



Ukraine-Denmark Energy Center

Biomass for power and heat generation in Denmark

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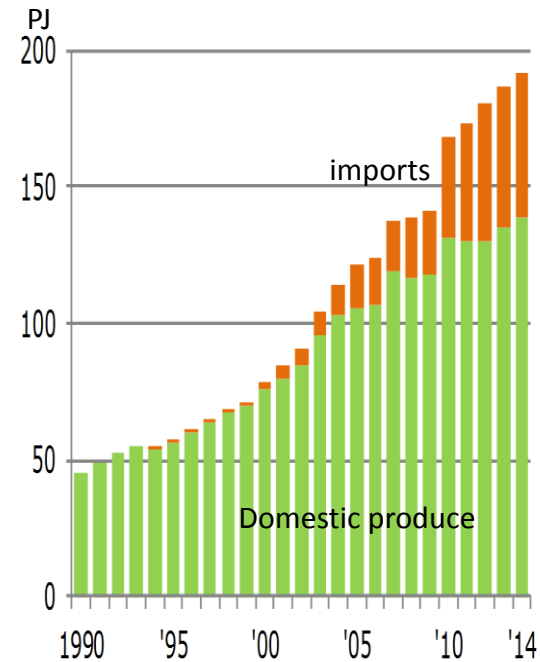
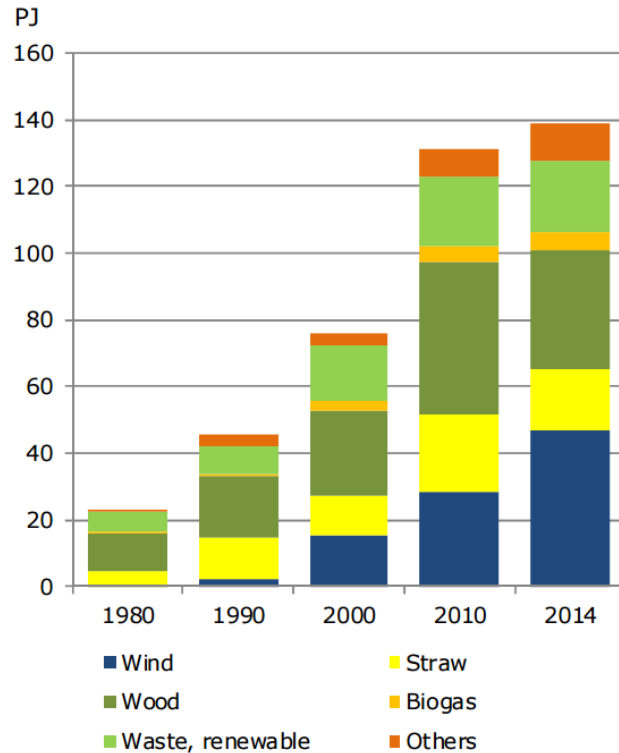
*Government cooperation on strategic energy planning between
Ukraine and Denmark*

The race for biomass in Denmark

- These years biomass to replace natural gas and coal is very popular in Denmark
 - The main reason is that coal and gas for heat production is taxed – a policy incentive
 - Fossil fuel is cheaper than biomass, BUT
 - Fossil fuel used for heating is heavily taxed, biomass is not
 - Fossil fuel + tax is more expensive than biomass
- 3 markets:
 1. Large scale power generation is not feasible today – power price is low
 2. Small scale generation units near end of designed lifetime
 3. Individual heating based on biomass is much cheaper
- This presentation focus on
 - Biomass in the Danish energy mix
 - Recent significant conversion projects

Biomass in Denmark

Renewable energy production by type

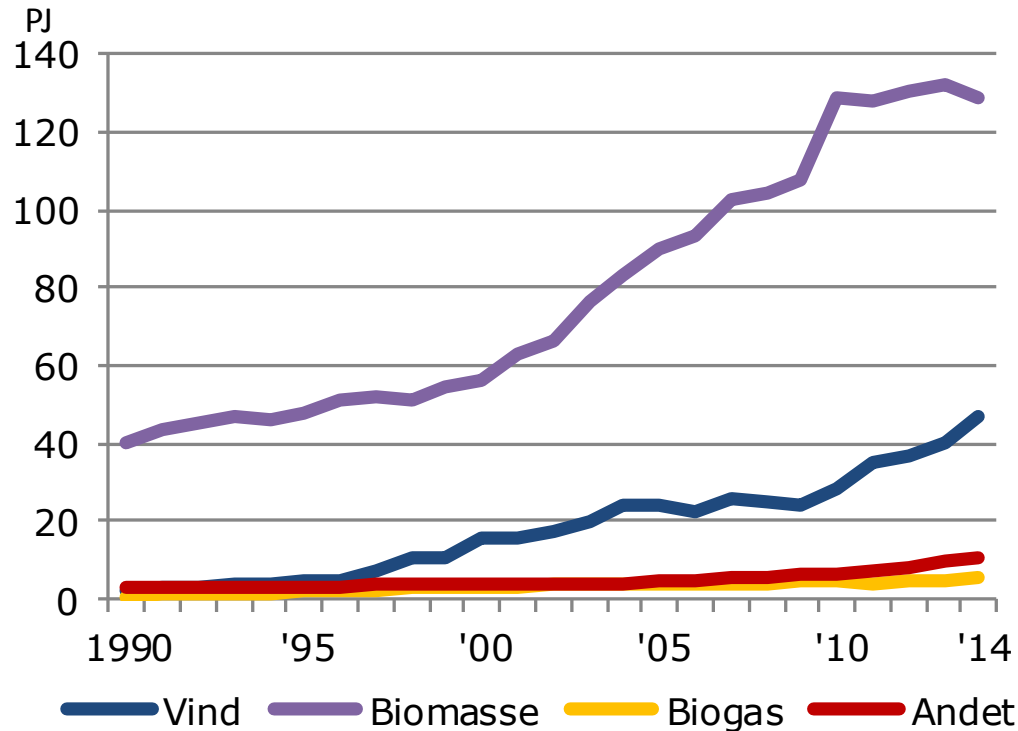


Production 140 PJ + Imports 55 PJ (mainly wood pellets for large CHP plants)

Renewables cover **27 % of total demand** – of which biomass 18 %

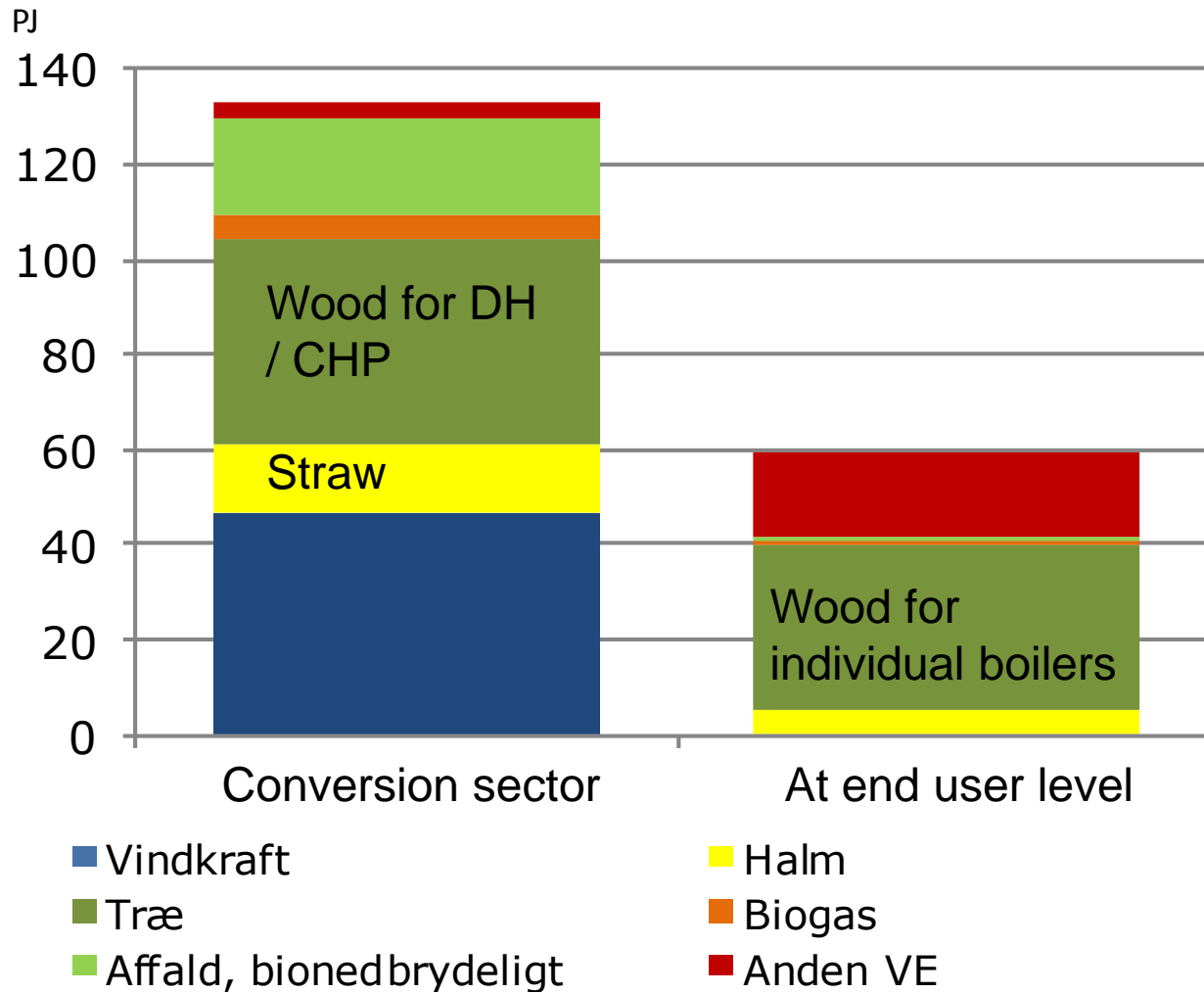
Renewables in Denmark

is not only wind !



Denmark is world famous for large share of wind, but use of biomass is nearly 3 times higher

Consumption of Renewables 2014



Rationale behind investments

- Investments in energy sector are big and lasts many years
- Danish regulation enables coverage of investment in tariff and
- Depreciation over lifetime of technology

- Investment decisions in biomass based heat production are based on lifetime cost analysis and relies on exception of taxation for biomass

- These calculations shows conversion to biomass or replacement with new biomass plant is cheapest

Examples of projects

1. Conversion of large-scale coal fired CHP
2. Conversion of large-scale gas fired CHP
3. New medium-scale biomass CHP
4. Small scale boilers

Studstrup 3

- 350 MWe, 450 MW DH extraction unit, baseload power plant and utilized cooling water to cover 80% of district heat to 2nd largest city Aarhus
- 1984: Built as coalfired unit – design lifetime 30 years. 1.3 mio. tons coal/year
- 1995: Refurbished with deNOx and desulphur equipment
- 2016: 15 year lifetime extension and wood pellets equipment, total investment 175m EUR
- 20% of lifetime extension and 80% of biomass equipment financed by heat company
- New operational regime: mainly following district heat demand as back pressure – power generation on coal only as backup for power system
- Expected consumption 800,000 tons pellets and 140,000 tons coal

Before conversion



First shipload of pellets September 2016



Skaerbaek 3

- 420 MWe, 440 MW DH extraction unit
- 1998: Built as natural gas fired unit
- Low in merit order due to expensive fuel and low value as power generation asset
- 2014-2017 new separate boiler for wood chips and fuel handling equipment, total investment 240m EUR
- NG boiler fully operational as reserve, Biomass boiler to supply steam for existing CHP capacity on biomass is 90 MWe and 320 MW DH capacity
- Same operational regime: supplying district heat as back pressure – power capacity on natural gas still to be offered as peak load for the power system
- Expected consumption 500,000 tonnes chips only limited NG

Visualisation of storage and new boiler



Start of construction 2015



Hillerød - new CHP

- Built for supply of district heat
- 1991: Medium scale CHP natural gas, 71 MWe, 78 MW DH. 80 mio m³ NG/year
- Weak economy due to expensive fuel and fuel tax
- 2014-2017 new CHP plant based on wood chips, total investment 25m EUR
- 4 MWe & 25 MW DH will supply 50% of DH demand
- Existing NG CHP still to supply DH during peak load

Visualization of new bio CHP



Existing NG CHP

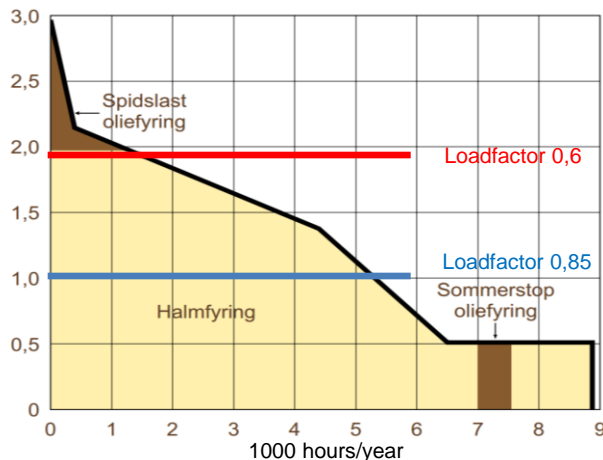


Small scale biomass boilers

- These years all investments in small scale district heating is about biomass, in particular chips

- Approximately 250 small gas engines CHP plants built in the 1990'ies
- Typical size 1-10 MWe and 2-20 MW DH
- Low to average utilization - load factor $\sim 0,6$
- End of the 20-25 year lifetime is near
- Power generation no longer feasible

- Minimum 100 new projects or proposals for biomass
- New smaller biomass boilers with higher load factor
- Very popular due to reduction in consumer prices !



News about recent projects

MØRKØV VARMEVÆRK – NY 1 MW BIOMASSEKEDEL



Mørkøv Varmeværk er blandt de decentrale kraftvarmewærker, der har fået mulighed for at etablere en 1 MW biomassekedel.

Biomassekedelcentralen placeres ved eksisterende kraftva...

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HANSTHOLM VARMEVÆRK – 6,1 MW FLISFYRET KEDELCENTRAL MED RØGGASKONDENSERING OG ABSORPTIONSVARMEPUMPE



Hanstholm Varmeværk etablerer et 6,1 MW flisfyret kedelanlæg (hedtvand) inkl. røggaskondensering og absorptionsvarmepumpe. Værket bestykes endvidere med nødstrømsanlæg samt anlæg for kon...

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SKJERN FJERNVARME – 5,5 MW FLISFYRET KEDELCENTRAL MED RØGGASKONDENSERING



Skjern Fjernvarme etablerer et 5,5 MW flisfyret kedelanlæg inkl. røggaskondensering. Værket bestykes endvidere med nødstrømsanlæg samt anlæg for kondensatrensning.

...

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RY VARMEVÆRK – NYT FLISFYRET KEDELANLÆG MED RØGGASKONDENSERING



Ry Varmeværk A.m.b.a. etablerer et 10 MW flisfyret kedelanlæg med røggaskondensering.

Investeringen er nødvendiggjort i kraft af utdssvarende træpillekedler (ombyggede kulkedl...

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VESTERVIG FJERNVARME – NYT FLISKEDELANLÆG INKL. RØGGASKONDENSERING



Vestervig Fjernvarme A.m.b.a. har etableret et nyt fliskekedelanlæg på 3,5 MW inkl. røggaskondensering.

Fliskekedelanlægget er etableret i ny bygning i forlængelse af eksisterende