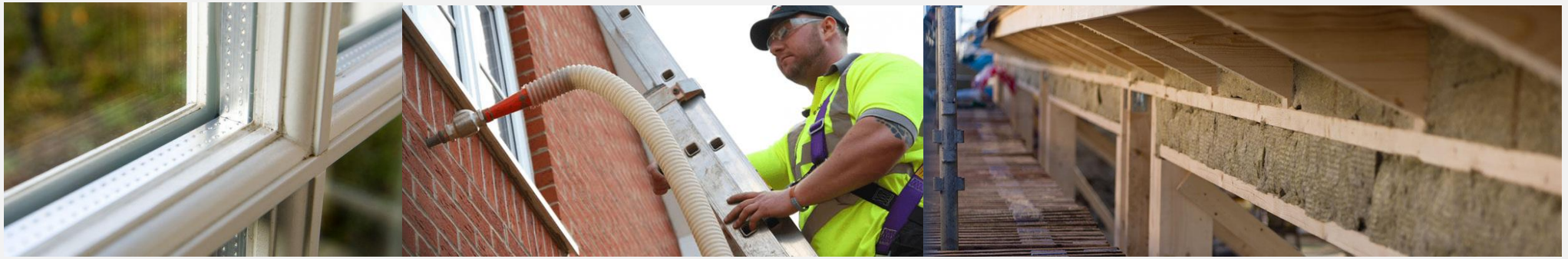

End-use heat saving potentials in Aalborg Municipality

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Introduction

- Balance between energy savings and energy production
- Geographical differences in potentials
  - Building types (type and age)
  - Heat supply costs (district heating or individual supply)

http://wumo.com/wumo/2017/09/06

Research Question

"What is the balance between end-use savings and supply costs within different areas of Aalborg Municipality?"

Focus on:

- End-use savings in existing buildings
- Aalborg 2050 BAU scenario

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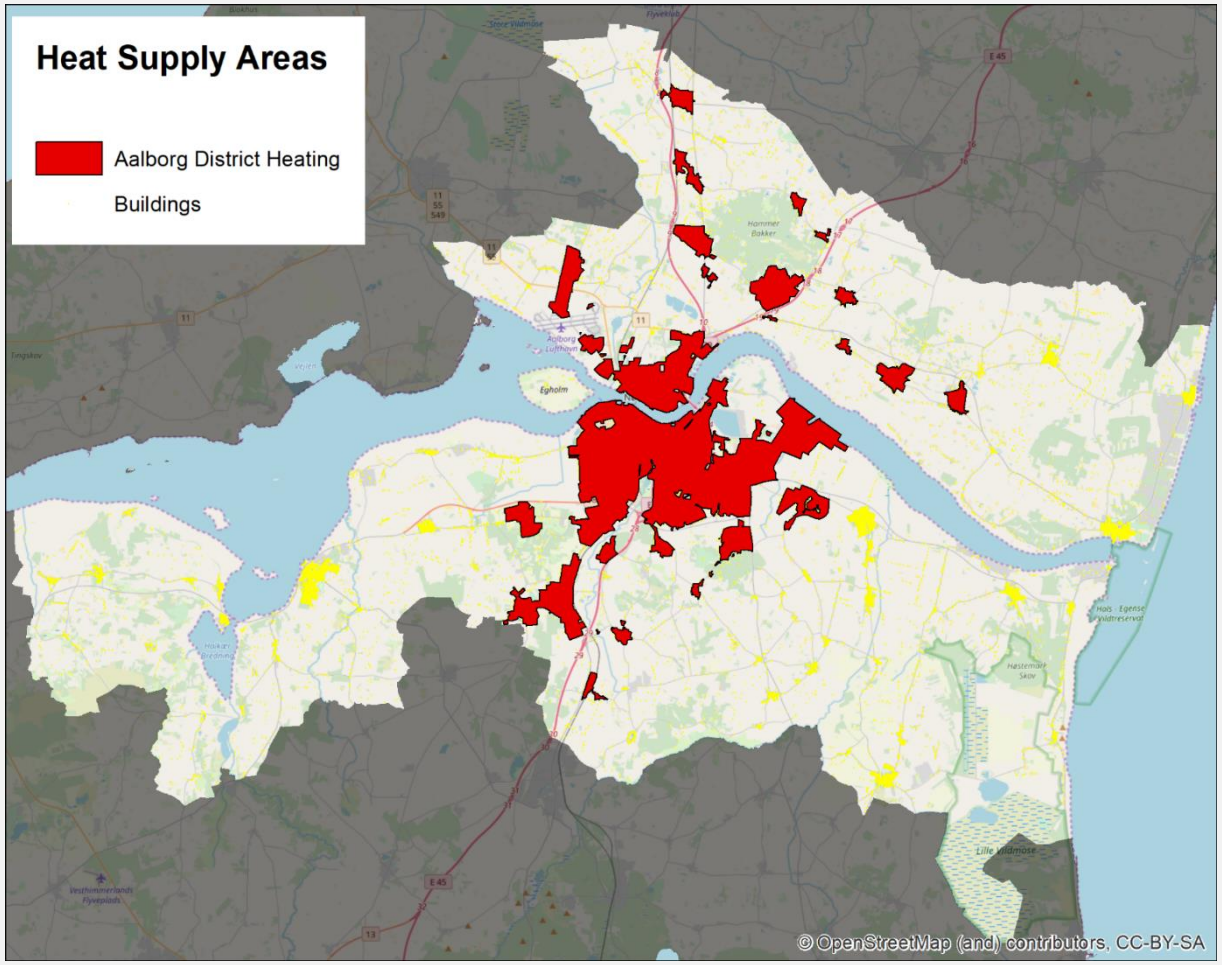
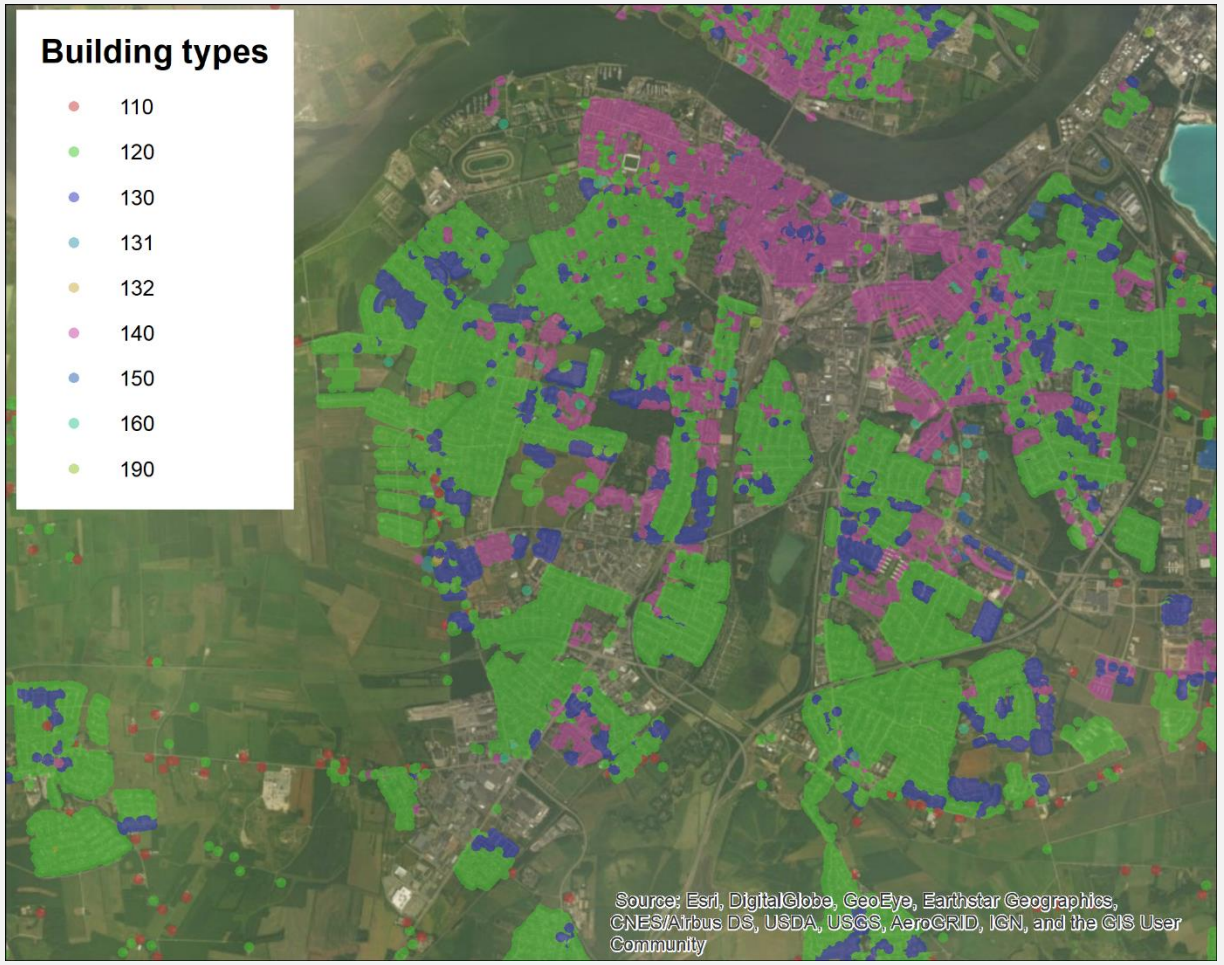
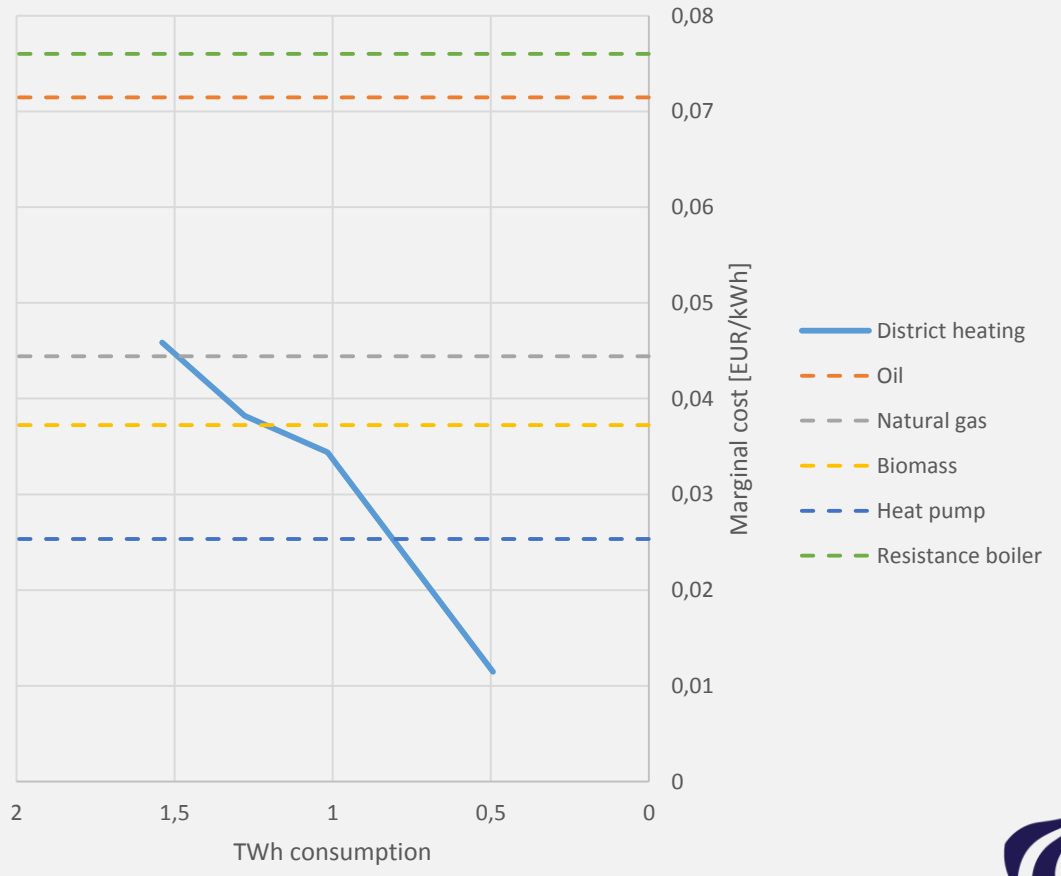
Mapping of heat demand in Aalborg





Heat supply cost curves

- District heating based on 2050 business as usual scenario
  - EnergyPLAN analysis
    - Hourly model
  - Marginal changes to heat supply
  - Marginal cost changes
- Individual heating based on marginal costs for fuel/electricity



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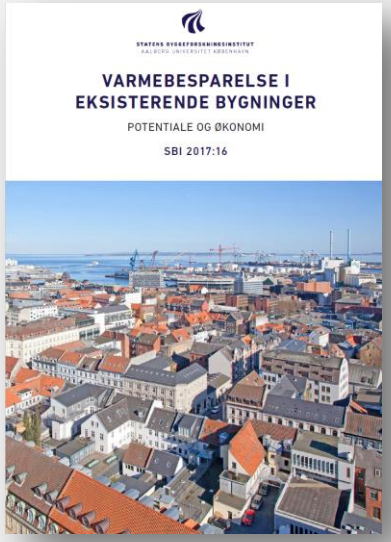
Different types of end-use savings and associated investment costs

Level	Energy saving measure
0	Point of departure
1	Basic renovation (building code)
2	Cavity wall insulation
3	Windows (A level)
4	Insulation of ceiling and roofs
5	Good practice for insulation
6	Energy saving focus when insulating
7	Scenario 6 + re-insulation of ceiling and roofs



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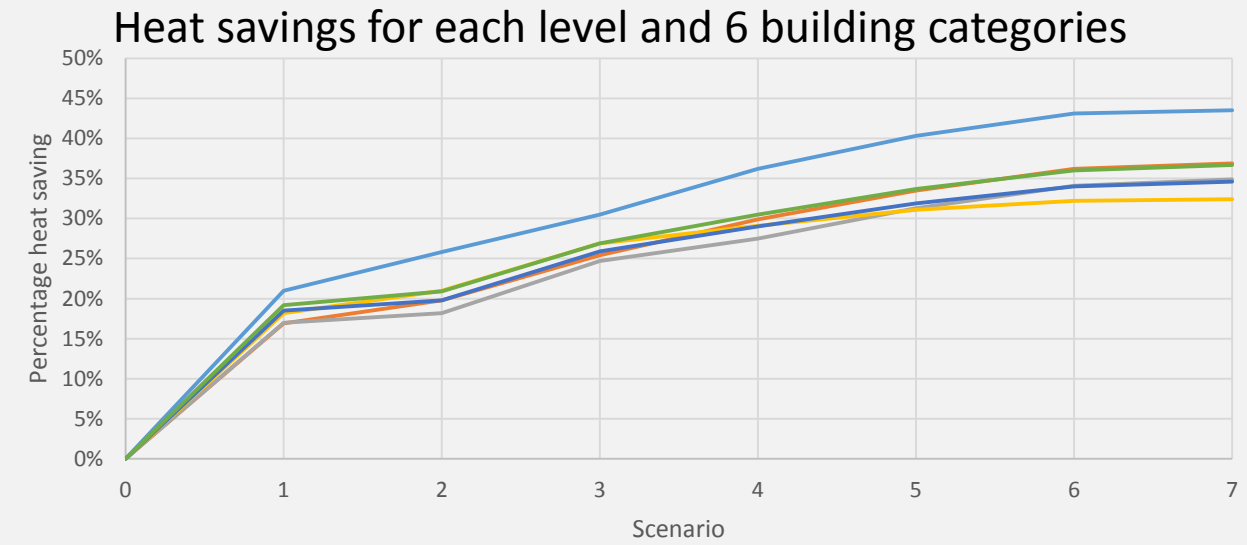

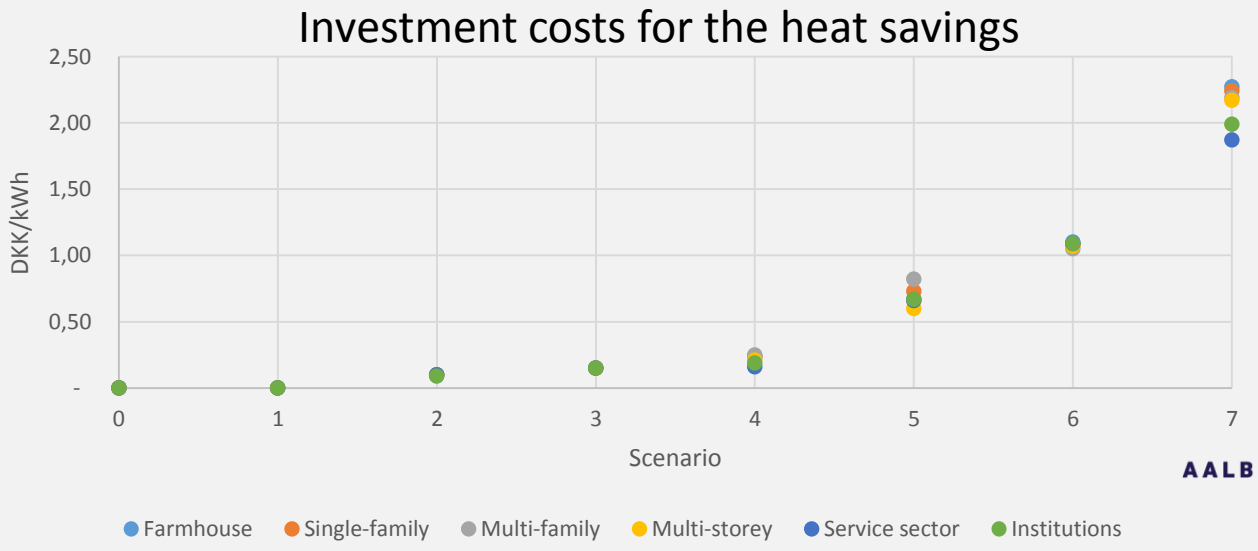

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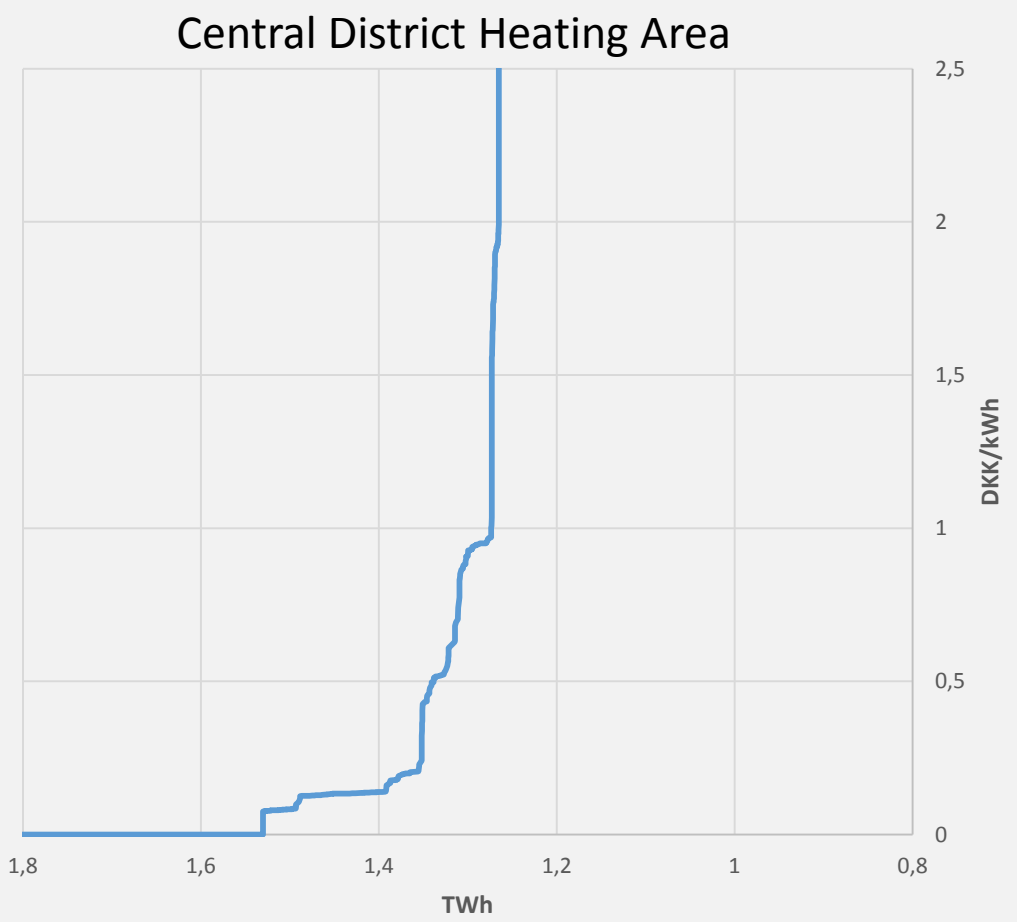
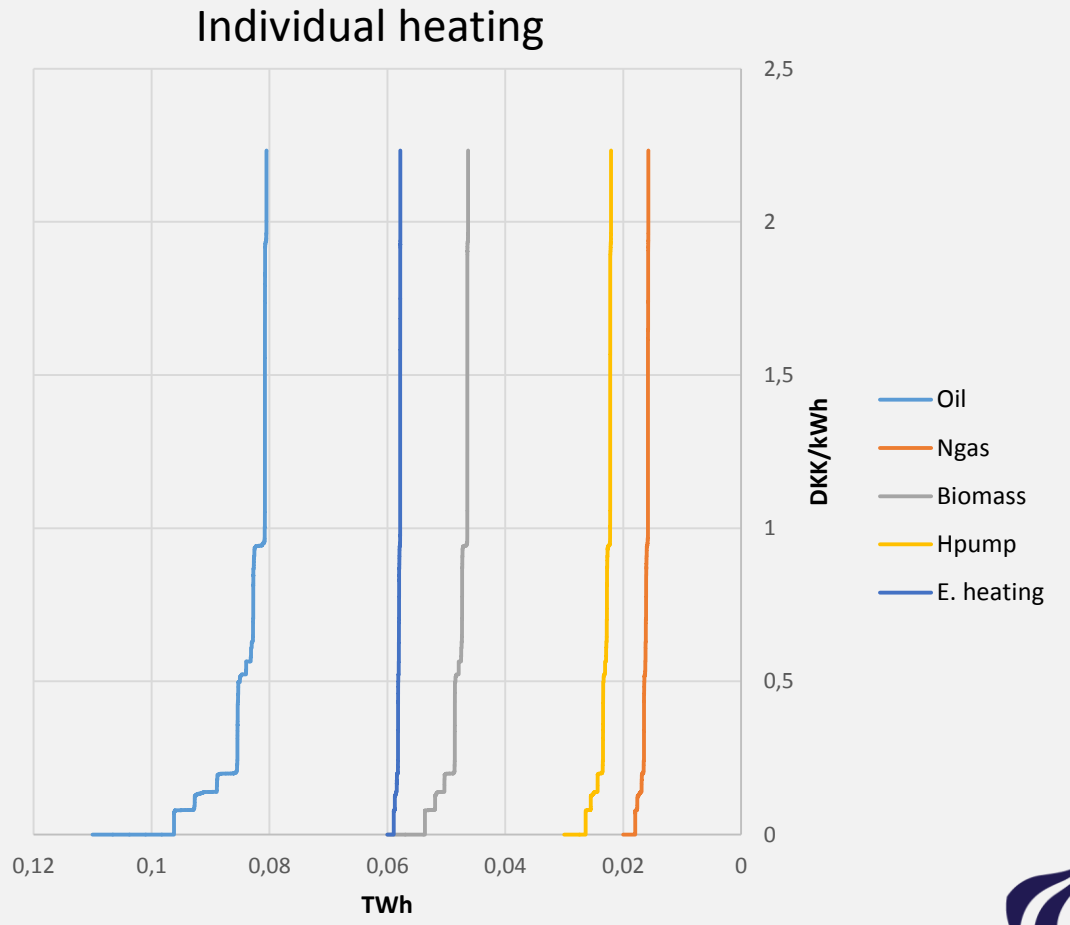
Heat savings costs for different areas in Aalborg





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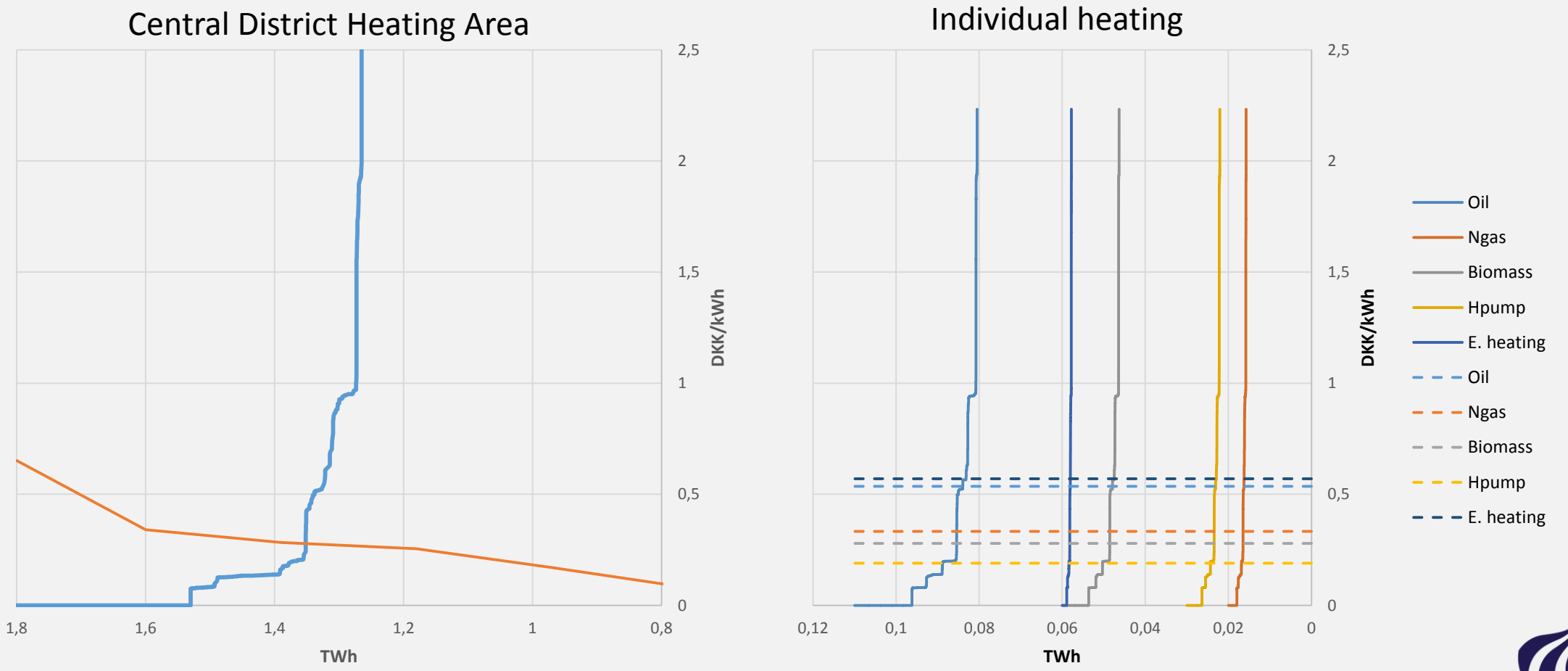
Heat saving costs compared to heat prices



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Overall savings rate in Aalborg Municipality

- Savings are compared to heat demand
- Buildings with individual heating need more renovation than district heating

	GWh savings	**Savings in modelled buidlings**	**Total heat demand reduction**
Central district heating	450	30%	25%
Individual oil	27	37%	24%
Individual gas	4	36%	20%
Individual biomass	11	34%	18%
Individual heat pumps	6	35%	23%
Invidividual electric boiler	2	33%	3%

Renovation of buildings depending on construction year

Level	Energy saving measure
0	Point of departure
1	Basic renovation (building code)
2	Cavity wall insulation
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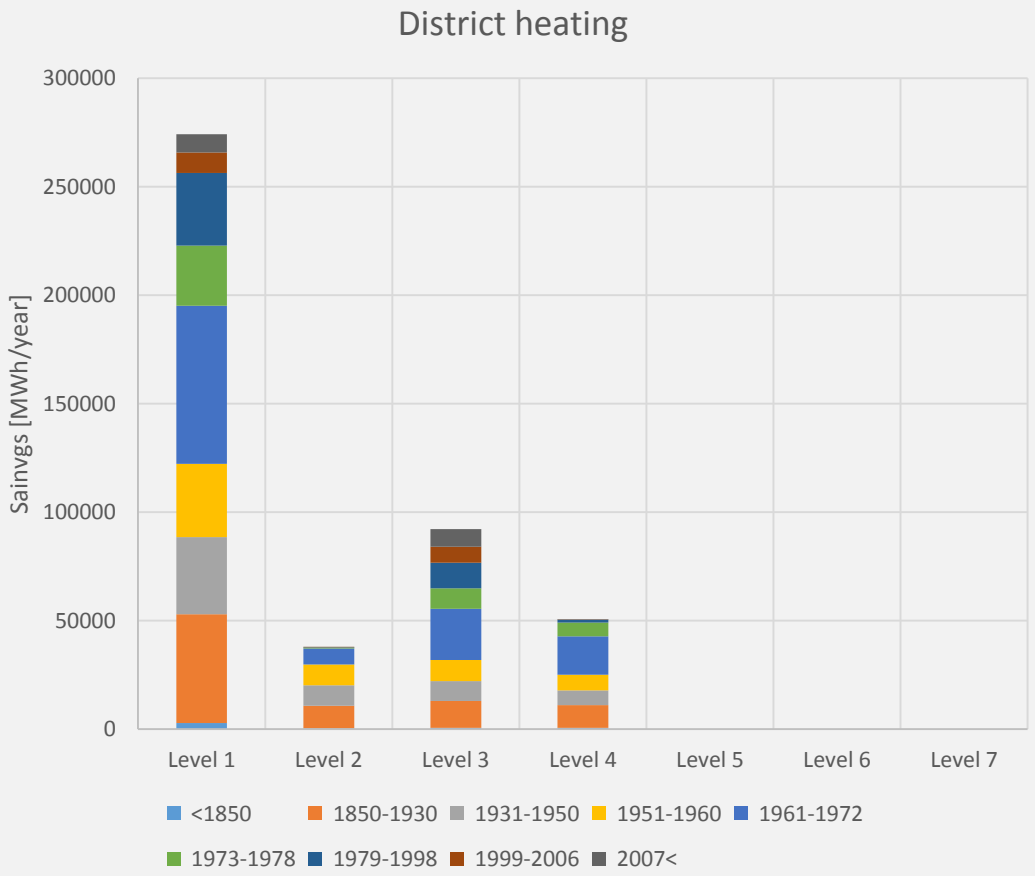

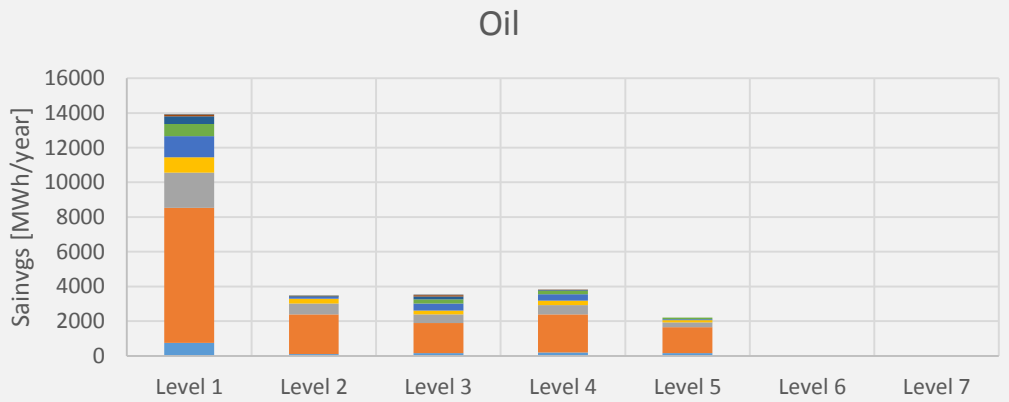

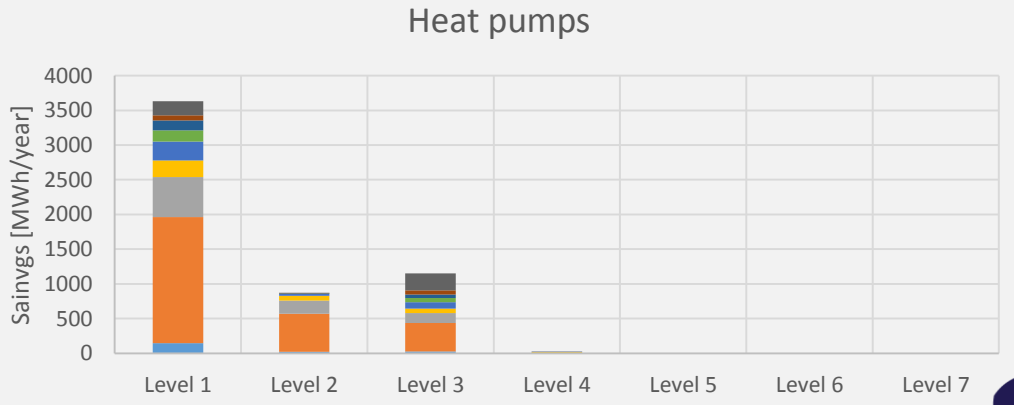

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Renovation of buildings depending on type of building

Level	Energy saving measure
0	Point of departure
1	Basic renovation (building code)
2	Cavity wall insulation
3	Windows (A level)
4	Insulation of ceiling and roofs
5	Good practice for insulation
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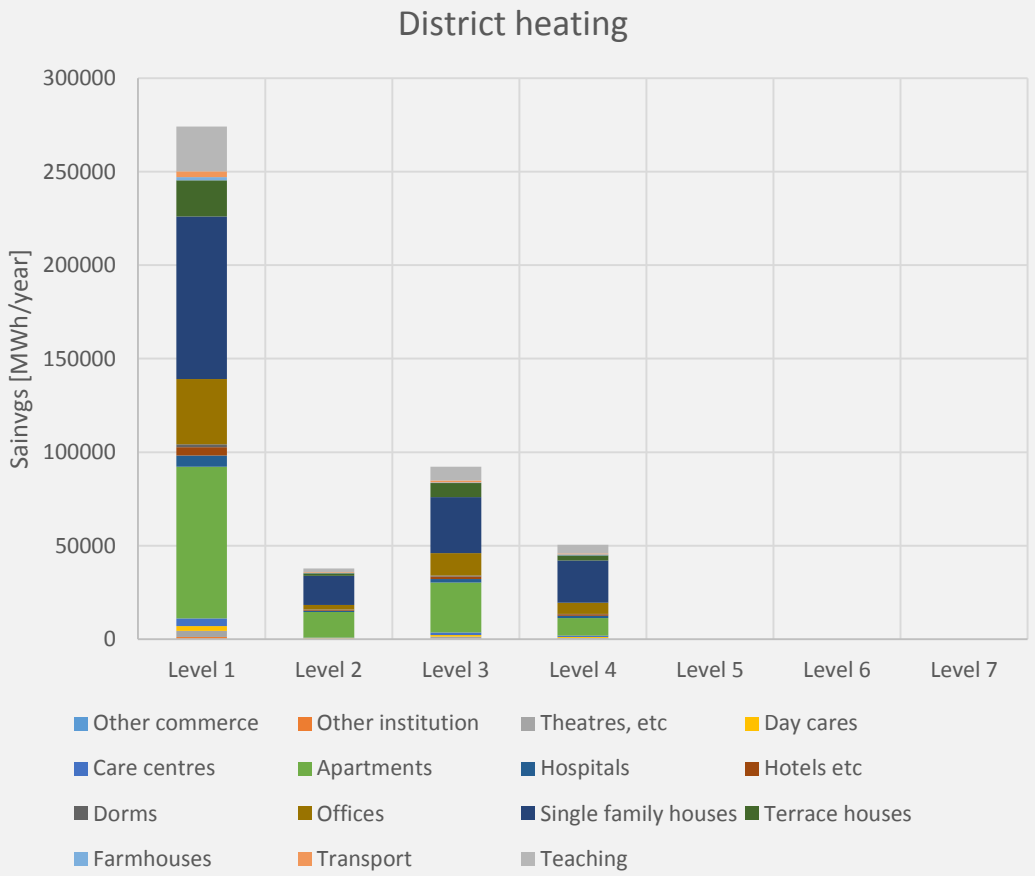

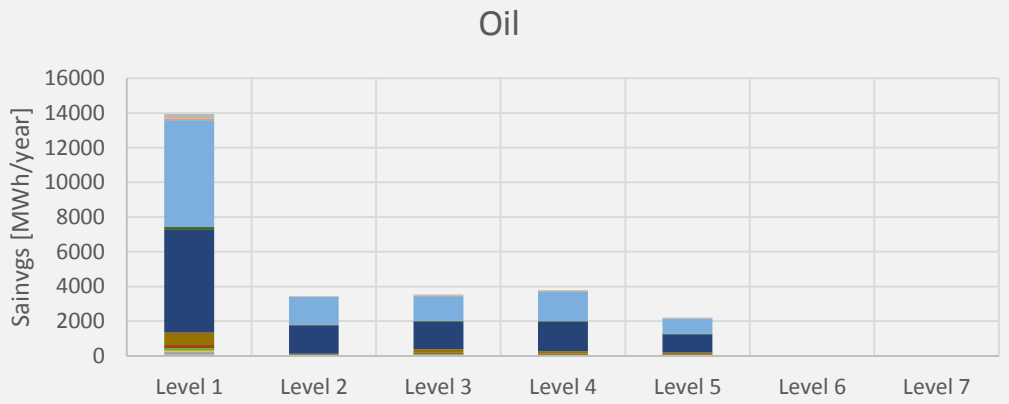

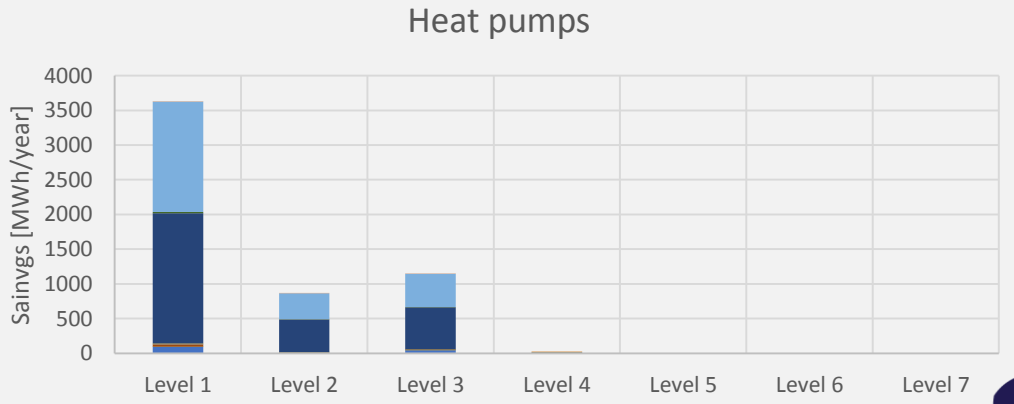

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Conclusion

- Under the given circumstances buildings are cost efficient to renovate
- Highest end-use heat savings potential in:
  - Older buildings primarily built before 1979
  - For district heating
    - Single-family houses and apartments
    - Level 4 heat savings feasible
  - For individual heating
    - Single-family and farm houses
    - Level 5 for oil and level 3 for heat pumps

Discussion

- Data only for some of the building types
- Using average data for heat consumption and renovation costs for each building
- Other saving initiatives
- Variance in COP over the year