

POTENTIAL FOR INTEGRATION OF LARGE HEAT PUMPS IN DENMARK

RASMUS LUND – AALBORG UNIVERSITY
2015 NOVEMBER 2ND
4DH PH.D. SEMINAR



AALBORG UNIVERSITET

Agenda

1. The plan of my PhD research
2. Results and potential results
3. Collaboration with other PhD Fellows and/or industry in 4DH
4. Ideas for an abstract for the conference next year

Ph.D. research plan

	Ph.D. Courses	Teaching / Supervision	Writing of articles and thesis	External stay
Spring 2014				
Fall 2014				
Spring 2015				
Fall 2015				
Spring 2016				
Fall 2016				

Ph.D. research plan

Ph.D. topic: **Energy Scenarios for Denmark**

General framework: **100% RE in Denmark**

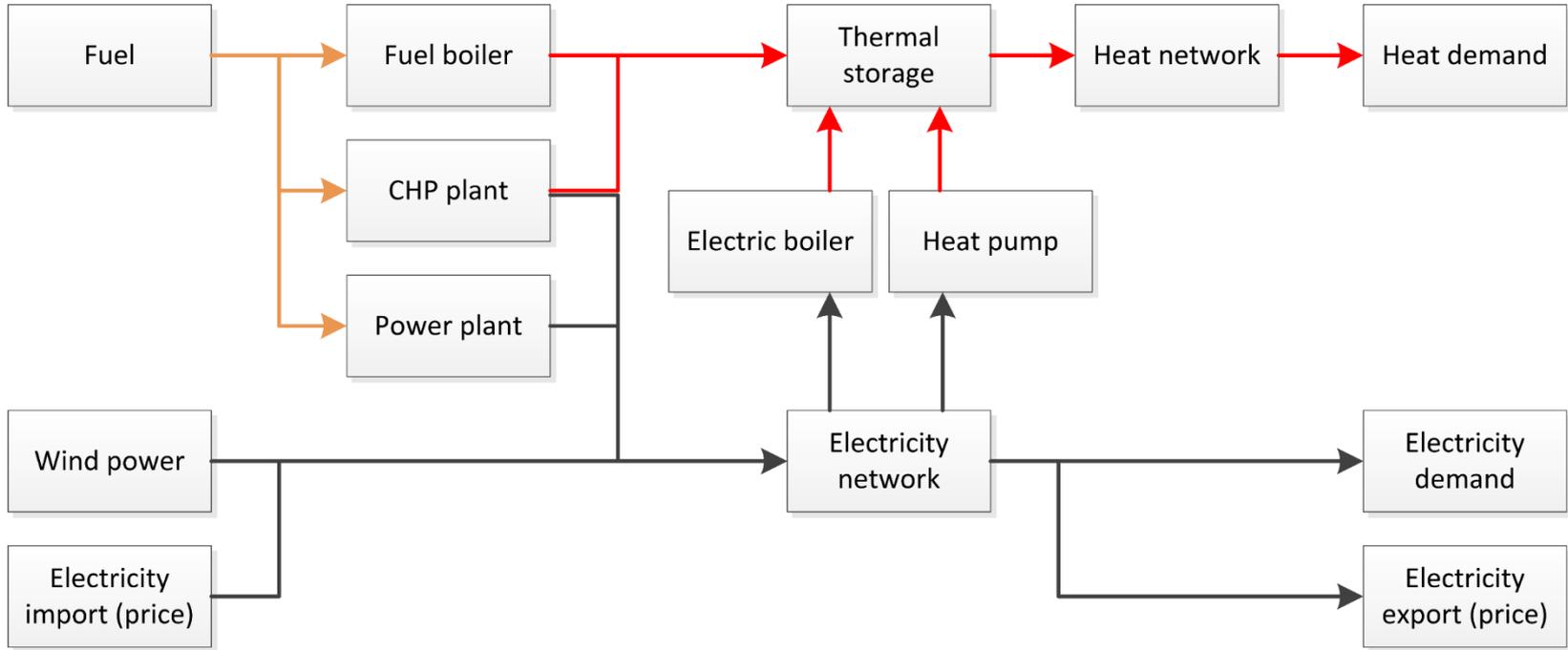
Main research areas

- Sources and potential for large heat pumps
- The role of large power and CHP plants
- Potentials of low temperature district heating
- Scenarios for future district heating in Denmark

Large heat pumps in district heating

- Large scale integration of wind and solar power
 - Increasing fluctuation
 - Reducing CHP heat output
- What is the techno-economic potential for integrating heat pumps in DH in Denmark?
 - Today?
 - In a 100% RE-system?
- Biomass scarcity will increase in the future
- Heat pumps or electric heating?

Large heat pumps in district heating



Methodology

- Comparing simulation and optimisation models
- Using the same input data for both models
- Analysing two systems
 1. Reference 2015
 - Current system
 - Historical data
 2. 100% RE system (2050)
 - Based on CEESA

MODEST and EnergyPLAN

	MODEST	EnergyPLAN
Type of calculation	Cost minimization	Simulation
Result	Operation of optimal system	Operation of user defined system
Time divisions	Up to 99	8784 (one full year)
Years of operation	Up to 99	1
System functions	User defined	Predefined options
Temporal operation	Depending on time divisions	Continuously from hour to hour
Aggregation level	User defined - Max 400 nodes	Aggregated on plant types

Results of Current Study

Preliminary results

- Heat pumps are more feasible than electric boilers
- Significantly bigger potential in decentral DH areas than central DH areas
- Similar tendencies are found for both 2015 and 2050
- Both models agree on the above, disagree on feasible capacities

Collaboration

Project	Collaborators
Copenhagen Energy Plan	Municipality of Copenhagen and HOFOR
Analysis on insulation standard for 4GDH pipe networks	Soma Mohammadi
Analysis of potential heat sources for heat pumps for DH	Urban Persson
Popular article in “Fjernvarmen” about potential heat sources for heat pumps	Dansk Fjernvarme and Grøn Energi
Analysis on potential integration of heat pumps for district heating in Denmark	Louise Trygg and Danica Ilic (Linköping University, Sweden)
Energy system potentials in low temperature DH concepts	Xiaochen Yang and Dorte Skaarup Larsen

Abstract for 4DH Conference 2016

Energy system potentials in low temperature DH concepts

- In cooperation with Xiaochen and Dorte
- How do the different low temperature concepts perform in an energy systems perspective
- Comparison of alternatives from the system perspective
 - Low or ultra-low temperatures?
 - Storage: Individual, local or central?
 - Electricity integrated in building heating solution or not?
- Which solution will provide the lowest costs and fuel consumption and under which conditions

THANK YOU FOR THE ATTENTION

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