



# Gasification of Biomass & Waste

## Country Report Denmark

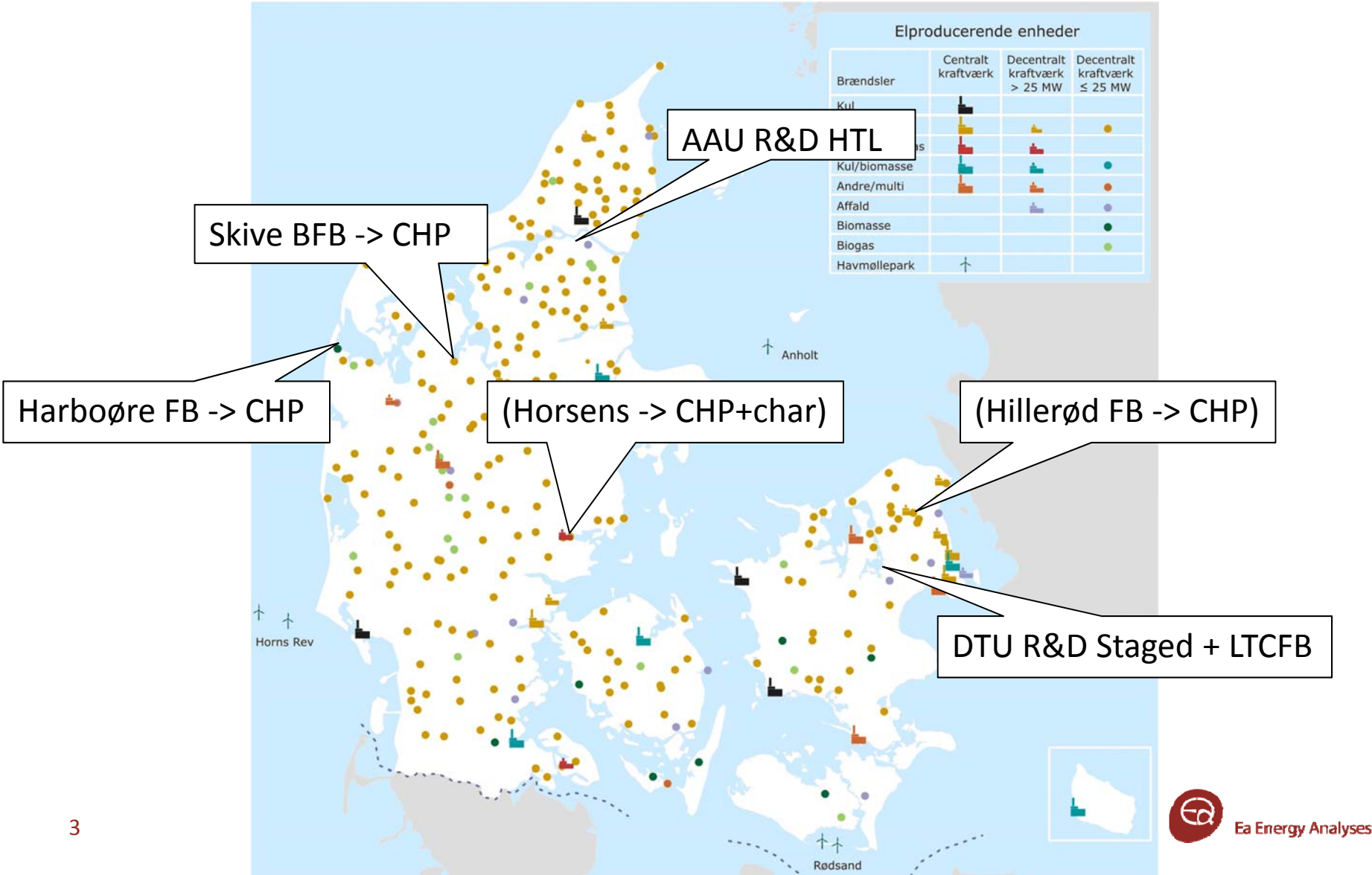
IEA Bioenergy Task 33  
Task meeting – 2 May 2017  
Innsbruck – Austria

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Ea Energy Analyses

# What do we discuss in Denmark?

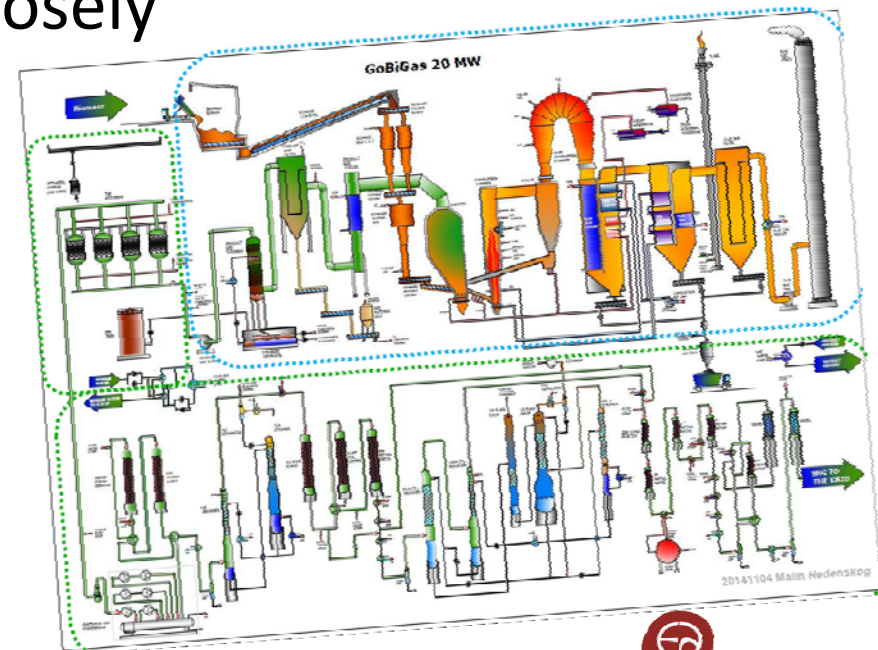
- Wind electricity prices decreasing dramatically
  - Kriegers Flak, Vattenfall, guaranteed 5 €/kWh (37,2 oere)
  - German off-shore project, DONG Energy offer w/o subsidies
- DONG Energy announced coal stop in 2023
  - Most plants have already been converted to 100% biomass
- District heating sector to be privatized
  - Advisers argue that consolidation and competition will bring lower heat prices
  - Mergers and profit to replace non-for-profit and consumer owned companies
- Large heat pumps and electricity tax reduction
  - Taxation analysis pending
- Survey of bioenergy sector, job creation and export
- Climate commission: no subsidy for RE/market to decide

# Biomass gasification plants



# Current activities on new plants

- Limited on CHP
  - “The framework conditions challenging”
- None on BioSNG
  - Following GoBiGas closely
  - No support
  - Danish involvement
- None on liquids



# New R&D projects

- Sewage sludge gasification in Viking staged gasifier at laboratory (DTU)
- Flexible polygeneration concept aiming producing bio oil/char or gas for CHP as desired on low value fuels in 100 kW LTCFB (DTU)
- Bio oil generation via pyrolysis in pressurized H<sub>2</sub> atmosphere with catalyst in bed (DTU)

# Partnership for Thermal Gasification

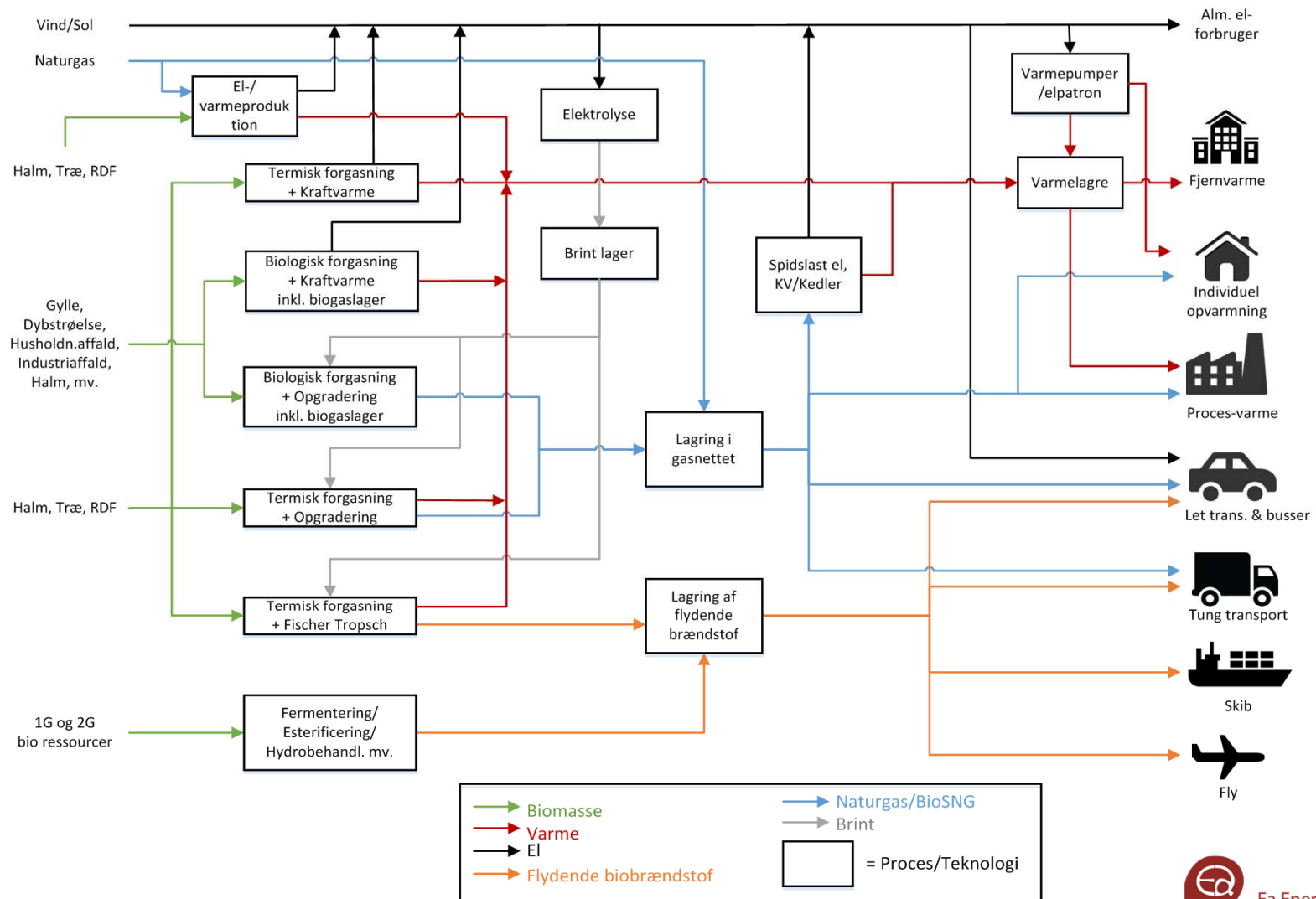
- Report on gasification status now public
- Study on integration of gasifiers in the energy system now public
- Study on framework conditions now and in 2030 ongoing – draft report being discussed
- Strategy project ongoing – recent public workshop to set off

# Study on integration of gasification

- Study done by Ea Energy Analyses in 2016
- Socioeconomical optimization in 2050
- Balmorel model – [www.balmorel.com](http://www.balmorel.com)
  - Covering electricity, heat, gas infrastructure
  - Well established background data
- Focus on biomass -> gas -> consumer routes
- Assuming that liquid biofuels for transport are generated via gasification route
- Base scenario + 15 alternative scenarios



# Balmorel optimization model



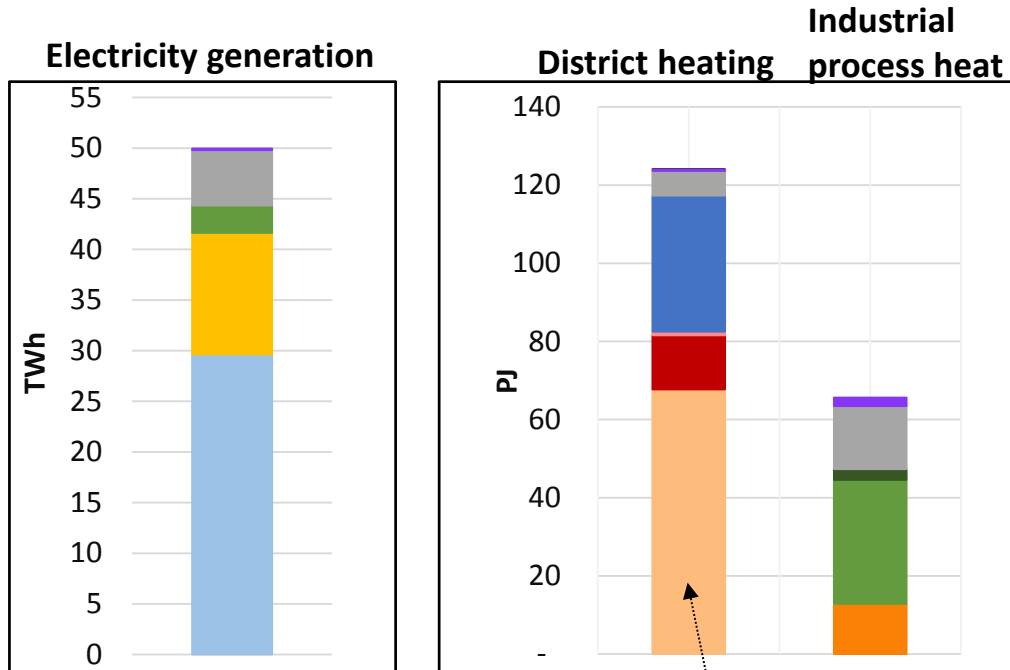


# Base scenario (DK, 2050)

- Fuel prices : IEA 450 ppm-scenario
- CO<sub>2</sub>-price 107 €/ton (based on IEA)
- Road transport primarily liquid fuels
- Biofuel plants situated in Denmark cover the demand for liquid fuels for transport
- Gas demand: 31 PJ
  - for industrial process heat, domestic heating and transport
- In alternative scenarios these factors are altered

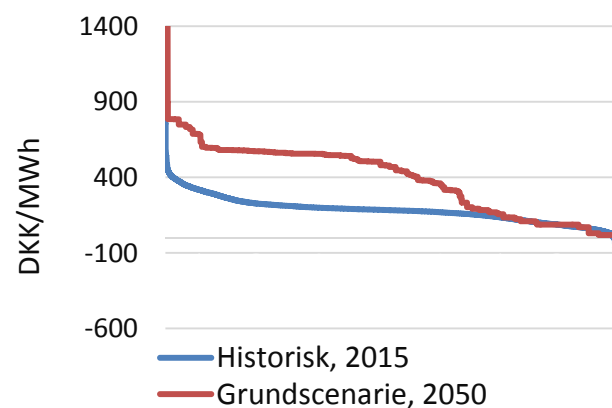
# The Danish energy system 2050

## Base scenario (socioeconomical optimization)

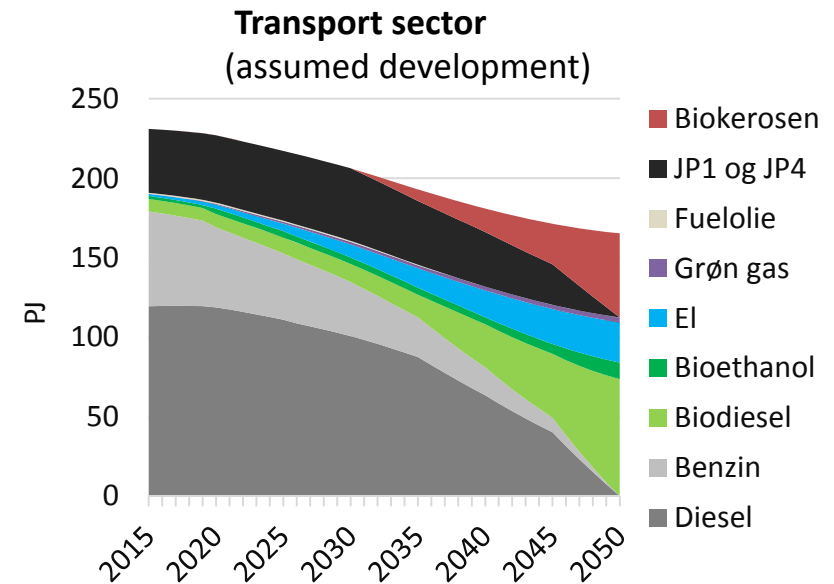


- Vardepumper
- RDF
- Affald
- Overskudsvarme fra biobrændstofproduktion
- Sol
- Vind
- Bio-SNG
- Naturgas
- Træpiller
- Træflis
- Halm

**Electricity price, duration curve**



Surplus heat from biofuel plants (gasification+FT) assumed placed in Denmark (127 PJ biodiesel or bio A1)



- Biokerosen
- JP1 og JP4
- Fuelolie
- Grøn gas
- El
- Bioethanol
- Biodiesel
- Benzin
- Diesel

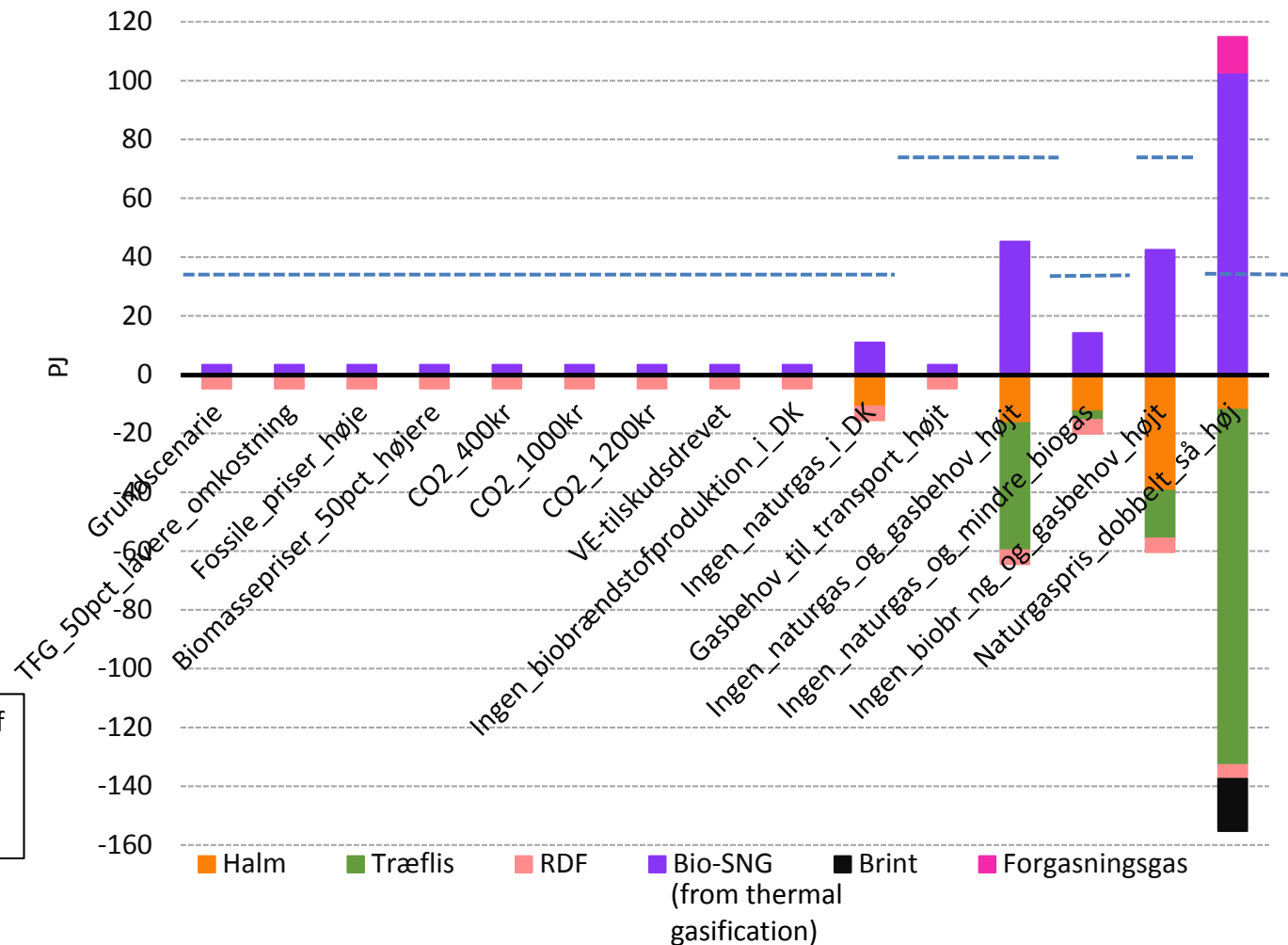
# Thermal biomass gasification

for power, heat, industry and transportation (excl. liquid biofuels)

Alternative scenarios, Denmark, 2050

Generation of  
bio-SNG and  
product gas

Consumption  
of waste and  
biomass



# Main messages from the study

- Gasification for **bio-SNG** and possibly **liquids** may play a role in 2050
- **No small scale gasifiers for CHP** - especially as it is assumed that product gas cannot be stored
- Interesting to **gasify wastes** such as RDF as incineration is costly
- **Biomass gasification** will be socioeconomic if:
  - natural gas is phased out politically or reaches prices around 13 €/GJ
  - and CO<sub>2</sub>-prices at the same time reach 110 €/ton
  - and gasification is demonstrated, upscaled and sees a significant cost reduction until 2050
- **Methanation of CO<sub>2</sub>** by adding H<sub>2</sub> has low socioeconomic potential
- **Gasification for indirect co-firing** in large CHP plants has not been analyzed directly – the potential depends on what role biomass CHP will play in general

# Study on framework conditions

- How do framework conditions in Denmark influence implementation of gasification
- How will framework conditions develop towards 2030
- How well off is thermal gasification in comparison with alternatives
- Next step is to develop a RD&D strategy for deployment of thermal biomass gasification in Denmark

# Current Danish support scheme

- CHP
  - Space heating generated from biomass (product gas) is tax-exempted (indirect subsidy, compared with e.g. natural gas). Value max 8 €/GJ<sub>heat</sub>
  - Electricity generated via gasification receives a fixed tariff or a supplement to the spot price (until November 2023) + additional amounts  
Total 2017 subsidy is 18 €¢/kWh<sub>e</sub>
- BioSNG
  - No subsidy for upgrading producer gas to natural gas quality (no equality with biogas)
- Liquid biofuels
  - No certificates apply for generating biofuels







Thank you!

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