

# Country Report Denmark

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Renescience waste conversion plant Nortwich, England

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## Policy update 1

- Danish biofuel targets are strictly following EU directives, i.e.
  - Blending 5 % (vol) bioethanol into gasoline
  - Blending 7% (vol) biodiesel into diesel
- According to EU directive aim is 10% renewable energy in transport sector by 2020
  - Not clear how Denmark will reach this. Currently the use of RE in transport is (2016):
    - Bioethanol 1.2% of total road transport
    - Biodiesel 4.6% of total road transport
    - Electricity 1.0% of total road transport
    - Biogas – very little
- Biofuels used has to follow the EU directive on sustainability.
- No domestic production of bioethanol. Two producers of biodiesel (rape seed and waste fat/oil).
- No incentives for use of liquid biofuels (only exempted from CO<sub>2</sub> tax). Biogas used for road transport get economical support (14 USD/GJ).



## Policy update 2

- As part of a new program to stimulate the economic growth it was decided in November 2017 to allocate funds to promote production of advanced biofuels. Specific conditions have not been negotiated yet, but funding available will be around 2.6 mio € annually for years 2019-2025.
- New Danish energy agreement for 2020-2030 to be negotiated in 2018
  - No details out yet but most likely:
    - Target of 50% of all energy from renewable sources by 2030
    - Reducing the use of biomass for energy (Heat and power) = more biomass for biorefining or less biomass import?
    - Currently large economical support for biogas, but likely to be reduced (gradually)
    - In transport sector the focus is on electrification for light vehicles, heavy transport (biogas?)
    - Most likely no (new) incentives to support (advanced) liquid biofuels

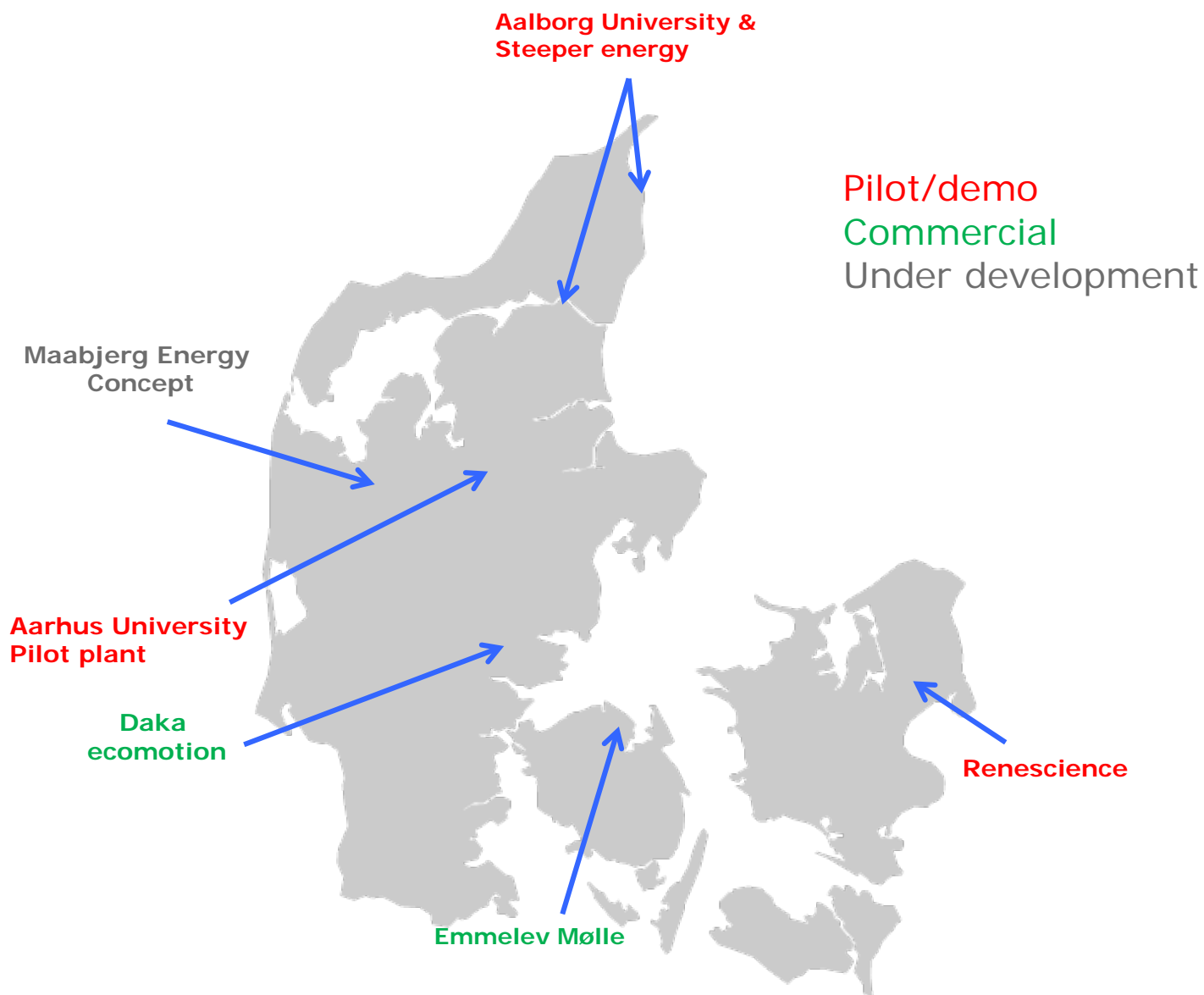


## Policy update 3

- Re-launch of National Bioeconomy Panel
- In August 2017 a new National Bioeconomy Panel was appointed by the Minister of Environment and Food. The panel consists of 15 members from industry, universities and organizations (e.g. Confederation of Danish Industry) .
- The first National Bioeconomy panel was setup in 2013 and evaluated in 2016. One of the products was a report in 2014 with four recommendations for how to promote the development of bioeconomy in the near to long term perspective
- The new panel will have a strengthened business focus. One of the first focus areas for the panel is to look at new values chains for green biomass.



# Pilot, demo and commercial facilities in Denmark



## Maabjerg biorefinery – project still alive (?)

- National blending target for advanced bioethanol - fit size of plant
- Upcoming economical support
- Plant size
  - 80 mio l ethanol
  - 50 mio m<sup>3</sup> CH<sub>4</sub>
  - Heat and Power for 25000 households
- NIR funding of 39 mio Euro in 2014.
- Final decision required a secured market (EU 2G blend level) and government guaranteed loans
- Status?



## HTL for fuel production – several initiatives in Denmark

Two pilot scale facilities for HTL (hydrothermal liquefaction) of biomass for fuel

- Aarhus University

- Current focus on treatment of sludge eventually mixed with biomass fibers used as filter aid
- HTL of biomass/lignin for higher value applications



- Aalborg University in collaboration with Steeper Energy (Hydrofaction technology)

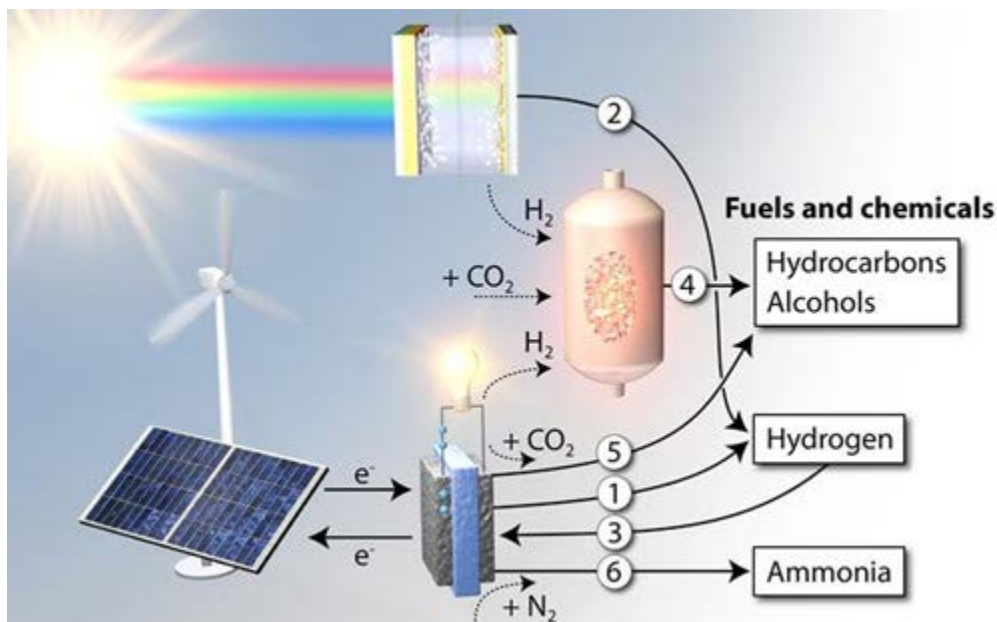
- In November, the Hydrofaction™ pilot plant in Aalborg Denmark surpassed 4750 hours of hot operation with over 1750 hours of oil production hours
- December - Steeper Energy partnering with Silva Green Fuel, a Norwegian-Swedish joint venture, to construct a \$59M industrial scale demonstration plant in Norway.

<http://www.biofuelsdigest.com/bdigest/2018/01/16/the-silver-in-silva-the-story-of-steeper-energys-59m-advanced-biofuels-project-in-norway/>



# The Villum Center for the Science of Sustainable Fuels and Chemicals

- Large consortium funded by 150 MDKK (25 M USD) from Villum Fonden (2016)
- Lead by Prof Ib Chorkendorff, Technical University of Denmark
- Overarching aim is to develop better catalysts to convert sunlight into fuels and chemicals
  - Thermally driven processes for CO<sub>2</sub> reduction to fuels and chemical building blocks
  - Electrochemical CO<sub>2</sub> reduction to fuels and base chemicals





## Biogas sector

- Large support for biogas (receives 25% of all public support for RE, contributes with 10% of RE!)
- Biogas sector expanding by a factor of 4-8
- Manure and household waste are main feedstocks, but straw is increasingly being used (and research focus on how to better include straw)



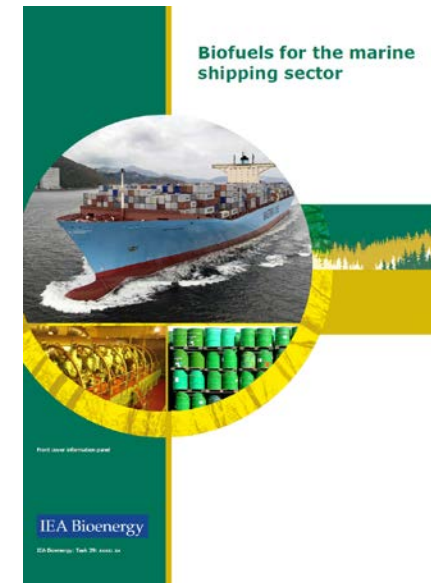
- Technology development on reforming of CO<sub>2</sub> to methane, but simply changing the equilibrium by excess H<sub>2</sub> will give 30-40% more methane
- Potentially 40% of the current use of natural gas can be substituted
- Water or chemical scrubbing units connecting biogas to the gas grid
- A goal of gas in heavy transport, but very few initiatives yet



# Marine biofuels

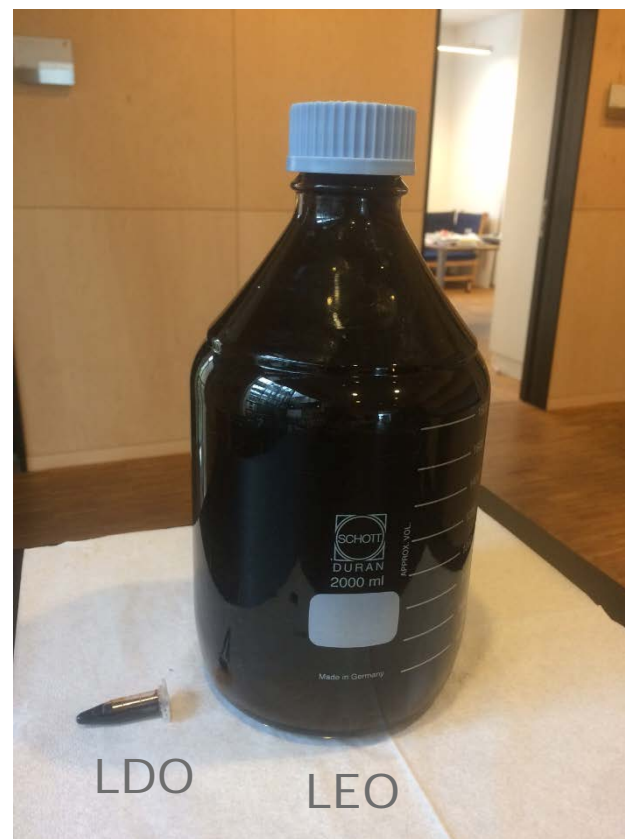


- Growing (urgent) industry interest
- International sulphur emission regulation by 2020
- Ongoing R&D between academia and industry
- Potential lignin fuel breakthrough...
- Task 39 report on Marine fuels have been well received – Claus gets many contacts



## Lignin-ethanol marine biofuels

- Lignin-Ethanol-Oil (LEO) is prepared by dissolving lignin (and any other organic compound) in ethanol
- Up to 40% dissolved lignin and other organics (energy density approx. 30 MJ/kg)
- LEO can be used directly in an LGI marine diesel engine
- By adding cetane enhancers, LEO can be used in non-modified marine diesel engines
- Preparation of LEO is simple. The process temperature is below 200° C  
Integration with e.g. 2G bioethanol or biogas plants
- Development and testing ongoing



Comparison of scale for laboratory preparations of lignin diesel oil (LDO) made by lignin solvolysis in ethanol and lignin ethanol oil (LEO) made by solubilizing lignin in ethanol

# More info

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