



Turning Sustainable Biomass into Competitive Bioenergy Solutions

Izumi Tanaka
Royal Danish Embassy
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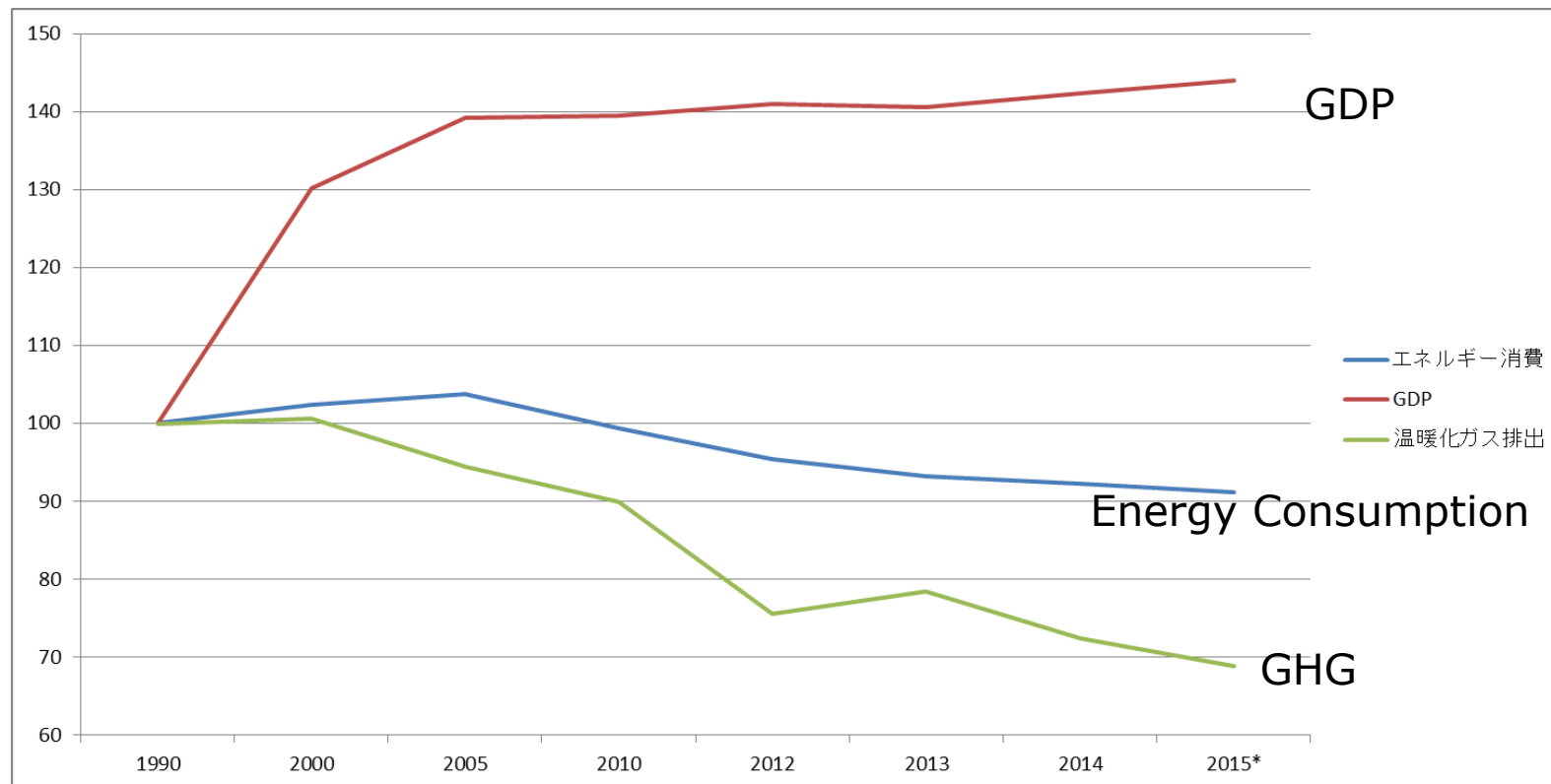


A low carbon society that is independent
of fossil fuels by 2050

(Decided not to utilize nuclear power in 1985)

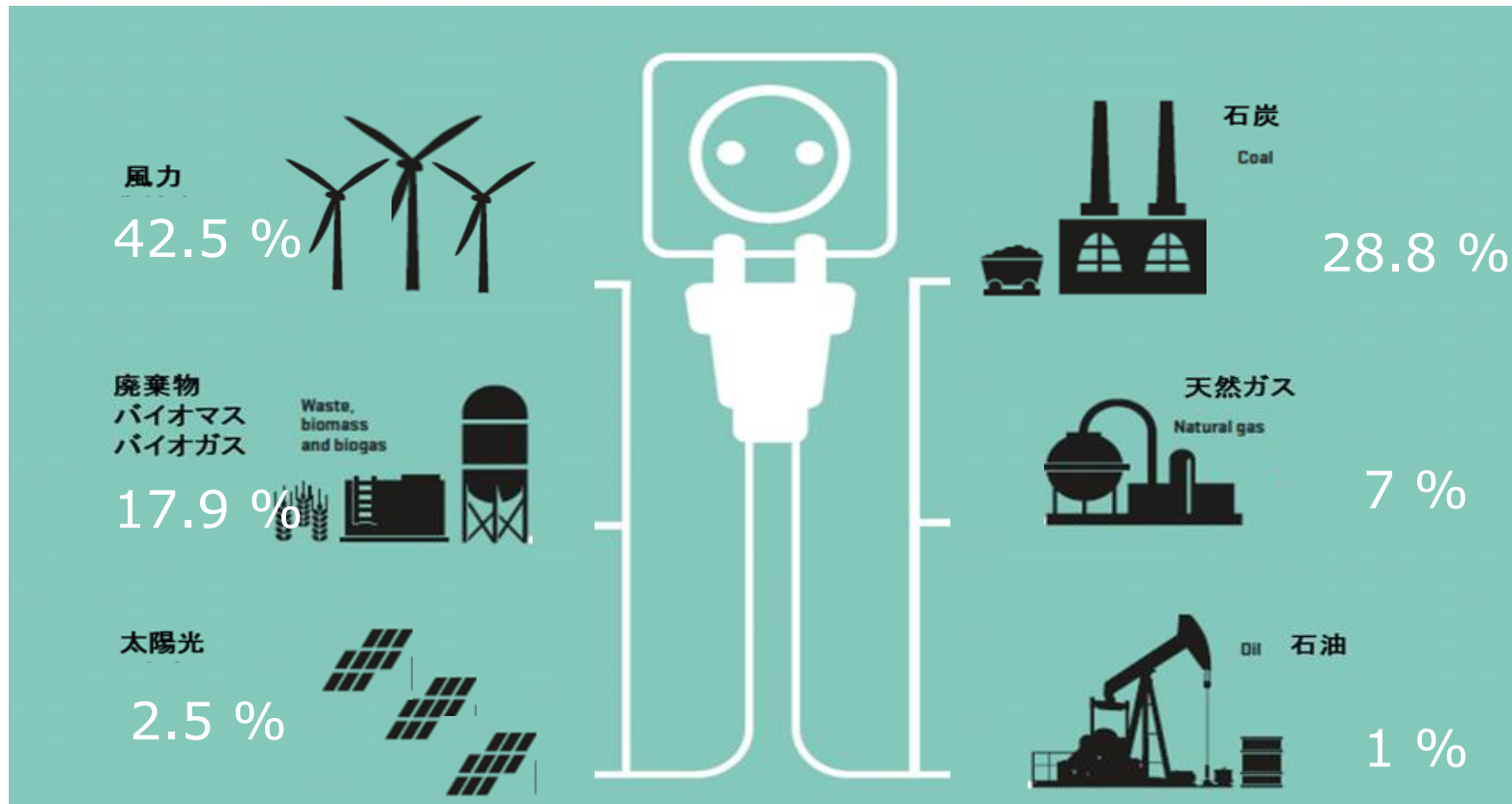


Decoupling of Economic Growth and Energy Consumption / GHG Emission



GDP 2010 価格水準

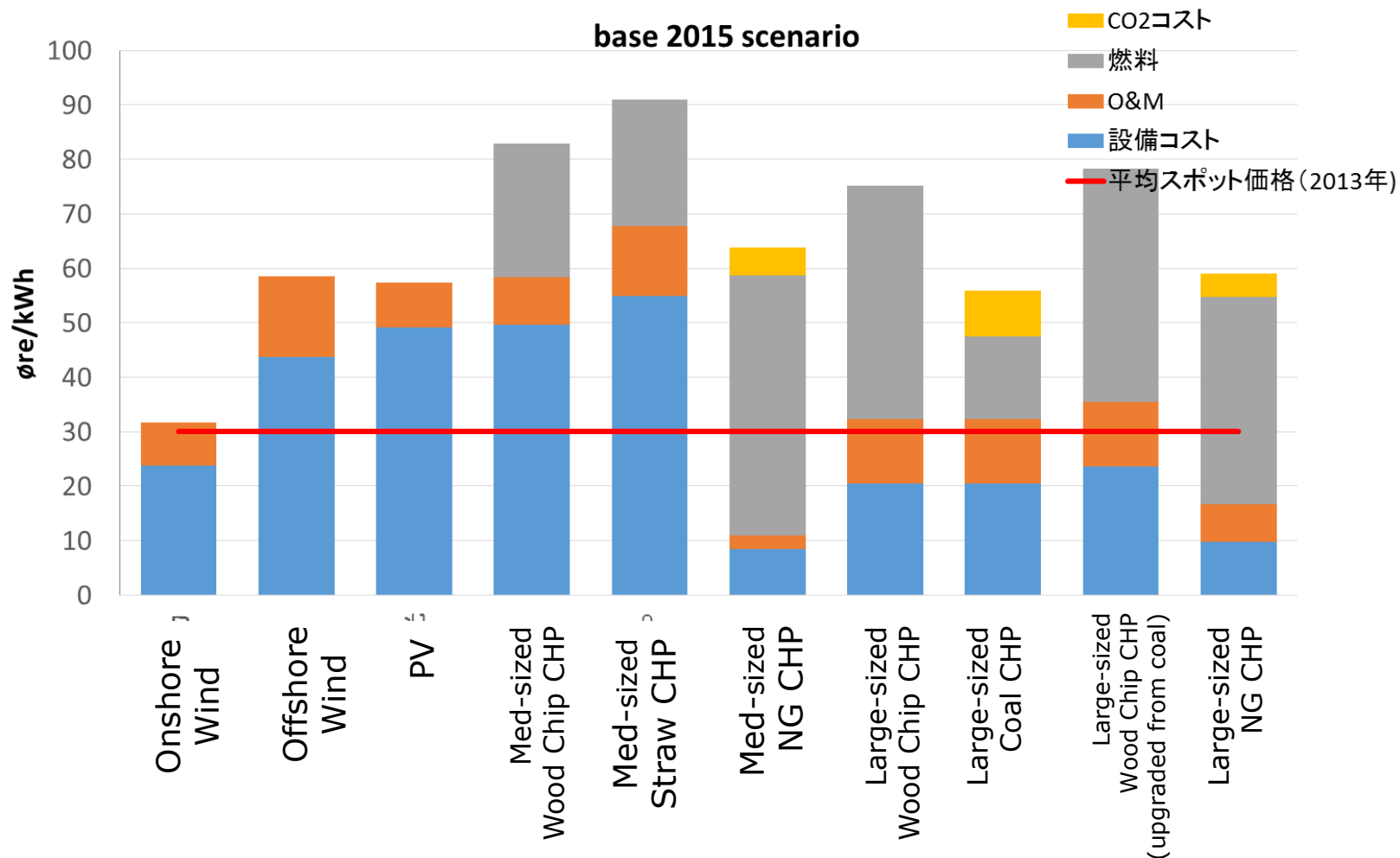
Power Generation (2016)



RE (Wind, Biomass, Solar) = 62.9%

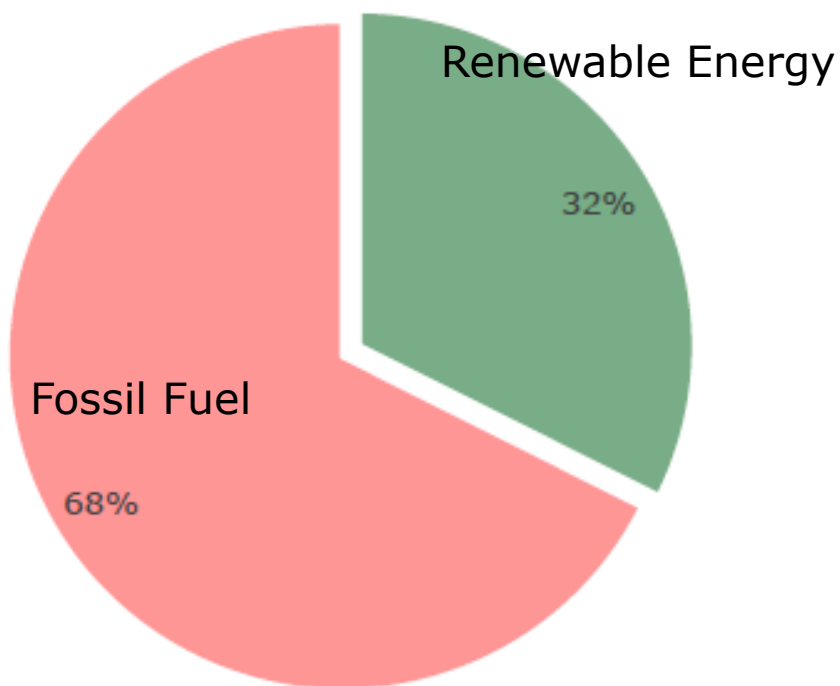


Power Generation Cost (2015)

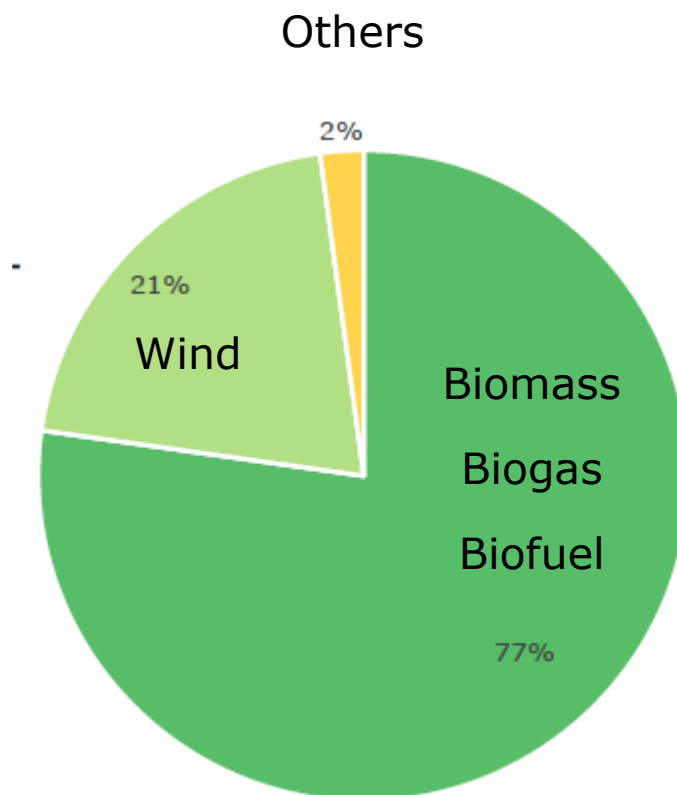




Energy Mix (2016)

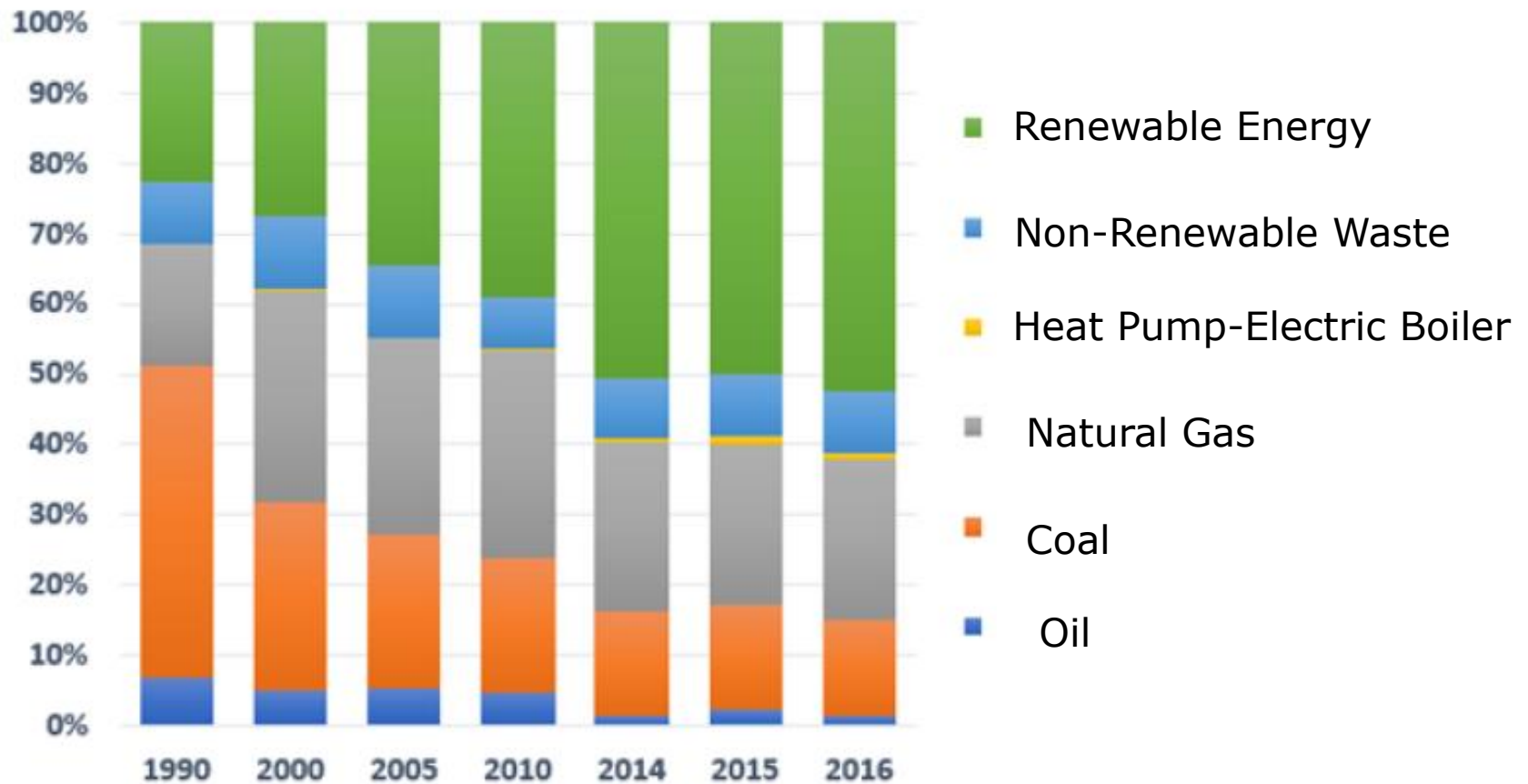


Renewable Energy(2016)





Trend in Source of District Heating



Energy plants

Farm scale Boilers (< 0,5 MW)

- owned by farmers

Farm scale Boilers, heating for neighbours (0,5 - 2 MW)

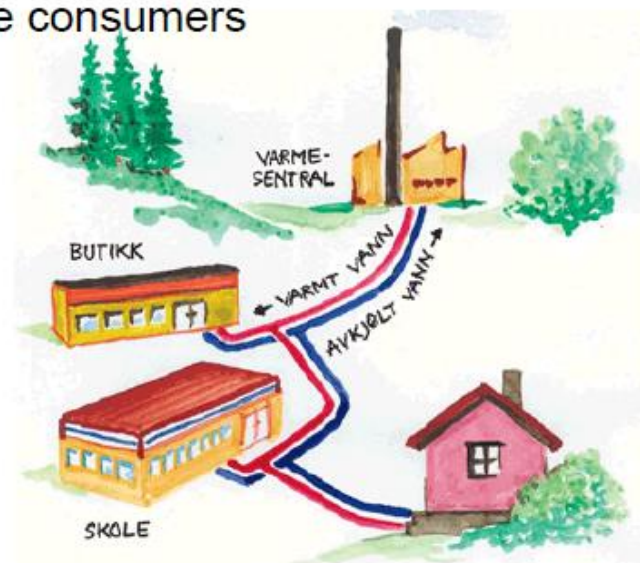
- owned by farmers

Local District Heating Plants (1 - 20 MW)

- owned by groups of farmers and/or by the consumers

Power Plants (> 100 MW)

- Public owned or by companies



Example of a Straw Boiler for Heat Only

Fuel consumption: 8500 ton straw/year/boiler

Energy content of straw = 14.4 GJ/ton

Efficiency of 94 %

Using straw since 1984

7,5 MW boiler from 2006

7,5 MW boiler from 2015

Operating time: 4300 full-load hours/year

Heat storage: 500 m³

400 m² bag filter

500 t ash/year → farmland fertilizer

Total cost including design, engineering, construction and testing: 35 million DKK (boiler ~ 10 million DKK)



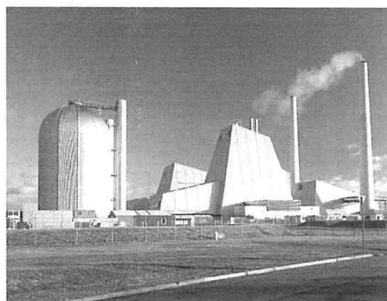
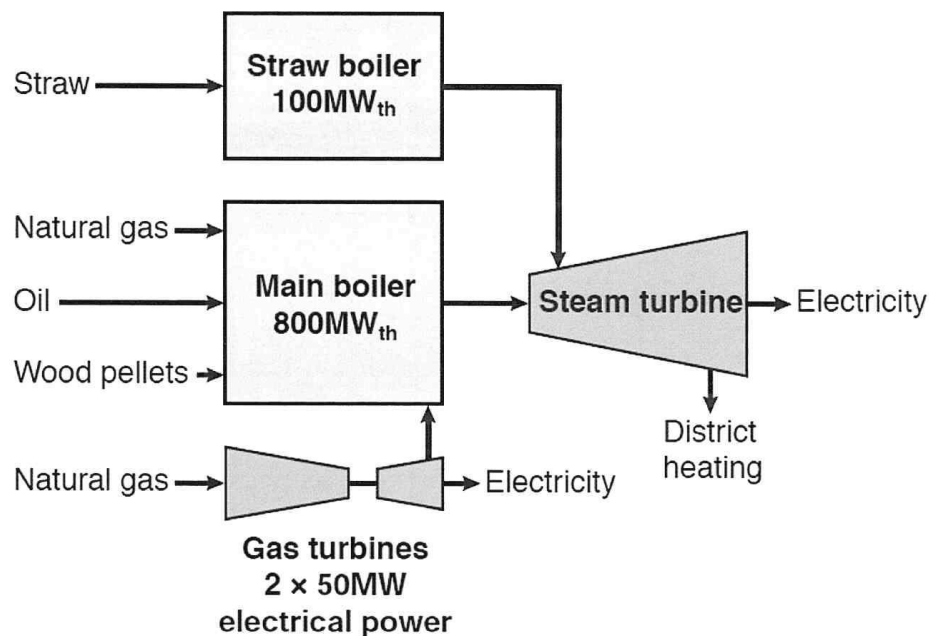
Example of Straw Use in CHP

Avedøreværket unit 2

Also unit 1 will be converted from coal to wood pellets

Data for Avedøreværket (Avedøre 2)

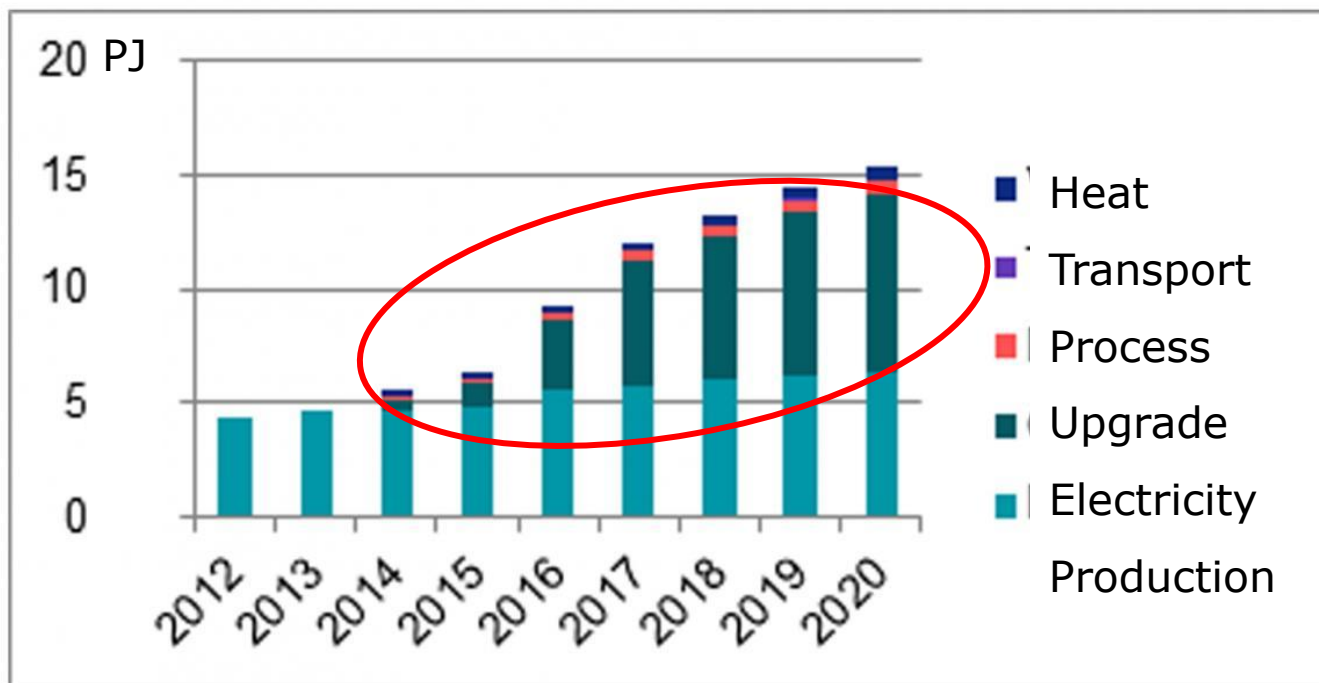
Commercial operation	2001
Supplier of boiler plants	FLS miljø, BWE, Vølund
Fuels	Oil natural gas wood





Biogas in Danish Energy System

Accounted for 18% of all gas consumed in Denmark in July 2018



<https://ens.dk/ansvarsomraader/bioenergi/produktion-af-biogas>



The Danish Approach to Woody Biomass

- Denmark has used biomass sustainably for more than 20 years
- Heating plants have utilised straw, wood chips and wood pellets for efficient heat production since the 1980s.
- Wood pellets used in large CHP plants, largely supplied by Europe and North America* where the forest areas are growing and national legislation ensures sustainable forestry.

* North America alone the growth in forests is 400 million m³ per year. This corresponds to 150 million tons of wood pellets/year, which is 10 times Europe's total consumption per year today.





Biomass Agreement from 1993

- Danish Parliament made an agreement concerning increased use of biomass in the energy supply sector
- Centralised electrical power plants were obliged to buy 1.4 million tonnes of biomass per year, including at least 1 million tonnes of straw
- Resulted in a significant shift towards substituting coal-based CHP plants with biomass-based CHP plants
- Biomass based CHP generation got a higher priority in many local areas, including areas with natural gas





Ensuring Sustainable Woody Biomass

- Ensures sustainable biomass, locally and imported, through a voluntary agreement signed by the Danish Energy Association and the District Heating Association in 2014
- Requires CHP utilities to document sustainability
 - calculations of the carbon footprint in the value chain
 - guarantee that the productivity of the forests by replanting
 - forestry has minimal impact on the ecological system and conserve of biodiversity
 - companies and suppliers have to respect local and national legislation.
- Schemes used: Sustainable Biomass Partnership, FSC and PEFC





Sustainable Biomass Partnership (SBP)

- Industry-led initiative formed by major European utilities that use biomass mostly in the form of wood pellets in large thermal power plants
- Developed a certification framework to provide assurance that woody biomass is sourced from legal and sustainable sources
- Designed as a clear statement of principles, standards and processes necessary to demonstrate such compliance
- FSC and PEFC standards are used when possible



Important Aspects of Biomass in Denmark

- Biomass is a substitution for coal*
- Used significantly in heating
- Ensure sustainability of the source
- Variety of policy instruments used to promote use of biomass

*Phase out coal in power production by 2030



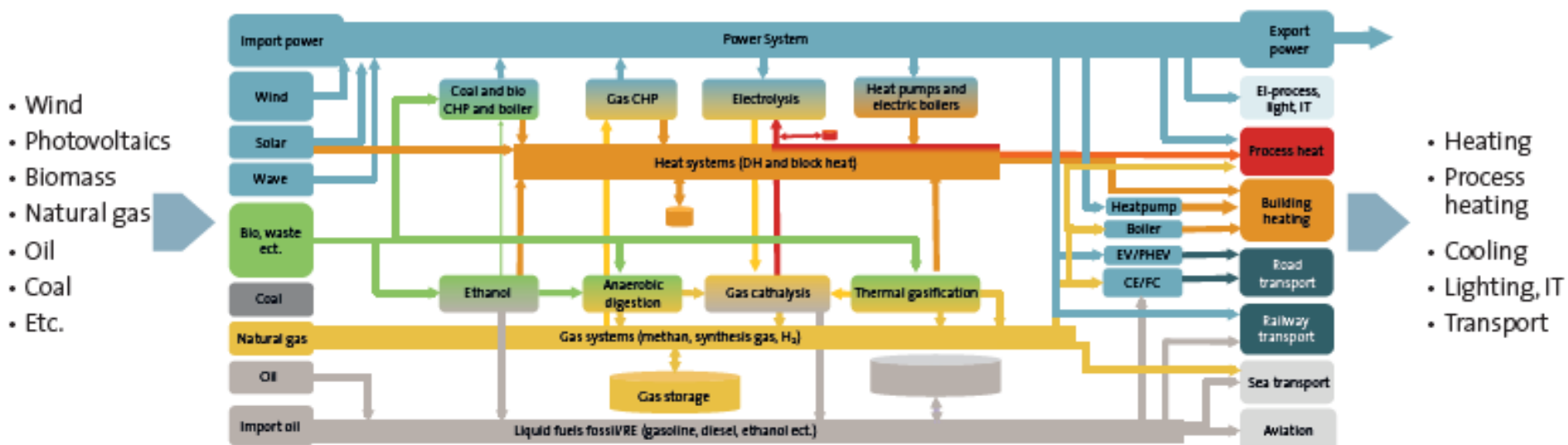


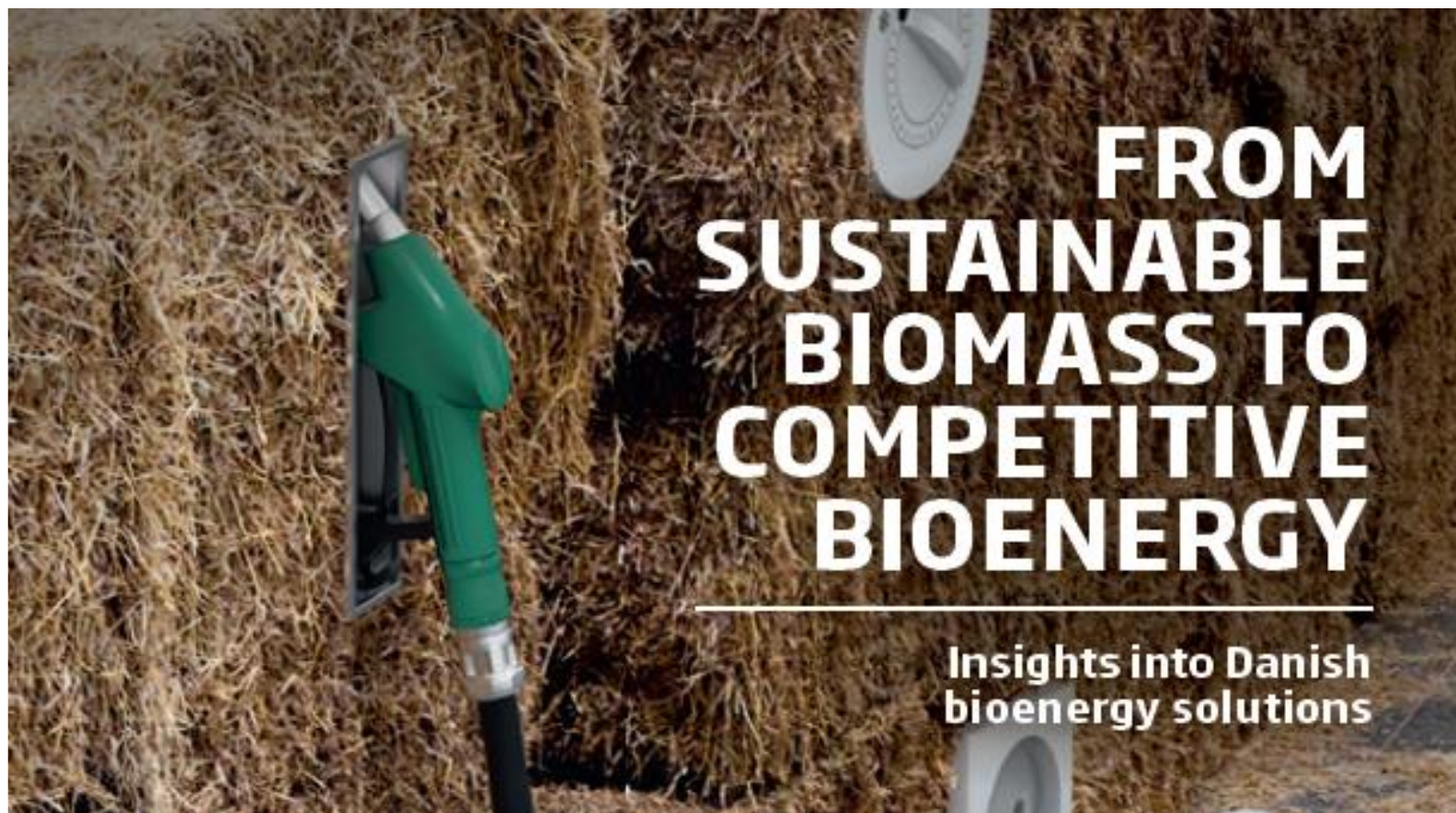
Vision of an Energy System

Energy resource
Sustainable resources

Energy system
Integrated robust and efficient energy system

Energy service
Minimised, stable costs





<https://stateofgreen.com/en/publications/from-sustainable-biomass-to-competitive-bioenergy/>