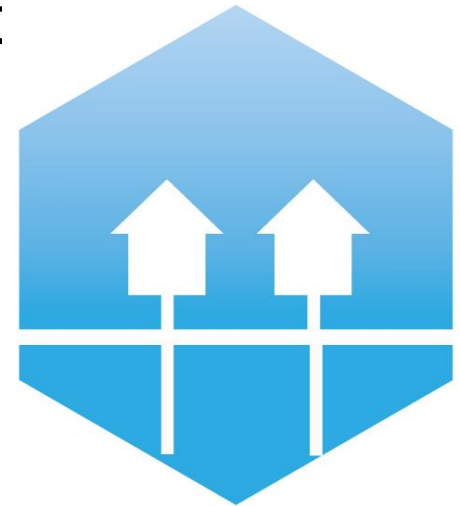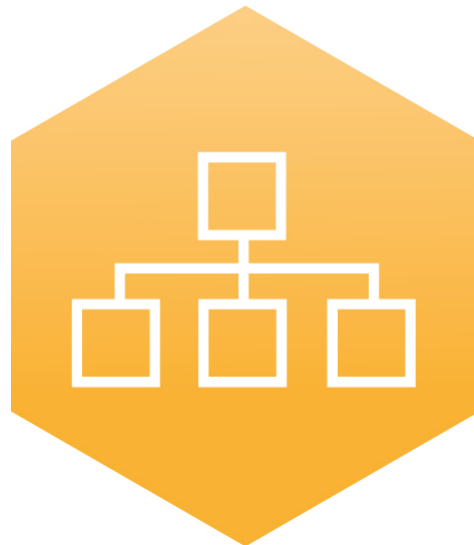# Smart energy systems
A study of possible district heating solutions for the Aarup area.

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4DH
4th Generation District Heating
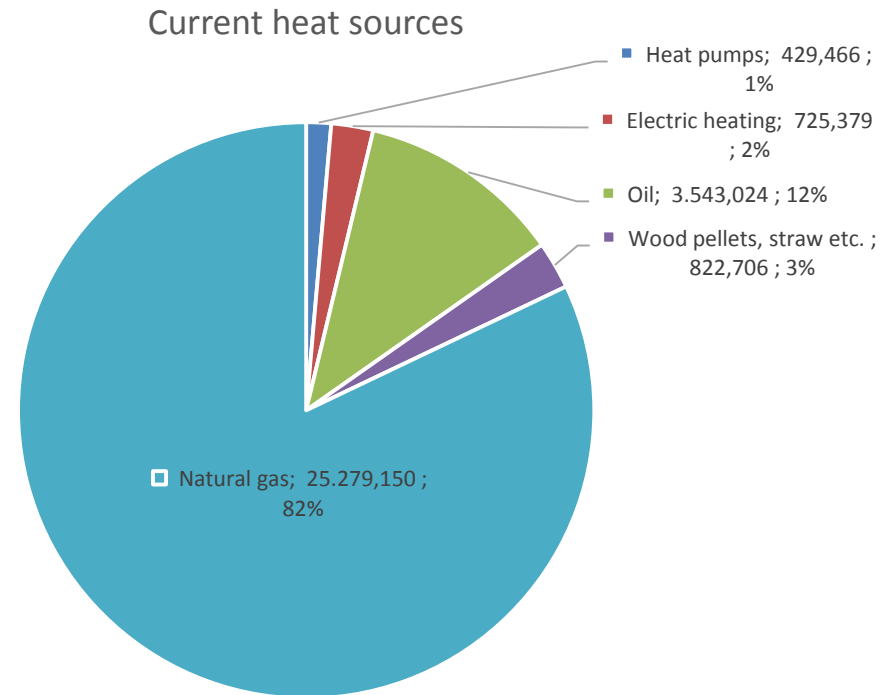**Technologies and Systems**

Agenda

- Introduction and framework conditions

- Scenarios

- Methods

- Results

- Conclusions

- Questions

Introduction and framework conditions

- Based on long term climate goals

- Town of Aarup
  - Located on Funen
  - 3120 inhabitants
  - 30.800 MWh-heat/year

Current heat sources

- Heat pumps; 429,466 ; 1%
- Electric heating; 725,379 ; 2%
- Oil; 3.543,024 ; 12%
- Wood pellets, straw etc. ; 822,706 ; 3%
- Natural gas; 25.279,150 ; 82%

Scenarios

- Reference scenarios
  - Current heating system
  - Individual heat pump
- District heating scenarios
  - Nine scenarios with 60°C forward/ 37°C return
  - Nine scenarios with 40°C forward/ 20°C return

  Technologies: Woodchip boiler, groundwater heat pump and solar heating

Methods

- Termis model of the DH grid
  - Heat loss
    - 60°C/37°C: 17 % heat loss
    - 40°C/20°C: 9 % heat loss
  - Grid investment costs
- EnergyPRO models of each scenario
- Private- and socioeconomic analysis of each scenario
  - Private economically includes taxes and VAT
  - Socioeconomic is the socioeconomic cost

Results

- ## Socioeconomic results
  - Individual heat pumps: 573 DKK (77€)/MWh-heat
  - Current configuration: 585 DKK (78,5€) /MWh-heat
  - DH with 10 % solarheat, rest HP, 60°C/37°C: 633 DKK (85 €) /MWh-heat
- ## Private economical results:
  - Individual heat pumps: 898 DKK (120,5 €)/MWh-heat
  - Current configuration: 909 DKK (122 €)/MWh-heat
  - DH with 10 % solar, 2 MW GW HP, rest woodchip boiler 60°C/37°C : 750 DKK (100,5 €)/MWh-heat

Conclusions

- Socioeconomically:
  - Individual scenarios are better
  - Heat pumps are preferable
  - Best DH scenario: 10 % solar heat and rest heat pumps

- Private economically:
  - DH scenarios are better
  - HP are feasible in DH system

- Feasibility of 4th generation DH

Heating price [DKK/MWh-heat]

	100 % Boiler	2 MW HP	4 MW HP	6 MW HP	100 % HP

Questions

Thank you for listening