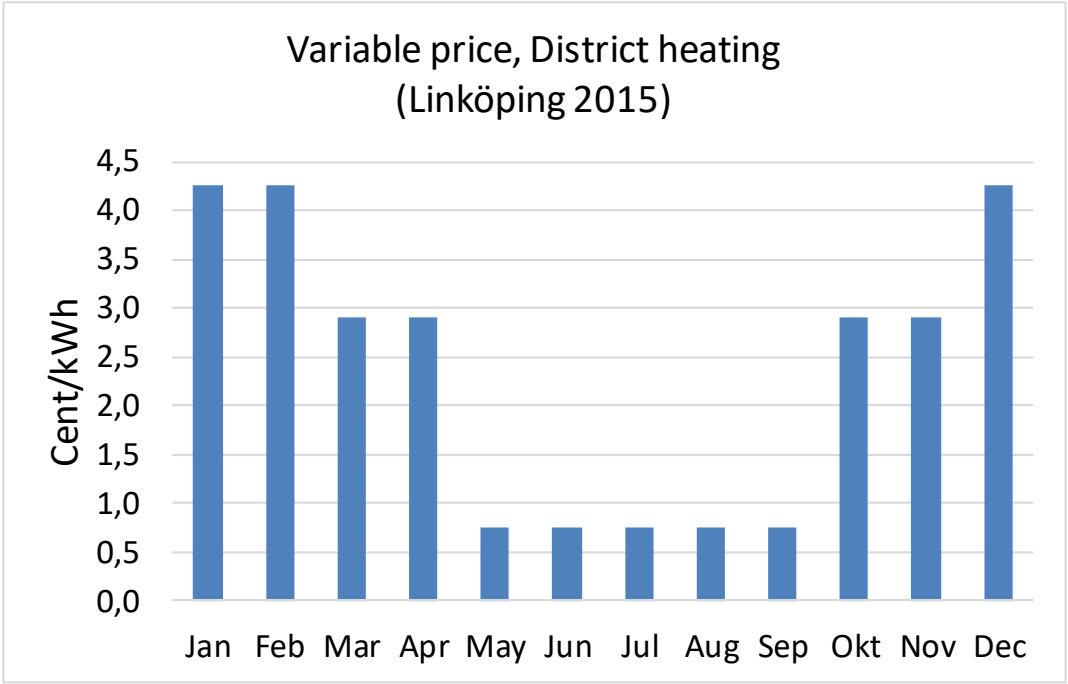
Electricity

- Elec prices: Nord pool, SE3, hourly values
- Costs for certificates, taxes etc. has been added



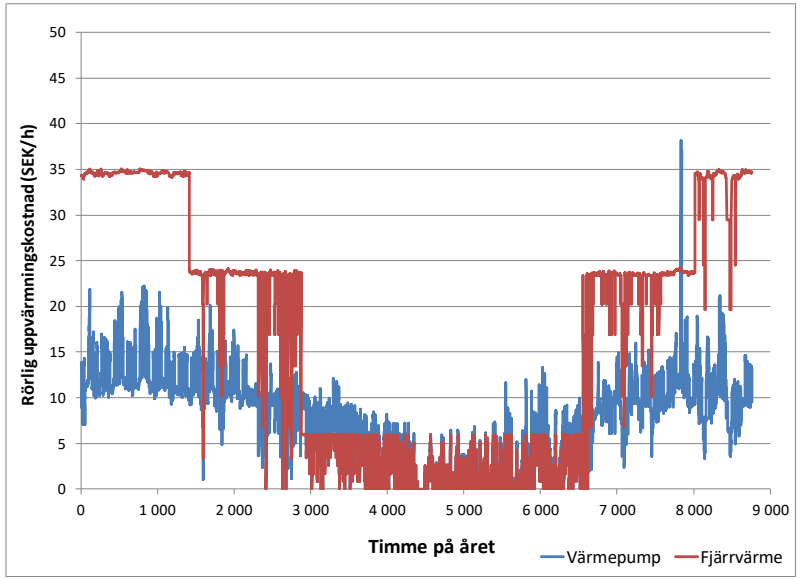
District heating

- Large difference between summer and winter
- VAT is not included



Result case study - Lowest variable cost

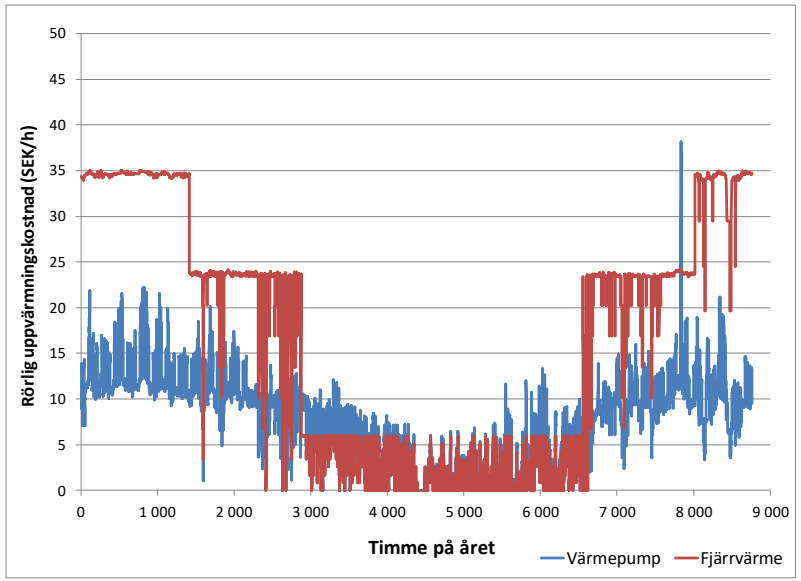
2015



	Space Heating (MWh/year)	**DHW** (MWh/year)	**Total** (MWh/year)
Heat Pump (lowest variable cost)	378	10	388
District Heating (lowest variable cost)	116	63	179
District Heating (auxiliary heating)	316	117	433
Total heating demand	810	190	1 000

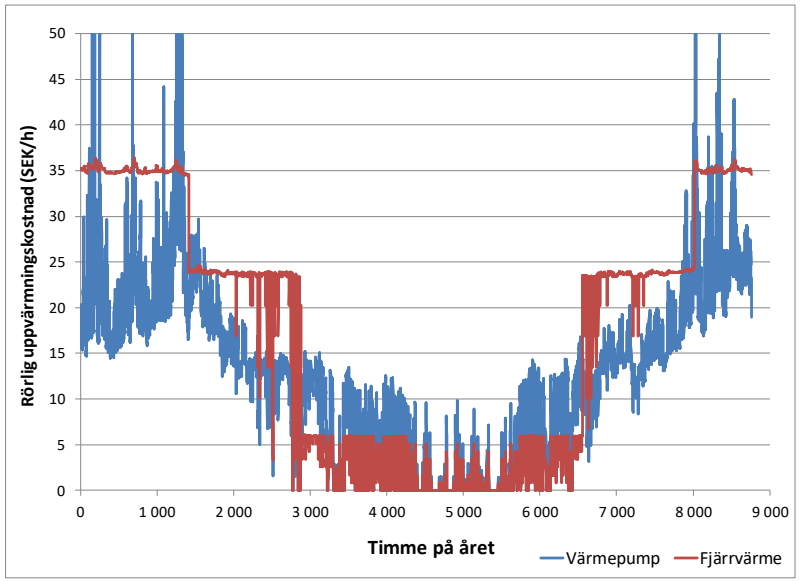
Result case study - Lowest variable cost

2015



	Space Heating (MWh/year)	**DHW** (MWh/year)	**Total** (MWh/year)
Heat Pump (lowest variable cost)	378	10	388
District Heating (lowest variable cost)	116	63	179
District Heating (auxiliary heating)	316	117	433
Total heating demand	810	190	1 000

2010



	Space Heating (MWh/year)	**DHW** (MWh/year)	**Total** (MWh/year)
Heat Pump (lowest variable cost)	311	0	311
District Heating (lowest variable cost)	186	68	254
District Heating (auxiliary heating)	626	122	748
Total heating demand	1123	190	1 313

LCC (net present value method)

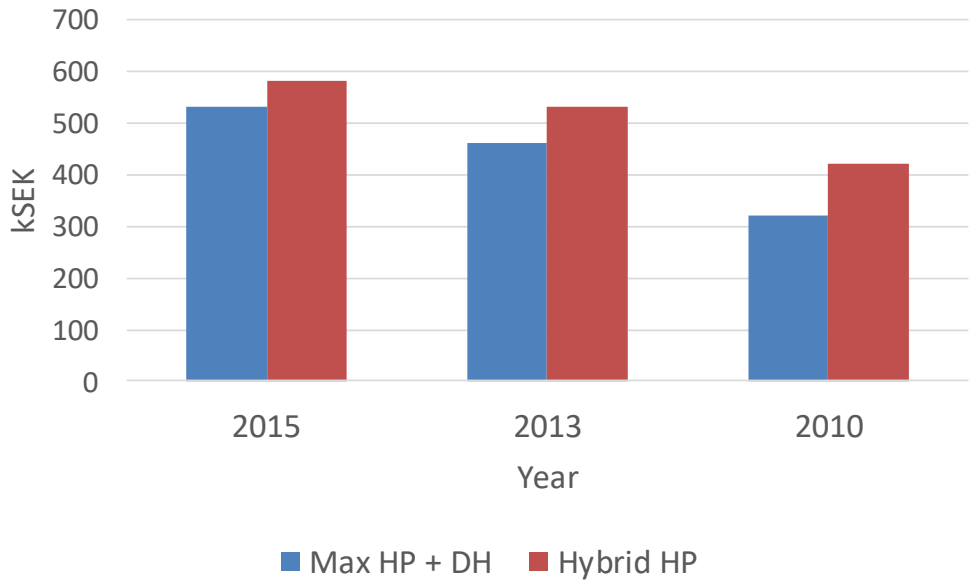
Assumptions:

- Discount rate: 6%
- DH already installed
- Elec. price: 2013 (base case)
- DH price: 2015

- The investment of a hybrid HP ca be 5-10 000 Euro higher
  - Compared to a traditionally installed HP with the same pay back time of 5 years

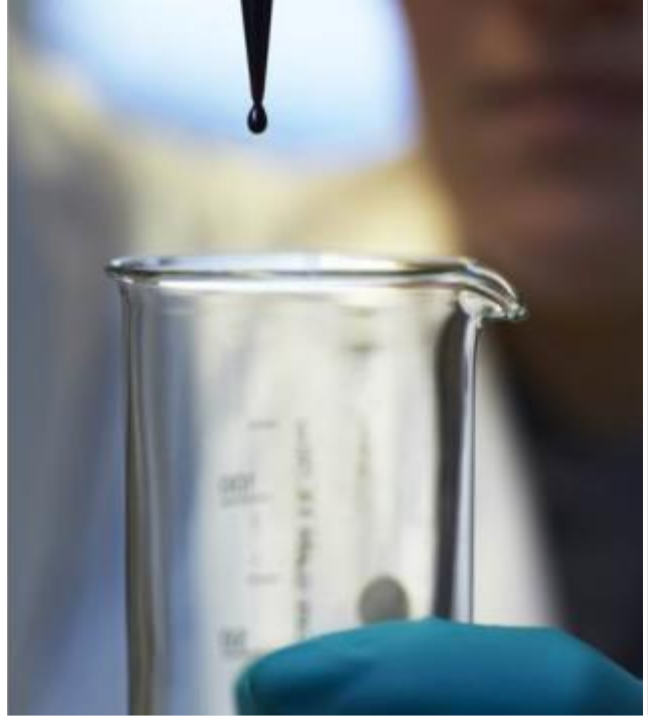
- Difference in heating cost:
  - Hybrid HP vs Traditional HP
  - Saving: 1 000-2 500 Euro/year

Pay back time: 5 years



Conclusions

- An algorithm has been developed
  - Choosing the alternative with the lowest variable cost
- Case study:
  - HP has the lowest running cost from Oct-Apr
  - DH has the lowest cost during summer
- Potential saving today: 1 000 – 2 500 Euro/year
  - (2-4% of the total heating cost)
- The investment of a hybrid HP ca be 5-10 000 Euro higher
  - Compared to a traditionally installed HP with the same pay back time of 5 years
- A hybrid solution benefits of variations in energy prices
  - A price structure with variations in energy price is needed



CONTACTS

Markus Lindahl

Markus.Lindahl@ri.se

010-516 5529

RISE Research Institutes of Sweden

BUILT ENVIRONMENT
ENERGY AND CIRKULAR ECONOMY

Thank you!

www.celsiuscity.eu - @celsiuscity

Supported by

Climate-KIC

Climate-KIC is supported by the EIT, a body of the European Union

Swedish Energy Agency

iea Energy Technology Network

IEA HPT