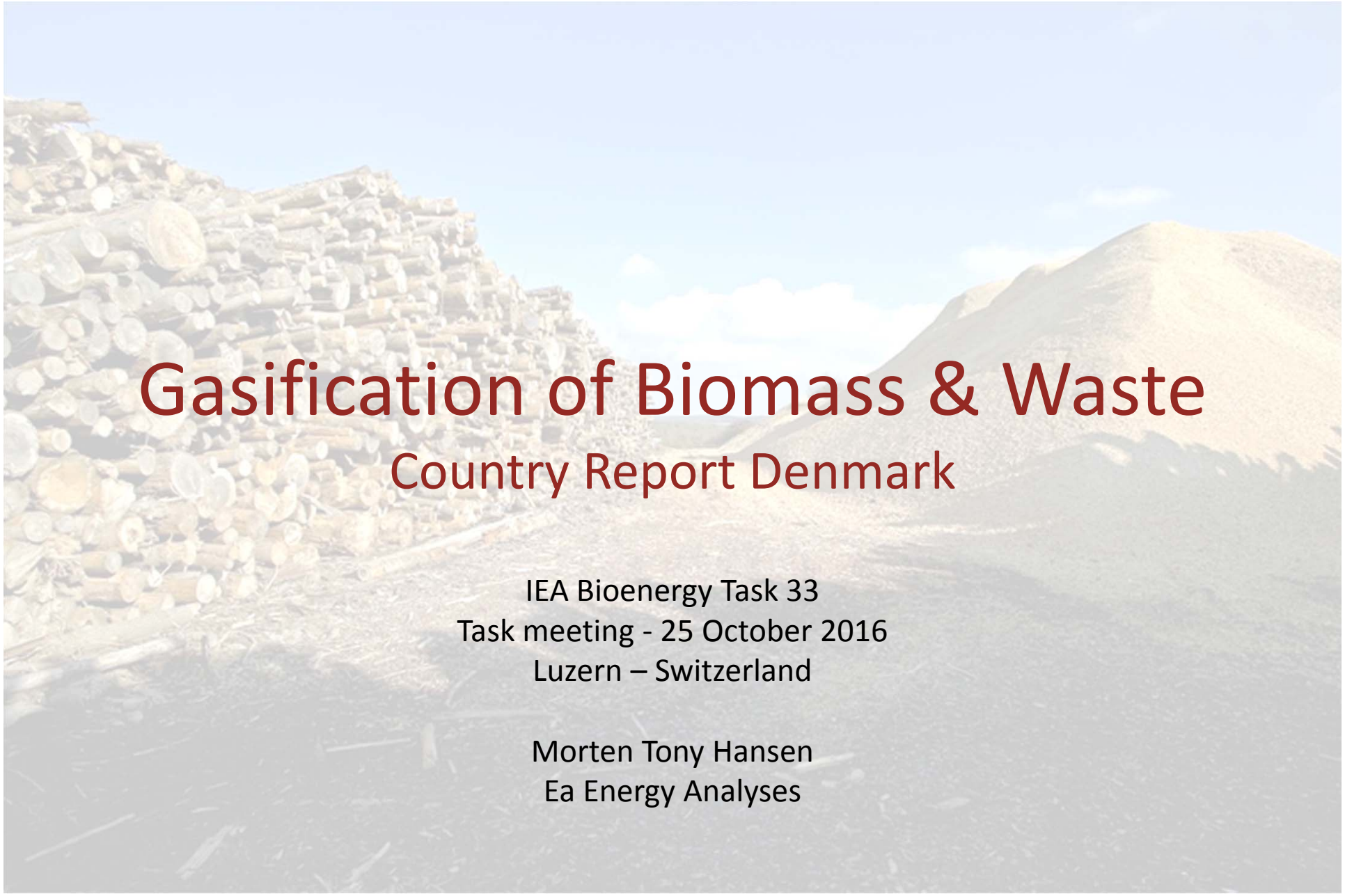

Gasification of Biomass & Waste

Country Report Denmark

IEA Bioenergy Task 33
Task meeting - 25 October 2016
Luzern – Switzerland

Morten Tony Hansen
Ea Energy Analyses

Ea Energy Analyses

What does Ea Energy Analyses do?

- Analyses and modelling of energy systems and measures
  - Independent - often with a societal perspective
  - High quality reports - relevant, creative, critical, advanced methods if needed
  - See www.eaea.dk for reports in English
- We like to make a difference
  - Policy oriented
  - Future oriented (2016, 2020, 2030, 2050)
- Bioenergy projects
  - Technology catalogues for the DEA
  - Biomass price projections for the DEA and energy companies
  - Market intelligence for energy companies and authorities
  - Switching from fossil fuels – advice for heating companies
  - Integration of bioenergy technologies in the energy system via models

Mixed Danish energy news

- Gasification news
  - 2½ gasification plants in operation
  - New interesting R&D projects
  - New technology data sheet on gasifiers
  - Report on gasification status ready
  - Report on modelling to fit gasifiers in the energy system nearly ready
- News on energy politics
  - Denmark signed COP21 agreement
  - Participation in Mission Innovation
  - WEC just awarded Denmark 1st place
  - Nationally, RE is also on the agenda

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Existing framework conditions

- Parliament energy agreement 2012
  - 2020: Half of electricity demand covered by wind
  - 2020: 35% of energy demand covered by RES
  - Bioenergy analysis by the DEA
    - Part of 2012 energy agreement
  - Four scenarios for fossil free 2050 outlined
  - Sustainable solid biomass plays a major role
  - Tax analyses are still on-going
  - Decision on scenario to be taken in 2020

- Current feed-in tarif: ~15 €c/kWh$_e$
  - No incentives for bioSNG
  - Feed-in tariff for upgraded biogas

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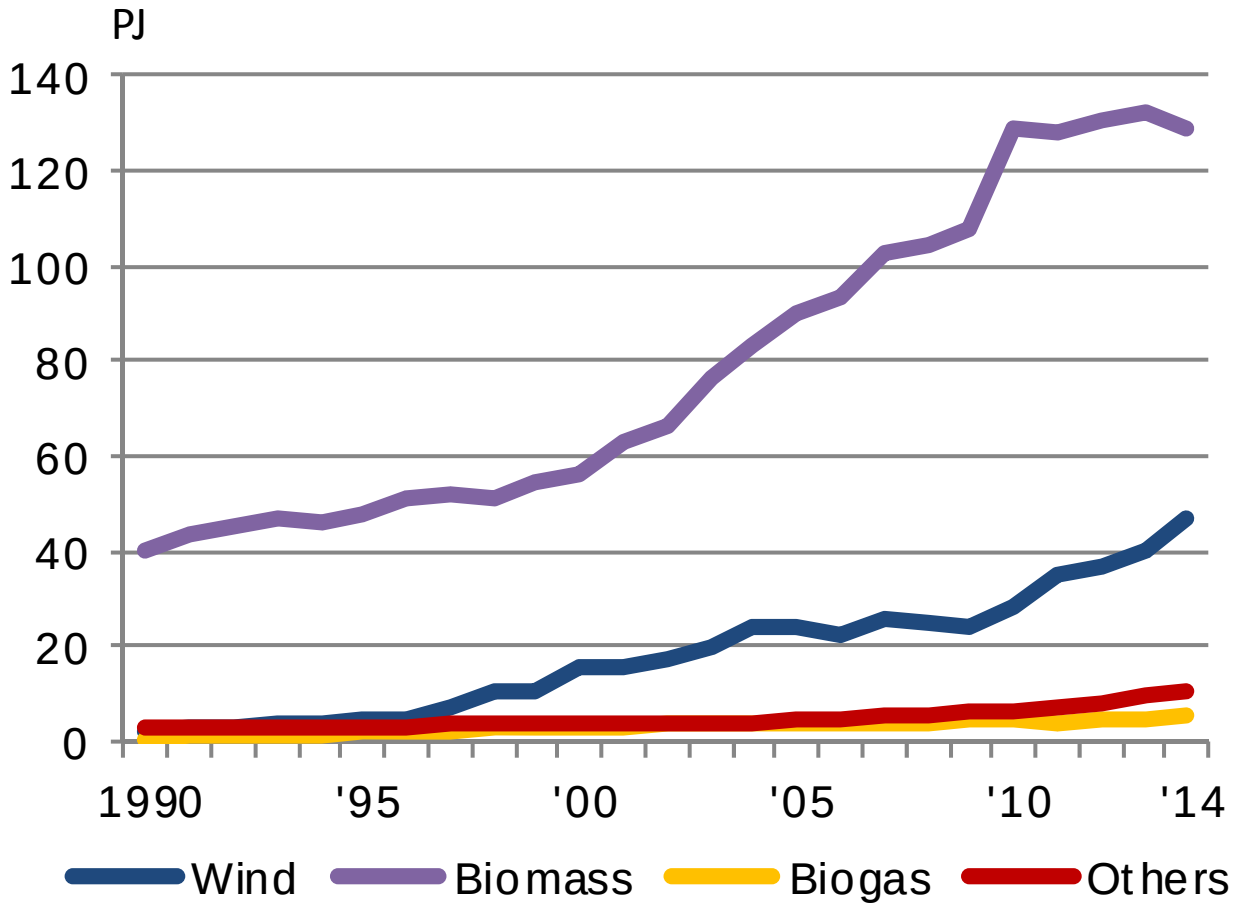
Bioenergy in Denmark - consumption

- Consumption of renewable energy by source:



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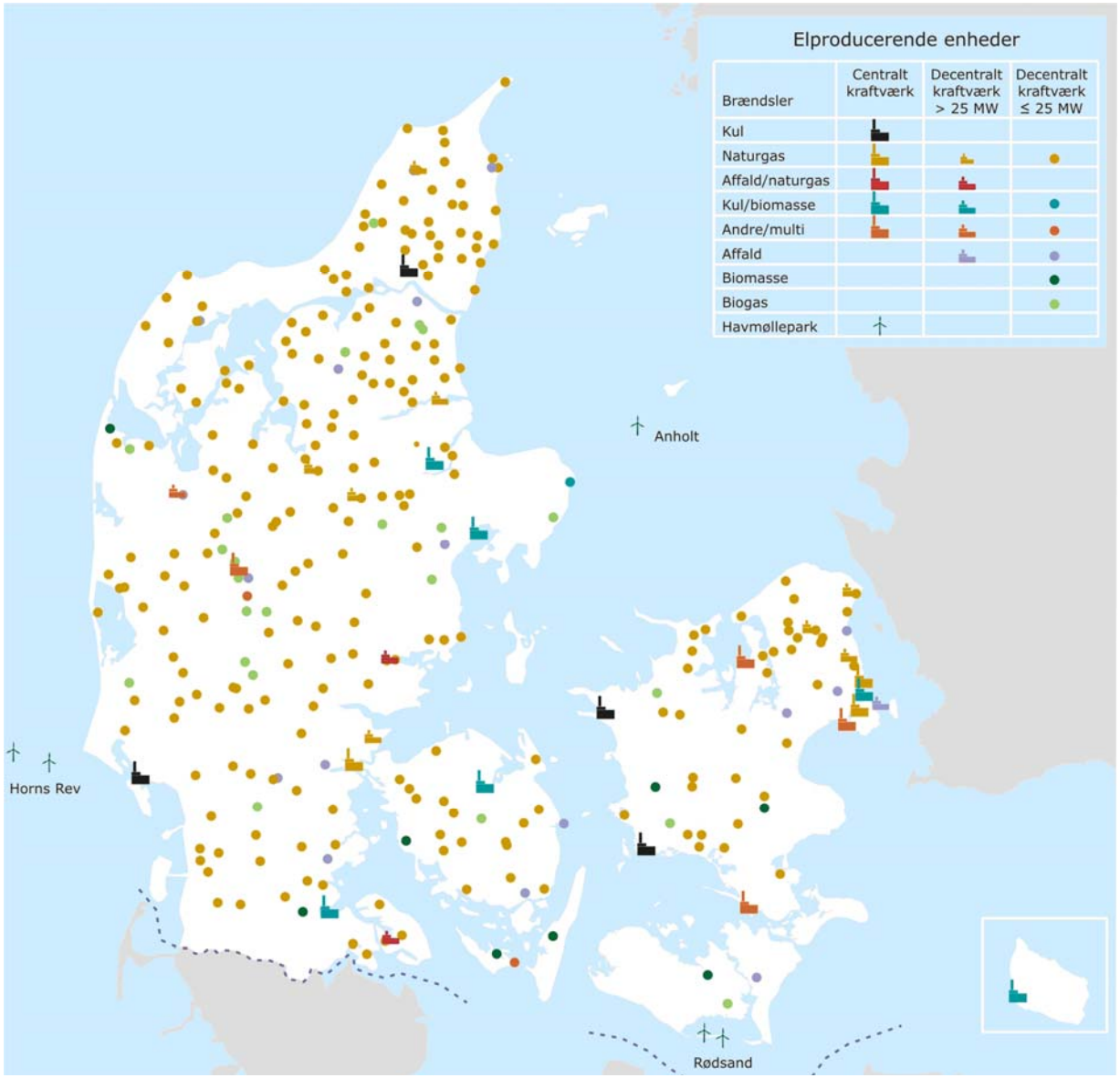
Danish thermal plants



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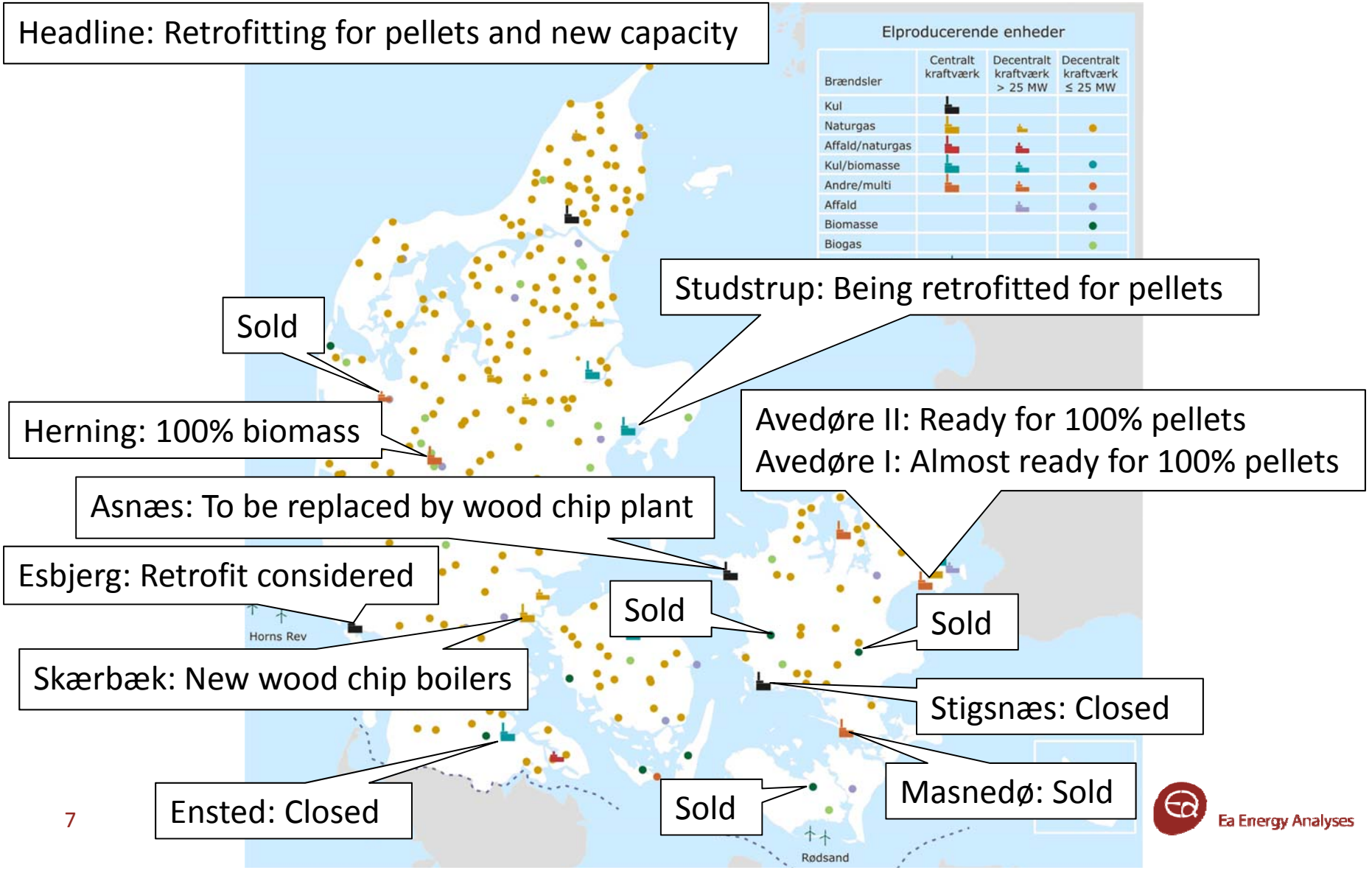
Danish thermal plants - DONG Energy



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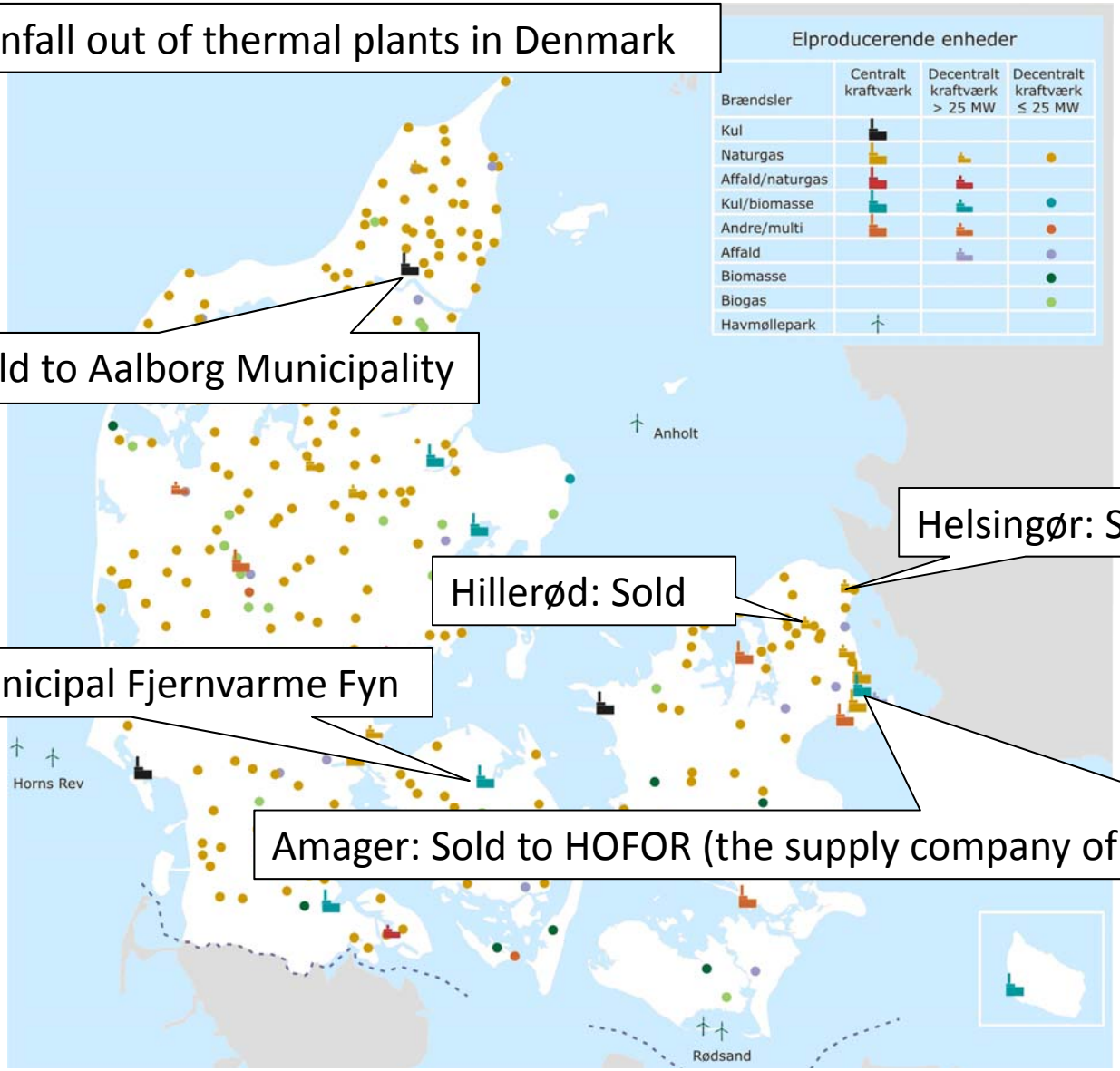
Danish thermal plants - Vattenfall

Headline: Vattenfall out of thermal plants in Denmark



Nordjylland: Sold to Aalborg Municipality

Helsingør: Sold

Hillerød: Sold

Fyn: Sold to municipal Fjernvarme Fyn

Amager: Sold to HOFOR (the supply company of Copenhagen)

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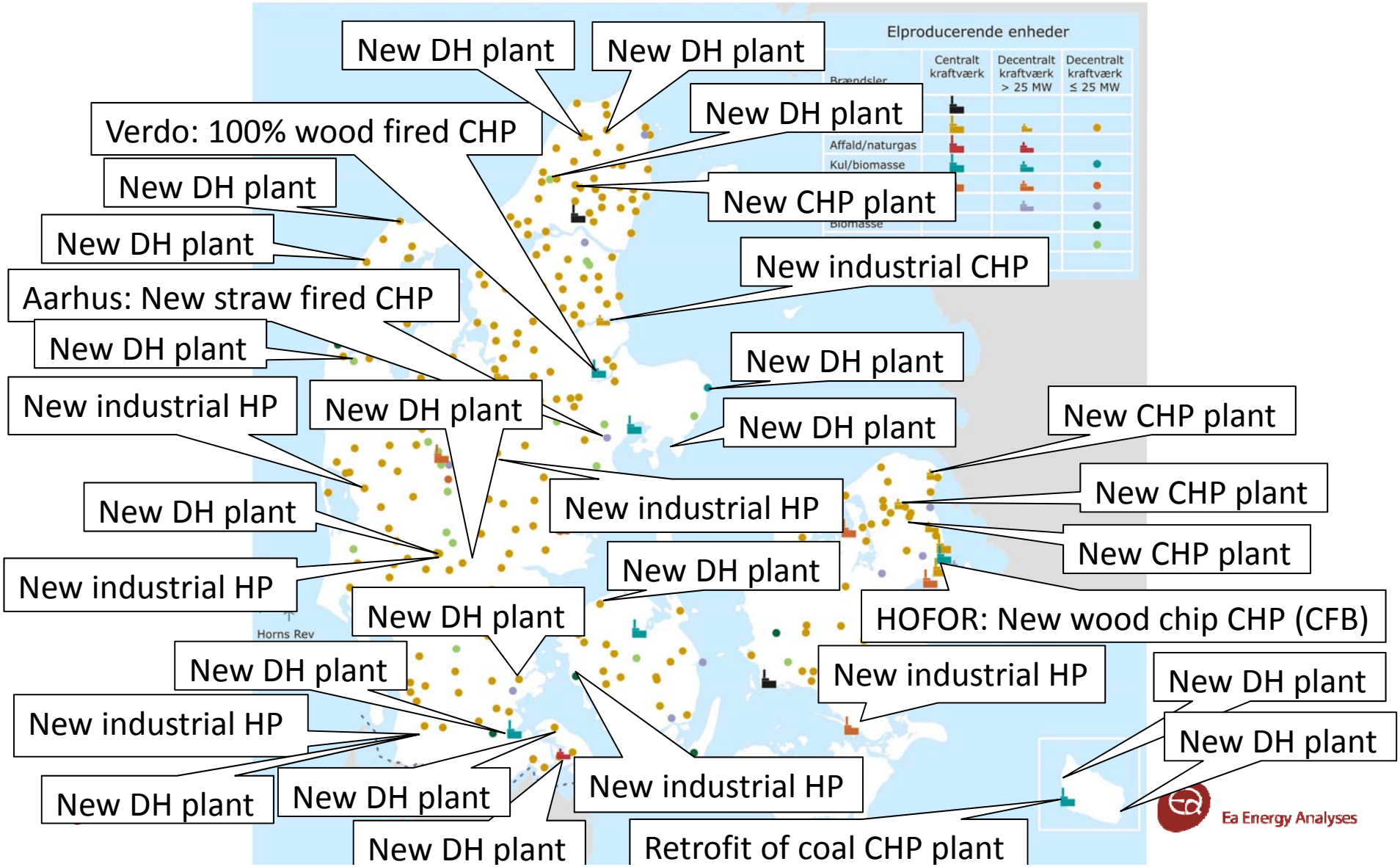
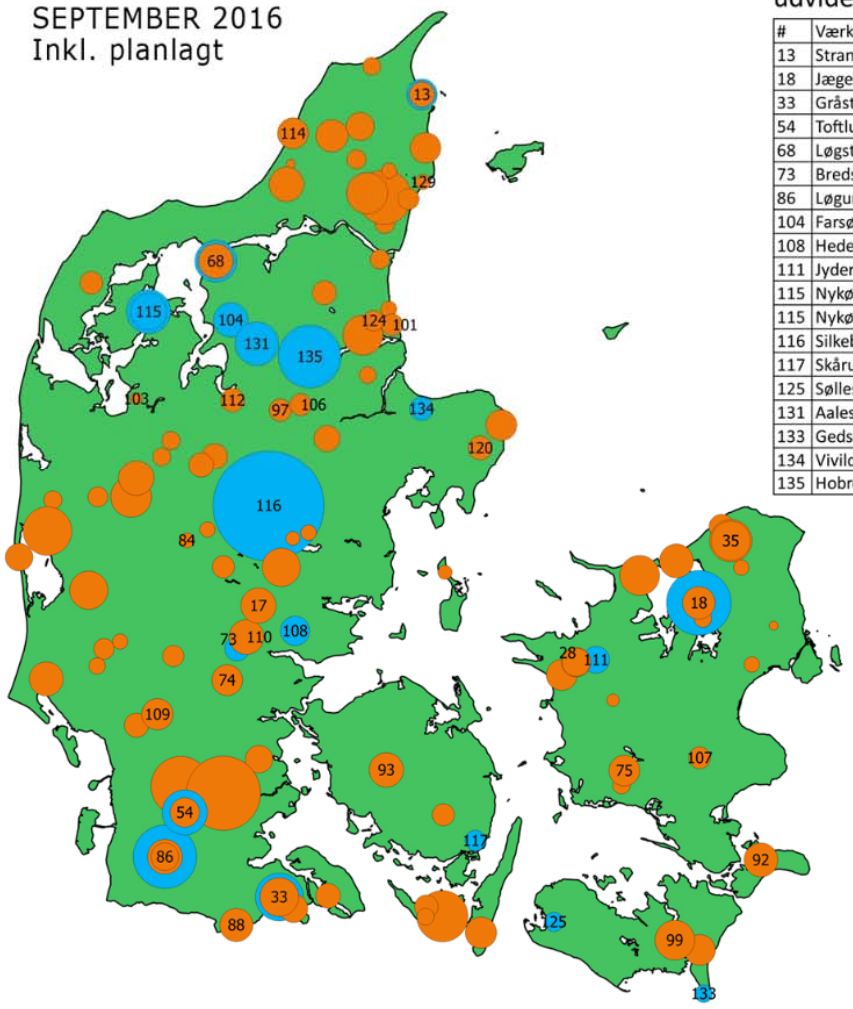
Danish thermal plants - others



Regarding Hybrid Systems…



Planlagte anlæg & udvidelser

#	Værk	Solfangerareal (m2)
13	Strandby	(8019)+4000
18	Jægerspris	(10000+3405)+40000
33	Gråsten	(19024)+10000
54	Toftlund	(11000)+15000
68	Løgstør	(15208)+7000
73	Bredsten - Balle	7800
86	Løgumkloster	(9699+5576)+36000
104	Farsø	15120
108	Hedensted	11000
111	Jyderup	9239
115	Nykøbing Mors	16708
115	Nykøbing Mors	(16708)+8000
116	Silkeborg	156694
117	Skårup (Sydfyn)	5418
125	Søllested	4701
131	Aalestrup	24129
133	Gedser	4000
134	Vivild	7000
135	Hobro	50000

Nyopførte anlæg & idriftsatte udvidelser

#	Værk	Solfangerareal (m2)
17	Tørring	(7284)+8467
28	Svebølle-Visking.	(7035+3000)+1000
35	Helsinge	(4733+14855)+3276
74	Egtved	12000
75	Fuglebjerg	12000
84	Kølkær	2873
86	Løgumkloster	(9699)+5576
88	Padborg	13961
92	Stege	14515
93	Tommerup	15000
97	Ørum	6375
99	Øster Toreby	20000
101	Als (Mariagerfj.)	5947
103	Ejsing	1800
106	Hammershøj	6000
107	Haslev	6010
109	Holsted	12500
110	Jelling	15290
112	Løgstrup	7031
114	Løkken	12096
120	Trustrup-Lyngby	7245
124	Veddum (VSV)	5500
129	Voerså	2873

I drift

Planlagt / planlagt udvidelse

Totalt solfangerareal (i drift): 1.003.024 m^2

Totalt solfangerareal (planlagt): 431.809 m^2

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New gasification 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_2 atmosphere with catalyst in bed (DTU)

Babcock & Wilcox Vølund - Harboøre

- Updraft type, forest wood chip fired
  - 1 MW_e (1.4 MW_e installed)
  - Tar challenge turned into flexibility advantage - bio oil
- 22 years of gasifier operation
  - CHP operation for 15 years
- The host is happy
- Supplier owns the plant
  - Needs a new demo plant
  - Feed in tariff challenging in Denmark
  - Electricity of low value in Denmark
  - Heat of low value in foreign markets
- Candidate for Success Stories

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Andritz/Carbona - Skive

- Europe's largest BFB for CHP
  - 28 MW_{fuel} - 6 MW_{el}
  - Wood pellets
  - Pressurized BFB by Carbona
- Co-financed by the DoE/EU/DK
- Stable operation, high availability
  - Fuel quality improved
  - Catalytic reformer changed - article
- Liquid fuel generation project
  - Further investments are made
  - TIGAS process from Haldor Topsøe
- Candidate for Success Stories

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Biosynergi Proces - Hillerød

- Demonstration CHP plant
- Upscale of Castor plant
  - Open core downdraft type
  - 300 kW_e / 750 kJ/s heat
  - Wet forest wood chips
- Status
  - CHP operational on natural gas
  - Gasifier operated for 1,000 h
  - CHP on producer gas tested
  - Continuous operation pending
  - Small electrical and mechanical issues to be solved – time consuming and costly

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Other technologies

- For transport sector and CO_2-neutral peak load capacity
- Hydrothermal liquefaction
  - Research projects & pilot plants
  - Universities & suppliers
- Pyrolysis plants
  - Bio oil and biochar in focus
  - Residues & difficult fuels
- Biogas boom
  - Upgrade to natural gas quality
  - Booming in plants promoted by NG suppliers

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