



BIOENERGY – A BRIDGE TO THE FUTURE ENERGY SYSTEM

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November 2015

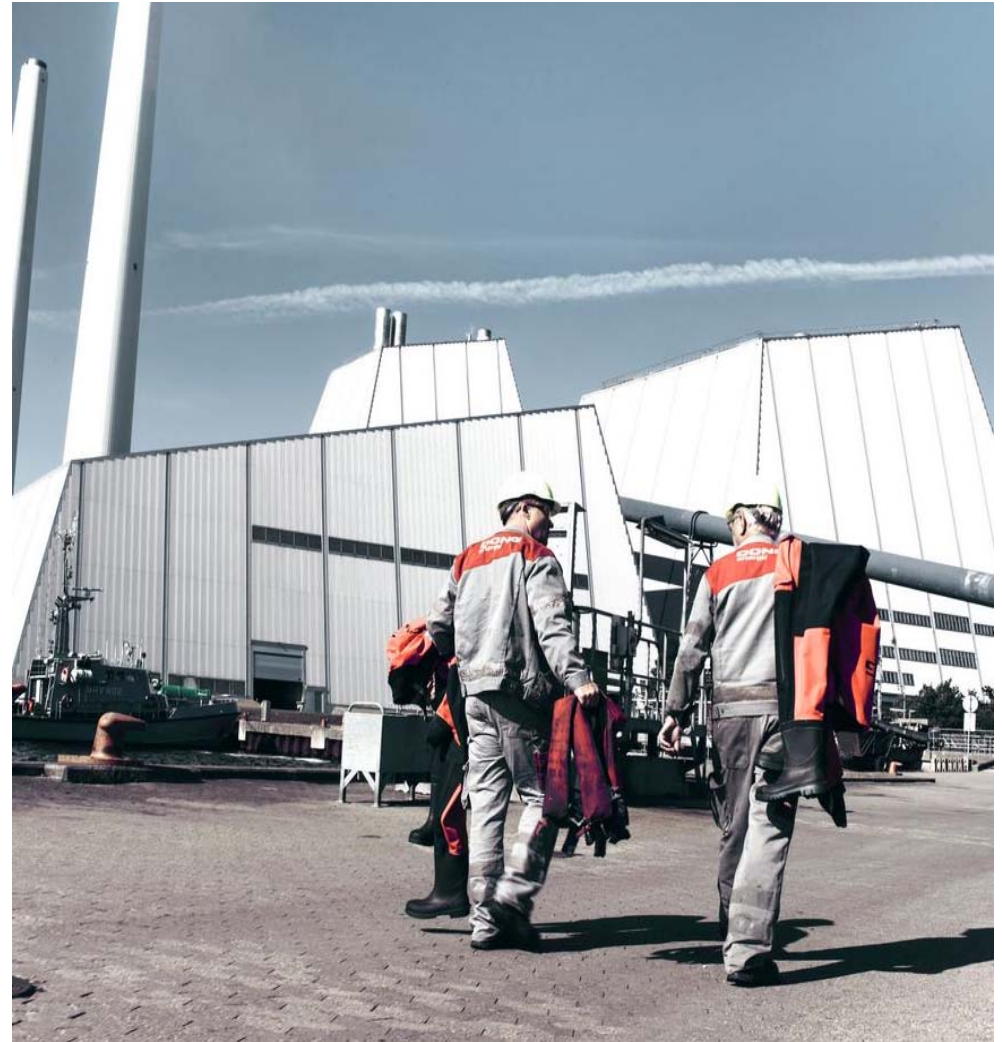
Agenda

1 DONG Energy and market conditions

2 Interconnectors and Powerhub

3 Biomass – Balancing of local market

4 Biofuel – Balancing of local market

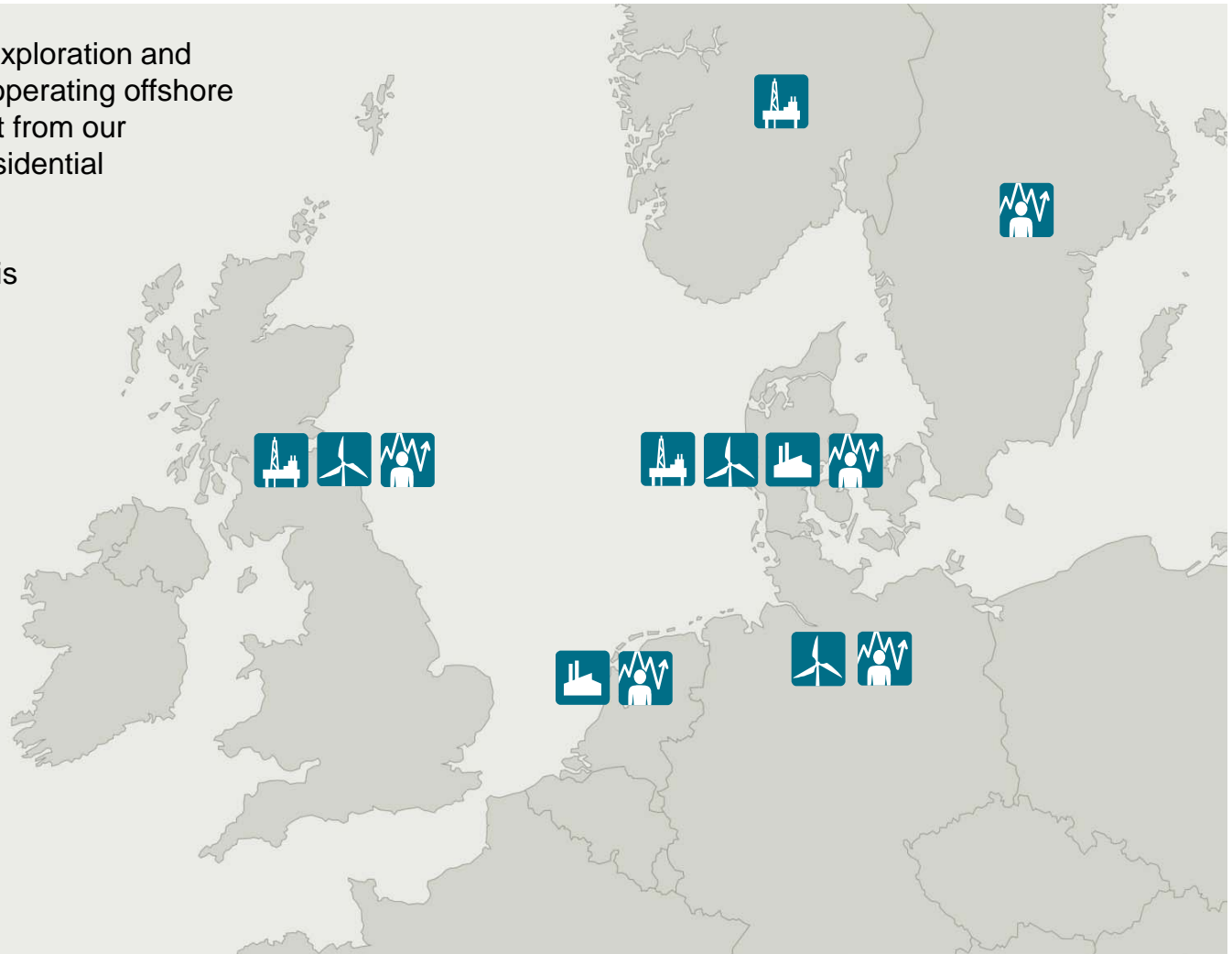


DONG Energy is one of the leading energy groups in Northern Europe

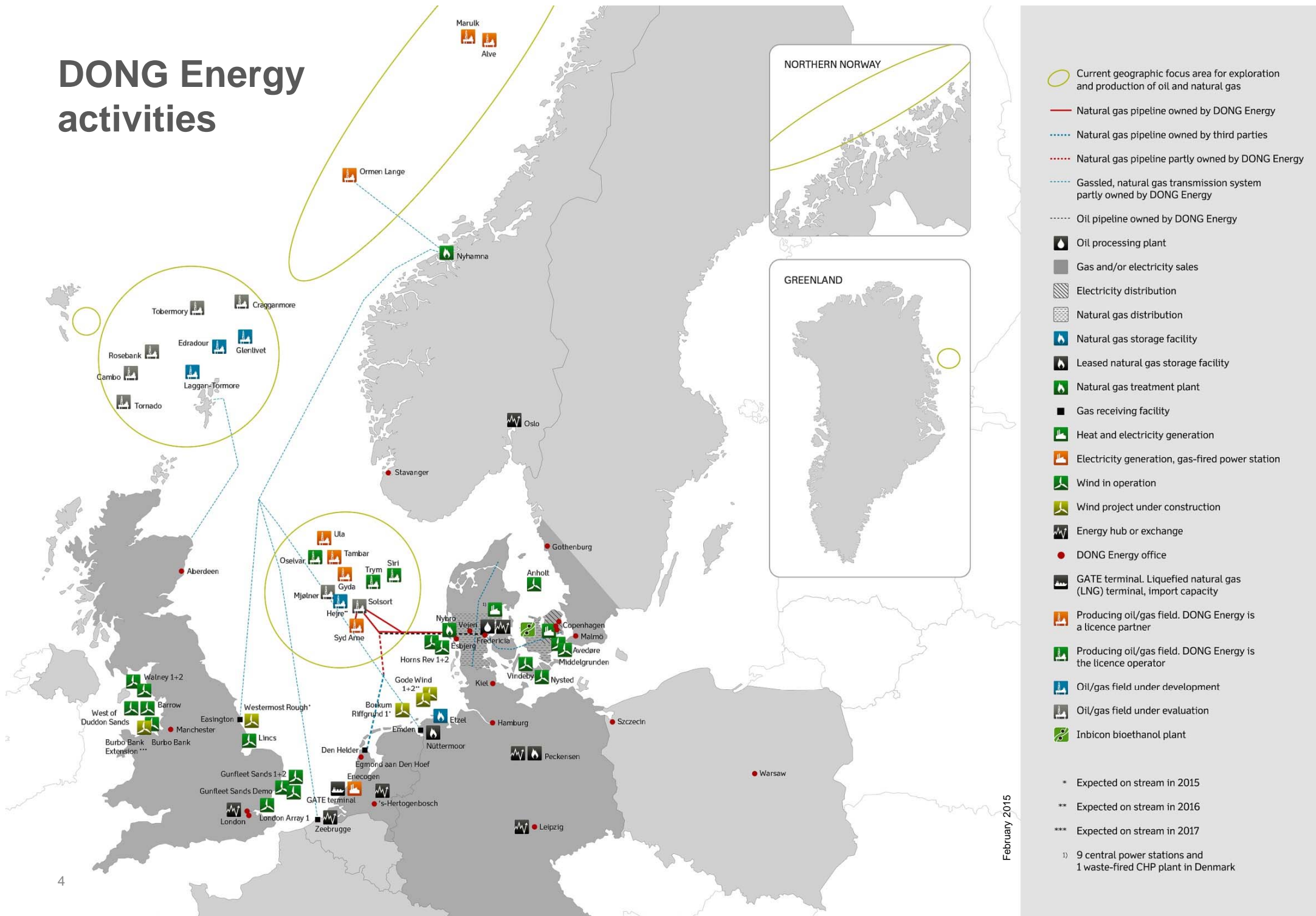
DONG Energy is engaged in oil and gas exploration and production, developing, constructing and operating offshore wind farms, generating electricity and heat from our power stations and providing energy to residential and business customers.

DONG Energy has 6,500 employees and is headquartered in Denmark.

-  **Exploration & Production**
-  **Wind Power**
-  **Thermal Power**
-  **Customers & Markets**



DONG Energy activities

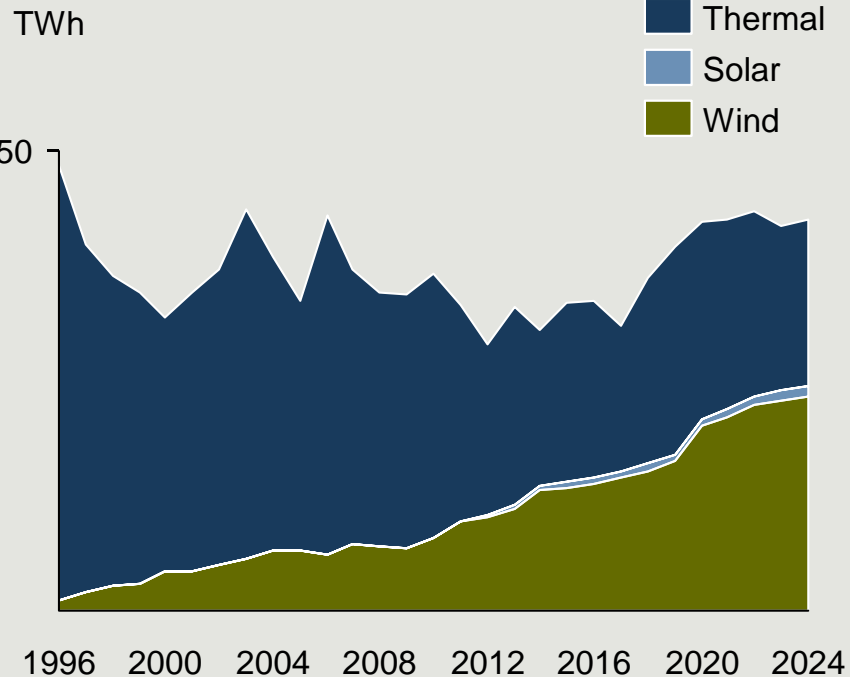


February 2015

Strong build-out of renewables puts pressure on Danish thermal production and prices

The green transition of the Danish power system

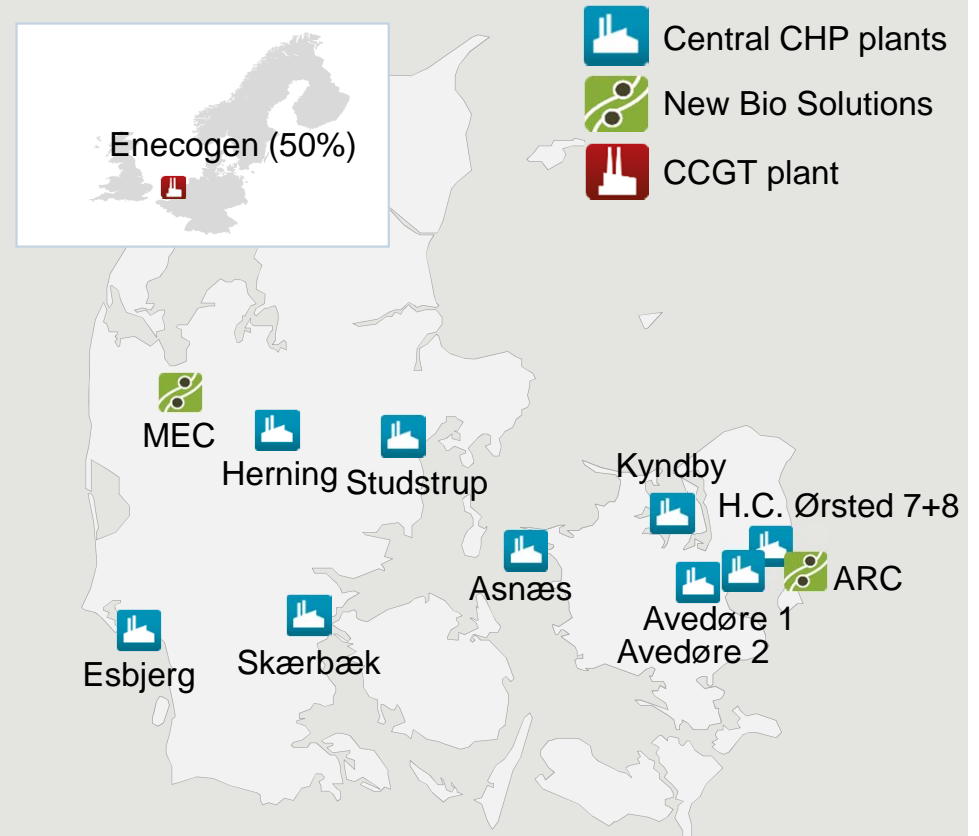
Power production by type



- The Danish power system is undergoing a major transition from fossil fuels to renewable energy. 40% of the capacity has been closed down.

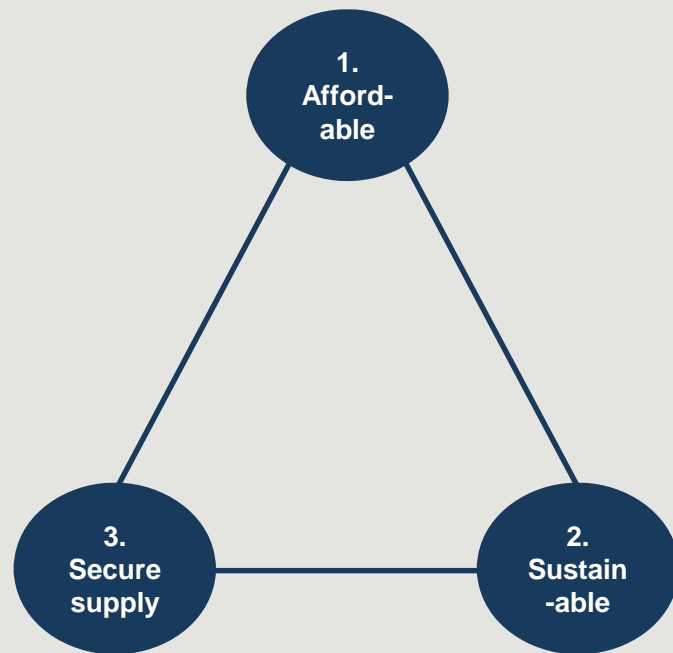
SOURCE: Energinet.dk

Asset base dominated by Danish central CHP plants



Biomass conversions address the full energy trilemma – in a way that other renewables cannot

The European energy trilemma



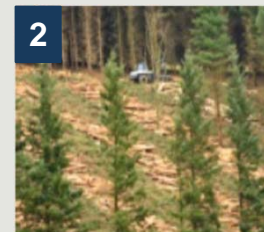
Universal value proposition of biomass conversions



1

Affordable

- Cost-effective CO₂ reductions
- Utilises existing plants and grid infrastructure



2

Sustainable

- Large untapped sustainable biomass resource base
- Resource increase in Europe / NA



3

Secure supply

- Converted power plants can maintain ramp up / down flexibility

- Challenge is to communicate message effectively
- ~100 GW of coal-fired assets in Northern Europe

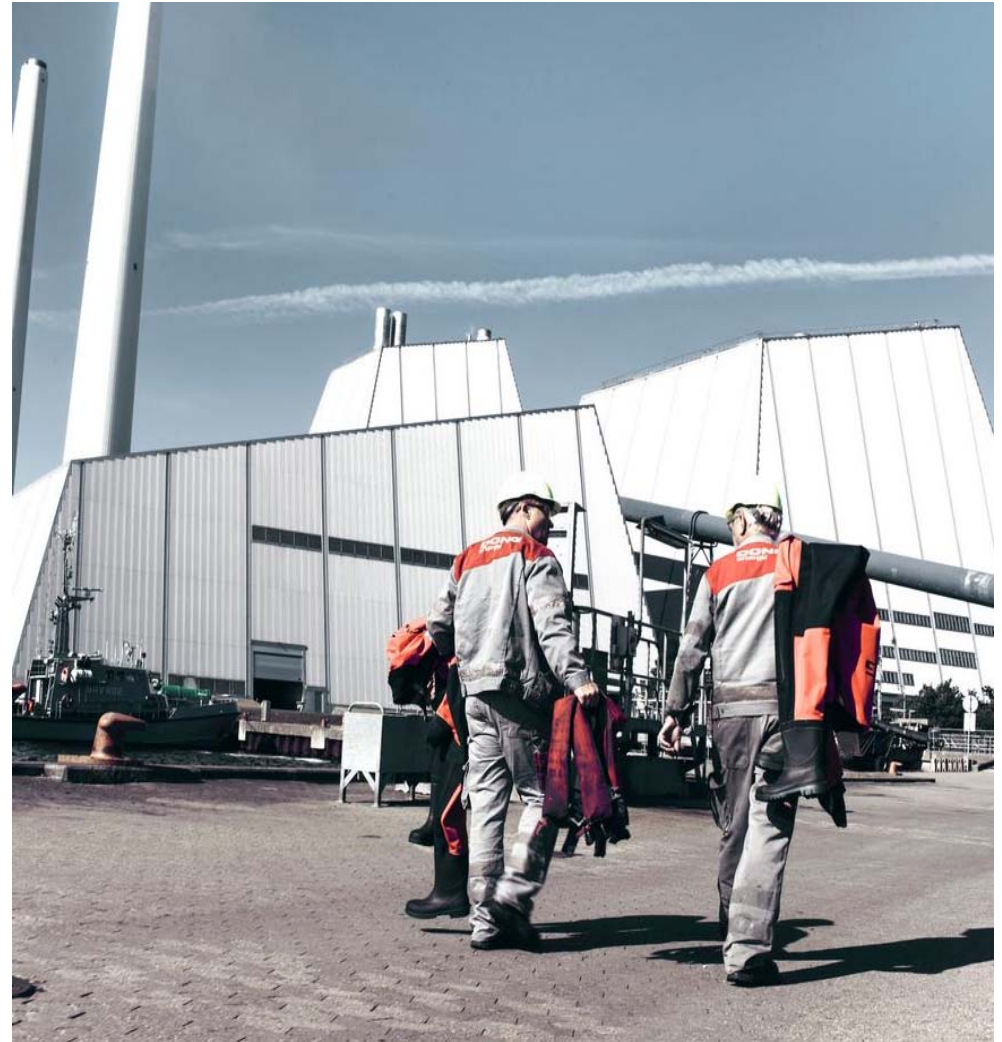
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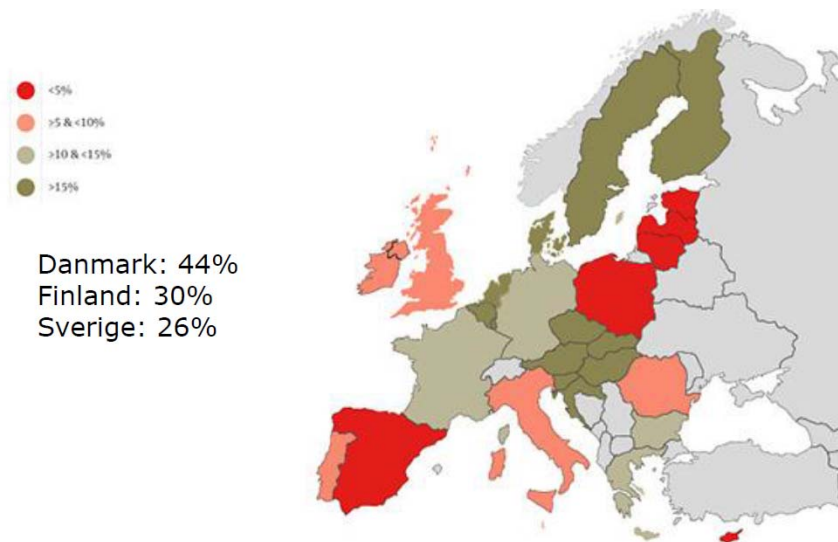
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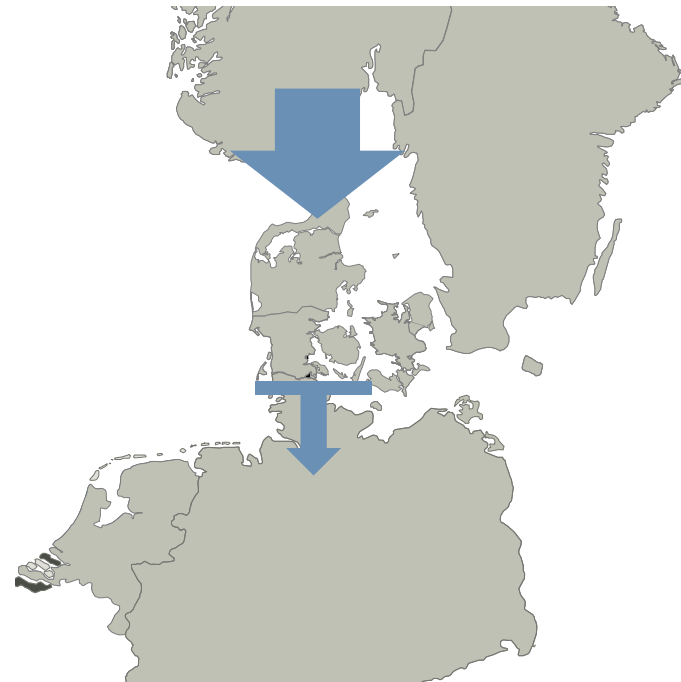
Interconnectors

EU target for interconnectivity is 10 % in 2020.

The Nordic countries are well ahead (2014 data)



Bottle necks inside Germany creates market distortions



Solution for remote islands

Power hub (SEV, DONG Energy, Schneider Electric)

- Renewable targets (installed)
 - 2012: 38%
 - 2015: 50% - no curtailment of wind
 - 2020: 80% - fossil free
- Frontrunner in new technology
 - Wind, hydro, batteries, tidal etc.
 - Integration of power and district heating systems
 - Holistic view on challenges and solutions
 - Member of Eurolectric Island Expert Group



Industries connected:

Over the past year, Kollafjørð Pelagic, the salmon farm Fútaklettur and Bergfrost in Fuglafjørður have been linked to Power Hub.

Power pump systems, compressor and freezer equipment at these plants are temporarily disconnected from the grid until SEV has managed to increase production.



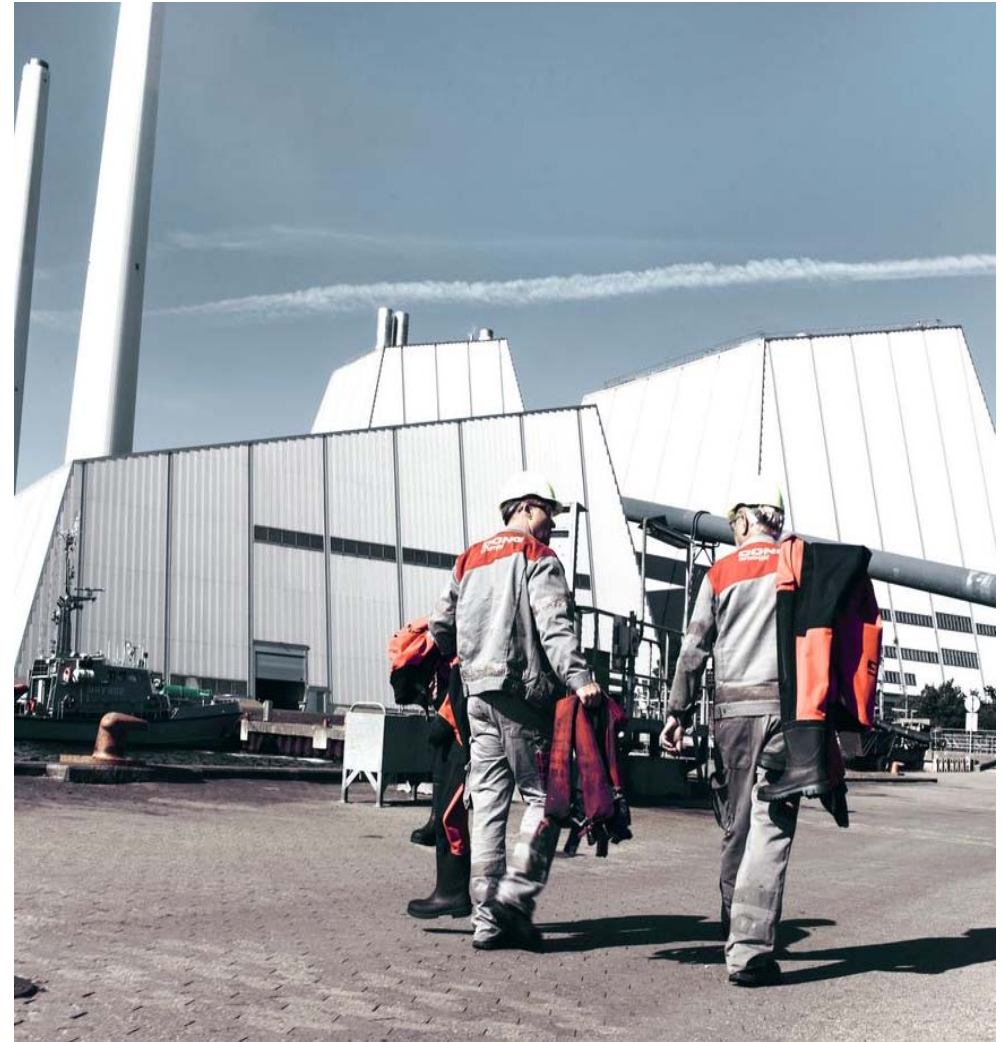
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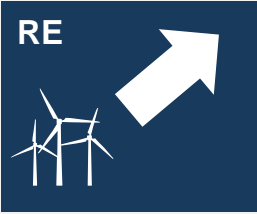
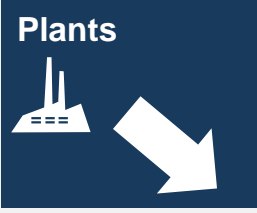

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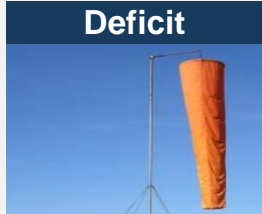




Despite large changes, there is still a need for flexible capacity in the energy system

Traditional thermal plants are being pushed out of the market

Type	Driver
RE 	<ul style="list-style-type: none"> National subsidy schemes
Plants 	<ul style="list-style-type: none"> Low market prices
IC's 	<ul style="list-style-type: none"> Physical build-out Limited capacity availability

There is still a need for flexible capacity

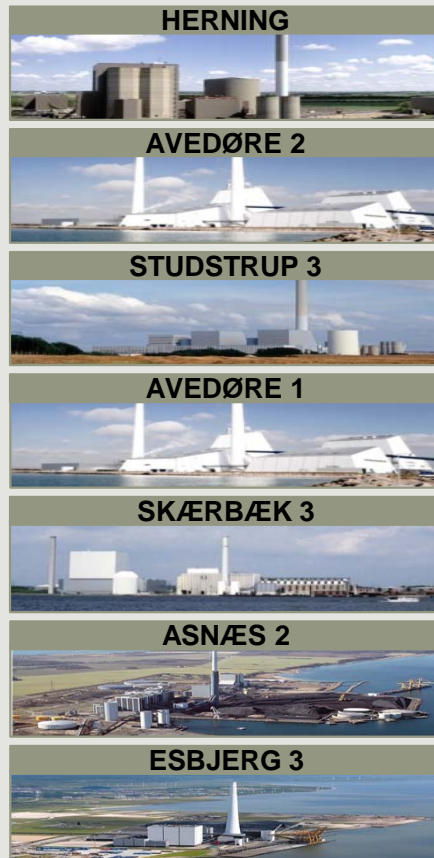
Event/Issue	System demand	CHP's
Deficit 	<ul style="list-style-type: none"> Back-up capacity 	<ul style="list-style-type: none"> Quick cold start Delivery for longer periods
Sudden shifts 	<ul style="list-style-type: none"> Fast ramping 	<ul style="list-style-type: none"> 4-5% of full load per minute
Surplus 	<ul style="list-style-type: none"> Low minimum load for CHP's 	<ul style="list-style-type: none"> 20% of full-load

Bio-conversions are well under way

Effective
Flexible
Green

Thermal Power's coal to biomass conversion pipeline

Converted unit



Completion



2016

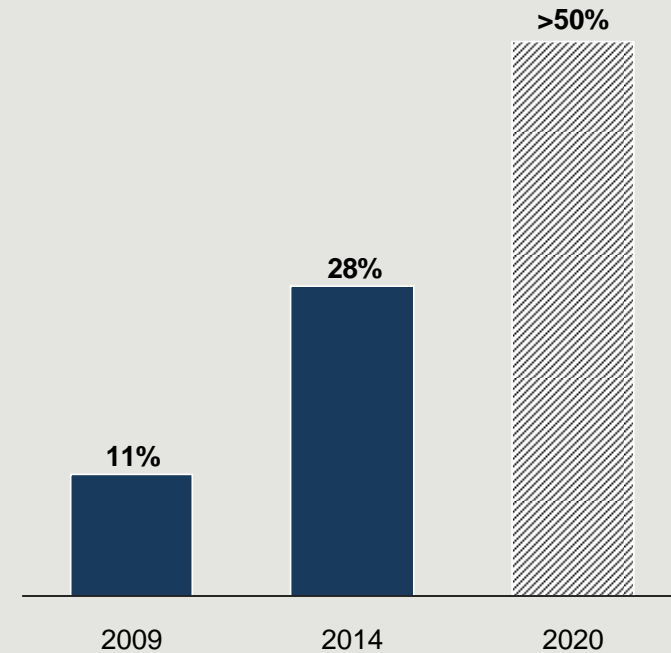
2016

2017

Expected
2018

Expected
+2020

Strategic target



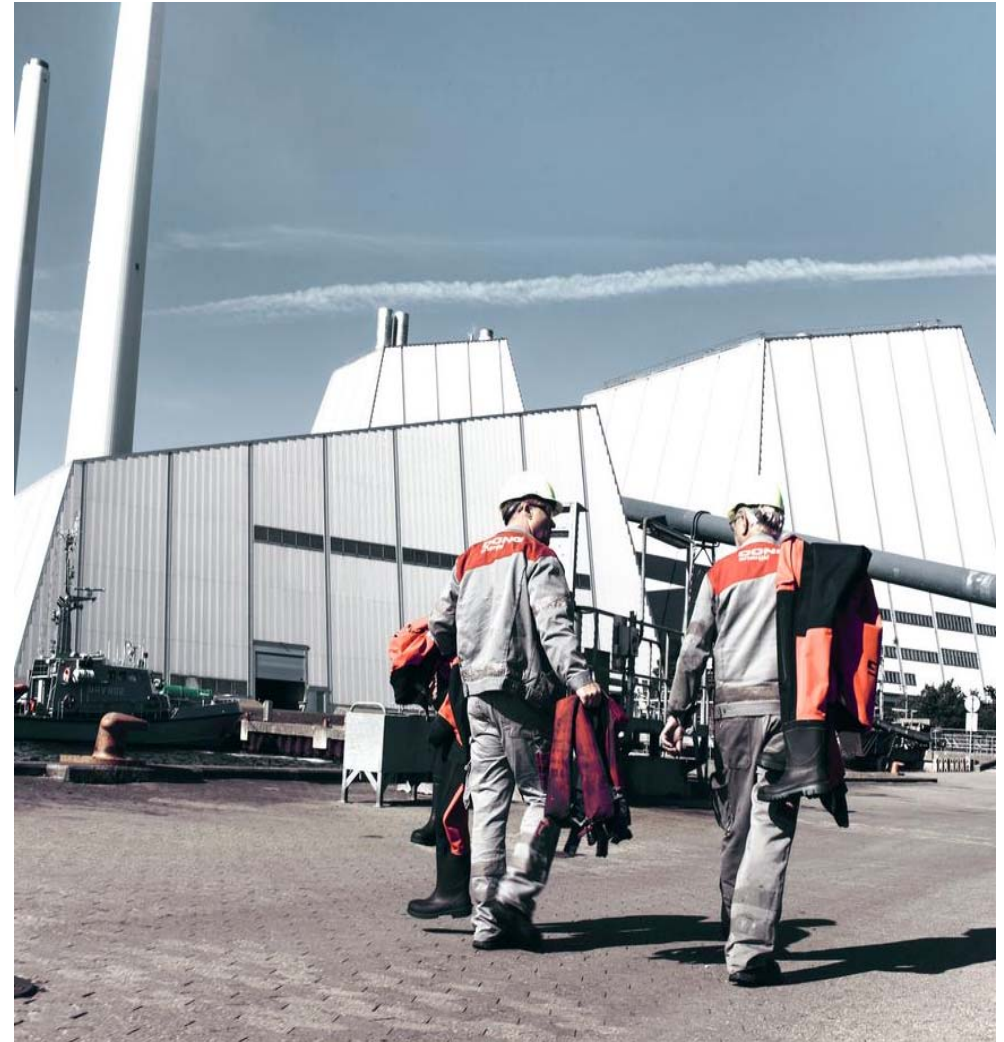
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Bio-fuels for storage and balancing – power plants

Use	Gas turbines, gas engines and conventional power plants
Storage and capacity	Gas in caverns (sufficient capacity) and liquid in old oil tanks (limited capacity?) Capacity is high in existing plants – number can be reduced over coming years with outphasing of power plants.
Cost	High marginal cost.
Investments	Dependant on existing and available storage capacity for liquid. New investments in generation equipment unlikely - no significant earnings

Bio-fuels for storage and balancing – distributed generation

Use	Generators in plugin hybrids. Used for emergency and grid balancing. Requires high number of plug-in hybrids in car fleet.
Storage	Current fuel infrastructure
Cost	High marginal cost. Eventual fee to car owner – size of fee ?
Investments	No new – extra investment. The generator is already there, and the infrastructure is available. Software investment for activation and control is needed.

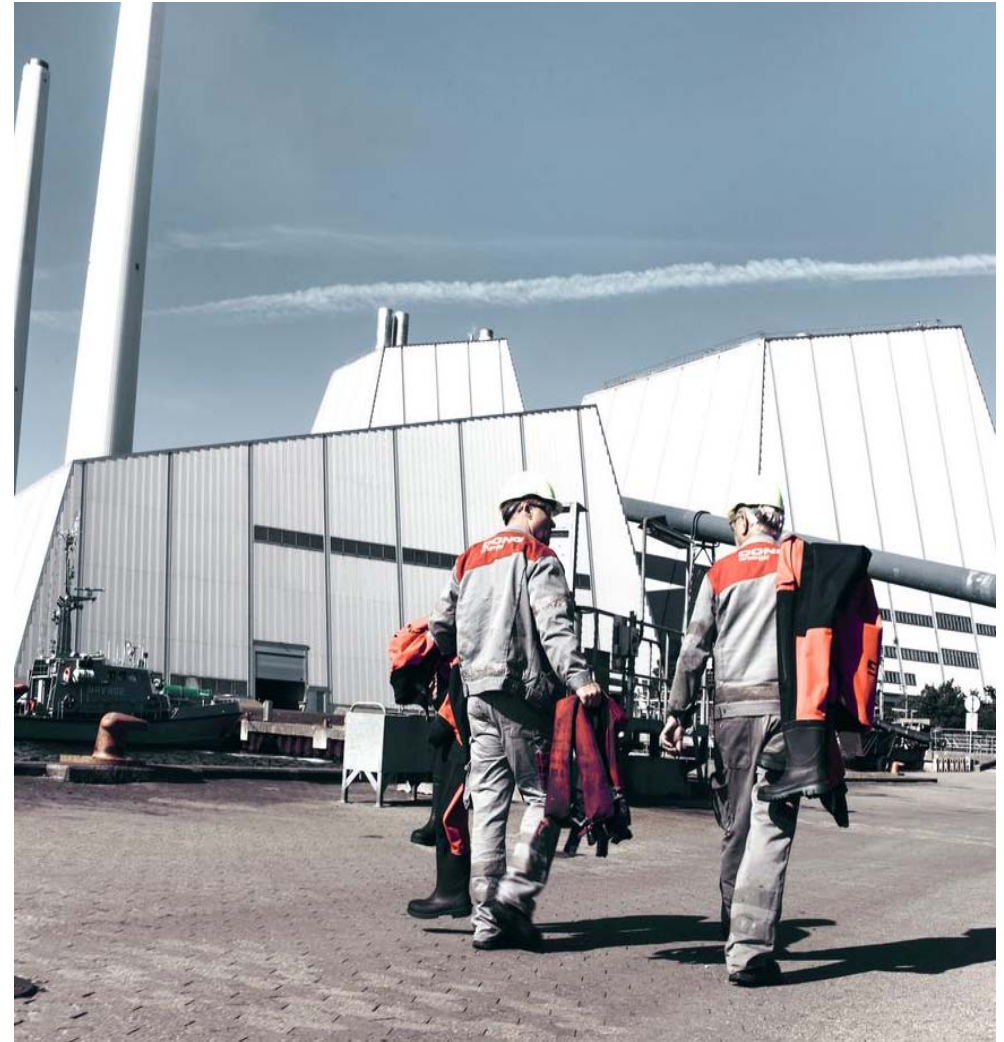
Conclusion

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Bio-energy - a bridge to the future energy system

