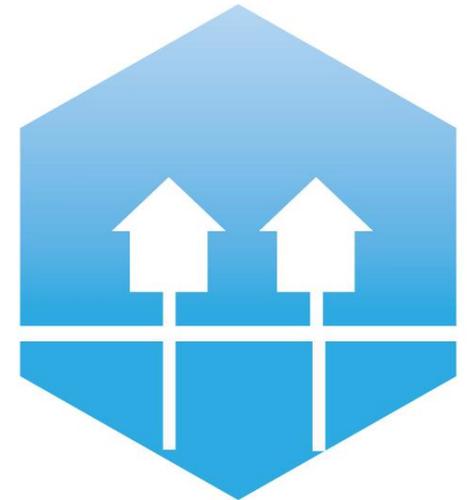
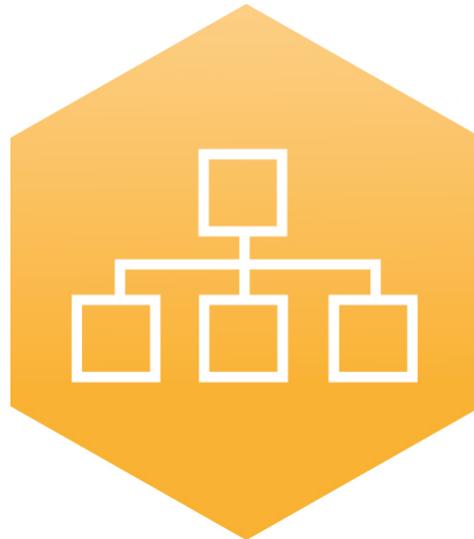


2nd International Conference on Smart Energy Systems and 4th Generation District Heating
Aalborg, 27-28 September 2016

Melissa Carina Gabert

Waste and Energy System Integration

– The Role of Refused Derived Fuel in Future District Heating



AALBORG UNIVERSITY
DENMARK

4DH

4th Generation District Heating
Technologies and Systems

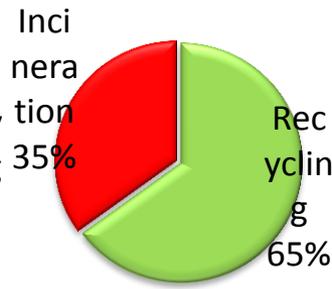
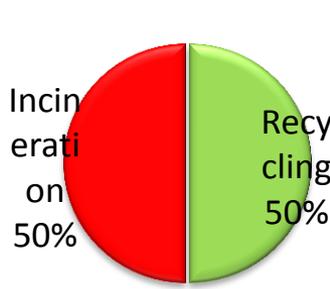
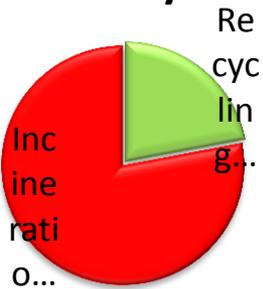
1.1. Problem



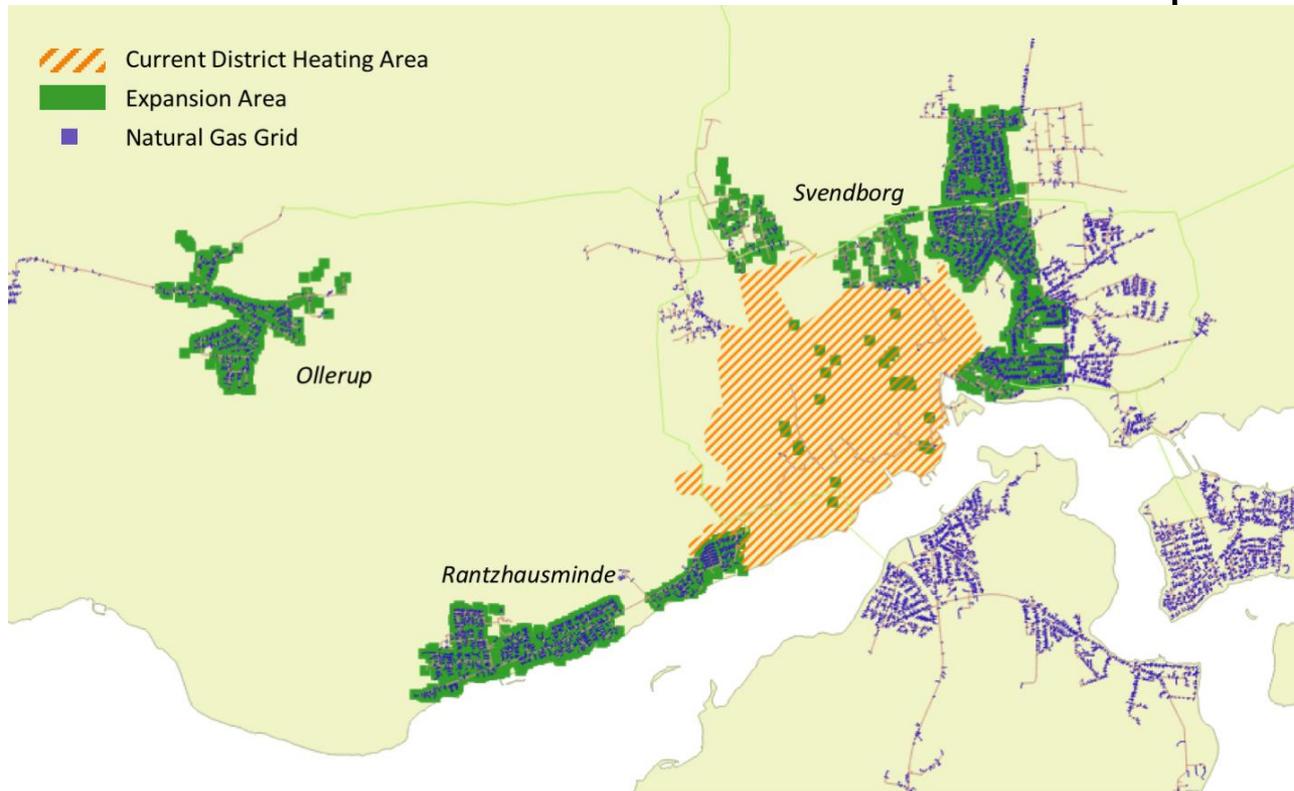
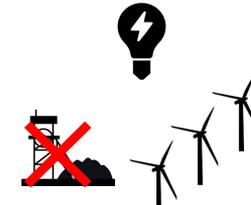
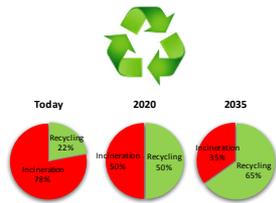
Today

2020

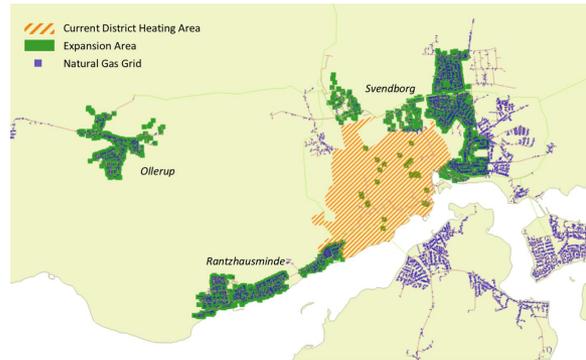
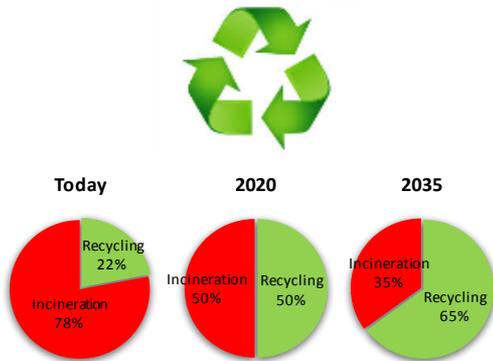
2035



1.2 Problem



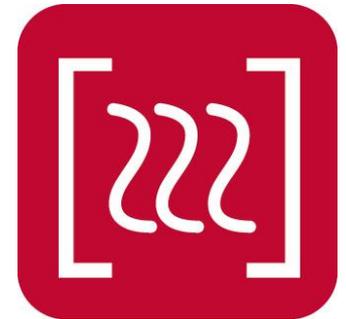
1.3. Problem



- Less local waste available for increasing district heating demands
 - Free incineration capacity
 - Electricity price fluctuations



2.1. Approach



2.2. Approach



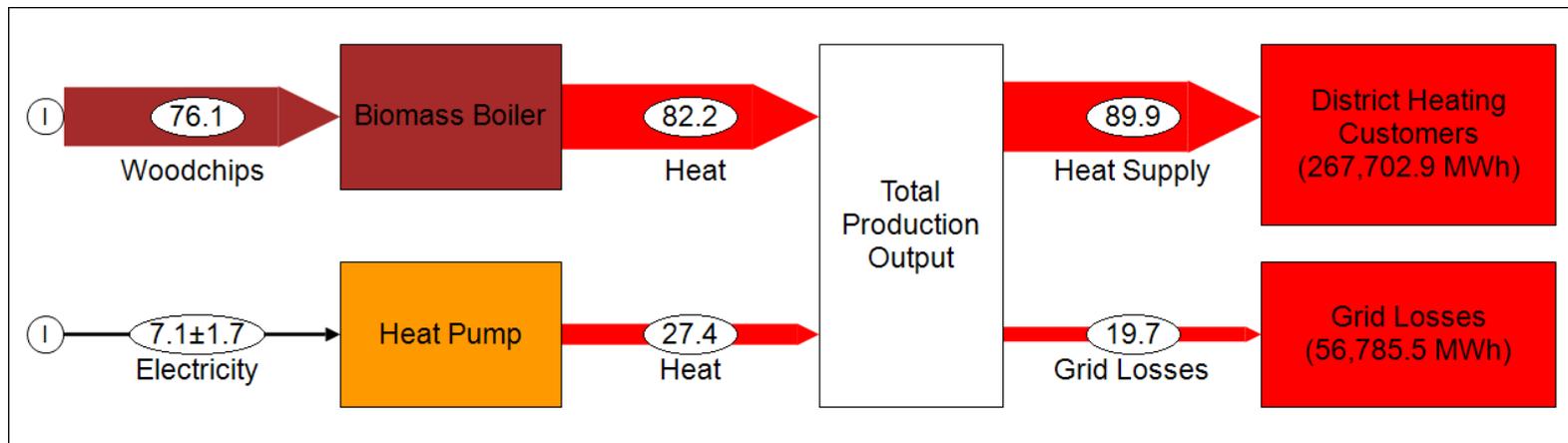
→System design in 2020 & 2035?

→Thermal storage yes/no?

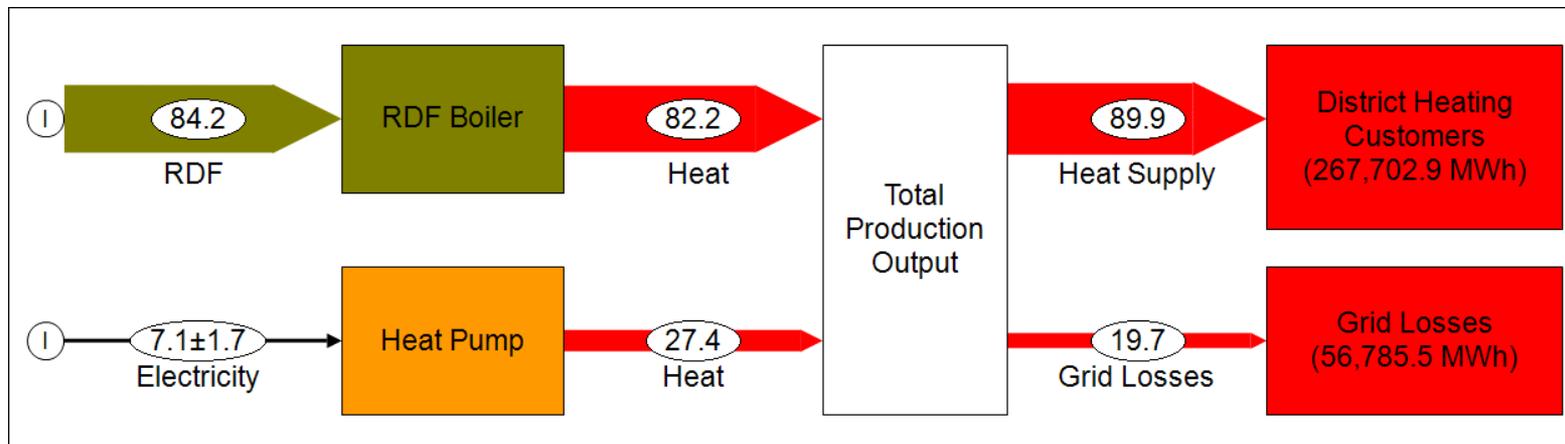
→RDF boilers competitive to biomass boilers?



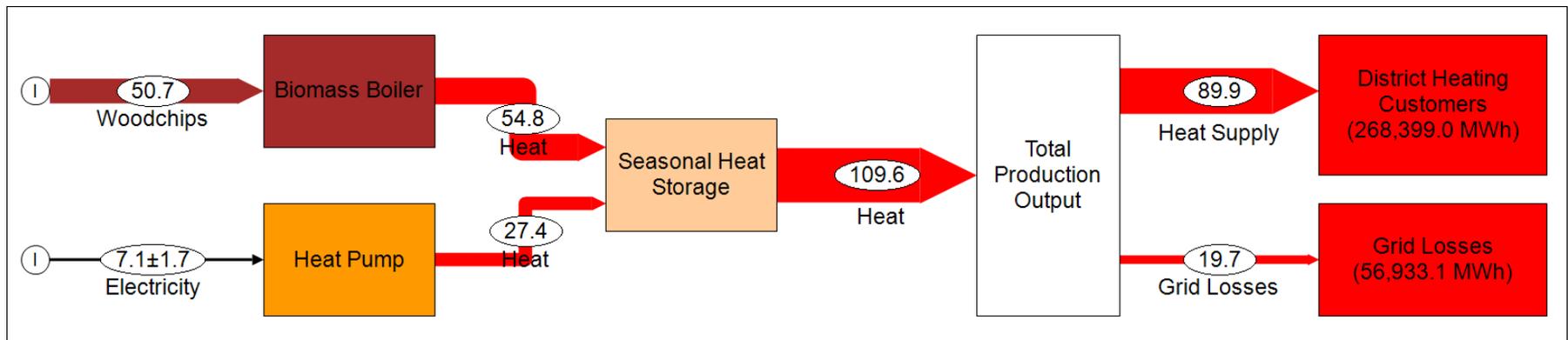
3.1. System Modelling 2035



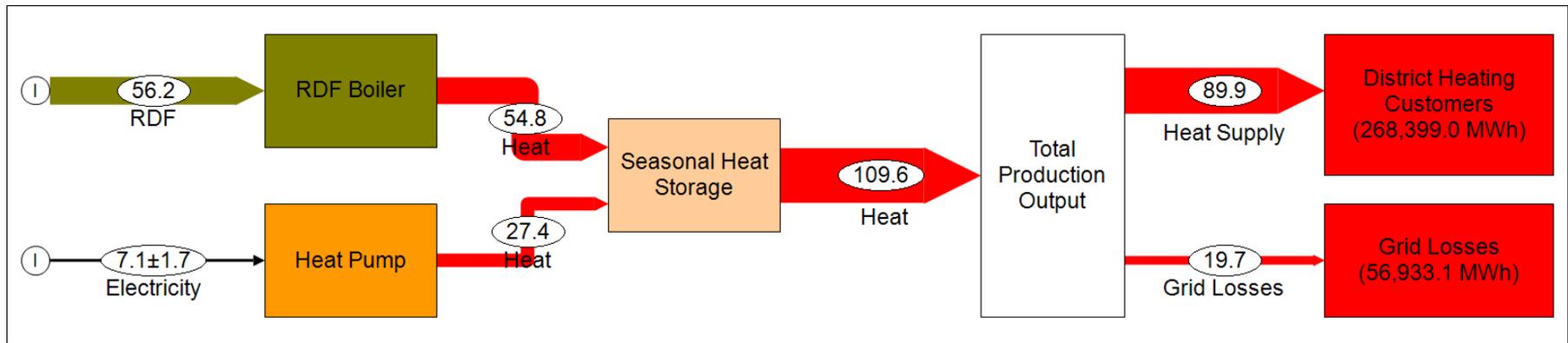
3.2. System Modelling 2035



3.3. System Modelling 2035

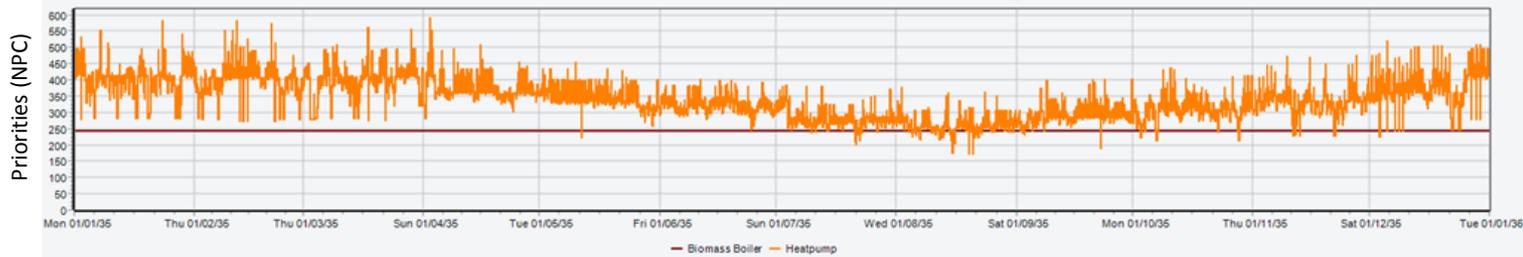


3.4. System Modelling 2035

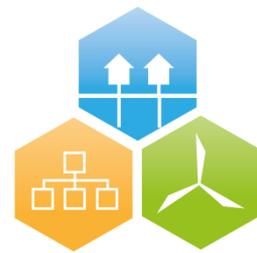
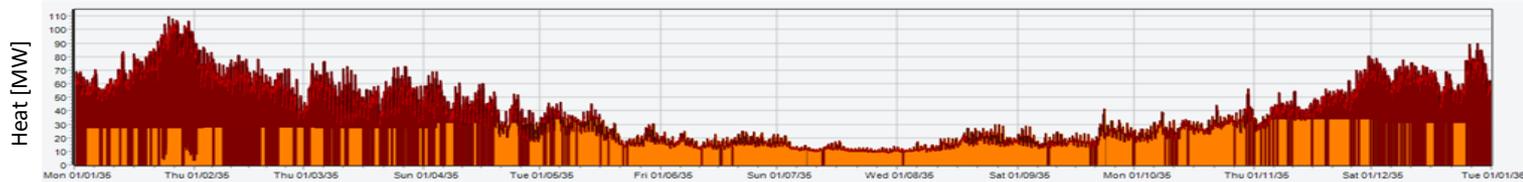
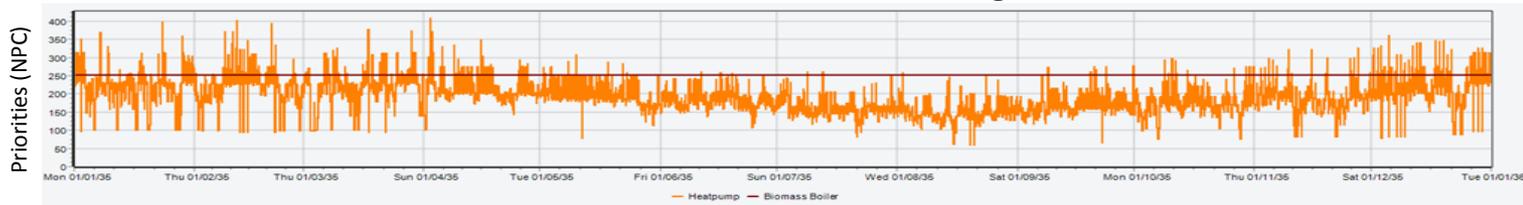


4.1. System Analysis 2035

Business Economic Modelling

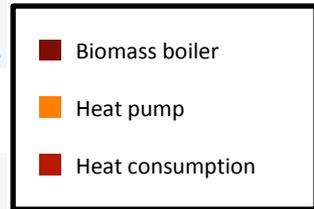


Socio Economic Modelling



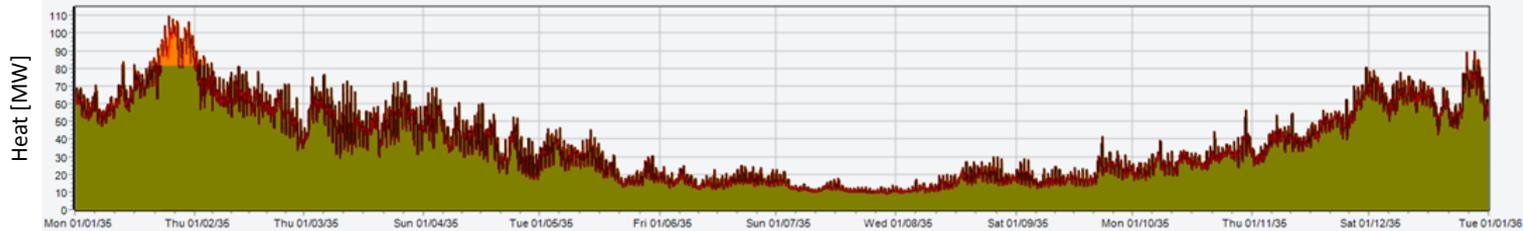
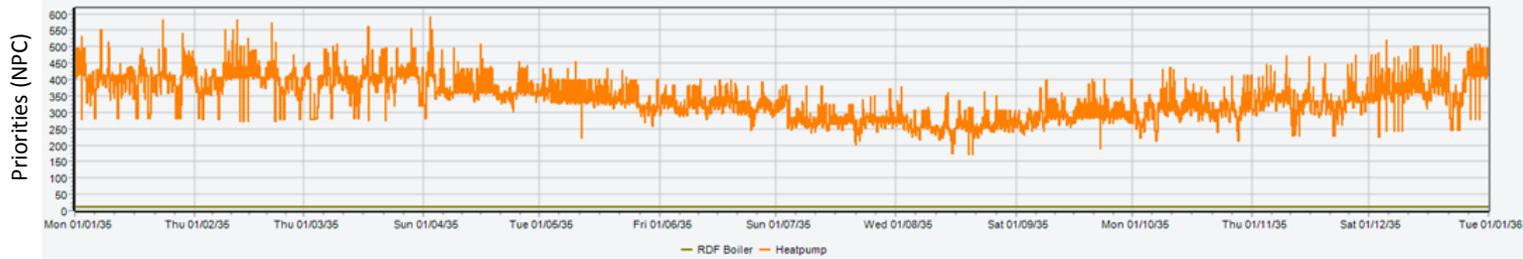
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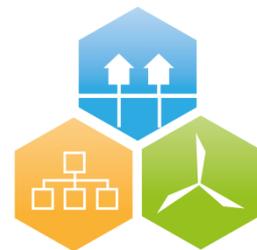
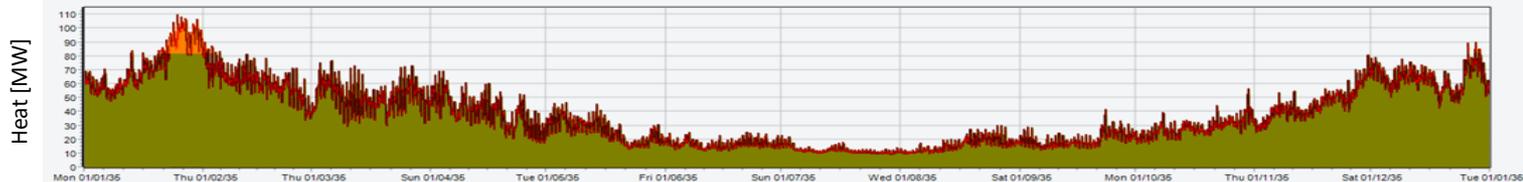
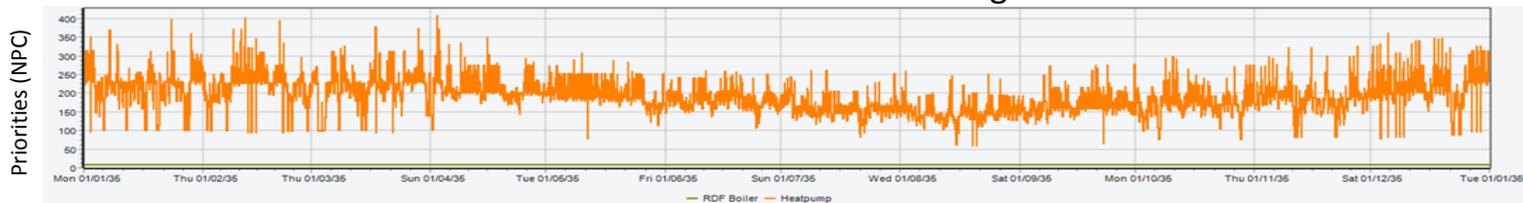


4.2. System Analysis 2035

Business Economic Modelling

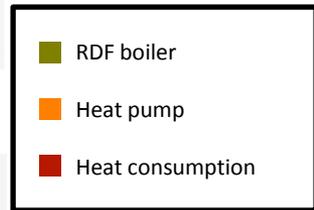


Socio Economic Modelling



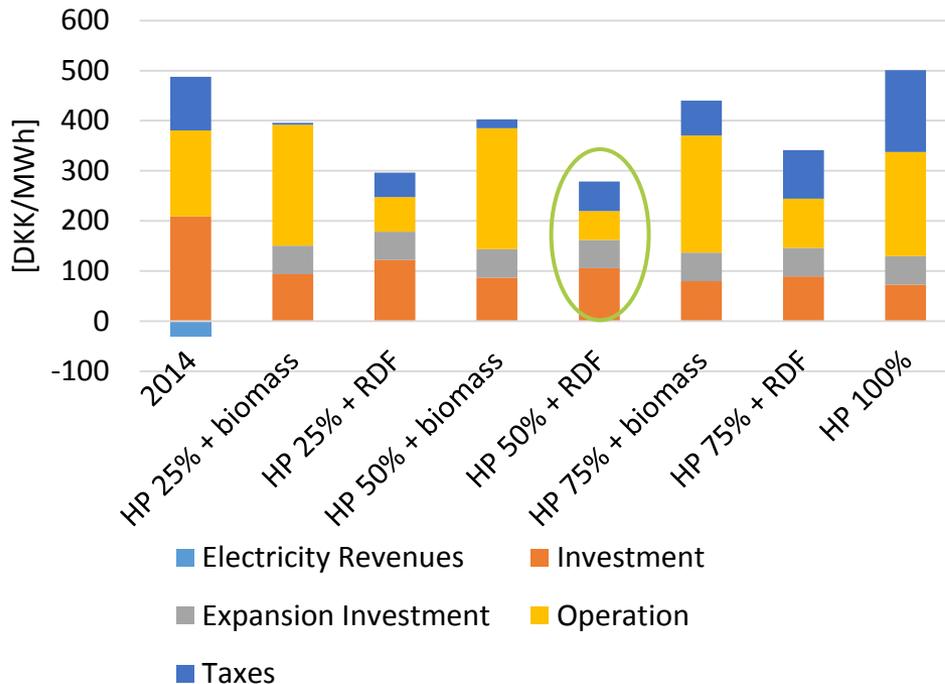
4DH

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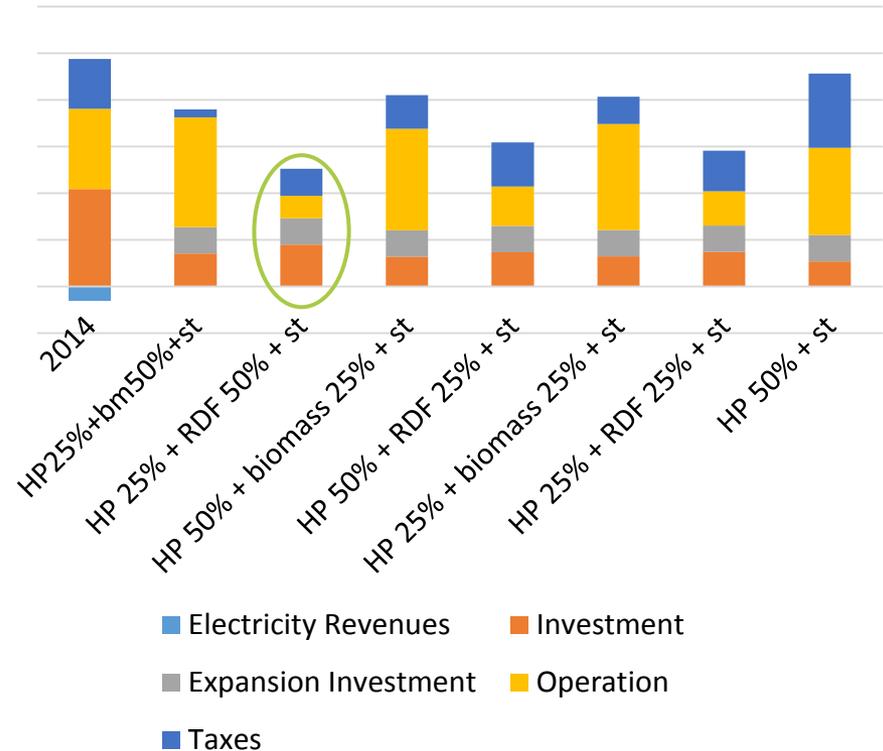


5.1. Economic Analysis 2035

Business Economic Heat Prices



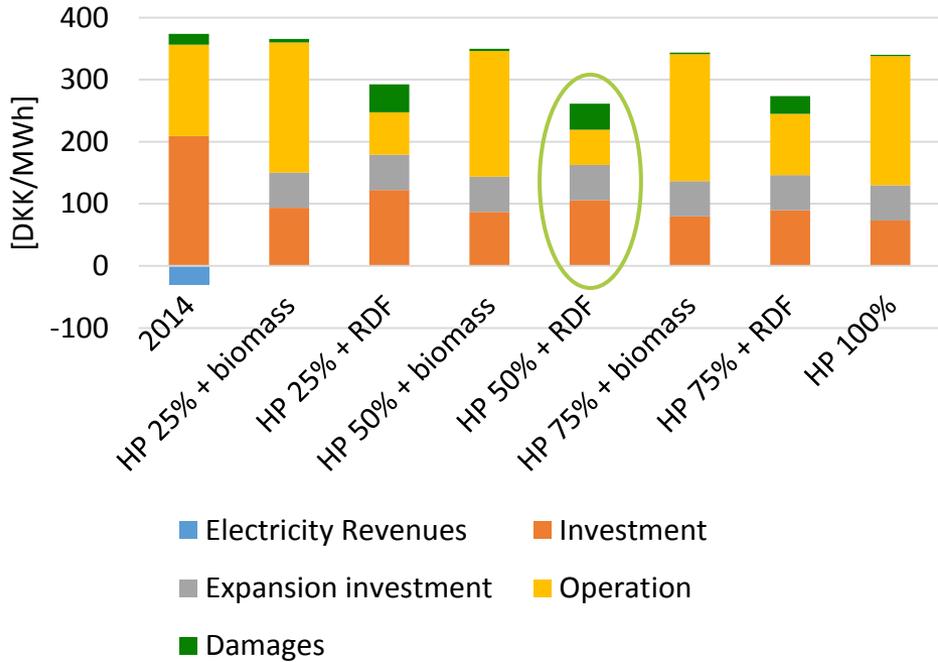
Business Economic Heat Prices + Storage



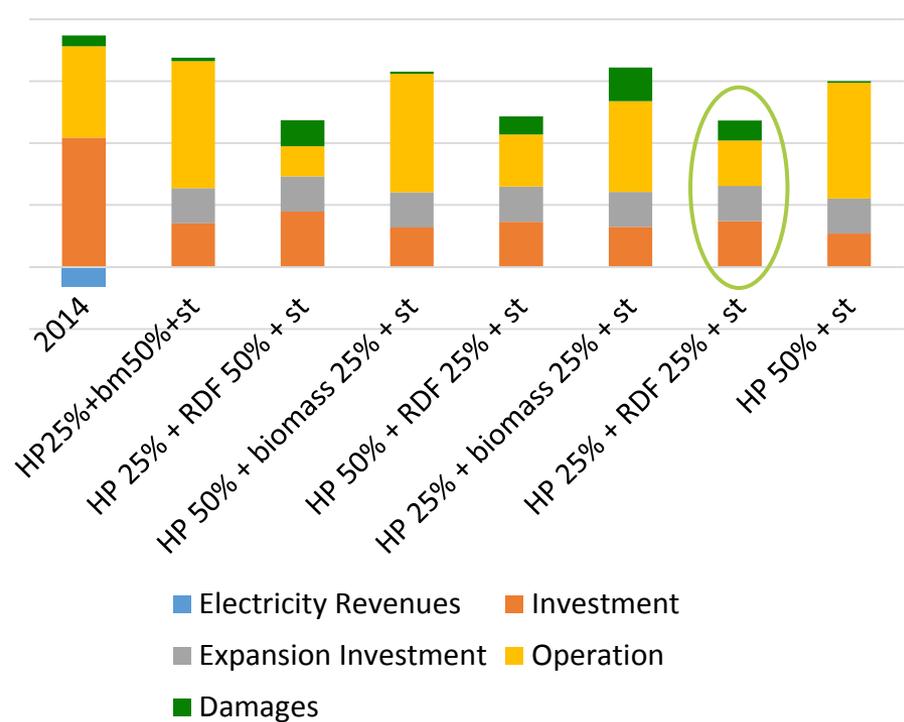
→ Best scenario in 2035 includes thermal storage

5.2. Economic Analysis 2035

Socio Economic Heat Prices



Socio Economic Heat Prices + Storage



→ Best scenario in 2035 includes thermal storage,
different under business or socio economics

6.1. Conclusion

- System design:
 - Business economics: 25% HP + 50% RDF boiler capacity + 61,000 m³ store
 - Socio economics: 25% HP + 25% RDF boiler capacity + 550,000 m³ store

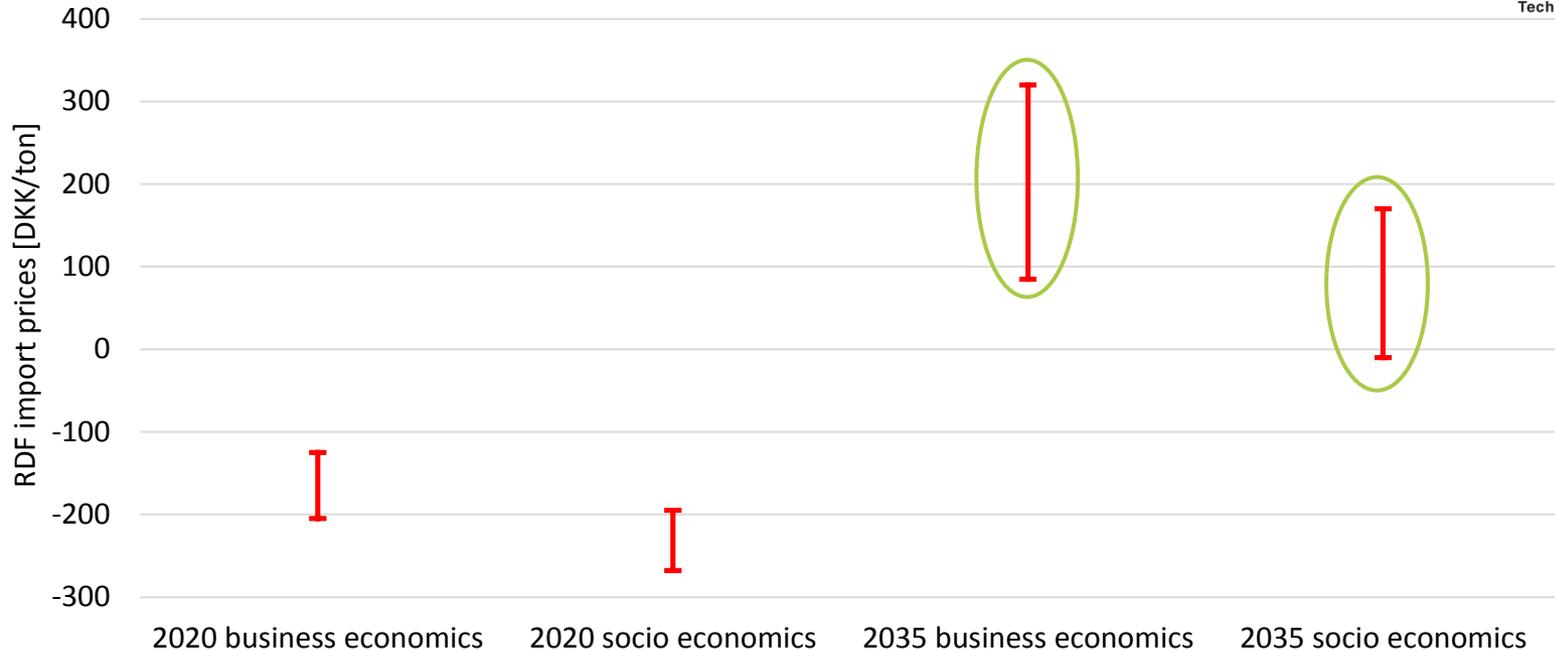
→ RDF has an important role in energy systems in short- and long-term
→ Scenarios including thermal storage appear to be more attractive



6.2. Conclusion



➤ RDF import prices competitive to biomass boilers:



→ RDF is competitive to woodchip boilers in all analysed scenarios

Thank you for your attention.



Open Questions

- Enough RDF available in Europe for Denmark, Sweden, Norway, Germany?
- seller's market: maximum RDF import price
- reserve capacity
- PSO

