

THE TYPE OF LARGE CHP PLANTS IN RENEWABLE ENERGY SYSTEMS

4DH SEMINAR – AUGUST 18TH 2014

RASMUS LUND – DEPARTMENT OF DEVELOPMENT AND PLANNING



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Presentation

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Ph.D. in 4DH since November 2013

Located at AAU Copenhagen campus

Main research area: Energy scenarios for Denmark

- 100% RE systems
- Suitable Technologies
- Energy savings and Individual vs. DH
- System perspective on low temperature DH

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Motivation

National policy of 100% renewable energy in 2050

Municipalities aims to be CO₂-neutral

Type of CHP plants in the future without coal?

DONG converts the Studstrup CHP plant

- Wood pellets
- Pulverised fuel plant

HOFOR plans to build new CHP plant at Amager

- Wood chips
- Circulating fluidized bed plant



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Motivation

A new role for CHP plants in renewable energy systems

- Balancing large amounts of fluctuating production
- Fewer operating hours

Sustainability of biomass energy

- Total consumption is important as well as the sources
- The Danish consumption should be within marginal production

CEESA suggests Combined cycle gas turbine plants

- Very flexible heat and electricity production
- In synthetic gas production wind power can be utilised



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Project

Purpose:

- To analyse the feasibility and fuel consumption for the different large CHP-plants in 100% RE systems in Denmark

Methods:

- Point of departure in CEESA 100% RE scenario for Denmark
- Modelling of scenarios in EnergyPLAN
- Assessment of the different CHP plant types

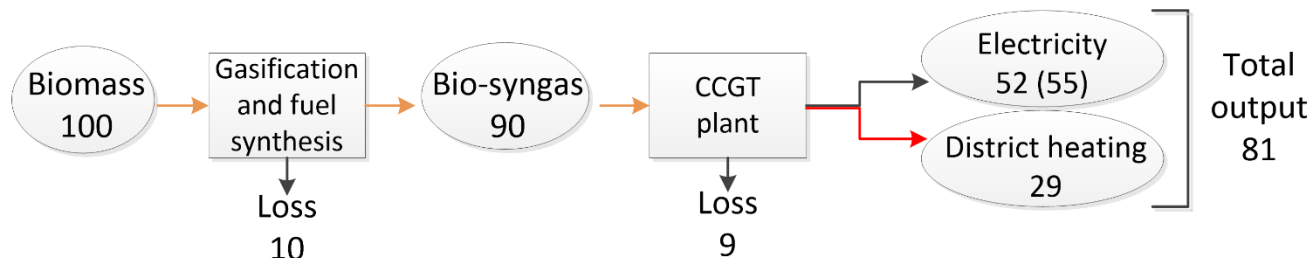
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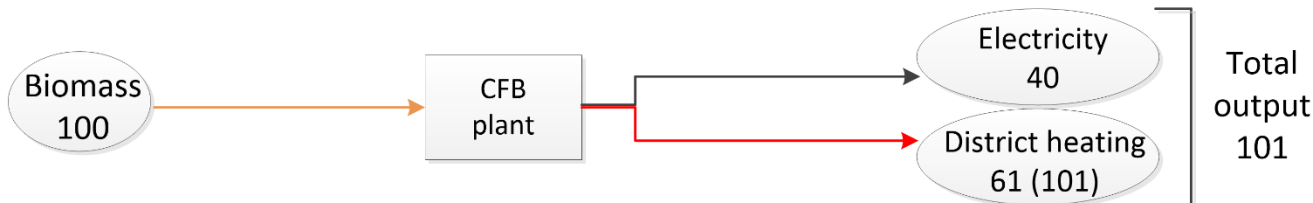
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Plant Assumptions (2050)

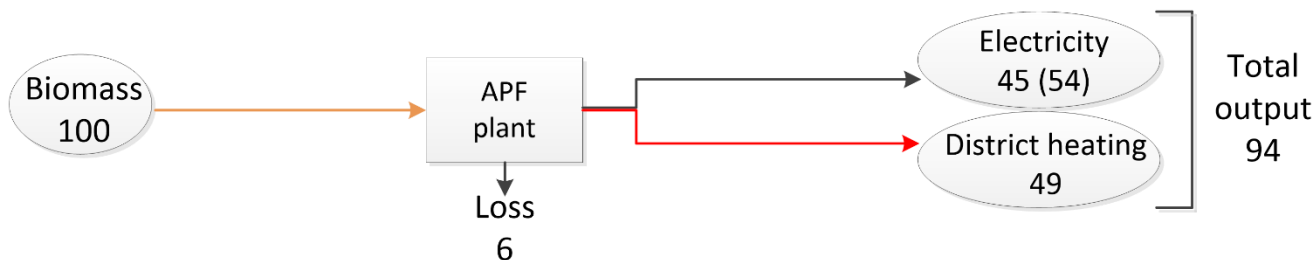
CCGT:



CFB:



APF:



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Results of Technical Analysis

Annual values	CCGT	CFB Low	CFB High	APF
Total scenario costs (BDKK)	146.5	147.1	147.7	155.3
Biomass consumption (TWh)	66.6	67.4	79.9	70.7

- Both CFB and APF plants utilises less production large heat pumps because of the lower flexibility
- Alternatives uses more biomass on annual basis
- CCGT is lowest on the two analysed parameters

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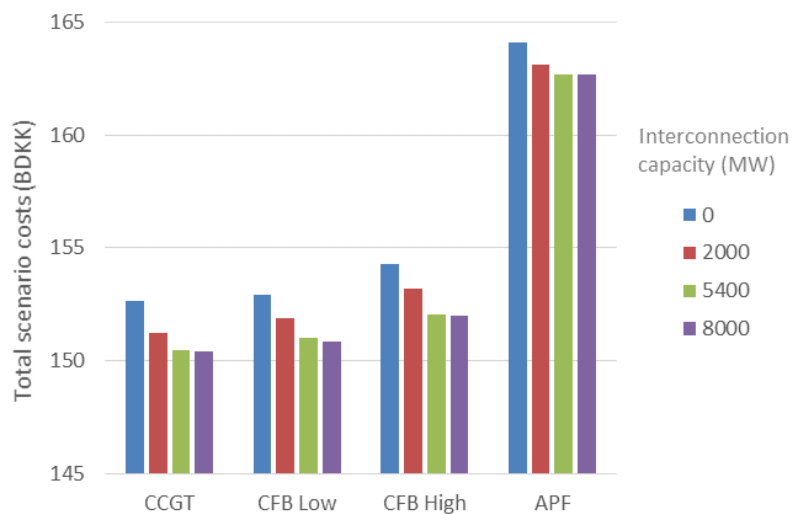
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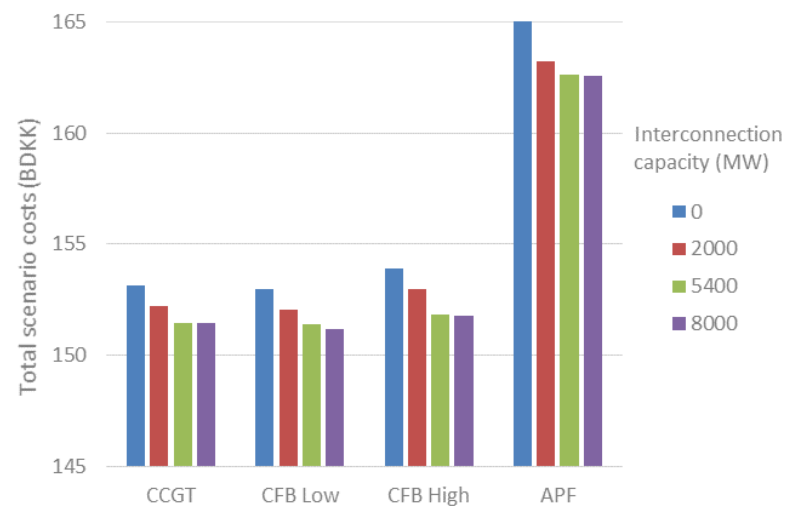
Electricity exchange analysis

- Market economic optimisation
- Costs decrease with increasing IC capacity
- CCGT scenario is the cheapest
- No significant effect above 5,400MW IC capacity

With biomass constraint



Without constraint



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Conclusions

- In renewable energy systems large CHP plants should have high flexibility of electricity and heat production
- Of the analysed types CCGT plants have the lowest
 1. total energy system costs and,
 2. biomass consumption
- Results solid to increased IC capacity and changing prices of electricity and biomass
- Public regulation for the large CHP plants should be revised to promote technology for the lowest possible costs and resource consumption

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THANK YOU

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