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Modelling of low-carbon district heating: lessons learnt from a Danish and a Czech case

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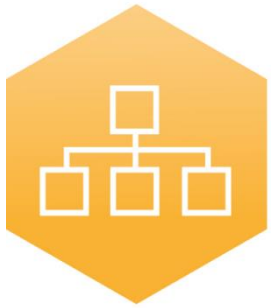
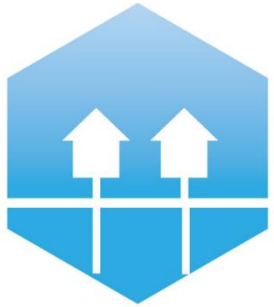




4DH
4th Generation District Heating
Technologies and Systems

Background

- Horizon2020 project progRESsHEAT - **renewables** locally and nationally in heating/cooling supply (http://www.progressheat.eu/)
  - Local modelling: identifying an optimal mix of heat savings, **district heating (DH)** expansion and individual heat supply

- Decarbonizing and expanding district heating important in municipal CO_2 reduction goals

- Heat pumps in DH
  - can improve flexibility needed to increase the share of intermittent RES
  - use available low-temperature heat sources

Case studies

- Focus: heat pumps, electric boilers and heat storage in local district heating systems in Helsingør and in Litomerice on the heat prices and CO_2 emissions

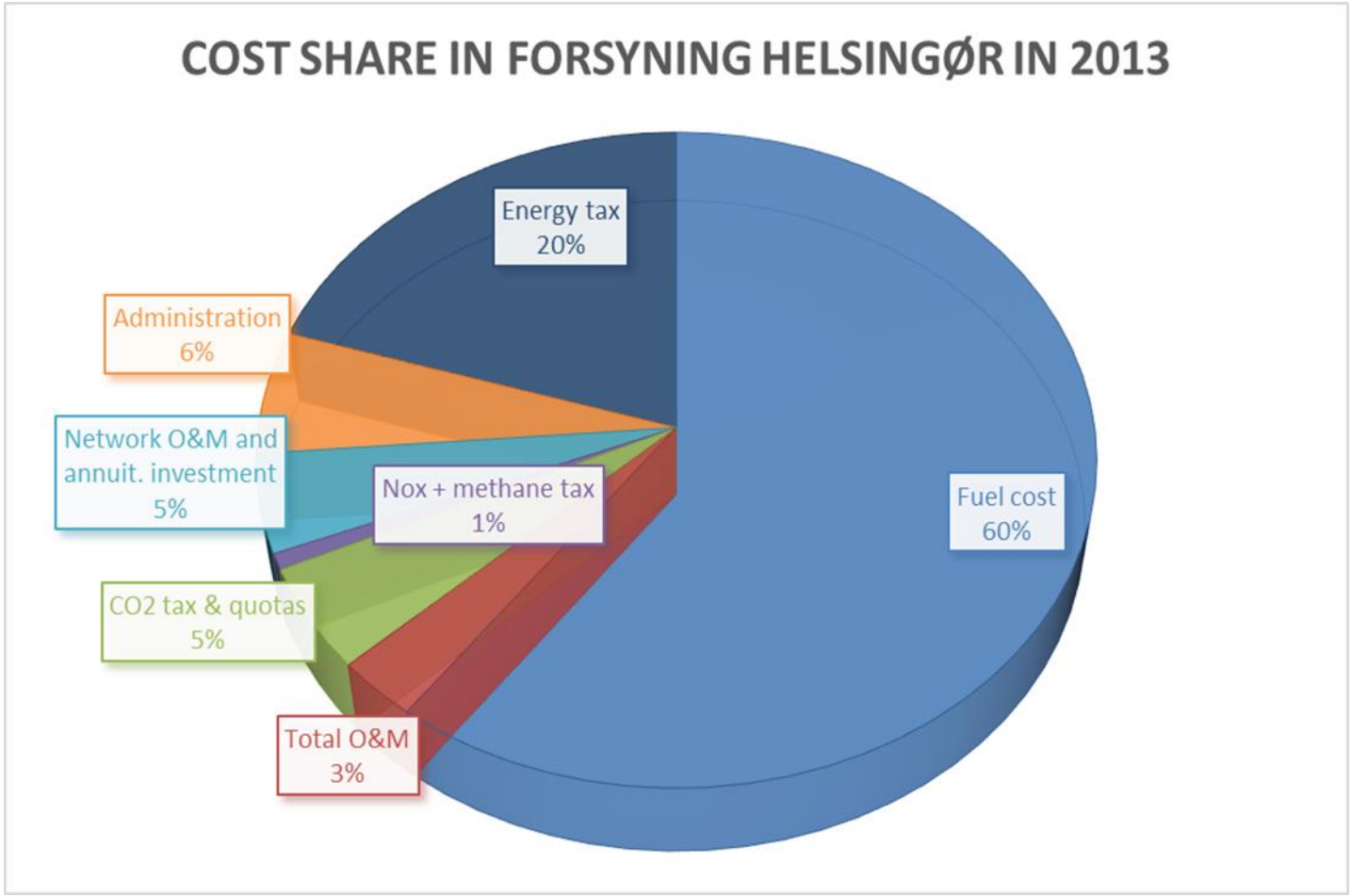
- DH in **Helsingør**
  - natural gas + connection to the neighbouring municipality (waste incineration +natural gas)

- DH in **Litomerice**
  - natural gas and brown coal

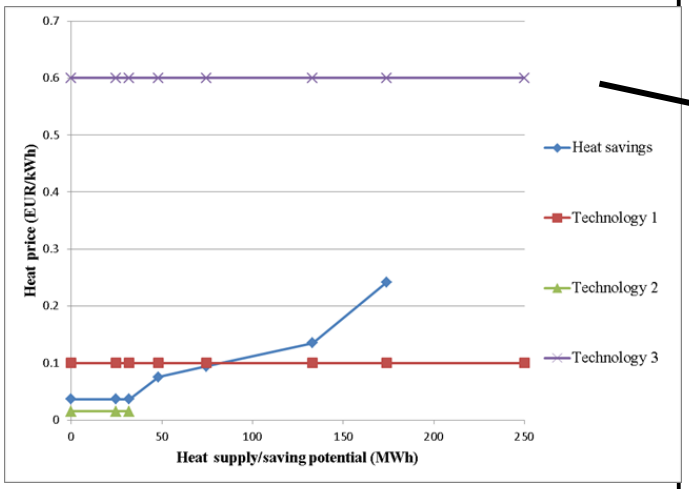
Local DH modelling with energyPRO

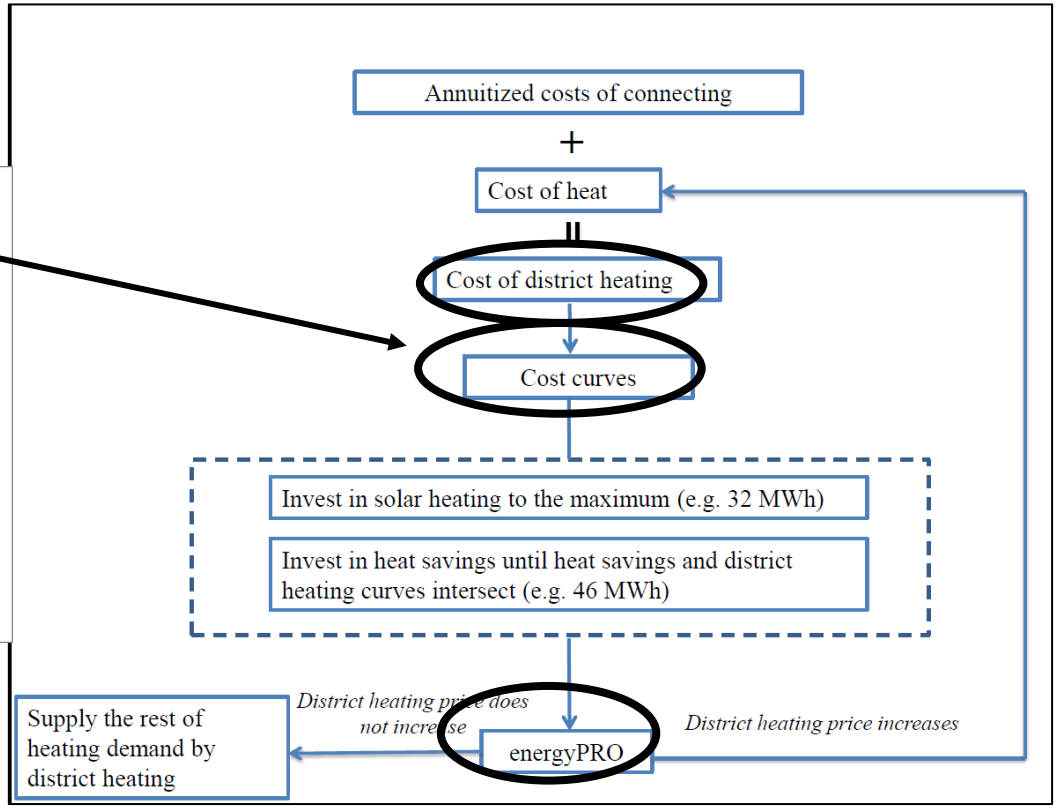
- commercial modelling software developed by EMD International
- techno-economic operation optimization, accounting for air temperature (heat demand), technical properties of units, maintenance costs, fuel prices, taxes and subsidies etc.
- optimization via an operation strategy - defined by user or calculated automatically (minimizing the net production cost)

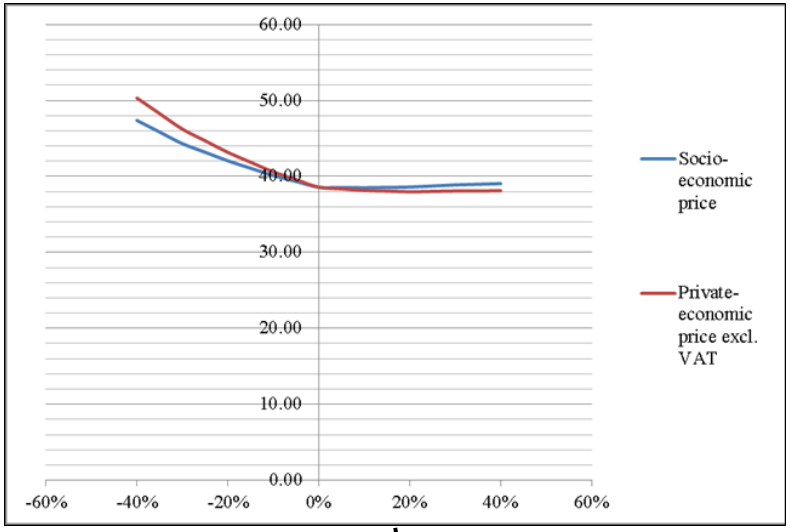
Cost elements for heat price



How do we use energyPRO?






60.00
50.00
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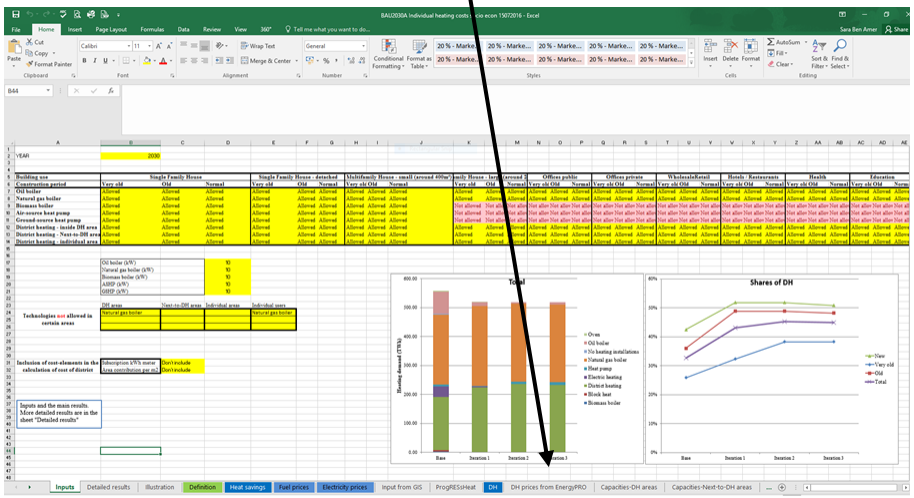
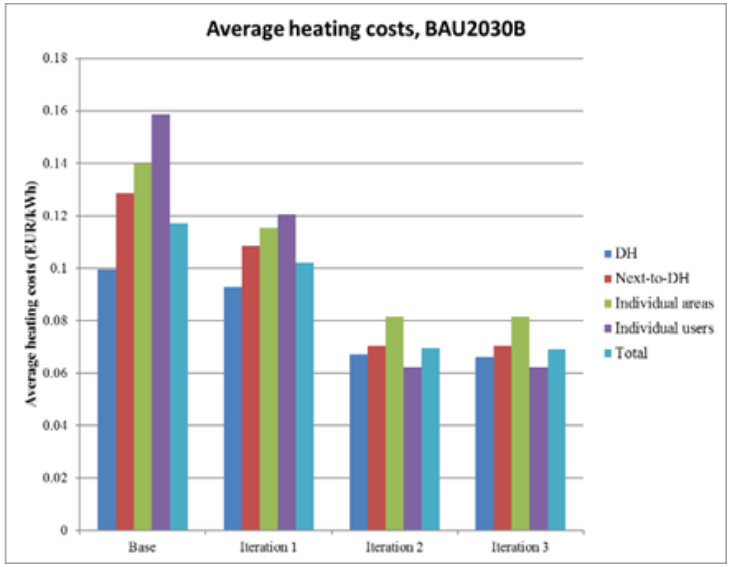
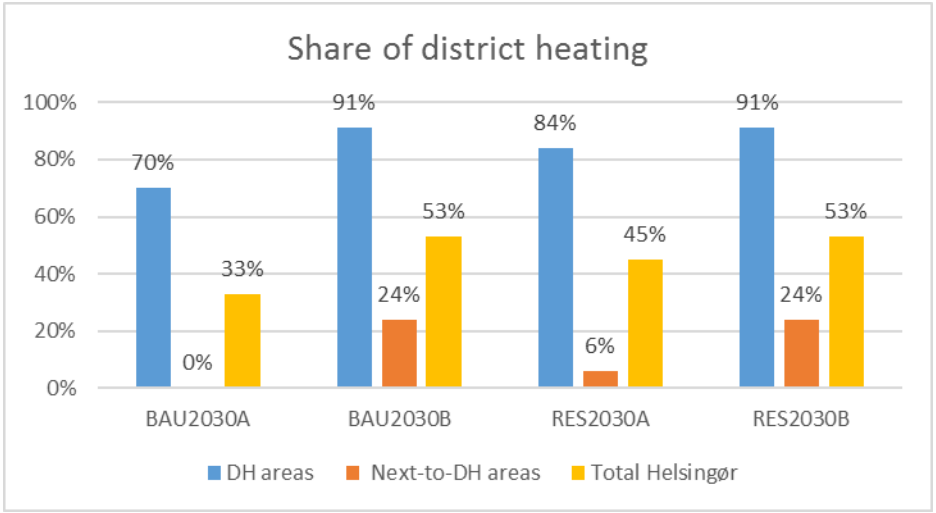
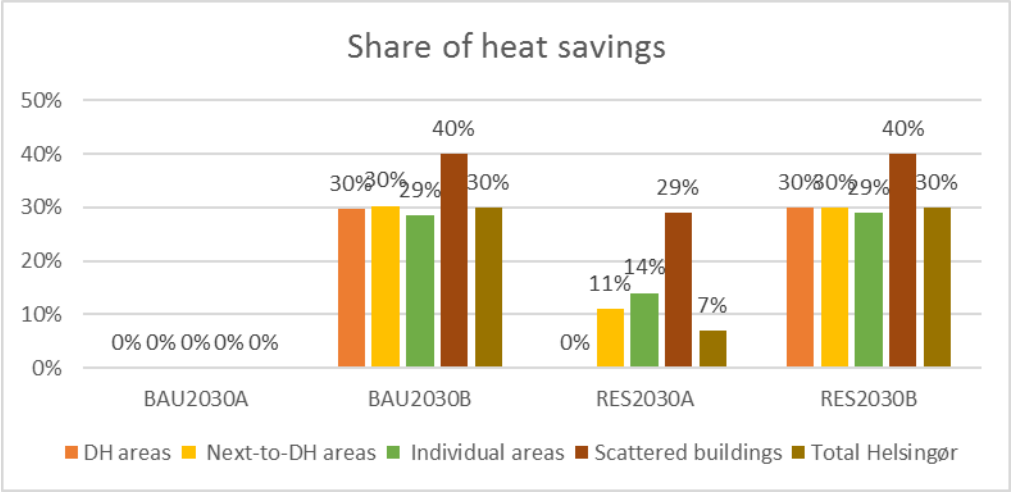
Private-economic price excl. VAT









share of RES, CO2 emissions…

More scenarios for 2030

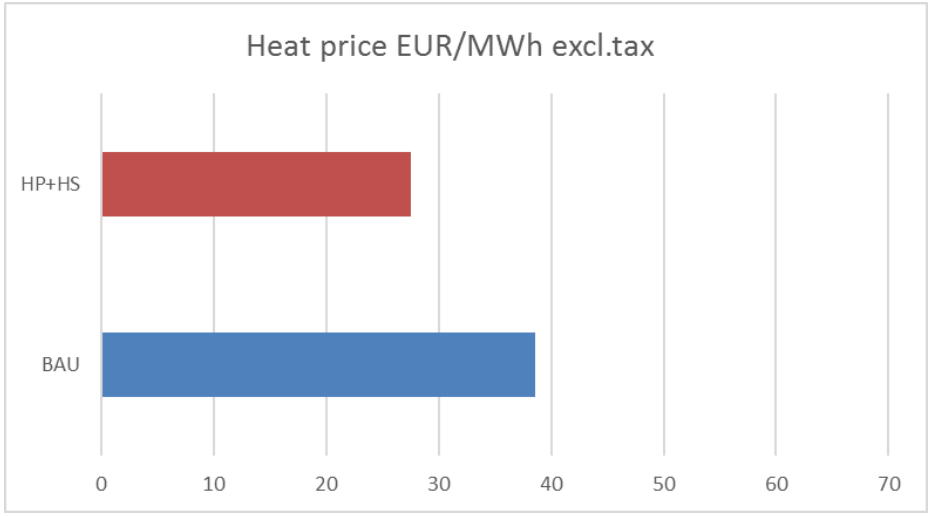
- Helsingør (DK)
    1. BAU (Biomass CHP to be implemented in 2018)
    2. Heat pumps + storage

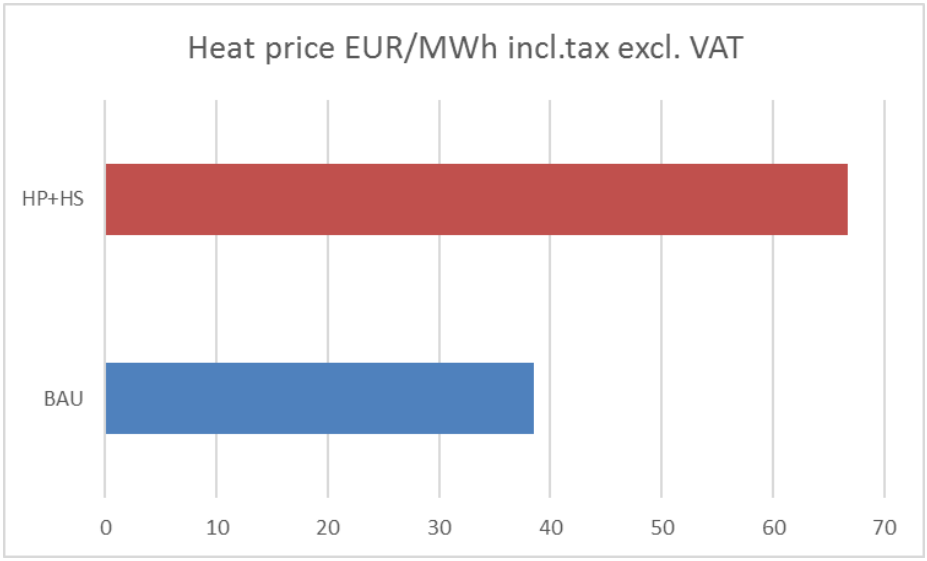
- Litomerice (CZ)
    1. BAU (coal+natural gas)
    2. Electric boilers
    3. Heat pumps + electric boilers
    4. Electric boilers + heat pumps + storage

Preliminary results

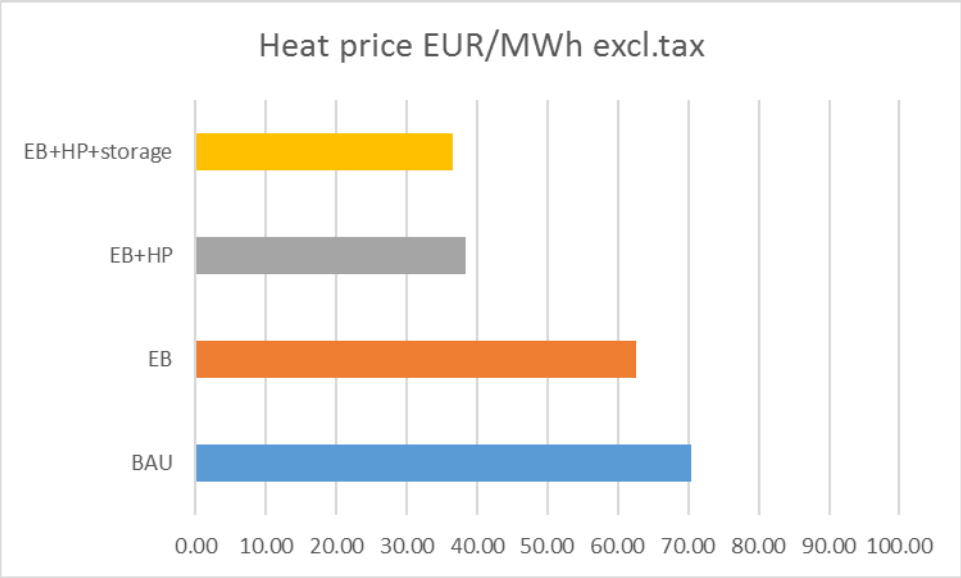
- Heat prices
- CO_2 emissions from DH

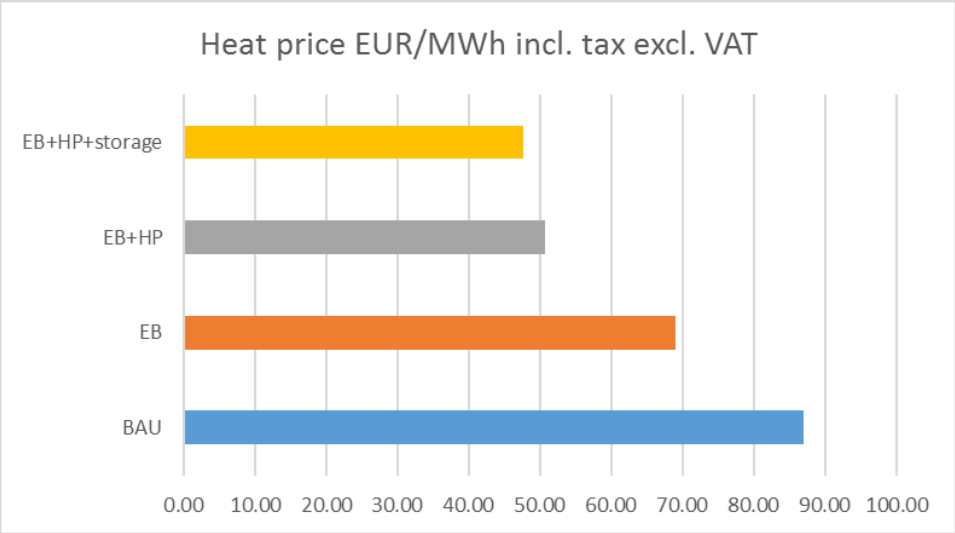
Heat price - Helsingør



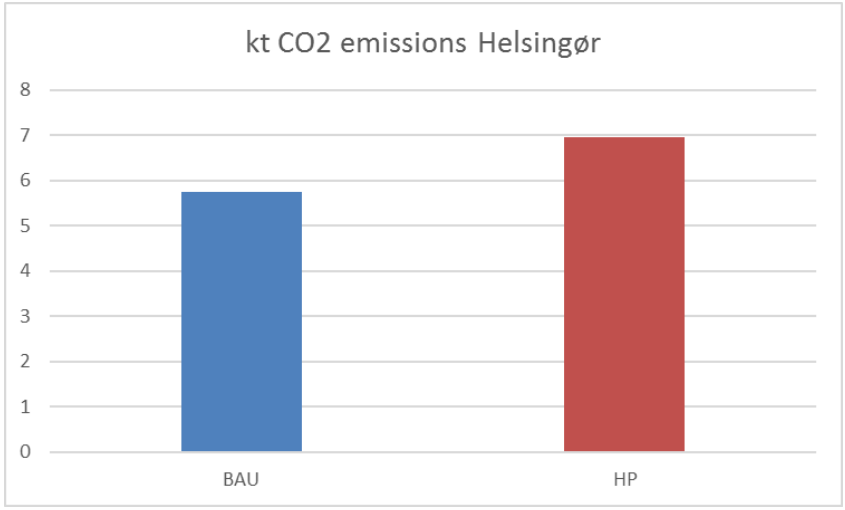


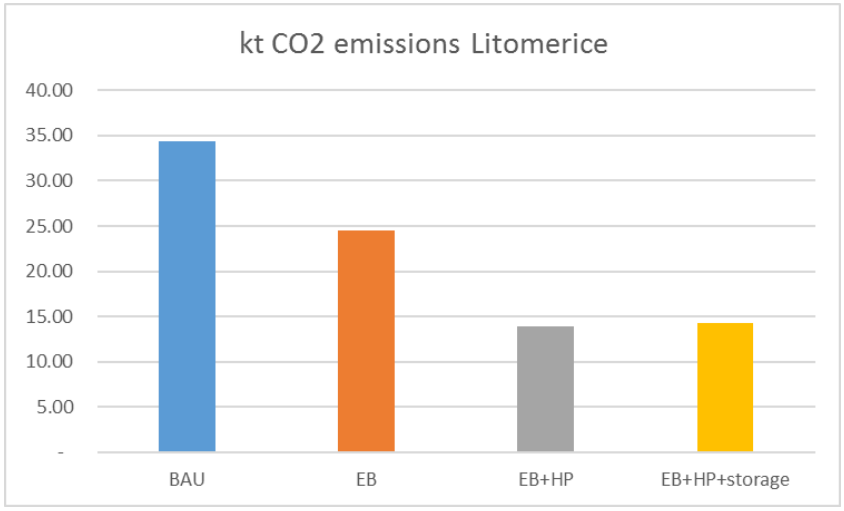
Heat price- Litomerice





CO2 emissions





Preliminary conclusions

- **Helsingør**
  - Least costly excl. taxes: heat pump + heat storage
  - Least costly incl. taxes: BAU (biomass CHP)
  - Lowest CO_2 emissions: BAU (assuming 100% RES biomass and not assigning CO_2 to its transport)
  - Taxation is main obstacle for utility heat pumps to be viable

- **Litomerice**
  - Least costly excl. AND incl. taxes: electric boiler + heat pump +heat storage
  - Lowest CO_2 emissions: electric boiler + heat pump +heat storage

Next steps

- This work: heat pumps work as base load, flexibility as interplay with heat storage-> Changing scenario setup
- Quantifying the value of flexibility - framework for assessing flexibility of a district heating system
- CO_2 allocation between electricity and heat in CHPs- in DK: 200% rule or 125% rule, in other countries?
- Assumptions on CO_2 content of electricity in the future
- Heat demand correlation with electricity production from wind and solar

Thank you for your attention. Questions?

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