

National Biomass Heat Supply Development Strategy

Experience with biomass for heating in
Europe - with focus on the Danish case

Final workshop
10 May 2018
Beijing

Jesper Werling
Ea Energy Analyses

What does Ea Energy Analyses do?

- Private Research and Consulting company based in Copenhagen, Denmark.
- Analyses and modelling of energy systems, energy technologies and measures
 - Analyses of electricity, gas, biomass and district heating systems and markets.
 - Independent - often with a societal perspective
 - Our projects are typically financed by Energy Companies, Utilities, Authorities and R&D funds.
- Bioenergy and China projects
 - Technology catalogues and biomass price projections
 - Switching from fossil fuels – advice for heating companies
 - Integration of bioenergy technologies in the energy system via models
 - Very close co-operation with the China National Renewable Energy Center for several years

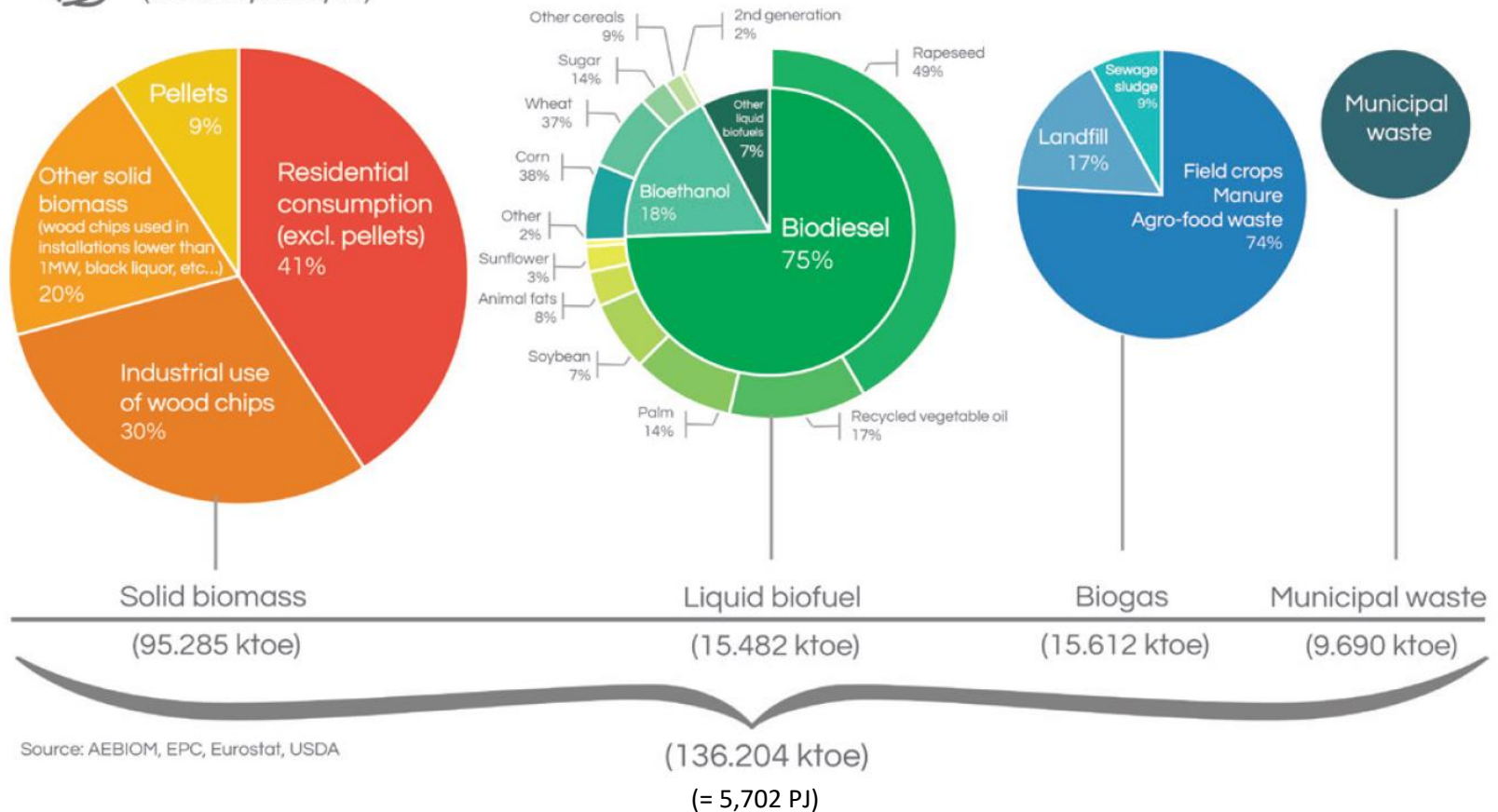


BIOMASS IN EUROPE

Biomass is a very diverse resource



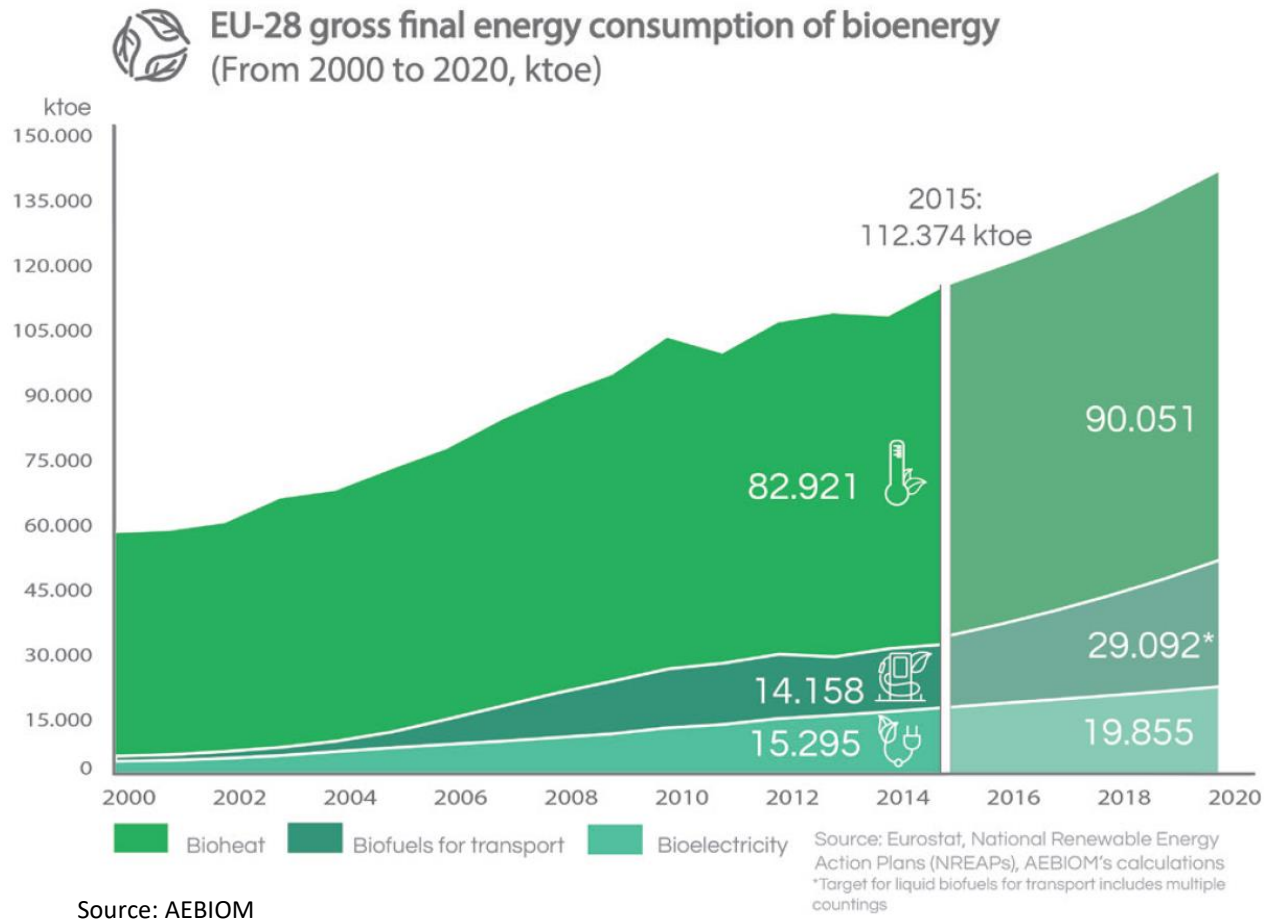
EU-28 gross inland energy consumption of biomass per use and feedstock (in 2015, ktoe, %)



Source: AEBIOM, EPC, Eurostat, USDA

Source: AEBIOM

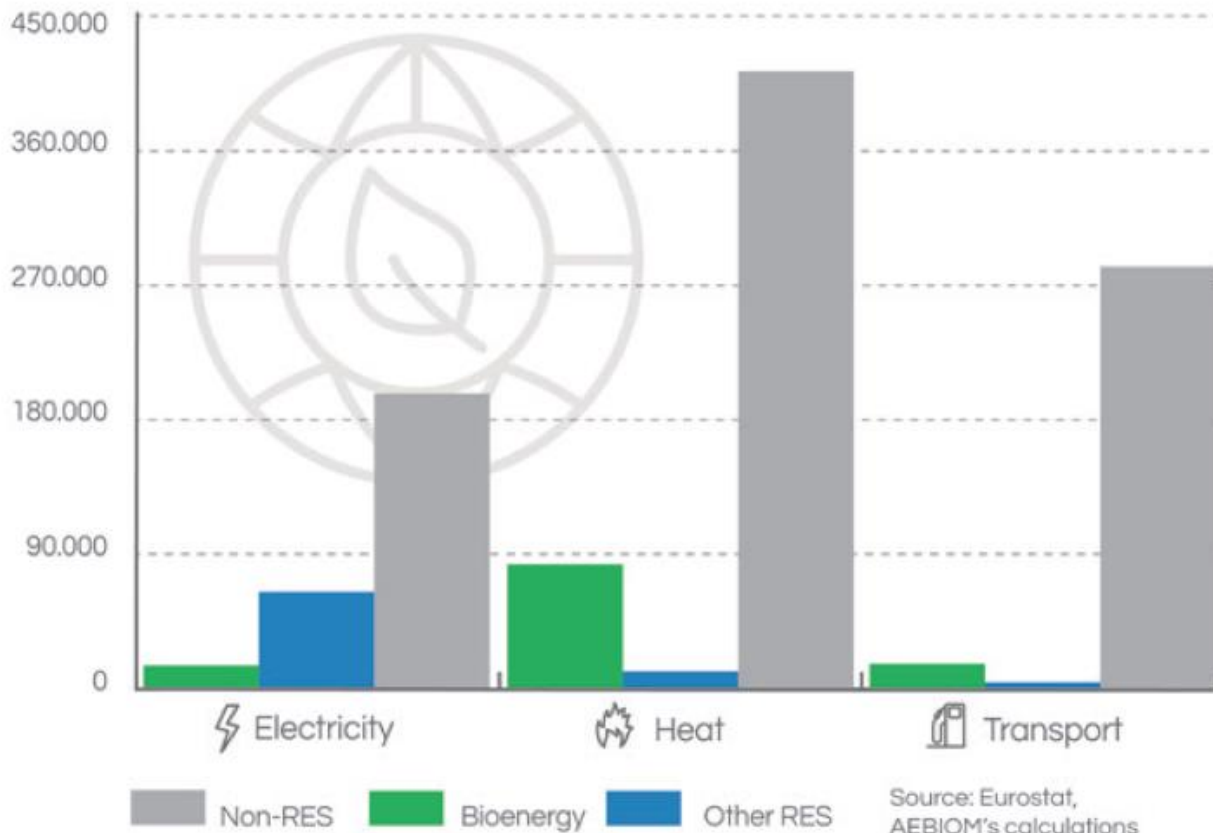
Biomass use almost doubled since 2000



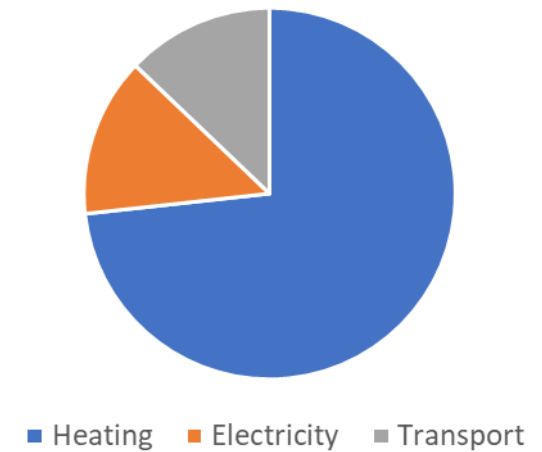
- Biomass use is the result of development over a long period
- Use for transport and electricity is a new development

Main part of biomass is used for heating

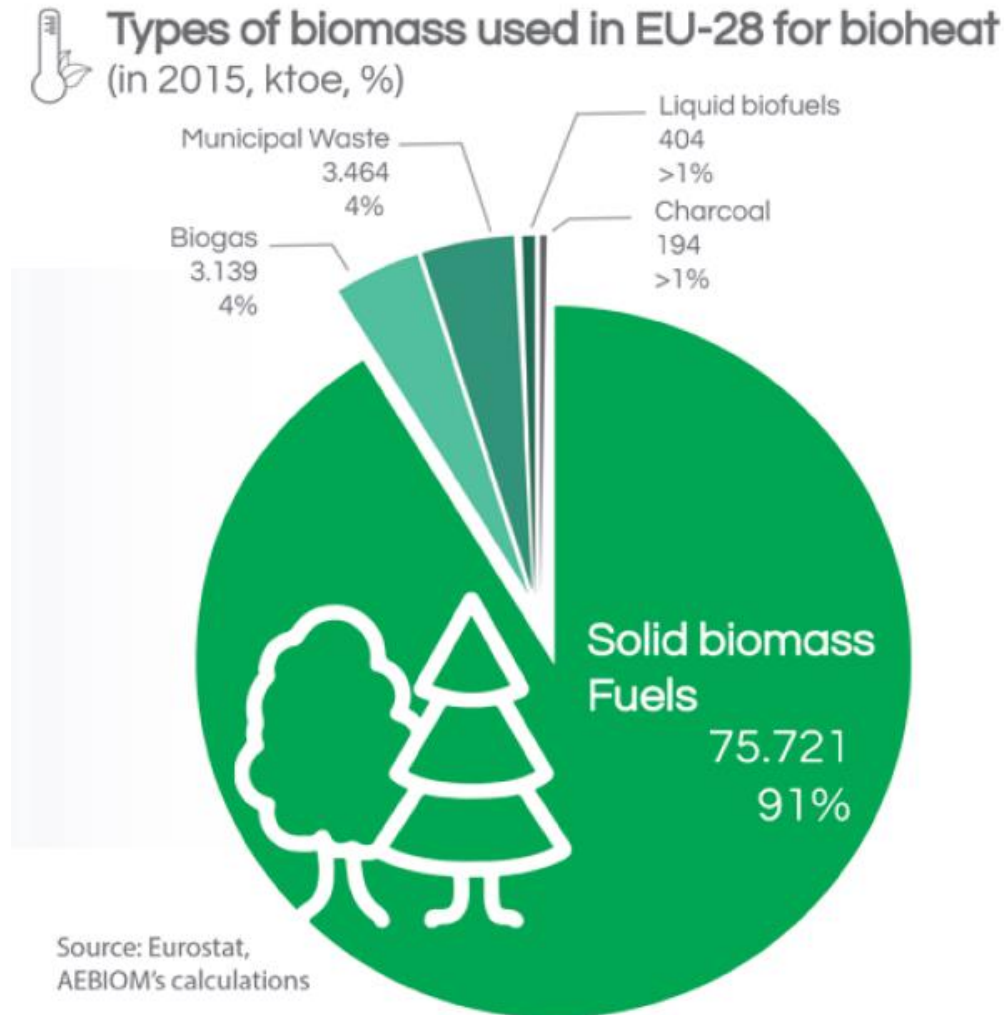

 EU-28 share of energy from renewable sources in the gross final energy consumption
 (in 2015, ktoe)



Biomass per market segment



Wood dominates as fuel for heating

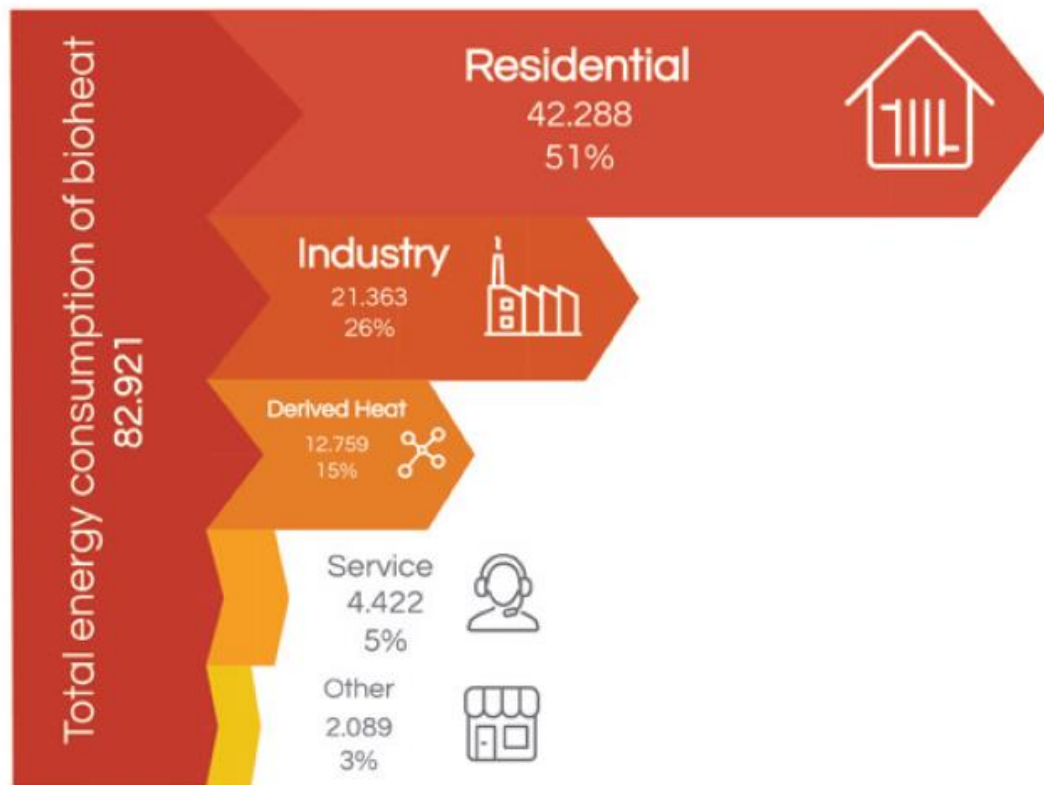


- Solid biomass is by far (91%) the first source of fuel used for bioheat, most of it being woody biomass.
- Limited use of agricultural residues for heating in Europe – only in some countries (e.g. Denmark)

Source: AEBIOM

Bioheat by sector in Europe

 EU-28 gross final energy consumption of bioheat
(in 2015, ktoe, %)



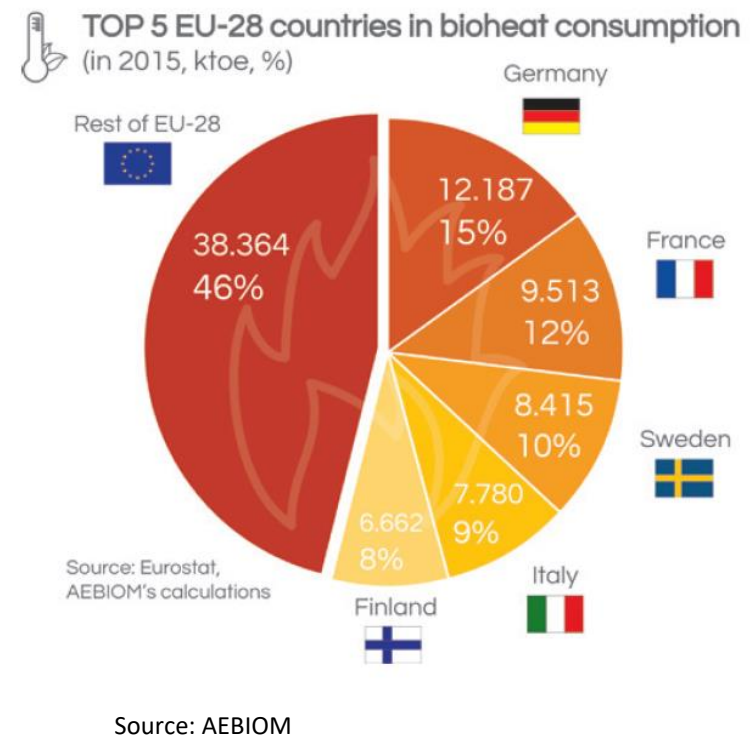
- Biomass for heating in residential sector is dominating
- The second and third most important sectors are industry and district heating

Source: Eurostat, AEBIOM's calculations

Source: AEBIOM

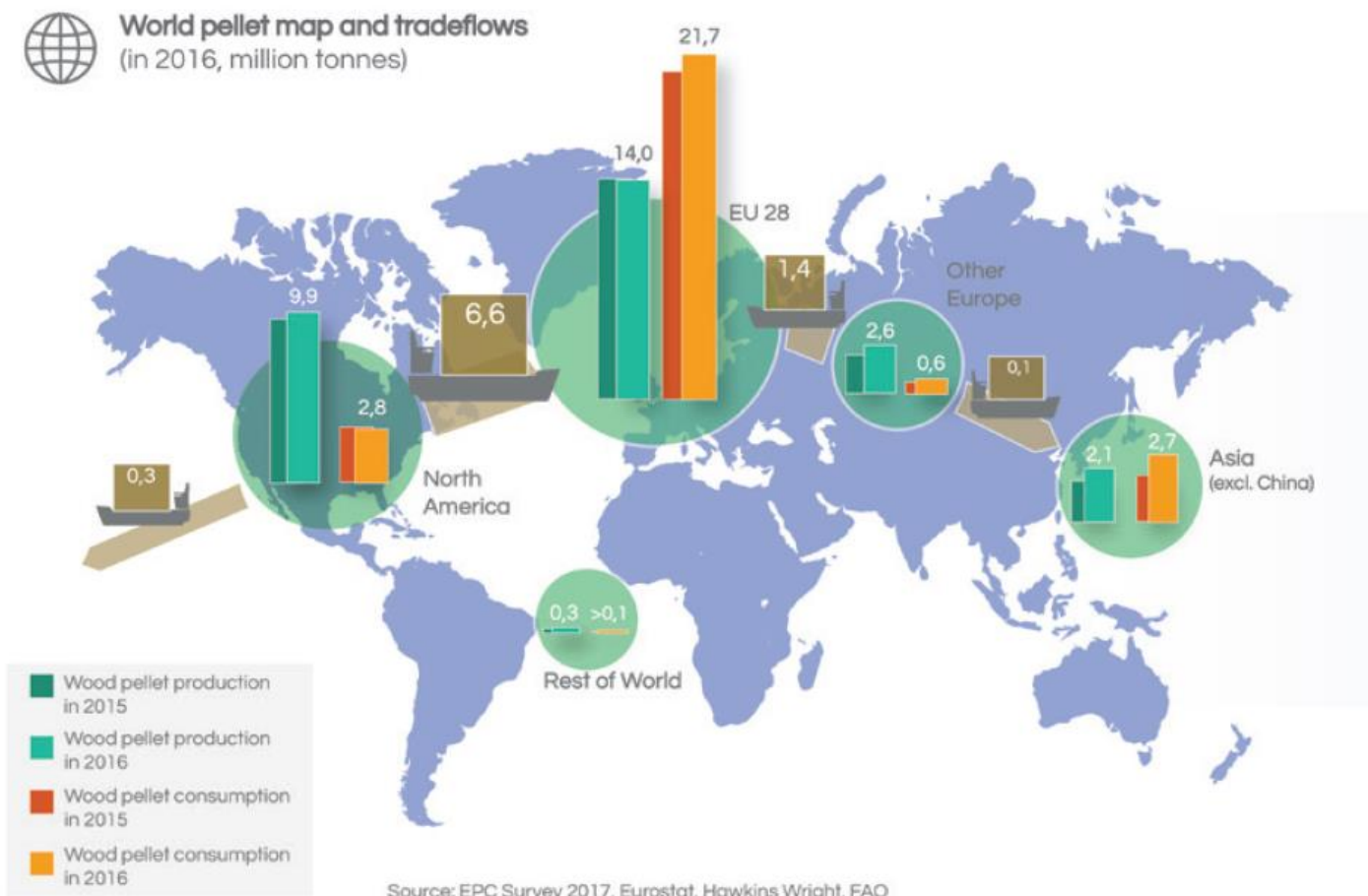
Biomass used for heat in different sectors across Europe

- Residential
 - Germany, Italy, France, Austria
- District heating
 - Denmark, Sweden, Lithuania, Finland
- Industry
 - Belgium, Finland, Ireland, Portugal, Sweden, Slovakia



Wood pellets are traded internationally

Other fuels are mostly sourced locally



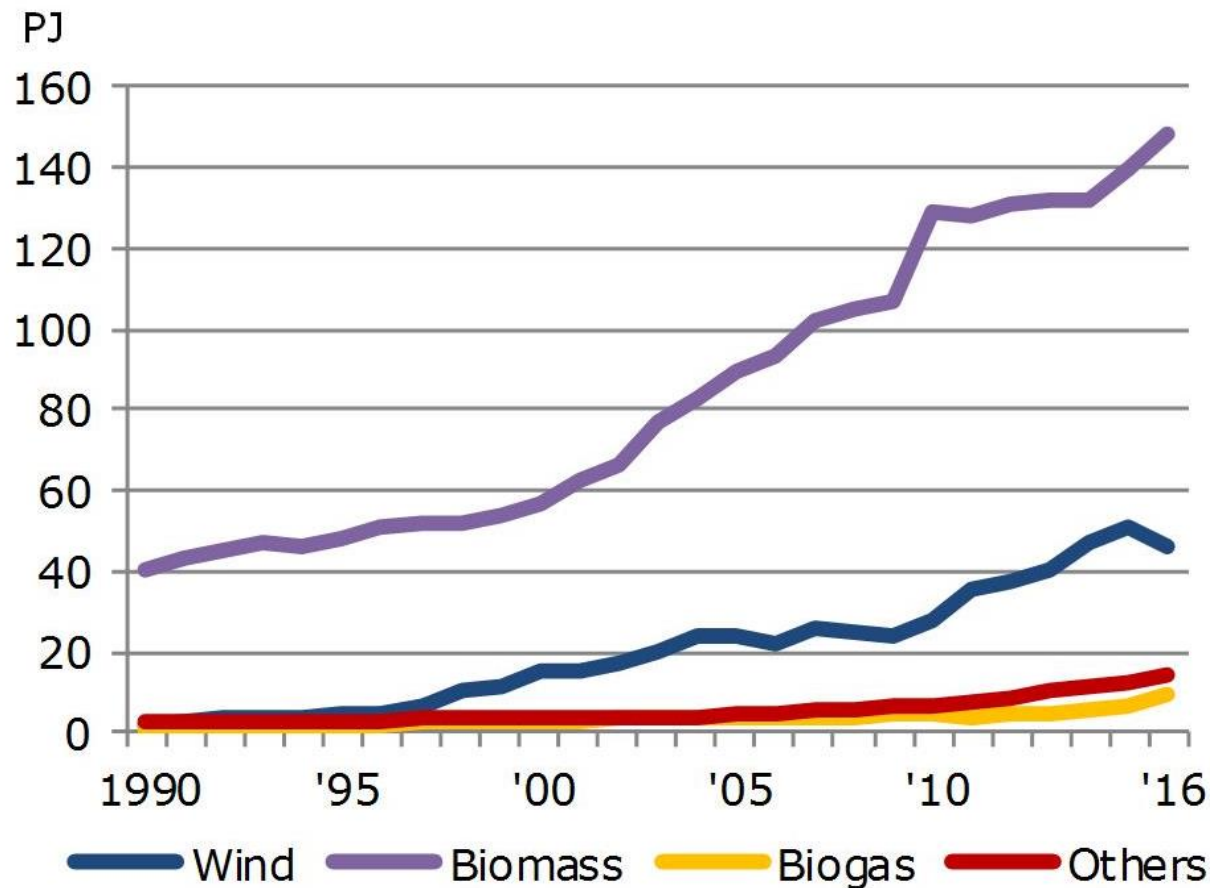
Source: AEBIOM

Sustainability issues

- Biomass is a limited resource and it should therefore be used intelligently
- In Europe increasing focus on sustainability of biomass
- Important issues:
 - CO₂-emissions (carbon balance)
 - CO₂-emissions in production
 - Indirect land-use
 - Biodiversity, safety, social rights
- Residues are normally considered as sustainable
- 4 countries have national sustainability criteria: UK, Holand, Belgium (by law) and Denmark (voluntary agreement)
- The EU Commission has proposed to introduce legally binding sustainability criteria for all EU countries from 2021

FOCUS: BIOMASS FOR HEATING IN DENMARK

Renewable energy in Denmark - consumption

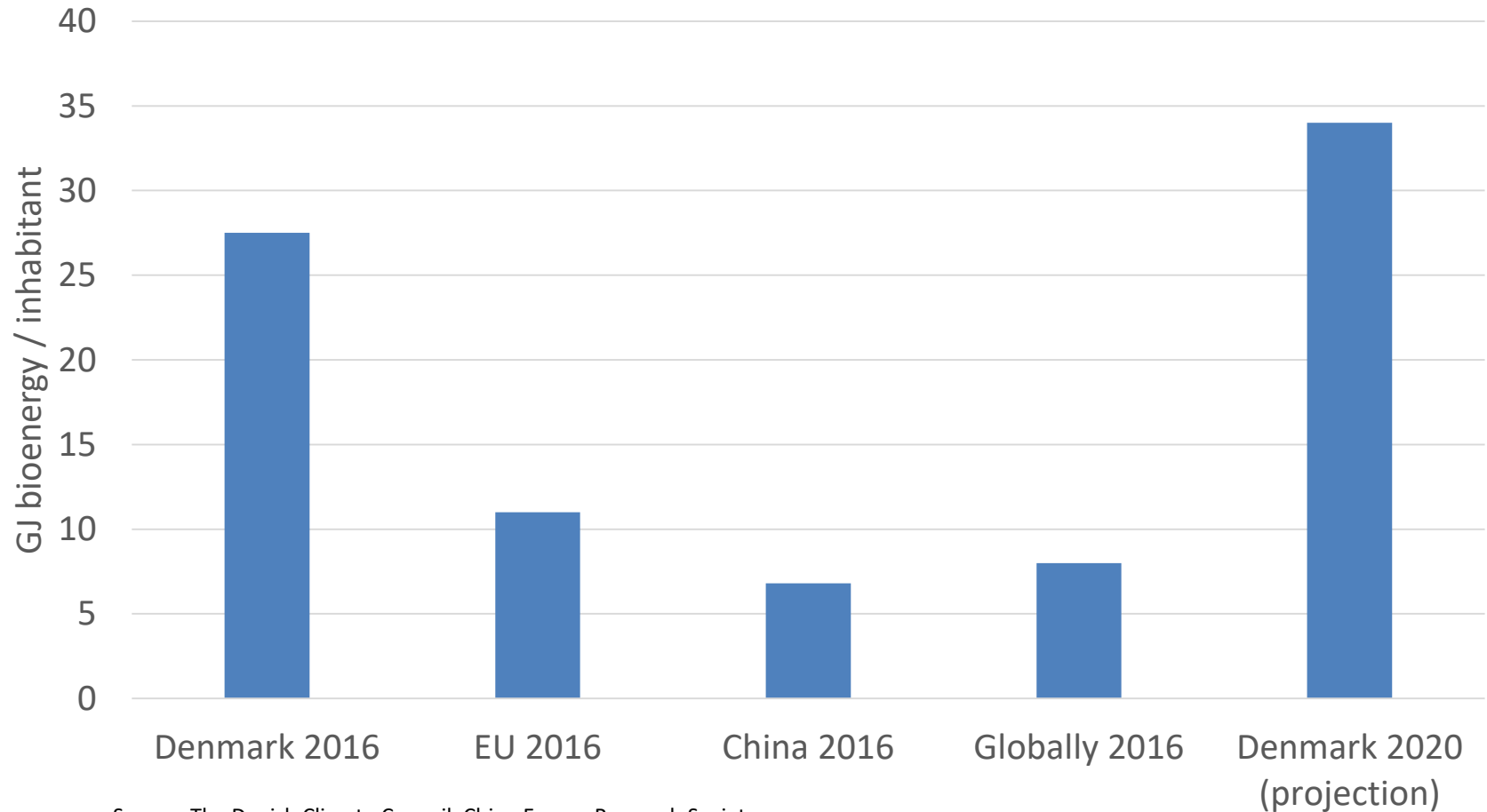


Source: Danish Energy Agency

- Biomass is by far the dominating RE source
- Significant rise since in biomass use, especially since 2000

Very high use of biomass in Denmark

Compared to many other countries



Source: The Danish Climate Council, China Energy Research Society

A significant share (43 %) is imported, especially wood pellets and to some extent wood chips

Bioenergy in Denmark - how?

- Ambitious climate and energy policy, starting 1985 with a decision not to use nuclear energy and later adding incentives for biomass and wind
- Based on energy agreements in parliament adopted by vast parliamentary majority, lasting usually two terms
- Instruments are a mix of non-financial regulation and taxes and subsidies
 - 80's and 90's: Agreement with the electricity sector to build out biomass capacity. Technology development on biogas and solid biomass CHP.
 - Since 2000: Electricity sector liberalized, economic incentives: taxes and subsidies. Local plans for RE-development. Mature technologies.
- Present agreement from 2012 includes a vision of an energy system independent from fossil fuels by 2050
 - Scenarios include biomass combustion as important, temporary step to develop a fossil free energy system

Bioenergy in Denmark - where?

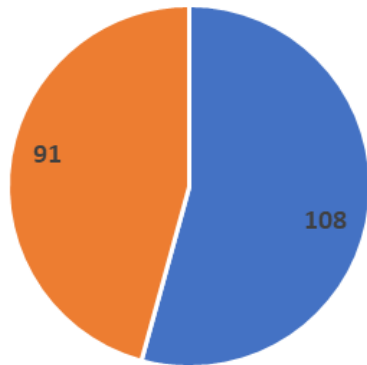
- Large utilities: Central CHP plants
 - Retrofit and new plants
 - pellets/chips/straw
- District heating plants: CHP/heat only
 - chips/straw/pellets/biogas
- Industry: CHP steam cycles/heat only
 - chips
- Public/private service
 - pellets/chips
- Private consumers
 - pellets/firewood/straw



Sources: DONG Energy,
nbe.dk, HOFOR, HWAM

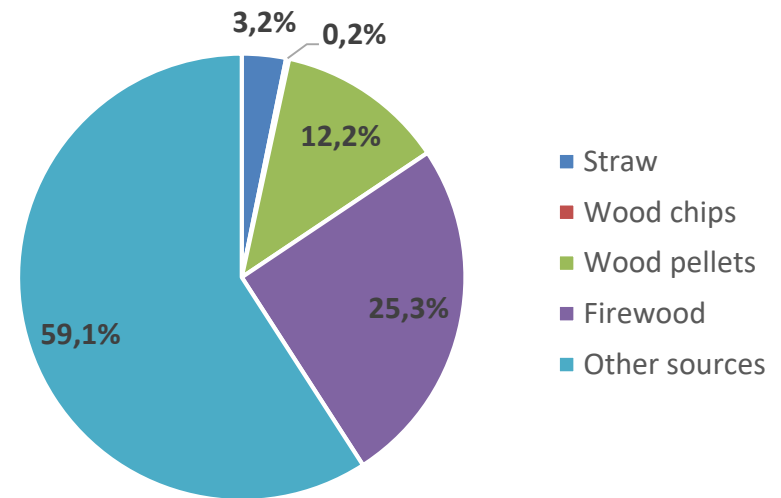
Heating in Denmark

Final heat consumption (PJ)



■ District heating ■ Individual heating

Individual heating

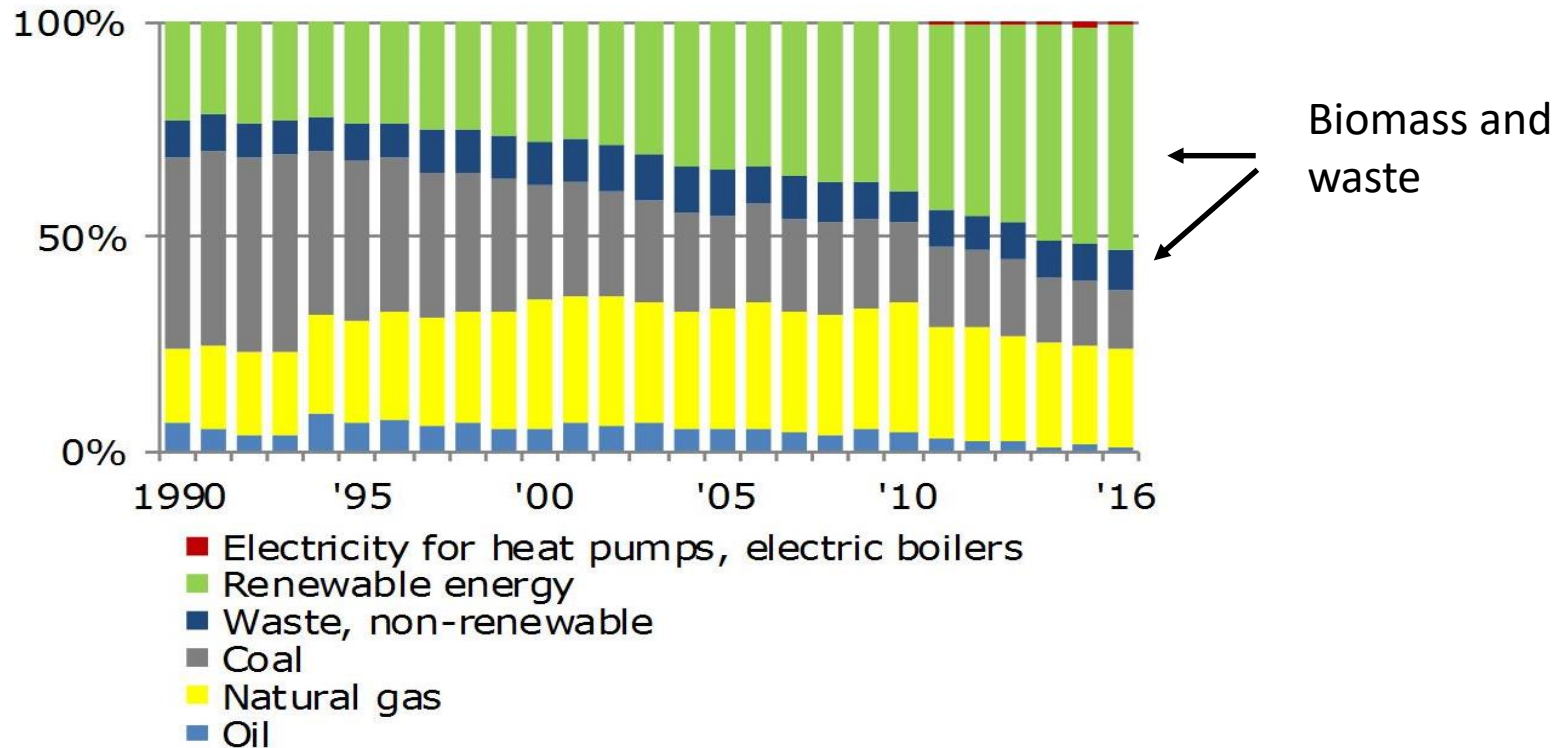


Source: Danish Energy Agency

- High share of district heating (54 %)
- Biomass account for 41 % of individual heating
- Firewood and wood pellets dominate for individual heating



District heating: Large increase in biomass use

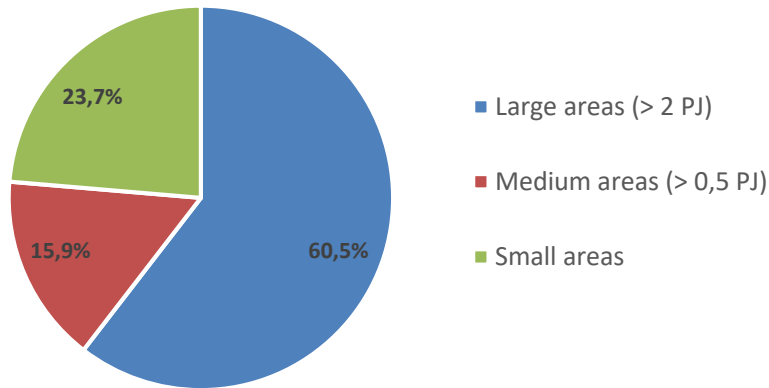


Source: Danish Energy Agency

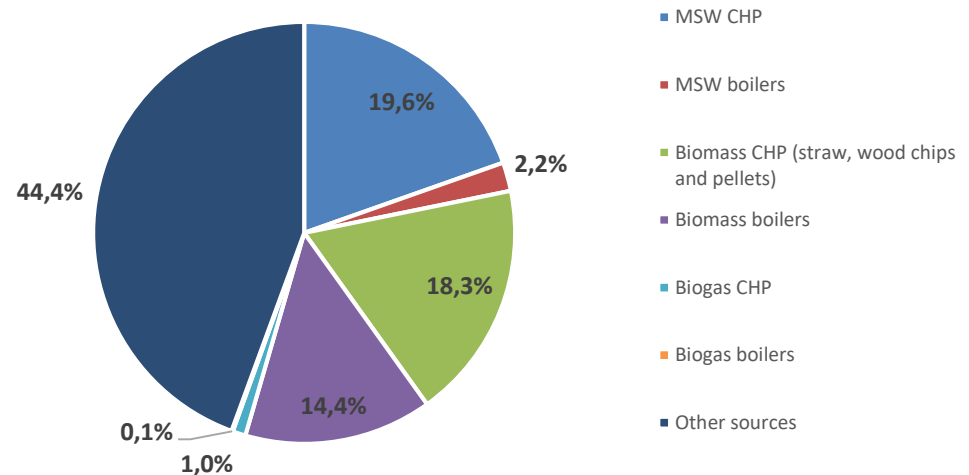
Biomass expected to increase even further in the coming 3-4 years

District heating in Denmark

District heating production 2016



District heating production 2016



Source: Danish Energy Agency

- More than 400 district heating areas
- Biomass (including MSW) accounts for 56 % of DH production
 - Of this: 14 % straw, 23 % wood chips, 26 % wood pellets, 37 % MSW
- A range different types of biomass fuels and production units used

Biomass district heating production units

Type	Number of units	Power capacity (MW)	Heat capacity (MW)	Average heat capacity (MW)
MSW CHP	32	370	1.044	33
MSW boilers	14	-	142	10
Biomass* CHP	23	811	1.553	68
Biomass* boilers	335	-	1.606	5
Biogas CHP	156	109	142	1
Biogas boilers	24	-	47	2
Total	551	1.366	4.399	8

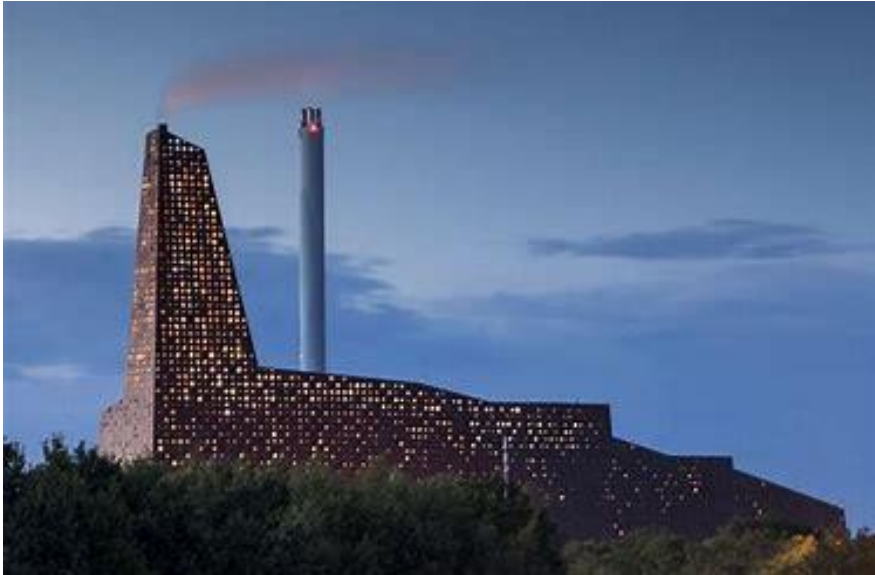
* Here biomass is straw, wood pellets and wood chips
Source: Danish Energy Agency

Currently 4 more large plants are being converted to wood pellets and wood chips which will increase the capacity over the next 3 years.

Biomass DH technologies in Denmark

- Large plants, mostly CHP
 - Co-firing coal with straw
 - Retrofit of pulverized coal to wood pellets (up to 100 %)
 - Indirect co-firing with separate grate fired boiler (wood chips straw)
 - Parallel lines of grate fired boilers
 - CFB – coal and straw, wood chips under construction
 - Retrofit of older coal boilers to wood chips (and wood pellets)
- Smaller plants
 - Grate fired – straw, wood chips
 - Gasification and engine
 - Biogas
 - ORC
- Development
 - Gasification (small and large)
 - Stirling engines

Case: ARGO MSW plant



- Supplies Roskilde and Greater Copenhagen
- 2 separate CHP units (1999 and 2014)
 - 30 MW electricity, 100 MW heat
 - Fuels: MSW, imported industrial waste, other types of biomass – yearly 260,000 tons
 - Grate fired boiler

Case: BIO4 wood chip plant



- Supplies Greater Copenhagen with heat
- 500 MW_{th} wood chips CFB boiler
 - 150 MW electricity
 - 400 MW heat
 - Flue gas condensation => very high total efficiency
- Expected yearly use of 1,2 mio. tons of wood chips – mostly imported
- In operation 2018-2019

Case: Hjallerup district heating plant



- Supplies 2000 heat consumers in the towns of Hjallerup and Klokkeholm
- Heat production based on straw, solar heating and natural gas
- Cheap straw is mainly sourced locally
- 1,8 MW straw fired Linka boiler from 2016
 - Fully automated
 - High efficiency (>90 %)





Thank you!

Jesper Werling - Ea Energy Analyses - +45 6039 1705 - jw@eaea.dk - www.eaea.dk