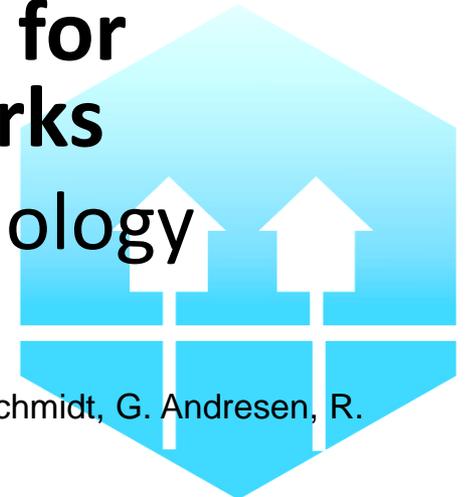
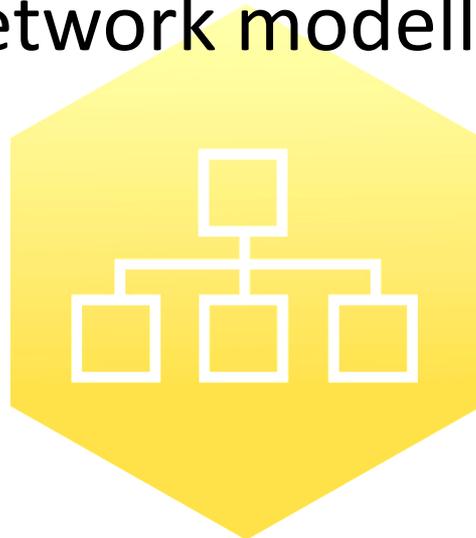


2nd International Conference on Smart Energy Systems and 4th Generation District Heating
Aalborg, 27-28 September 2016

Evaluation of smart energy management measures for District Heating Networks

Network modelling methodology



C. Marguerite, R-R. Schmidt, G. Andresen, R. Pedersen



AALBORG UNIVERSITY
DENMARK



4DH
4th Generation District Heating
Technologies and Systems

Presentation Outline



- The READY project
- Demonstration case: Aarhus
 - Objectives & Challenges
 - Modelling Methodology
 - Retrofitting scenarios Methodology
- Next steps



The READY project

Resource Efficient cities implementing **AD**vanced smart ci**TY** solutions



Objectives:

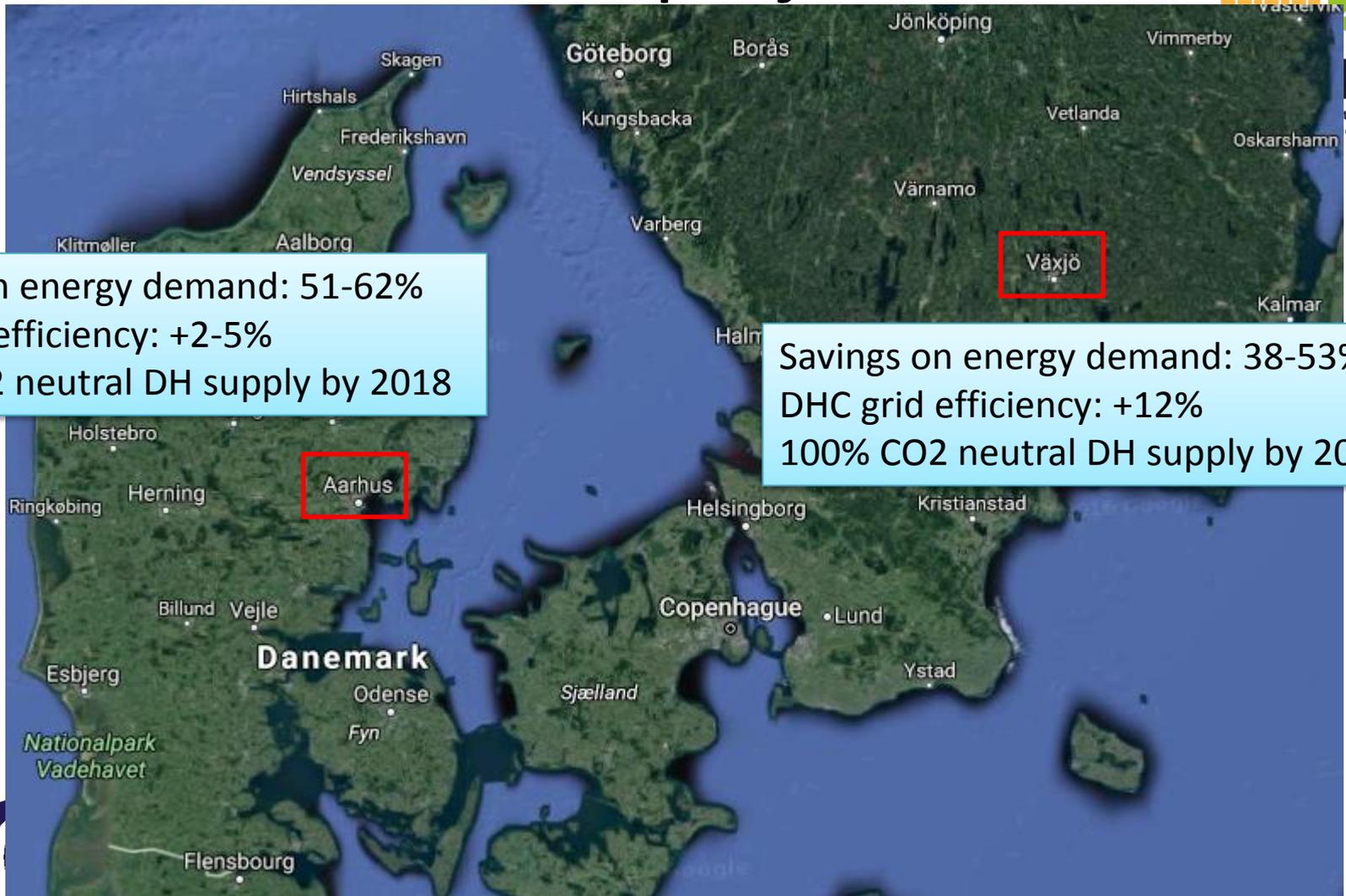
- Demonstrate new solutions for CO2 neutral districts:
 - Retrofitting
 - New solutions for LTDH
 - Storage solutions for flexible combined energy grids
 - Electricity and water efficiency



FP7-ENERGY-
SMARTCITIES-2012

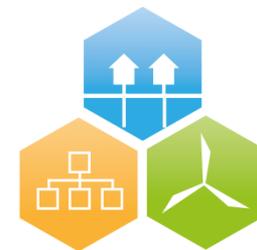


The READY project



Savings on energy demand: 51-62%
DHC grid efficiency: +2-5%
100% CO2 neutral DH supply by 2018

Savings on energy demand: 38-53%
DHC grid efficiency: +12%
100% CO2 neutral DH supply by 2016

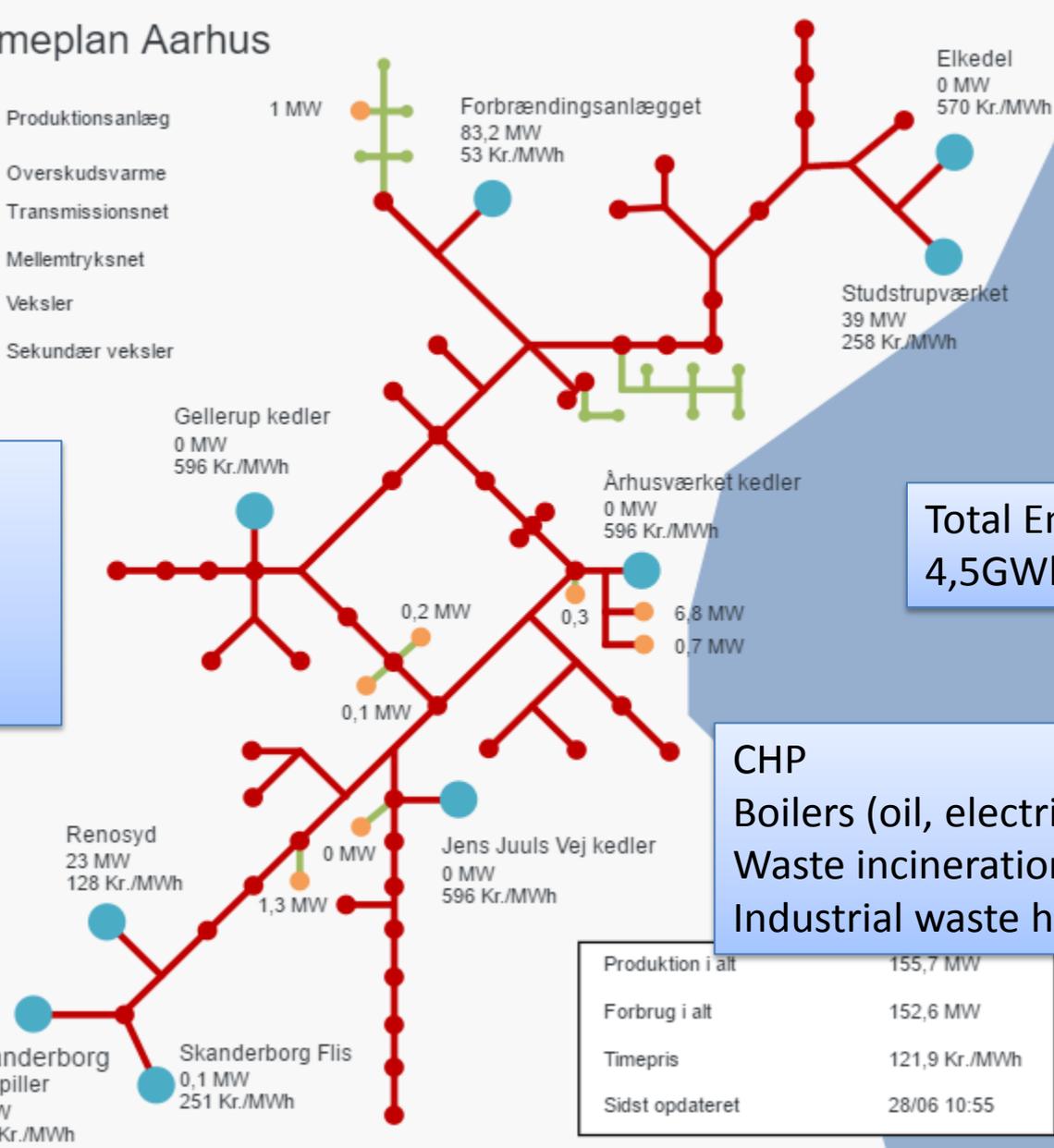


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Varmeplan Aarhus

- Produktionsanlæg
- Overskudsvarme
- Transmissionsnet
- Mellemptryksnet
- Veksler
- Sekundær veksler



Temperatures:
 -Transmission grid:
 120-50°C
 - Distribution grid:
 70-40°C

Total Energy demand
 4,5GWh/y

CHP
 Boilers (oil, electric and biomass)
 Waste incineration
 Industrial waste heat

Produktion i alt	155,7 MW
Forbrug i alt	152,6 MW
Timepris	121,9 Kr./MWh
Sidst opdateret	28/06 10:55



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4th Generation District Heating

<http://transmissionsnet.varmeplanaarhusapps.dk/>

Aarhus DH: Challenges



- **Integration of various heat sources** with different availability profiles and temperature levels
 - CHP: Consider electricity grid and prices
 - Renewables: solar, sea water HP
 - Waste heat: from industries, hospital
- Reduced heat demand due to **retrofitting** measures

→ *Which effects on grid performances?*

→ *Distributed storages: where? which capacity?*

→ *Which new control strategies?*



Demonstration Case: Aarhus DH



- To be investigated: impacts of different operational strategies on the network performances
- Scenarios to be simulated:
 - Retrofitting
 - Retrofitting + distributed storages
 - Heat pumps + wind2heat
 - Absorption cooling + solar collectors

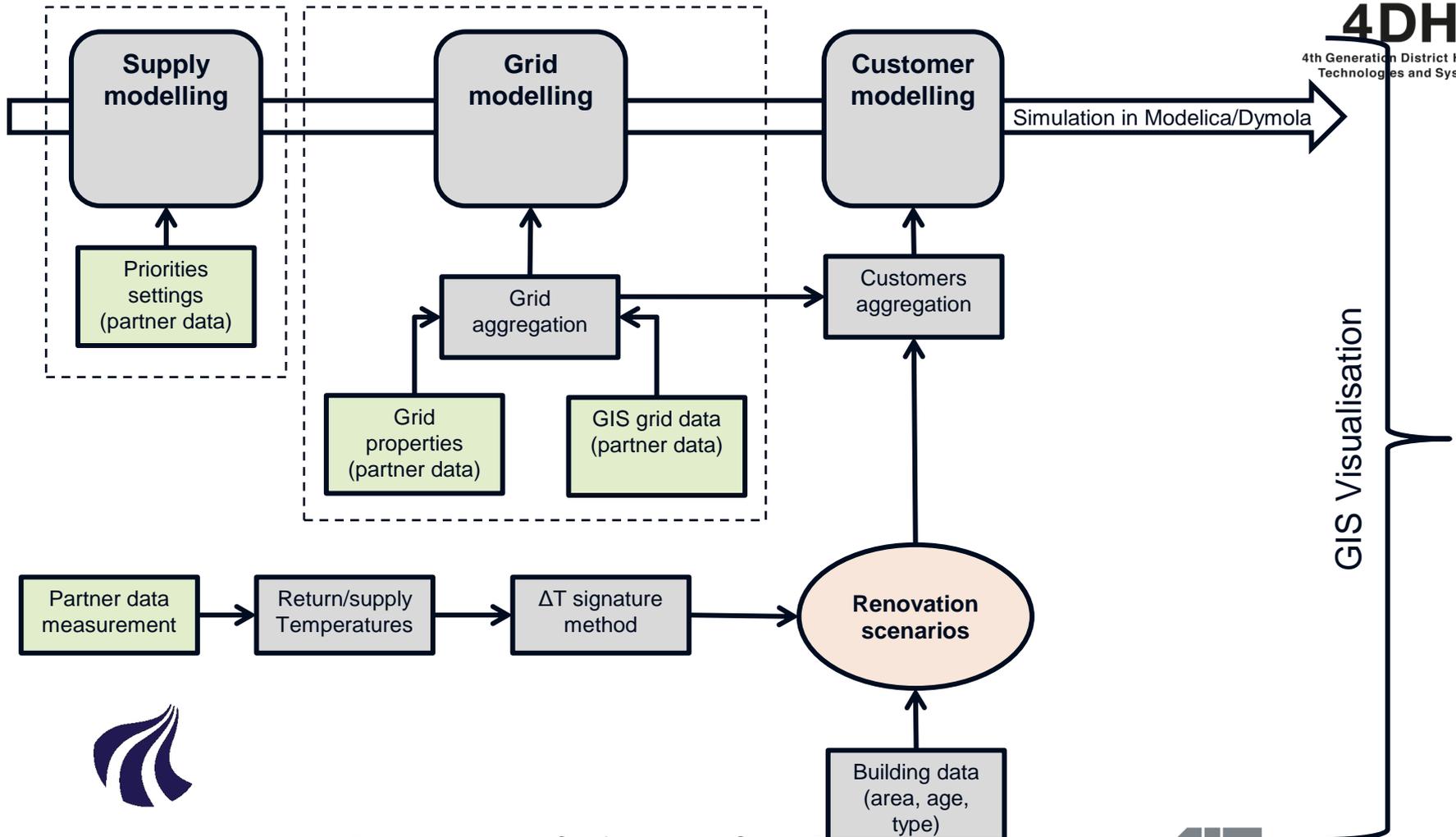


Modelling Methodology



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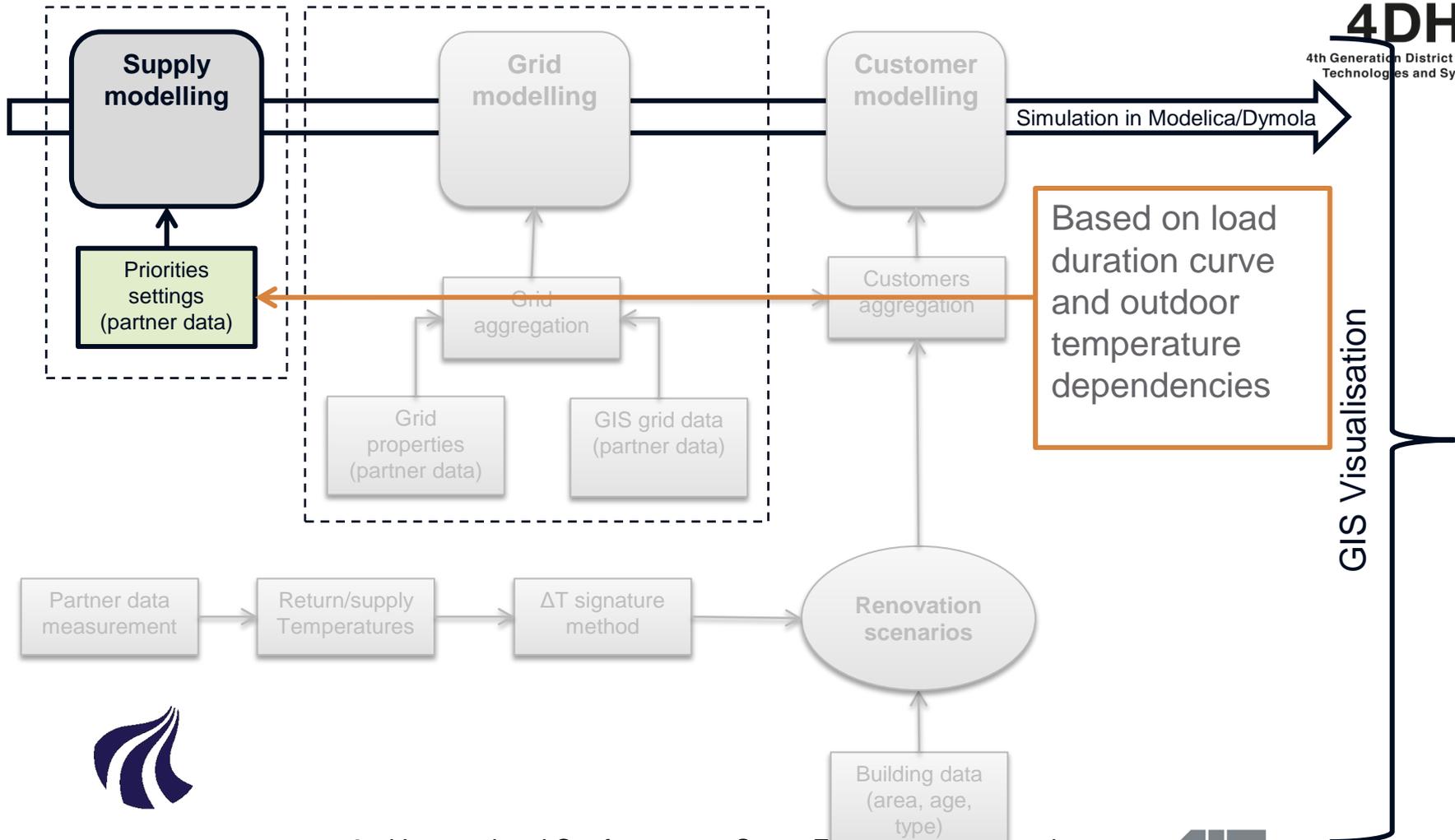


Modelling Methodology



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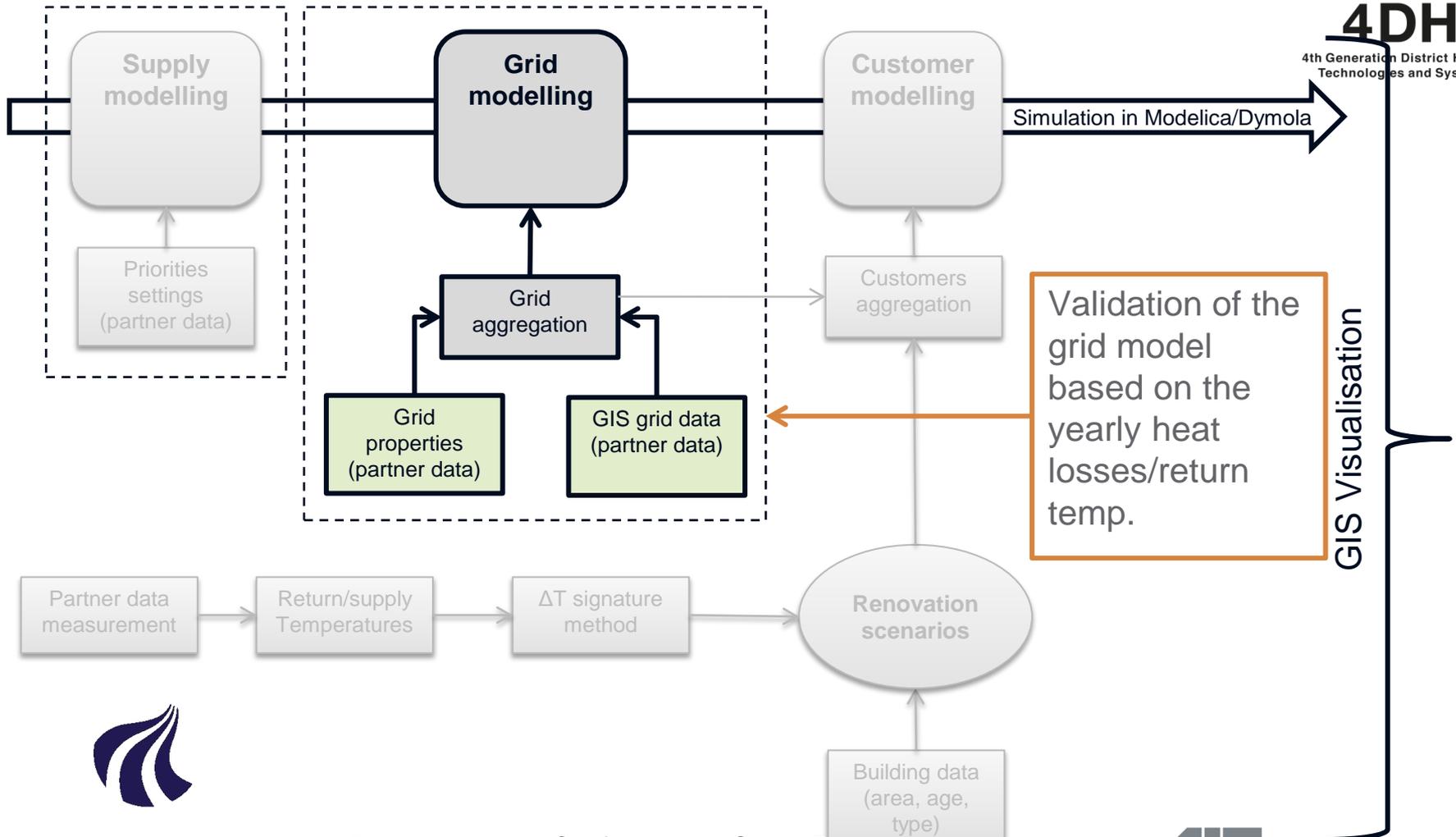


Modelling Methodology

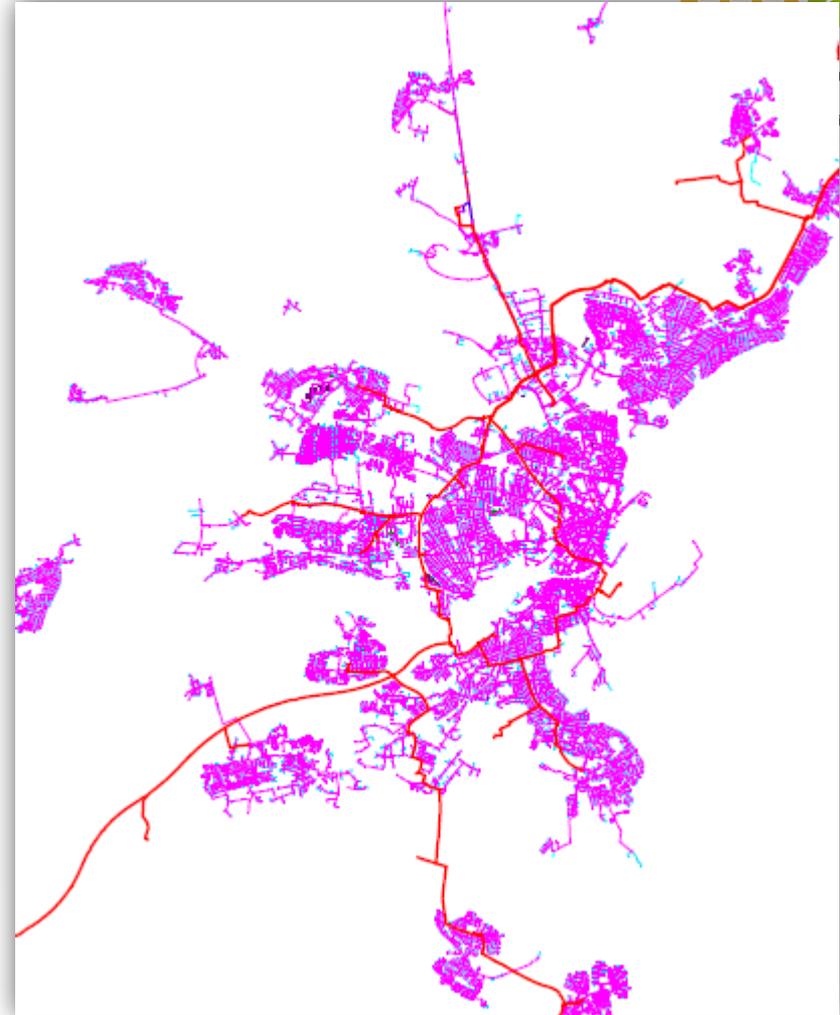
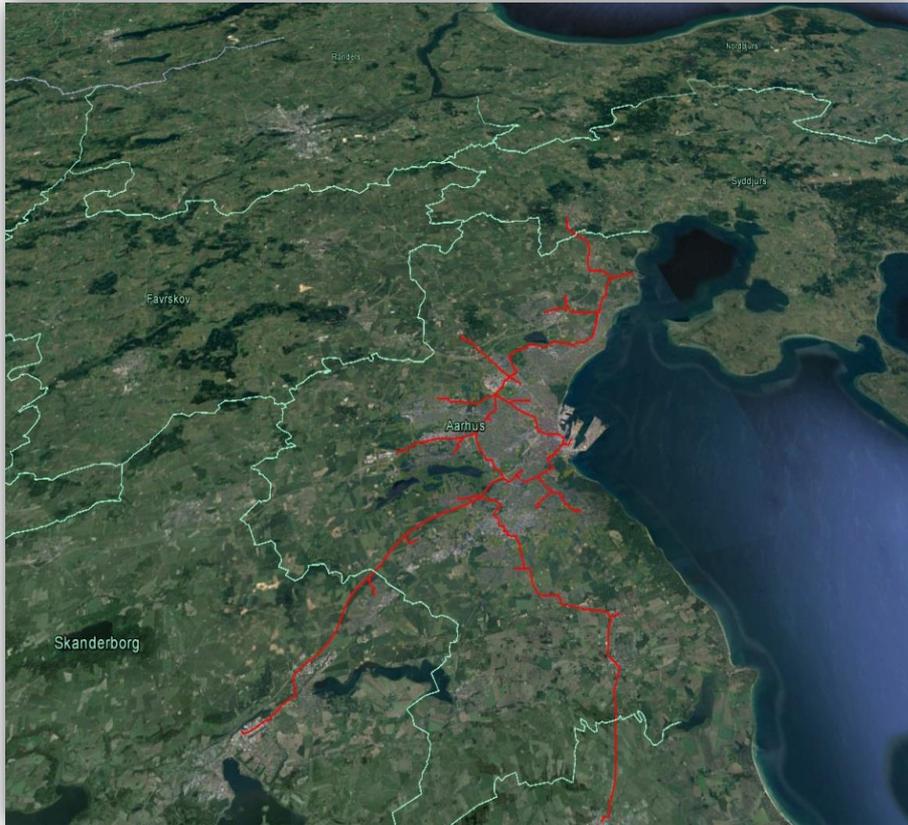


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Aarhus DH: Network aggregation



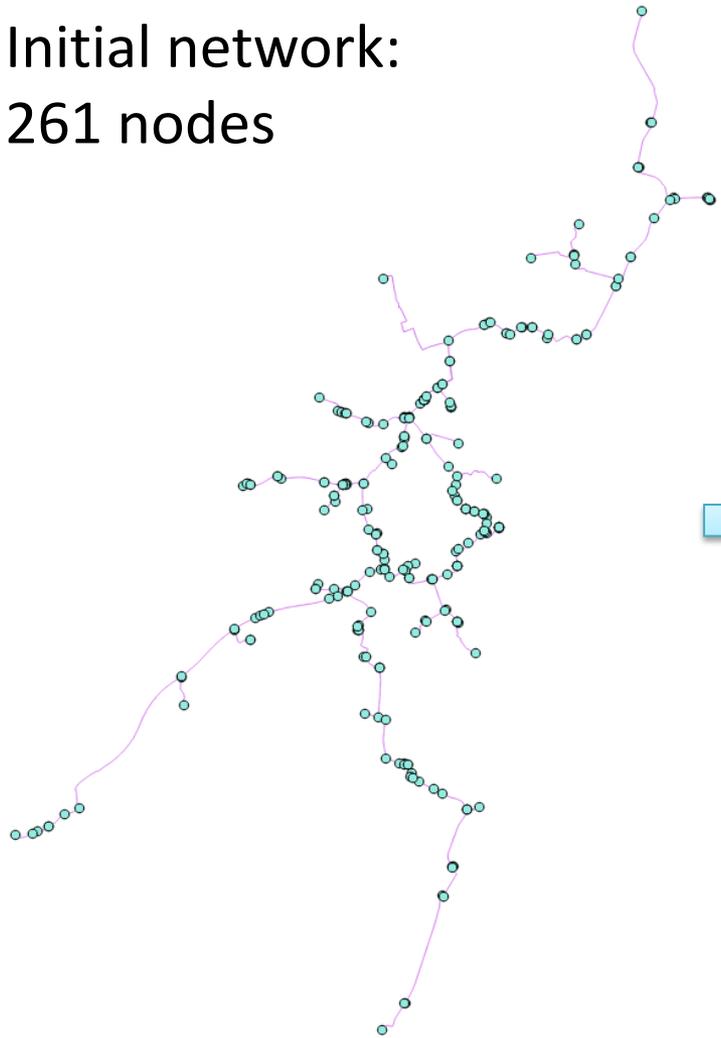
District Heating Systems



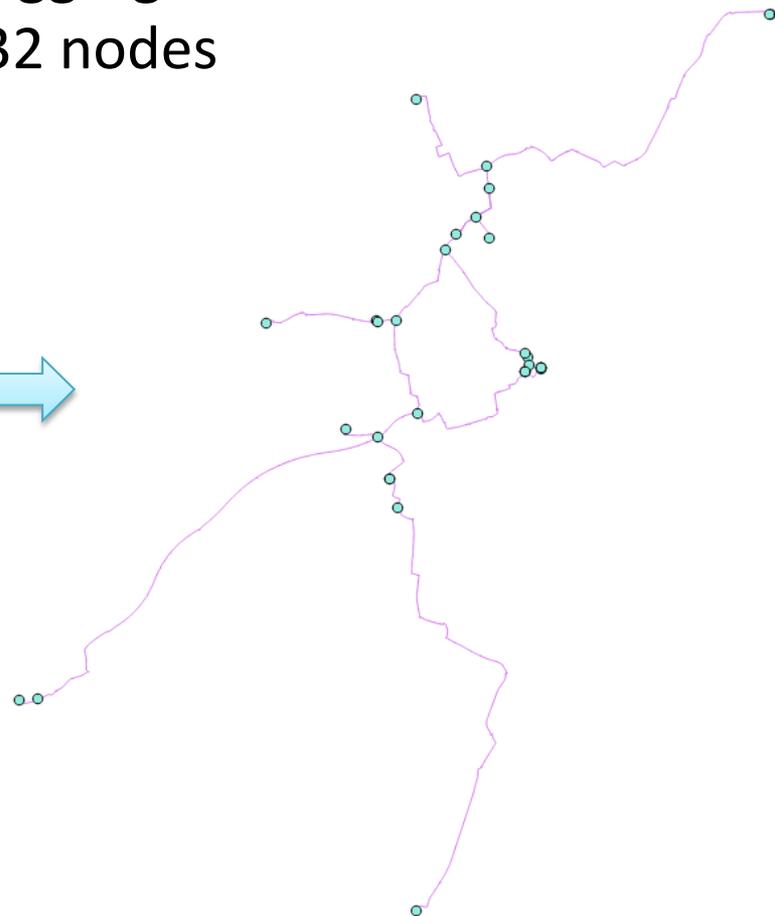


Aarhus DH: Network aggregation

Initial network:
261 nodes



Aggregated network:
32 nodes

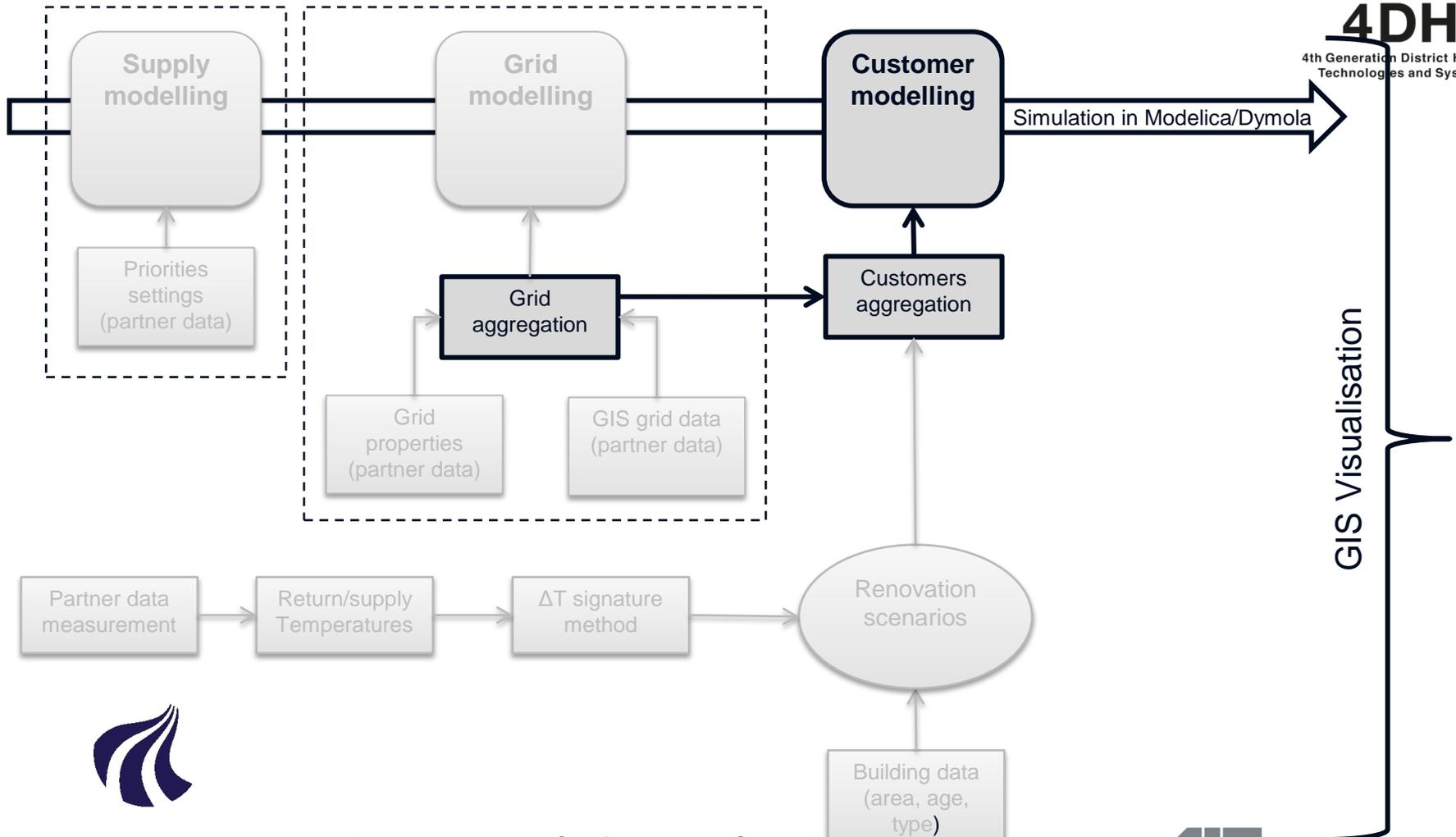


Modelling Methodology



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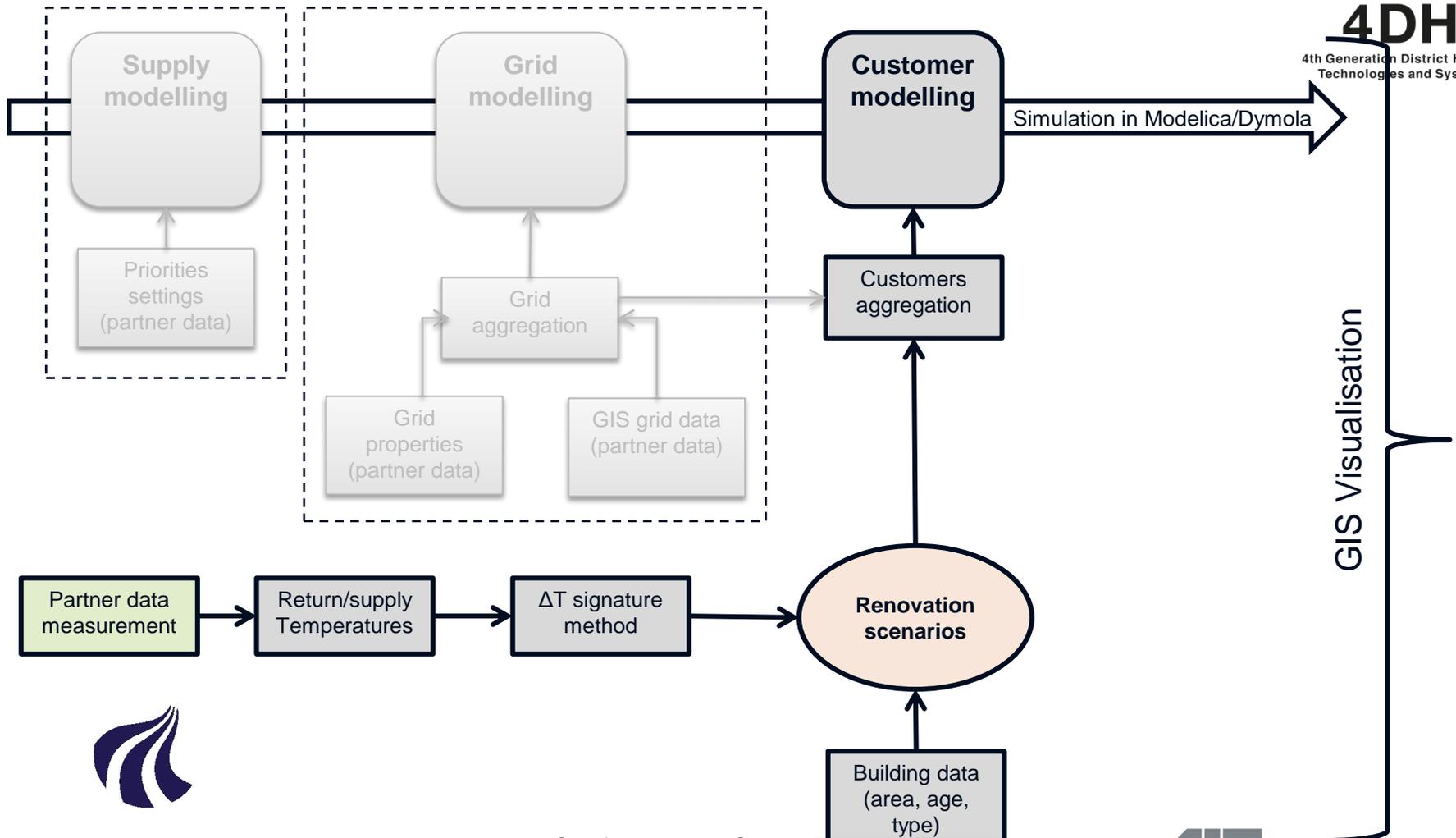


Modelling Methodology



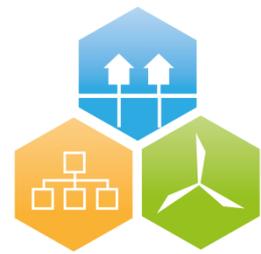
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GIS Visualisation

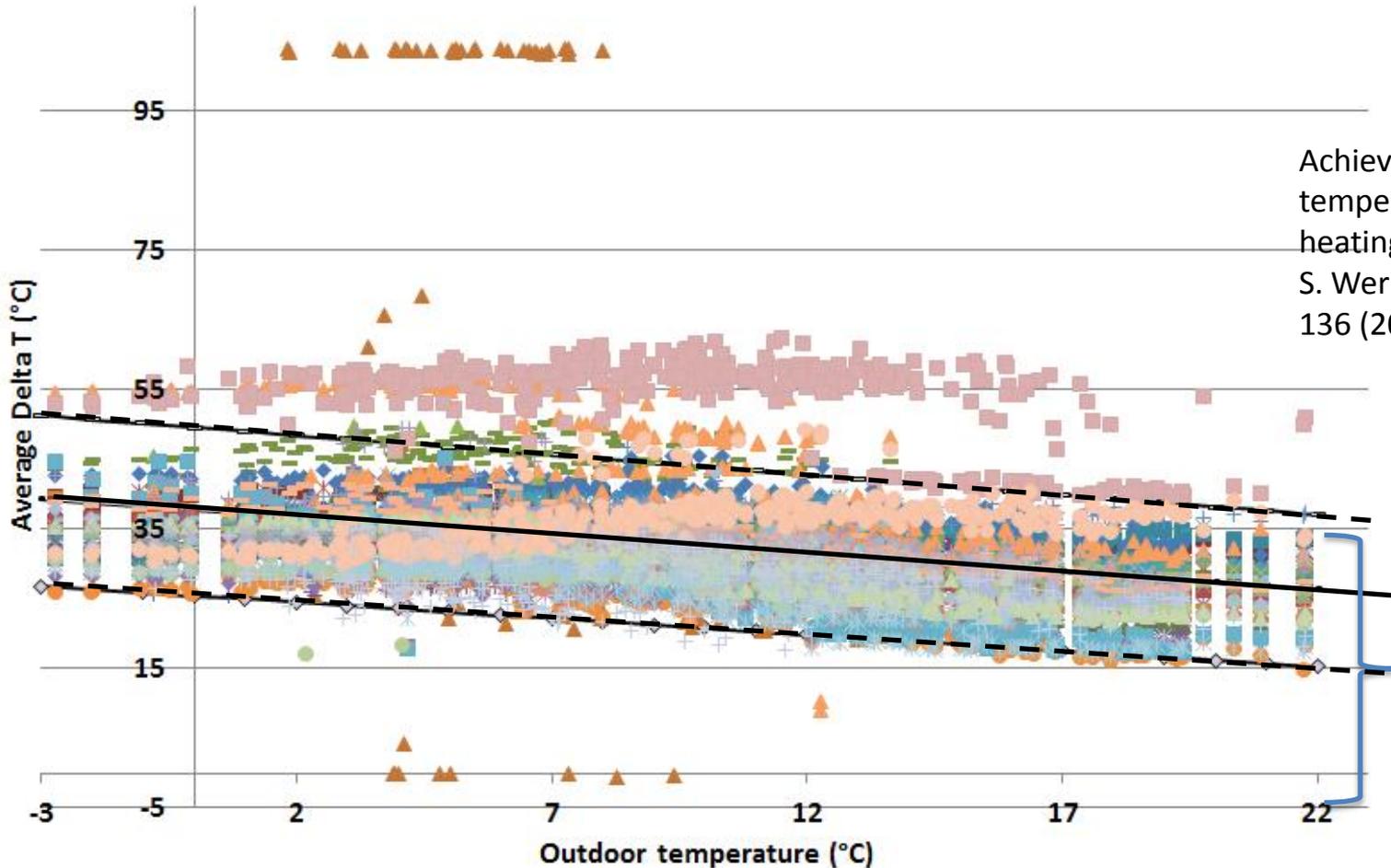




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Temperature difference signature method



Achieving low return temperatures from district heating substations. H.Gadd, S. Werner. Applied Energy 136 (2014) 59-67.

Focus on the substations with $\Delta T < 45^\circ\text{C}$

Temperature difference signature method

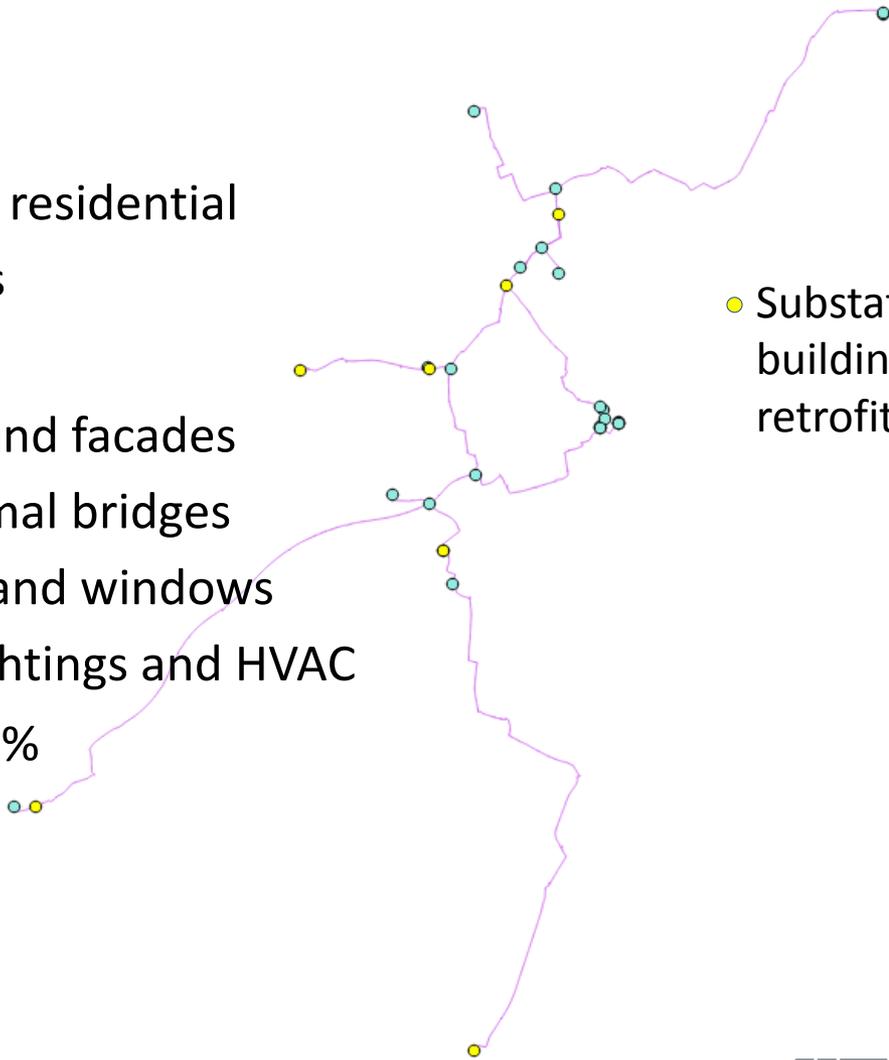
Type of buildings involved:

- 55% office buildings, 45% residential
- Construction year: 1970's

Renovation measures:

- Extra insulation in roofs and facades
- Removal of existing thermal bridges
- Super insulated glassing and windows
- Intelligent controls for lightings and HVAC

Expected Energy savings: 51%



- Substations supplying buildings to be retrofitted



Next steps



- **READY: end 2019**
- **On-going work for Växjö and Aarhus demo case**
- **Aarhus - Simulate retrofitting scenarios:**
Analyse the effects on the network of the return temperature, distribution losses, economic savings
→ how much retrofitting does Aarhus need to lower significantly the return temperature?
- **Simulate and analyse other scenarios:**
→ Integration of storages, renewables, use of waste heat



Thank you for your attention

