



Total Cost of Ownership of District Heating Compared to its Competing Technologies

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Introduction

■ District heating:

- Old!
- Dirty!
- Expensive!

■ The truth about district heating:

- The future!
- Clean!
- Economical!



Clean and nice waste incineration plant in Esbjerg, Denmark



Old house with a boiler

- ## ■ Why is the misconception about district heating so strong? Is the truth hidden?
- We decided to make a cost analysis for Denmark using publically available data from the Danish government, universities and international organizations to really see how DH stands cost wise against its rivals.
 - The conclusion is that the common misconceptions about district heating is simply wrong!
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Comparison

- To make the study reflect on future low energy buildings it was decided to look into two cases:
 - Traditional houses with yearly consumption of 15 MWh
 - Low energy houses with yearly consumption of 8 MWh

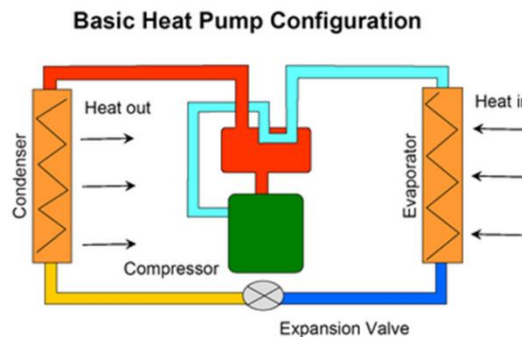
- District heating was compared to the following rival heating technologies:



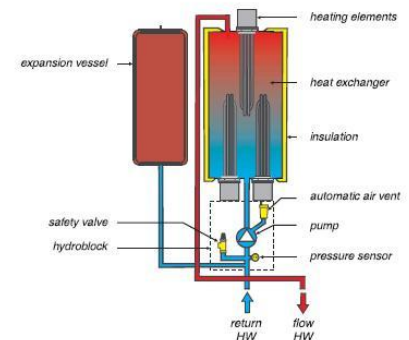
Solar thermal



Individual gas boilers



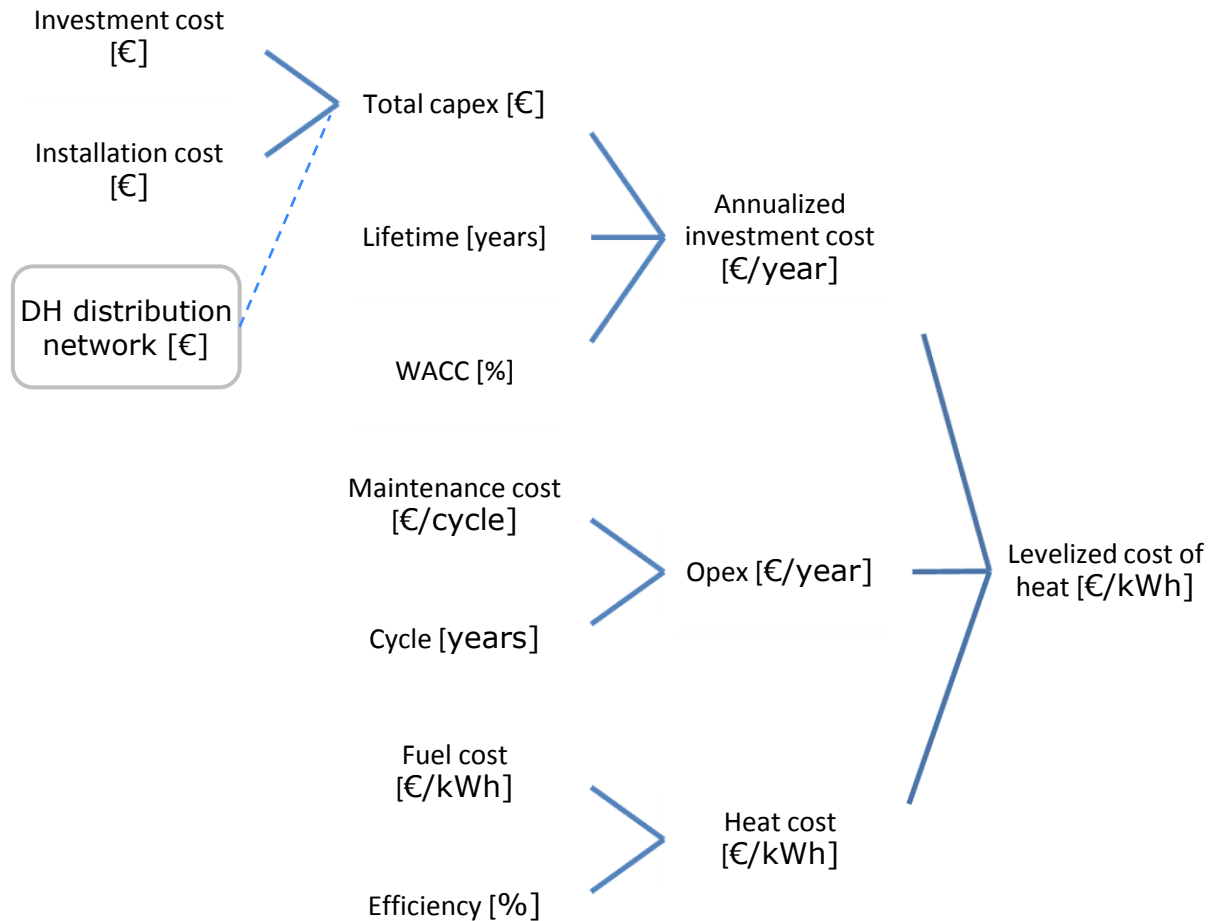
Ground/air source heat pumps



Electrical boilers

- The investment and installation costs, lifetime and efficiency used are from a publically available report made by the Danish Energy Association
- The energy prices for running the units are from IEA and the Danish Energy Association

Comparison method

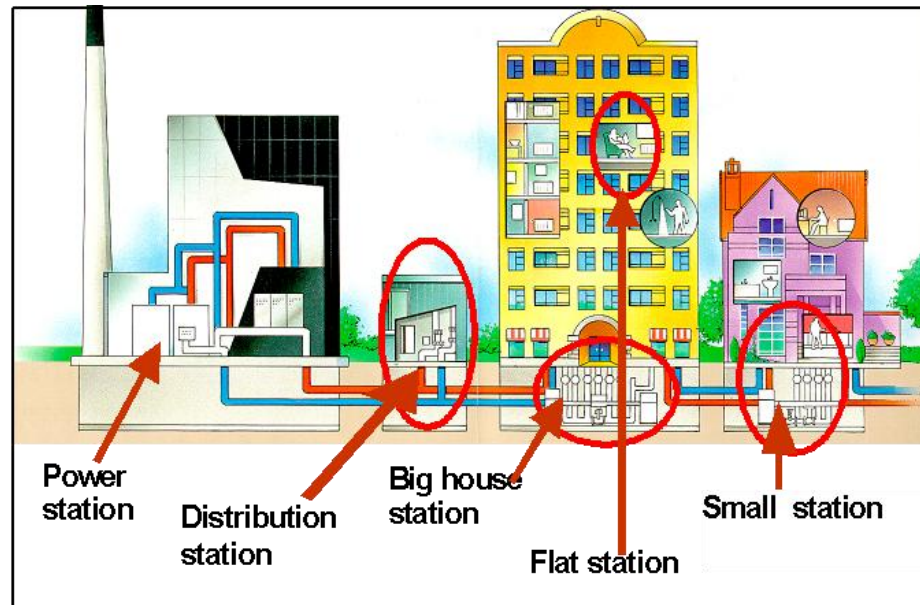


Rival technologies

Technology type	Technology type	Total heat cost	Limitations	Limitations
Solar thermal	Solar thermal	New building: 0.162 €/kWh	Needs to be coupled with alternative heating option	Needs to be coupled with alternative heating option
Gas boilers	Gas boilers	New building: 0,155 €/kWh Existing building: 0,12 €/kWh	Increased risk of fires due to possible bad operation and maintenance	Increased risk of fires due to possible bad operation and maintenance
Air heat pumps	Air heat pumps	New building: 0,230 €/kWh Existing building: 0,185 €/kWh	When outside temperature decreases the efficiency of the air source heat pump decreases.	When outside temperature decreases the efficiency of the air source heat pump decreases.
Electrical heaters	Electrical heaters	New building: 0,326 €/kWh Existing building: 0,304 €/kWh	Puts heavy strain on the electrical grid.	Puts heavy strain on the electrical grid.

The cost of district heating

- As mentioned before the cost of district heating is a bit more complicated to calculate than for individual heating solutions



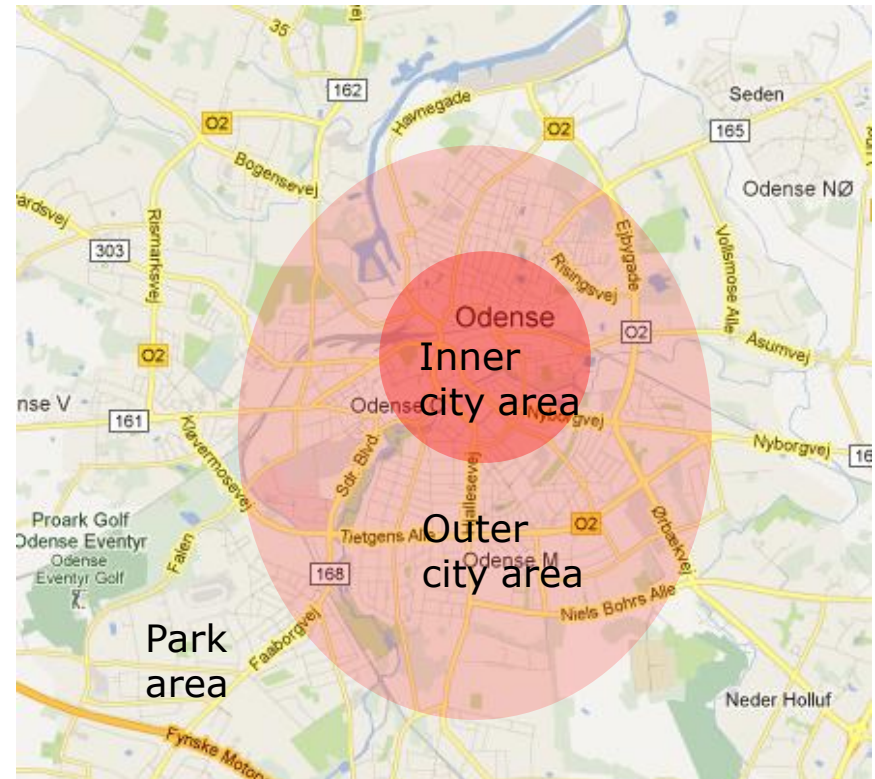
- The heat generation cost is further on dependent on the energy source, which offers wide range of possibilities
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District heating

- As the district heating complexity is high it was evaluated on different conditions for a network consisting of 3.000 consumers.

- Influence of the heat density area:
 - Inner city area
 - Outer city area
 - Park area

- Different energy sources:
 - Dedicated gas boiler
 - Waste incineration
 - Biomass boiler
 - Geothermal energy
 - CHP / Waste heat



Heat generation

Heat plant type	Specific investment costs	Operating and maintenance cost per year	Efficiency	Technical lifetime	Fuel price (2010)	Benefits
Centralized gas boiler	0,06-0,12 M€/MW	2-5% of investment costs	97-105%	20	0.046 €/kWh	
Waste incineration plant	1,1 M€/MW	5% of investment costs	98%	20	0.039 €/kWh	Solves social and environmental problems regarding household waste handling
Biomass boiler, wood-chips fired	0,3-0,7 M€/MW	1,8-3%	108%	20	0.034 €/kWh	CO ₂ neutral and fueled by a renewable energy
Geothermal	cheap (0,01 €/kWh) → High temperatures average (0,014 €/kWh) expensive (0,028 €/kWh) → Low temperatures Built on data from Icelandic geothermal plants. This can vary substantially.					CO ₂ neutral and fueled by a renewable energy
CHP / Waste heat from industry	The cost of heat from CHP is valued on the cost of the power production efficiency drop when heat is also produced. 0.014 €/kWh.					CO ₂ neutral and fueled by a recycled waste energy

Sources:

Technology CAPEX, OPEX , efficiency and lifetime data: Danish Energy Agency
 Fuel prices: International Energy Association and Danish District Heating Association

Distribution network and consumer installation

- Here the cost of the DH network and consumer installation is shown as a cost per kWh.
 - The higher the heat demand the lower cost per kWh is achieved

- Expected heat losses are relative to the total heat energy sold and are based on Danish district heating networks

Heat demand	Inner city €/kWh	Outer city €/kWh	Park area €/kWh
New buildings	0.050	0.051	0.060
Existing buildings	0.025	0.026	0.030
Heat losses in network			
New buildings	10%	20%	25%
Existing buildings	8%	10%	20%
Heat loss in consumer installation		2%	

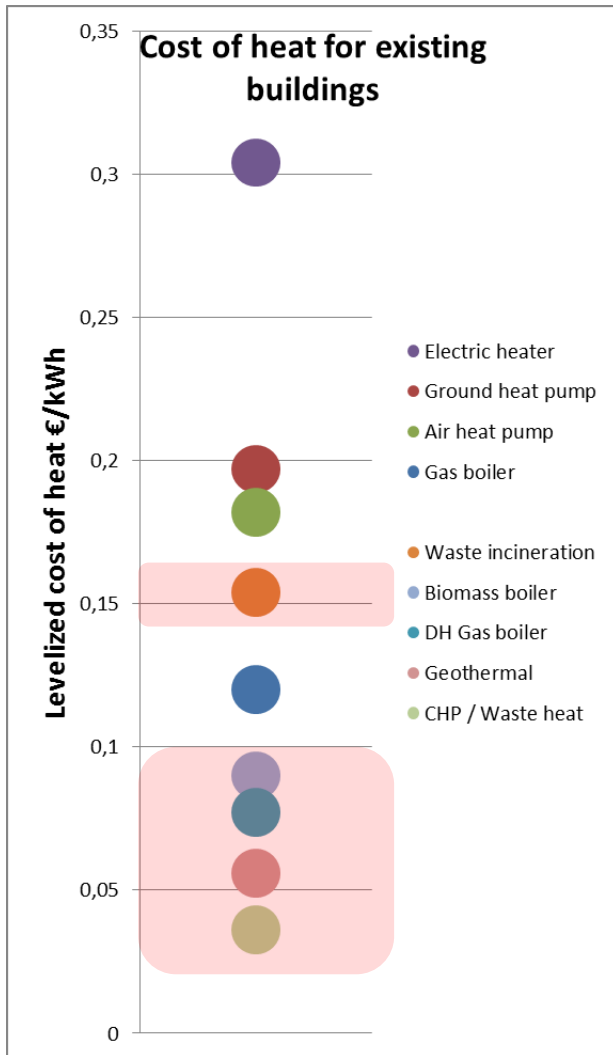
Sources:

Distribution network: Persson, U., & Werner, S. (2011). Heat Distribution and the Future Competitiveness of District Heating. *Applied Energy*, 568-576.

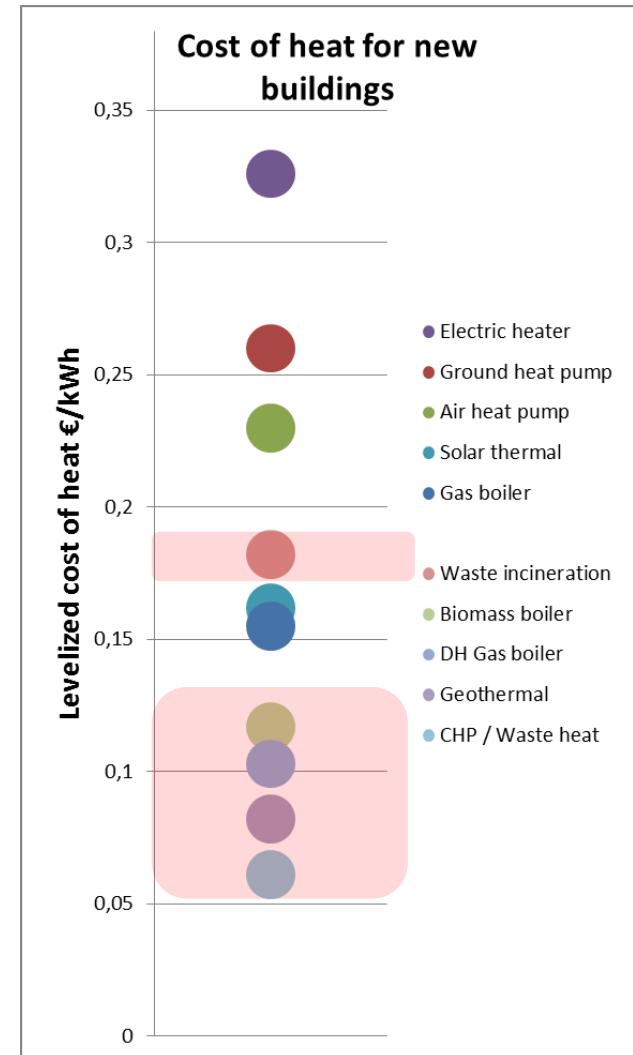
Consumer installations: Danish Energy Agency

Heat losses: Danish District Heating Association

DH compared to individual heating technologies



District heating



Conclusion

- The economical benefits of district heating are clear for inner and outer city areas
 - Park areas require more case to case analysis
 - Given an existing gas grid the main competitor is the individual gas boiler
 - In none gas grid all the individual heating solutions are on a similar cost level
 - Even in case of reduced future heat consumption district heating remains the most economical way to provide heat energy
 - What here has been shown gives clear indication that district heating is the economical heating solution!
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Questions?



Thank you for your attention

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