

# Welcome to Avedøre Power Station

DONG Energy – Thermal Power

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31/10/14



**Alarms**

**DONG Energy  
Thermal Power**

**Biomass**

**CHP - Avedøre  
Power Station**

**Your safety**

# ALARMS

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## Alarms

### Alarms

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- **Evacuation signal**

Tone Pause Tone Pause Tone  
5 sec. 5 sec. 5 sec. 5 sec. 5 sec.

Go to the gateway, swipe card at evacuation terminal and proceed to assembling point. Await information.

- **Attention signal**

Tone Pause Tone Pause Tone  
8 sec. 4 sec. 8 sec. 4 sec. 8 sec.

Go/stay inside, close doors and windows.

- **All clear signal**

Tone  
45 sec.

- **Local ammonia alarm** (horn + yellow flashes)

- **Local gas alarm** (horn + blue flashes)

**In case of evacuation we can only use the stairs – no lifts**

# DONG ENERGY

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

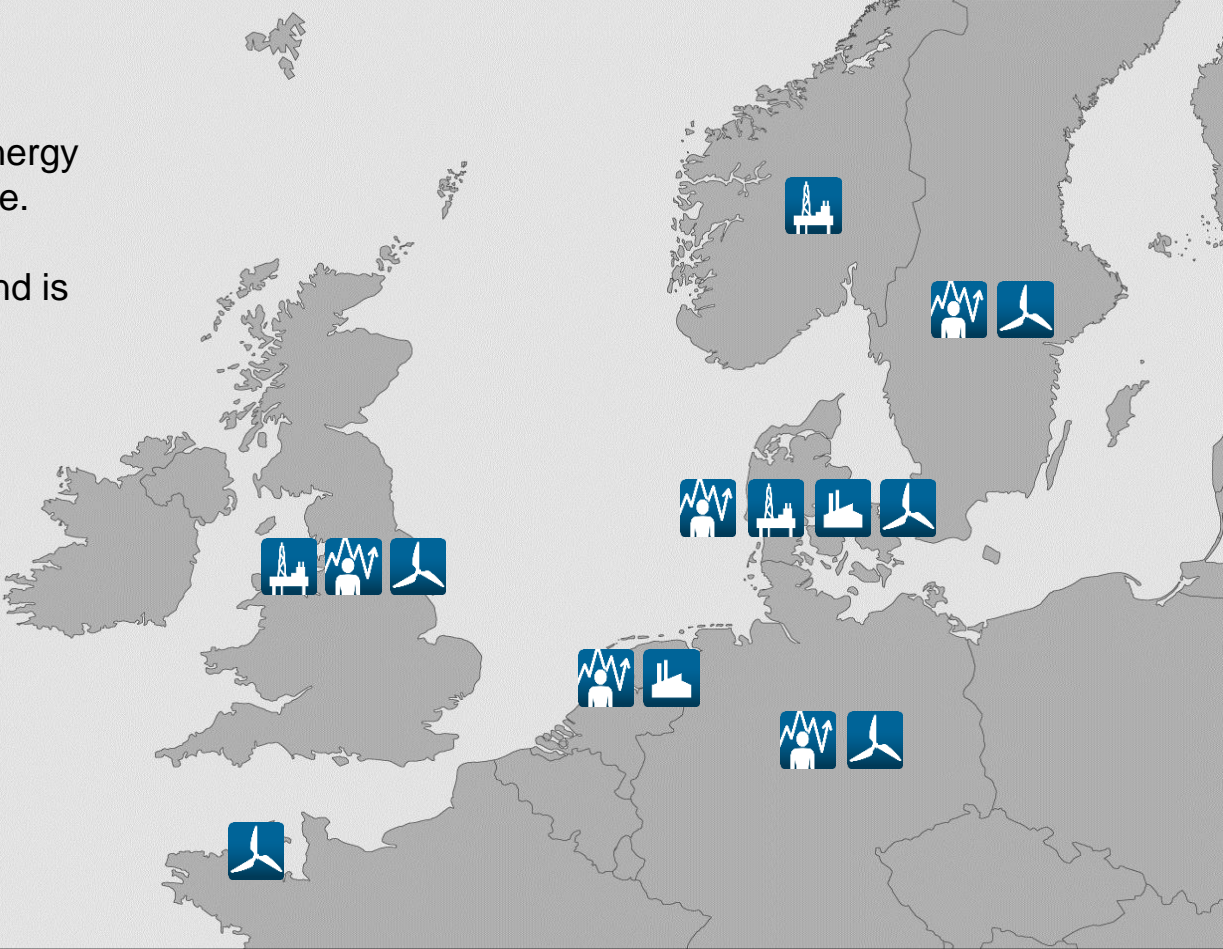
## Overview DONG Energy

Our business is based on procuring, producing, distributing and trading in energy and related products in Northern Europe.

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

The Danish State owns 58,8 %

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



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# Thermal Powers assets: 9 central plants, 1 waste-fired, NBS and Enecogen

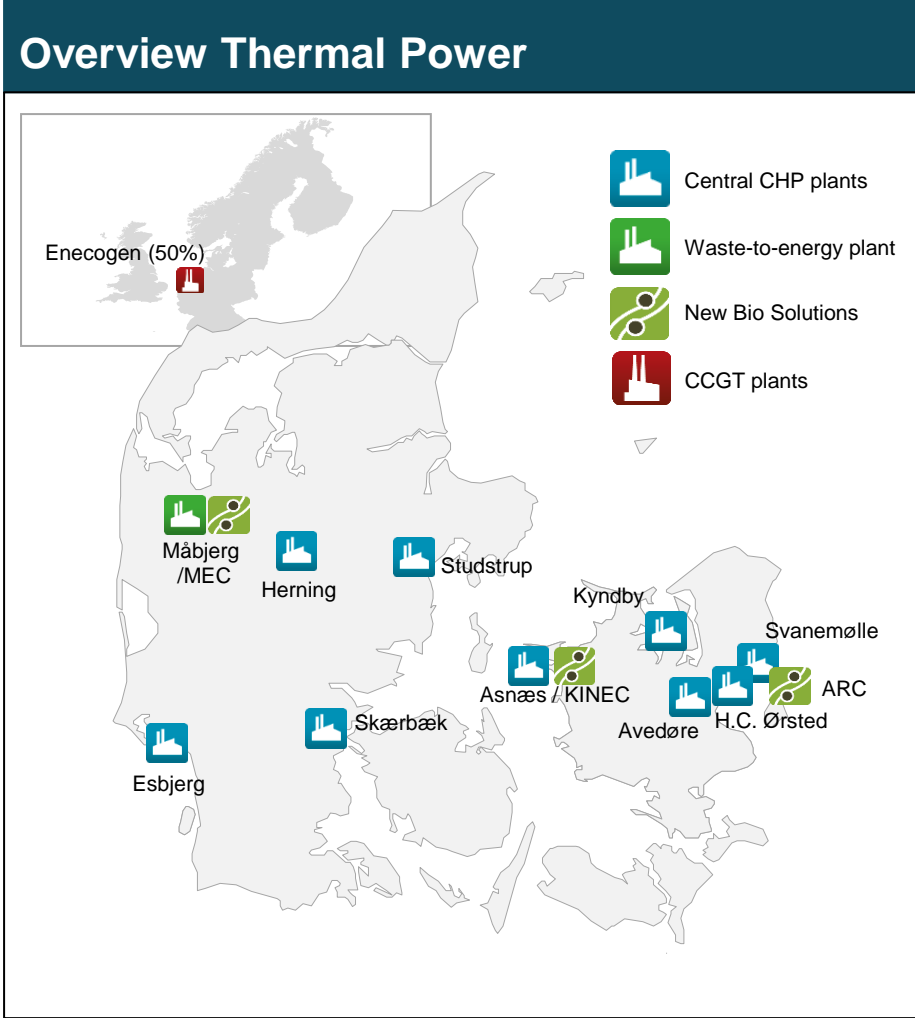
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# Thermal Power's strategy: Effective, flexible and green

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Thermal Power strategy	
Strategic pillars	Strategic priorities
Effective	Maintain and strengthen position as best-in-class thermal operator
Flexible	Create value in volatile and changing markets
Green	Deliver cost efficient green energy through biomass conversions
	Commercialise New Bio Solutions





# CO2-reduction in DONG Energy

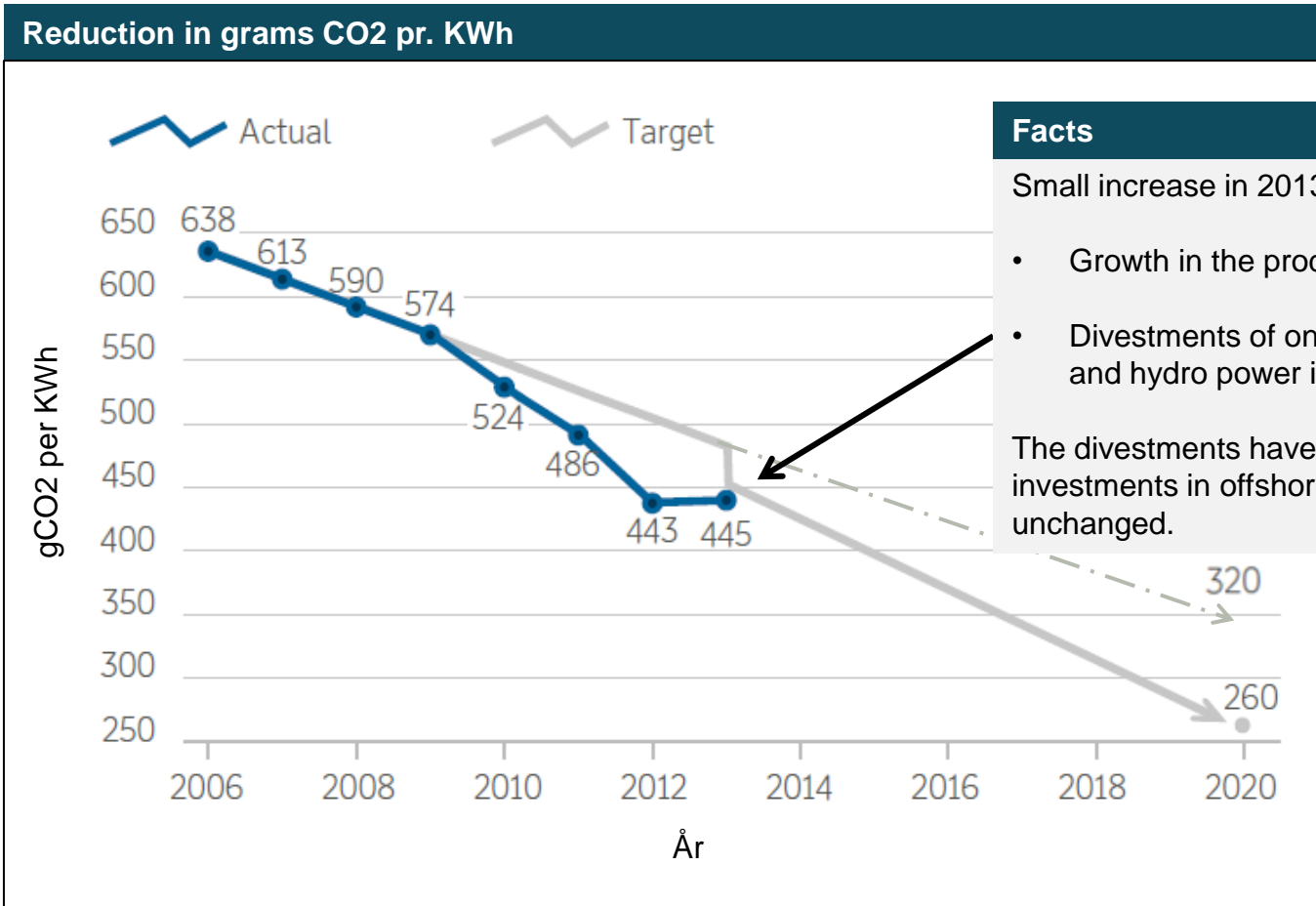
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**Facts**

Small increase in 2013 because of:

- Growth in the production from thermal power plants
- Divestments of onshore windmills in DK and Poland and hydro power in Sweden

The divestments have released capital for further investments in offshore wind, and the strategy for 2020 is unchanged.

# DONG Energy's power production is mainly coming from thermal production

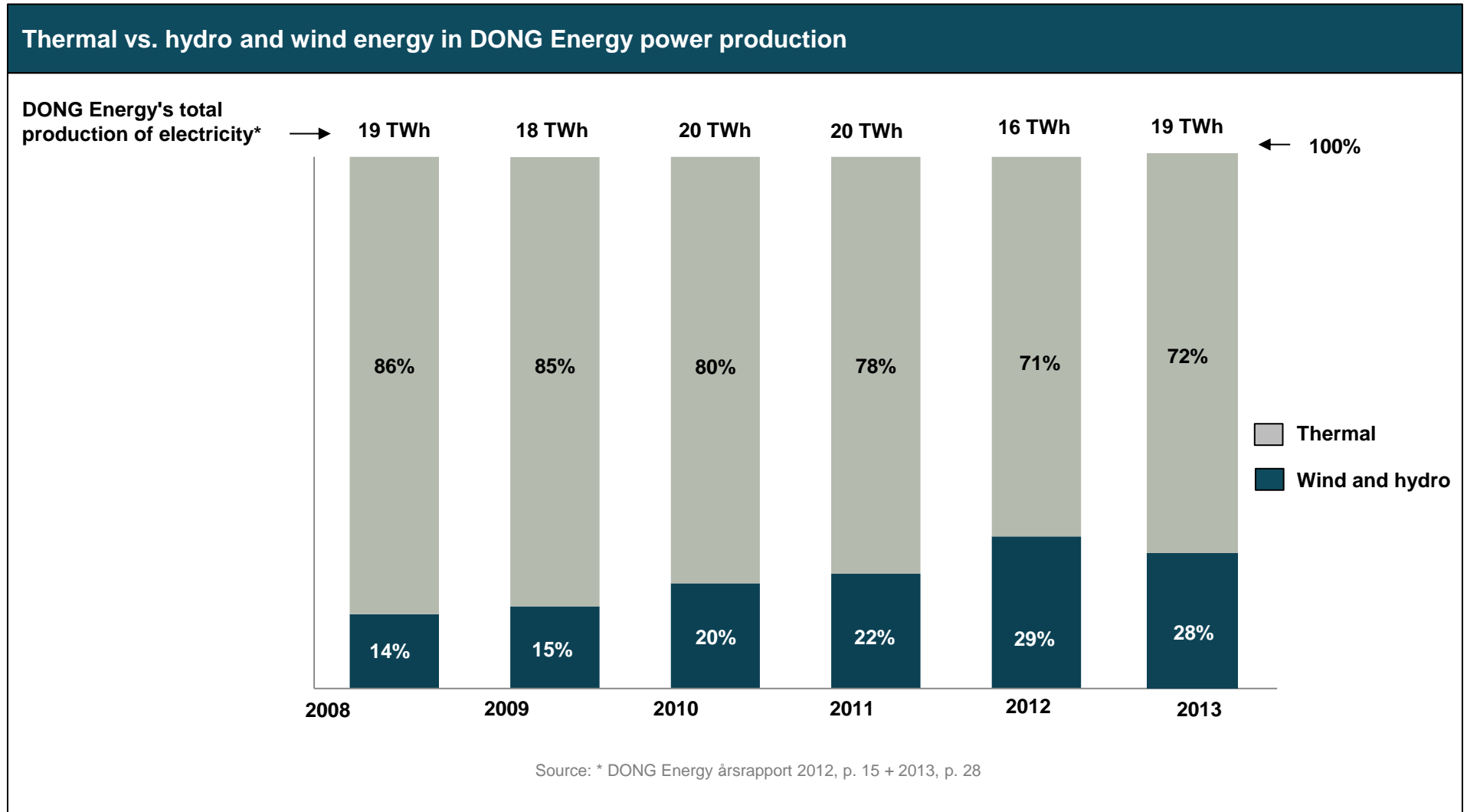
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# Biomass

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# DONG Energy has ambitious target of 50% biomass share in domestic CHP production by 2020...

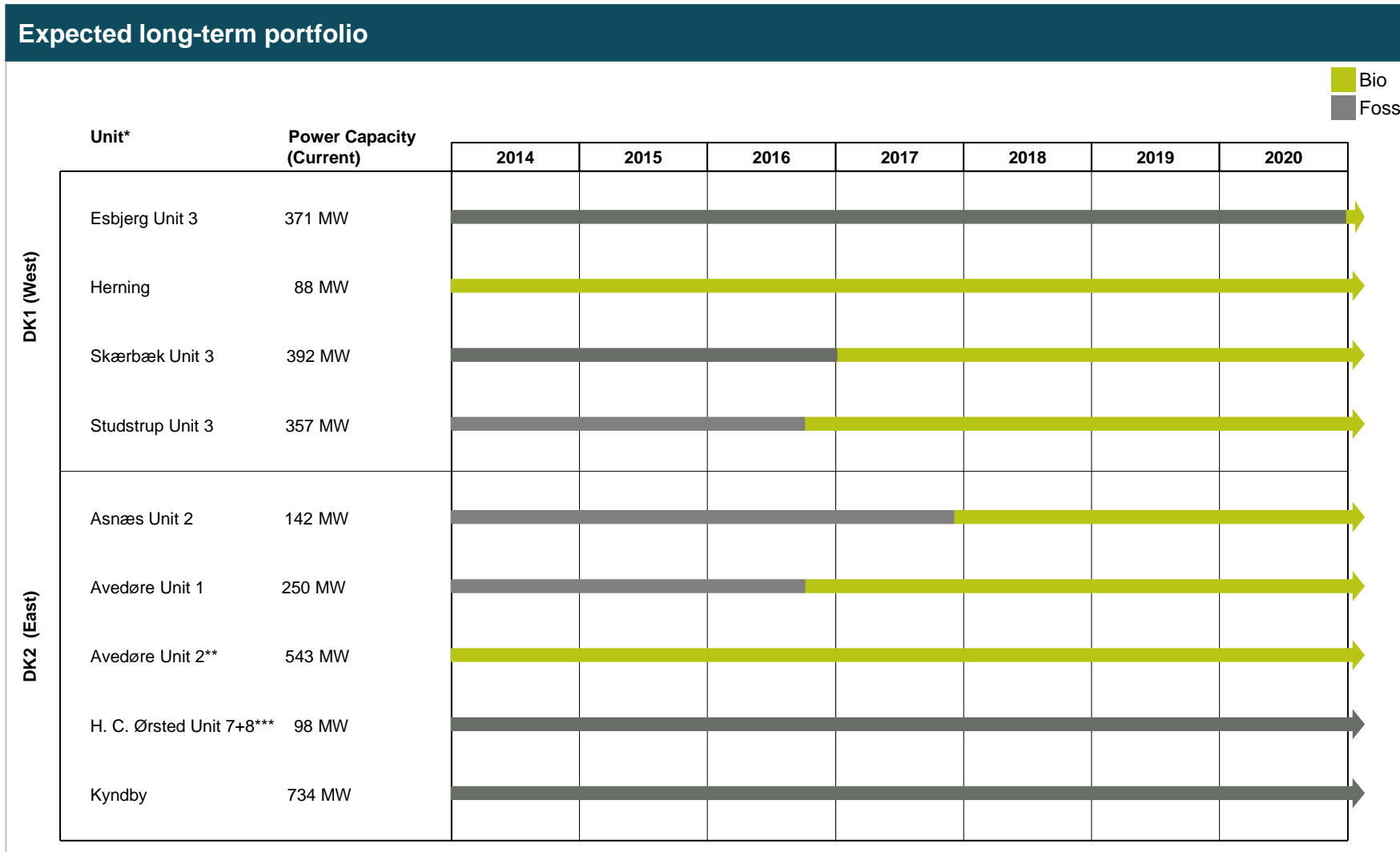
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\* Includes only units that are 'driftsklar'

\*\* Capacity is including gasturbines and biomass boiler

\*\*\* Unit 7 capacity is 75 MW and Unit 8 capacity is 23 MW

Source: Commercial Asset Management

# Facts about Studstrup and Skærbæk biomass conversions

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## Key facts about SSV and SKV biomass conversions

### Conversions

Studstrupværket 2016



Skærbækværket 2017



### Key facts

- Total capacity of 714MW electricity and 986MJ/s district heating
  - Heat to the equivalent of ~145.000 households
  - CAPEX of 1.3 billion DKK
  - Multi-fuel (coal, pellets, straw)
  - Lifetime extension of boiler, burner and mill modification, biomass storage and conveyers
  - ~ 650.000 tons wood pellets pr. year
- 
- Total capacity of 392MW electricity and 447MJ/s heating
  - Heat to the equivalent of ~60.000 households
  - CAPEX of 1.8 billion DKK
  - Multi-fuel (gas, wood chips)
  - New boilers, boiler buildings, biomass storage, harbour facilities
  - ~450.000 tons wood chips pr. year

# Facts about Avedøre biomass conversion

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## Biomass conversions on Avedøre Power Plant



### RECENTLY ACCOMPLISHED

- Unit 2 (2014):
  - Upgrade from 80 % to 100% capacity on wood pellets (on main boiler)

### NOT FINALLY DECIDED

- Unit 1 (2016-2017):
  - Conversion to 100 % capacity on wood pellets
  - 100 % capacity on coal firing
  - Fast fuel switch
- Fuel mix (consumption/year after conversion):
  - Woodpellets: > 1.500.000 tons
  - Coal: App. 500.000 tons
  - Heavy fuel and natural gas only for start-up and backup

# Last year we consumed approx. 800.000 tons of wood pellets on Avedøre Power Station

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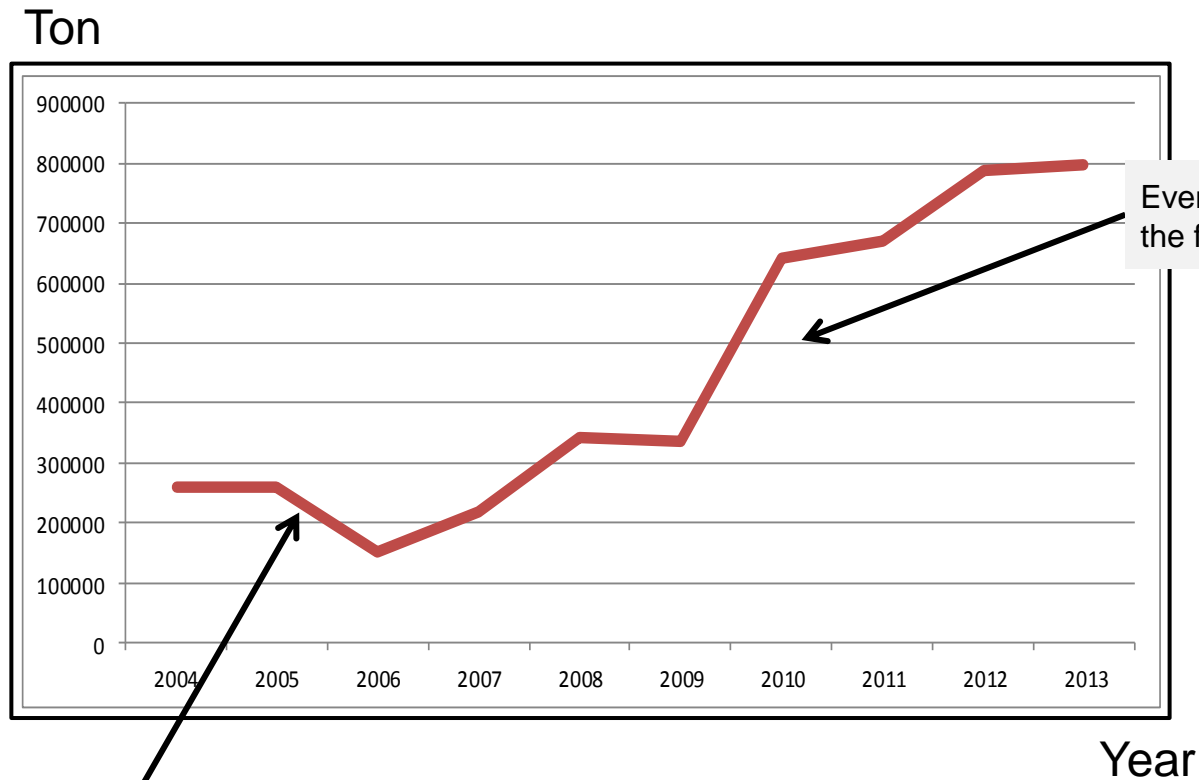
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Development in consumption of wood pellets on Avedøre Power Station



Lack of experience with wood pellets caused problems in the beginning

Eventually we improved the firing technologies

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# The two units on Avedøre Power Station

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## Overview



### Unit 1

- Commissioned in 1990
- Coal 85 tons/hour

### Unit 2

- Commissioned in 2002
- Wood Pellets 170 tons/hour
- Straw 25 tons/hour

# The Combined Heat and Power process

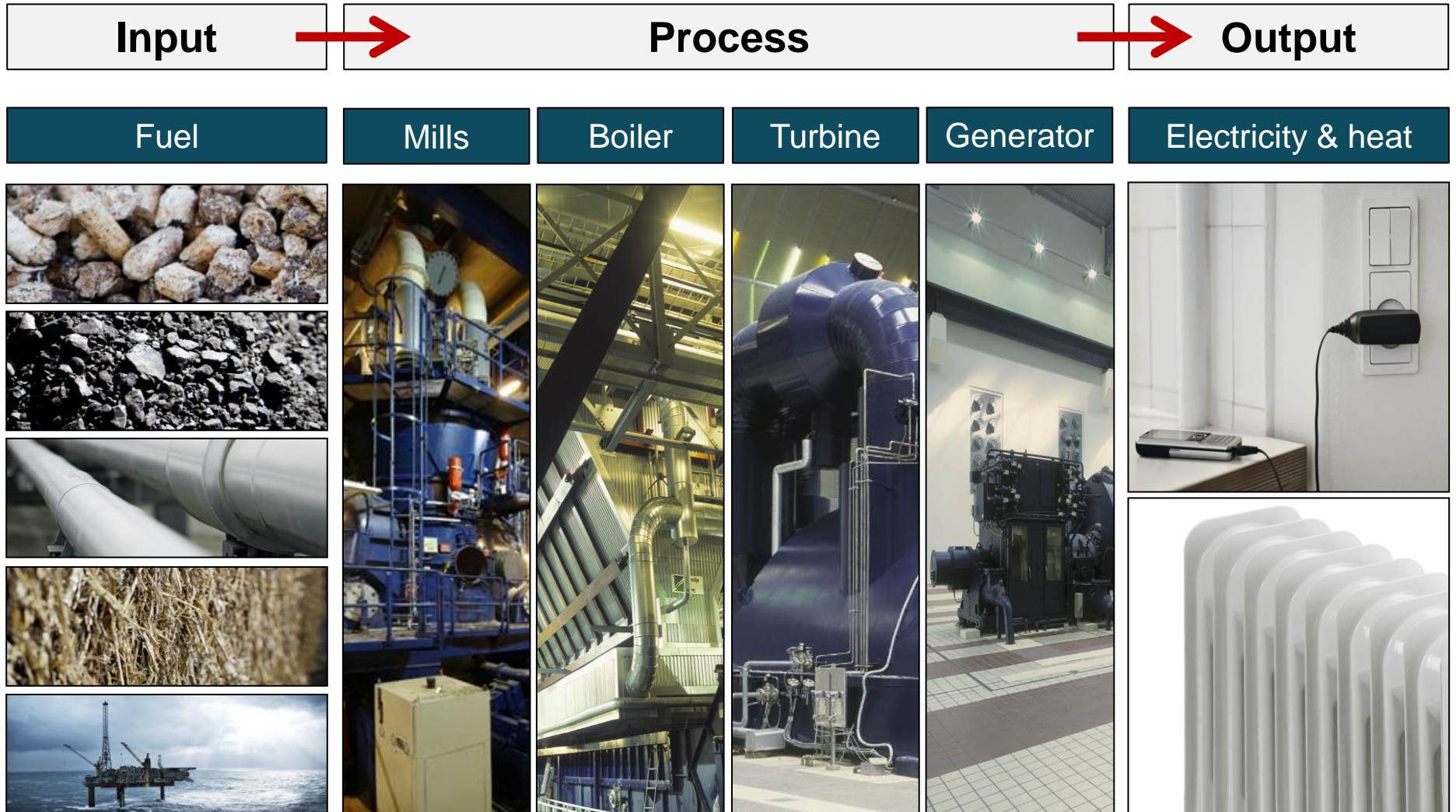
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# Overview of Avedøre Power Station

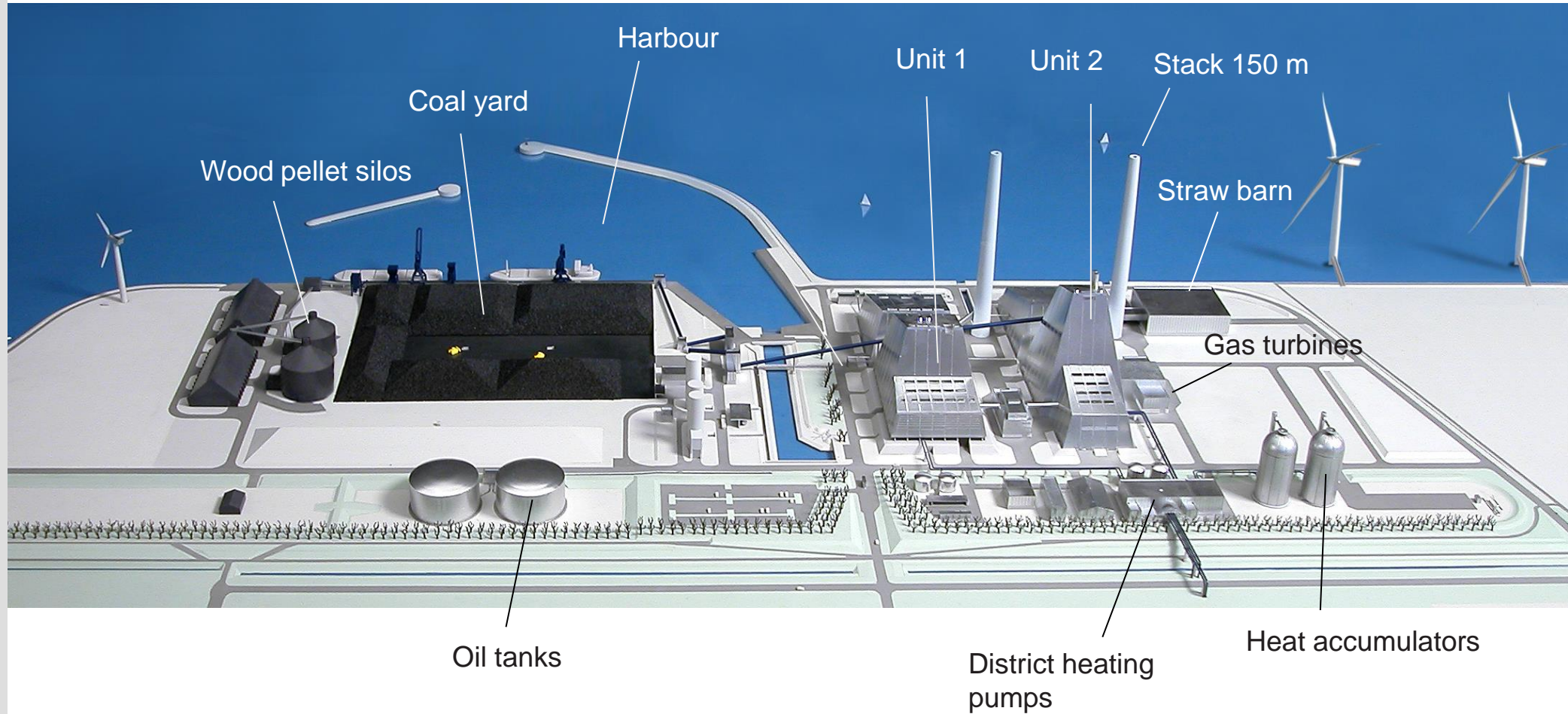
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# In 2013 in % of total energy amount on Avedøre Power Station: 32.057.922 GJ

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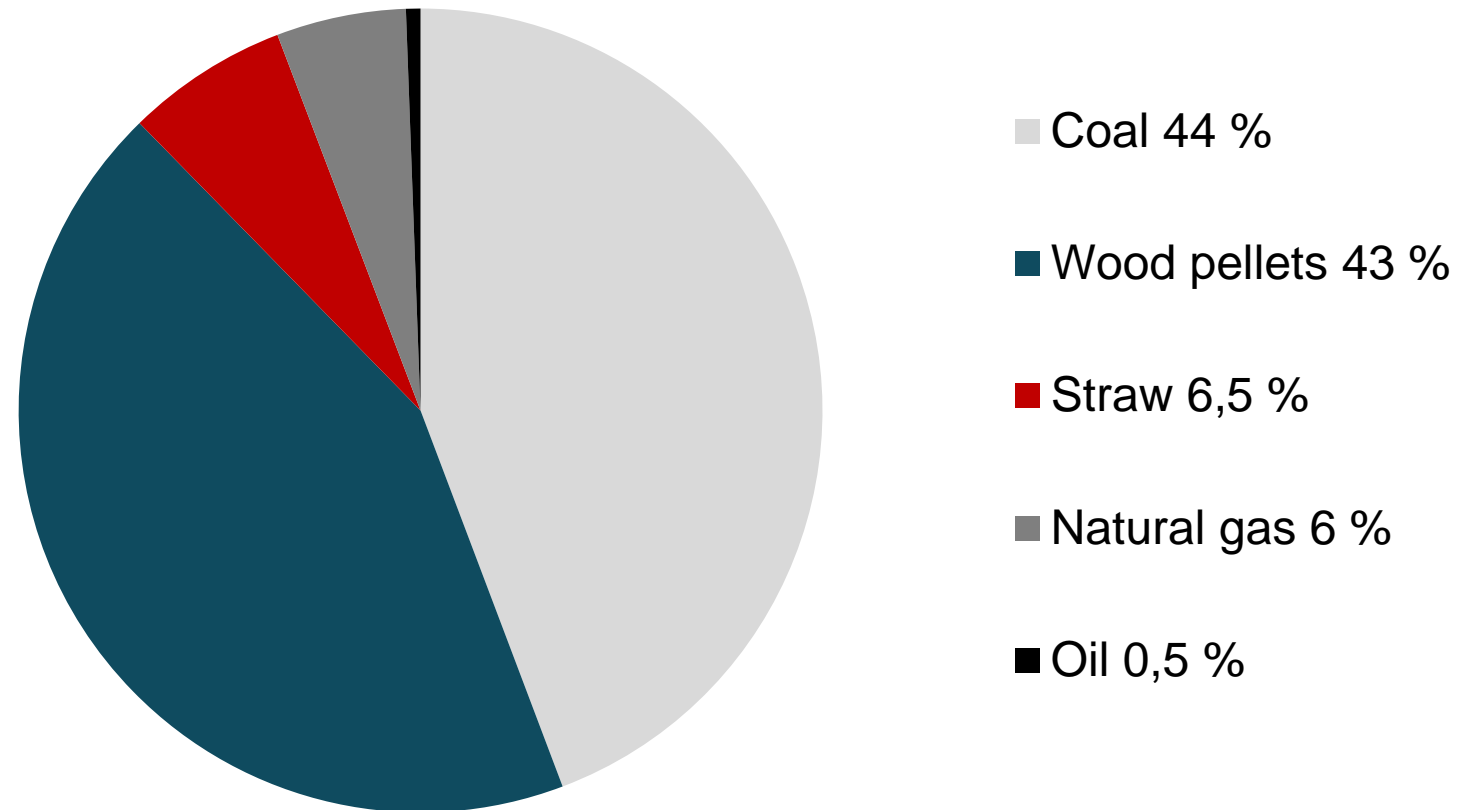
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Fuel share overview



## Unit 2: The Multi Fuel Unit fired with wood pellets, straw and gas

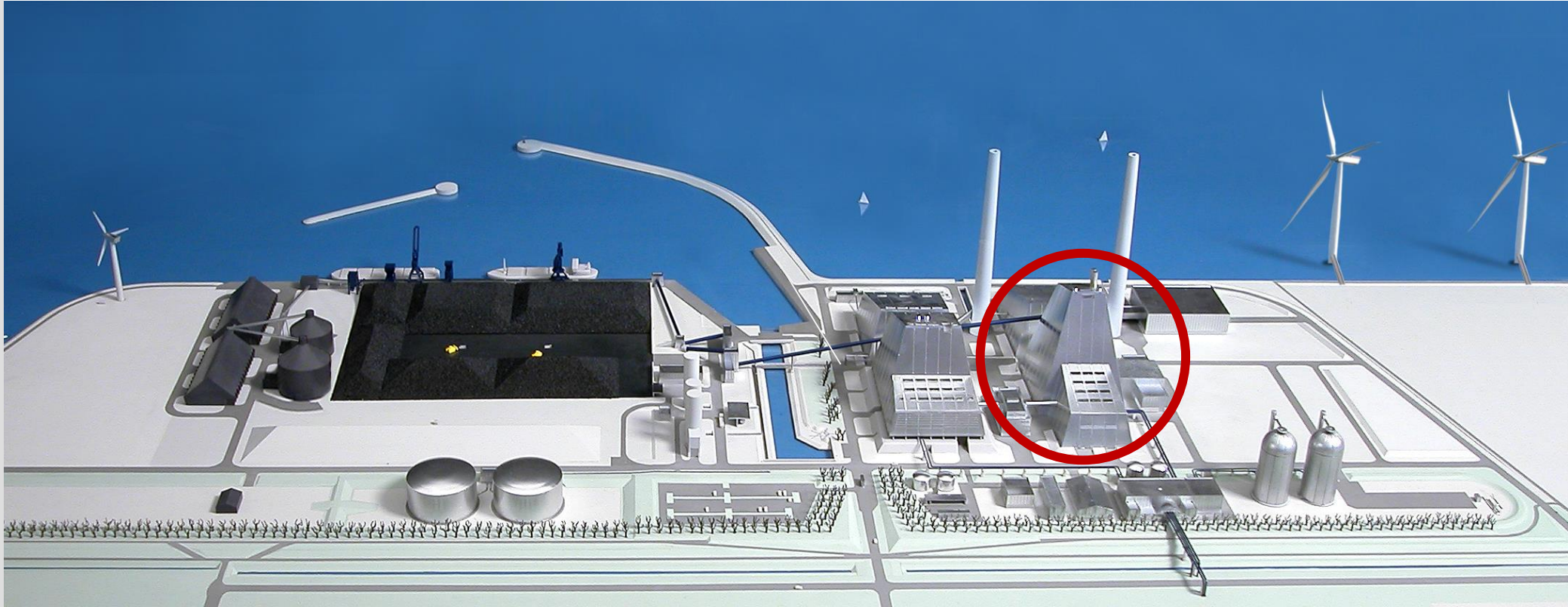
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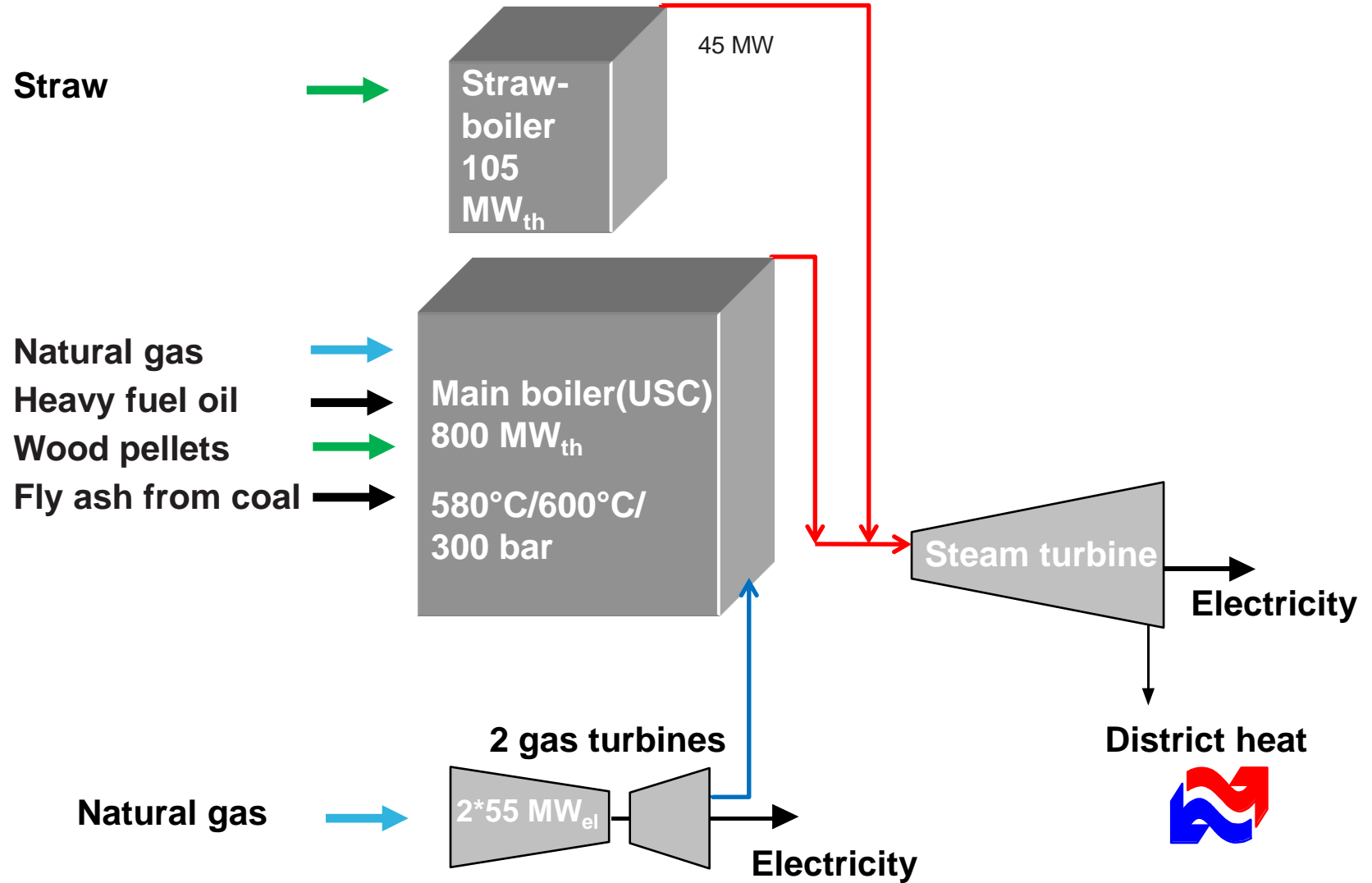
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Multi fuel concept Avedøre Unit 2

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# Unit 2

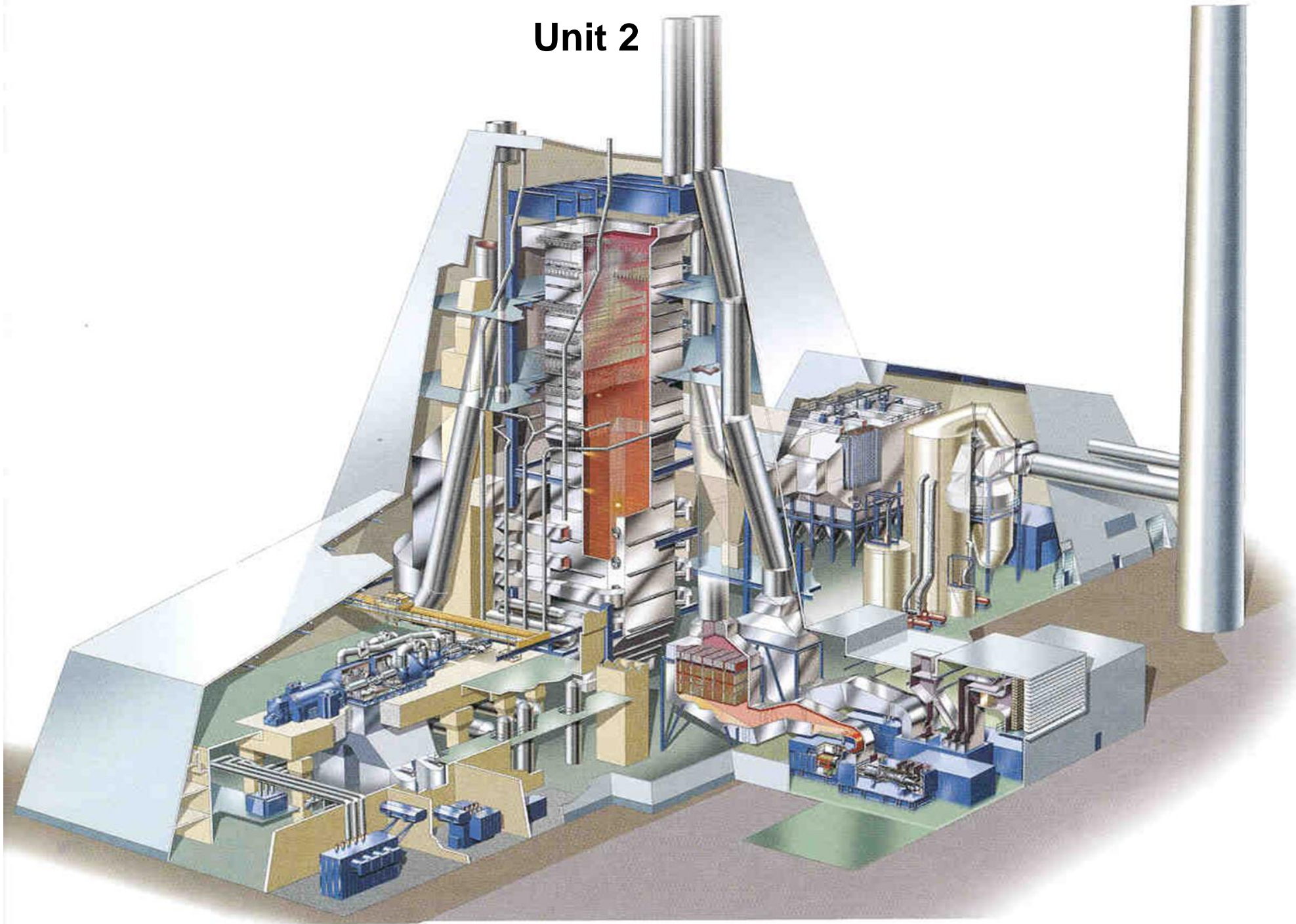
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# Production at Avedøre Power Station

■ Power production ■ Heat production

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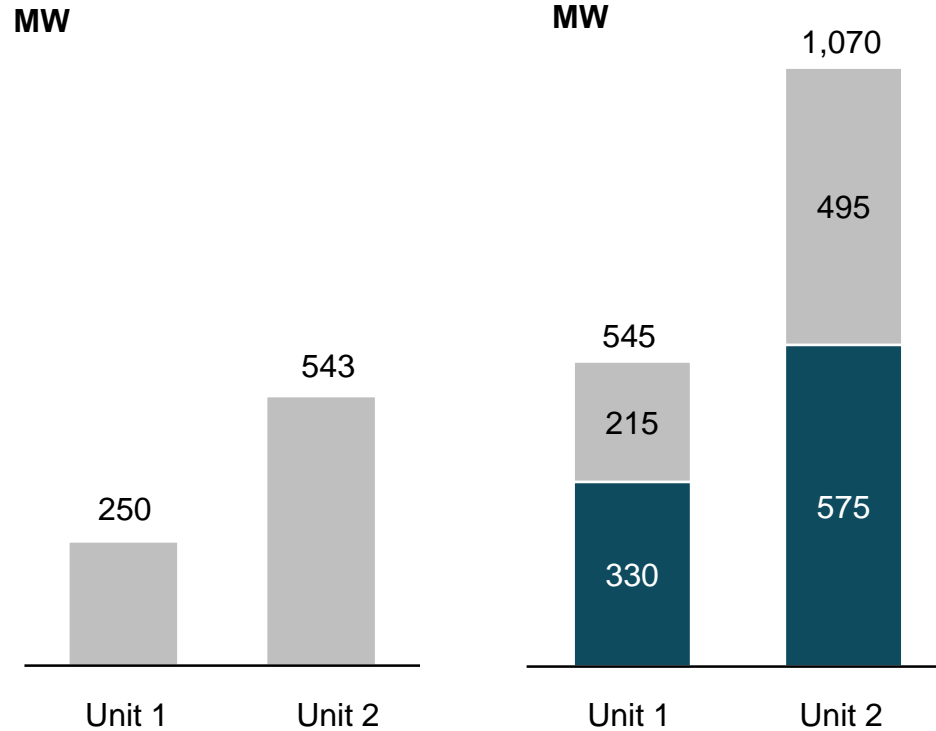
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## Electricity and heat production overview



- Electricity for 1,3 million households in Northern Europe
- District heating for 200.000 households in Greater Copenhagen



# Avedøre Power Station is one of the worlds most efficient plants

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<b>Electricity</b>	<b>Unit 1 42%</b>	<b>Unit 2 49%</b>
Electricity	42%	49%
Loss in condenser	50%	44%
Other losses	8%	7%

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<b>Electricity + district heat</b>	<b>Unit 1 91 %</b>	<b>Unit 2 94%</b>
Electricity	36%	37%
District heat	55%	57%
Loss in condenser	1%	1%
Other losses	8%	5%

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# District heating for 200.000 specific households in Greater Copenhagen

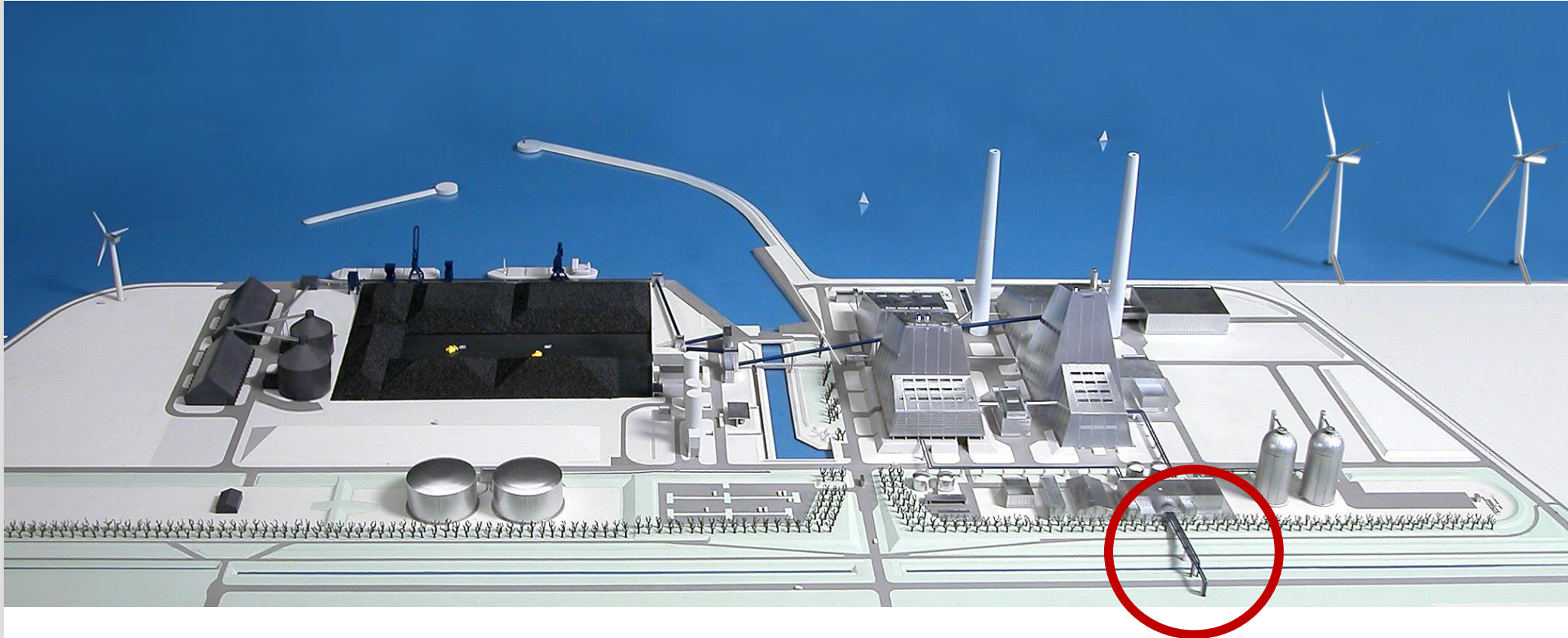
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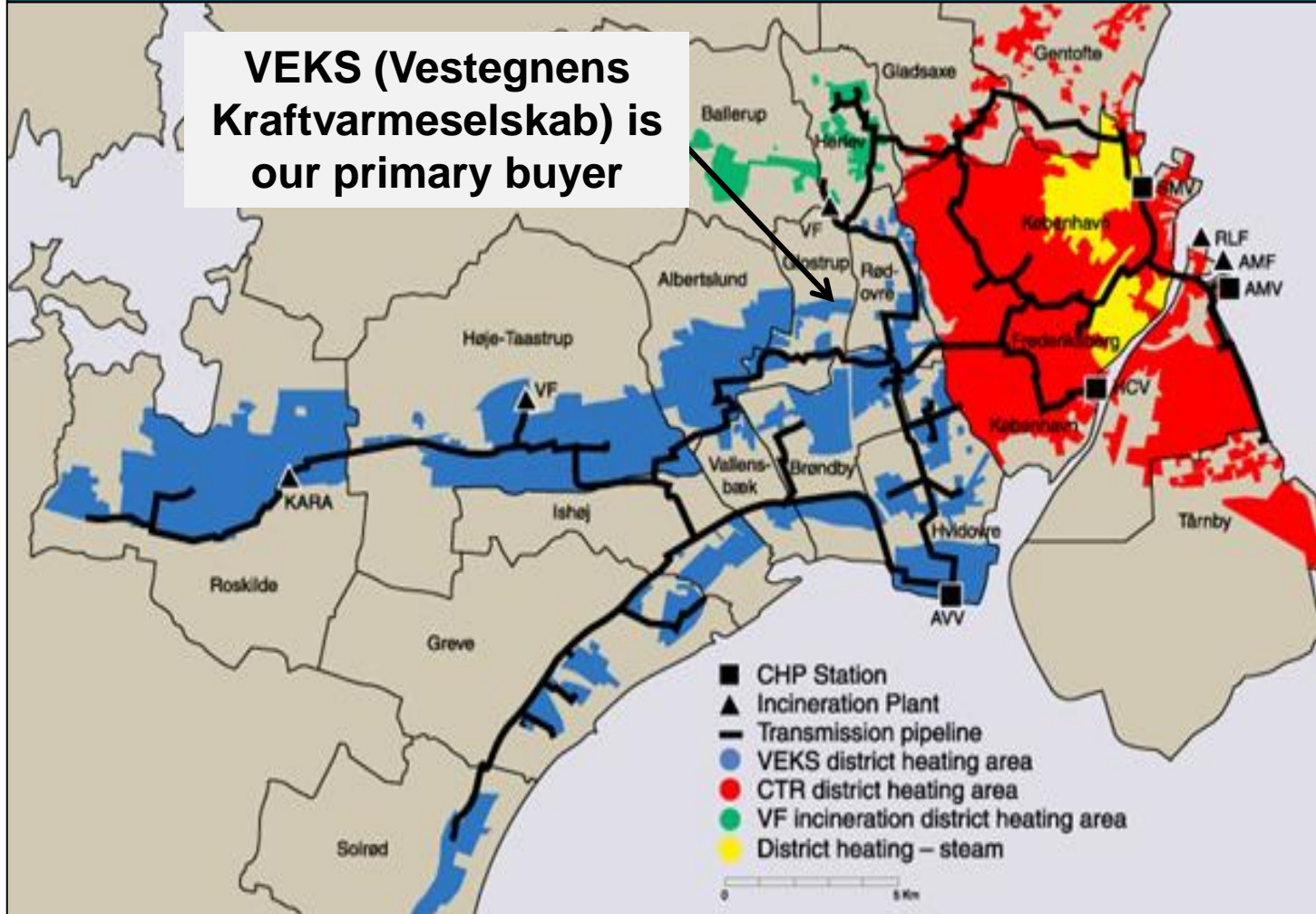
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# District heating grid in Greater Copenhagen

## Overview

**VEKS (Vestegnens Kraftvarmeselskab) is our primary buyer**



- Interlinked district heating system with cross-selling between heat companies
- Total heat market of 35,000 TJ/y in 2014 supplies heat equivalent to 500,000 households
- Heat companies (CTR, HOFOR and VEKS) have an ambition to replace all fossil heat production by 2025

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# Heat accumulator tanks – storage for district heating water

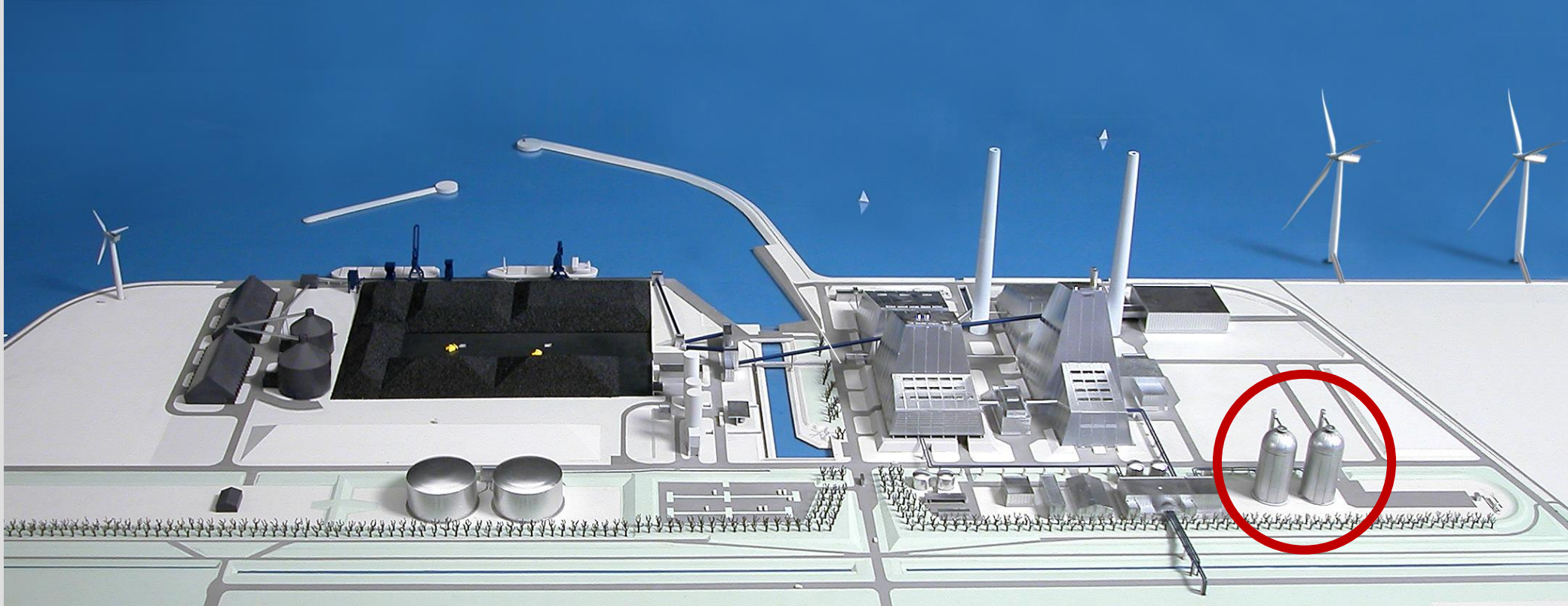
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# Cleaning of flue gas – we remove NO<sub>x</sub>, SO<sub>2</sub> and flyash

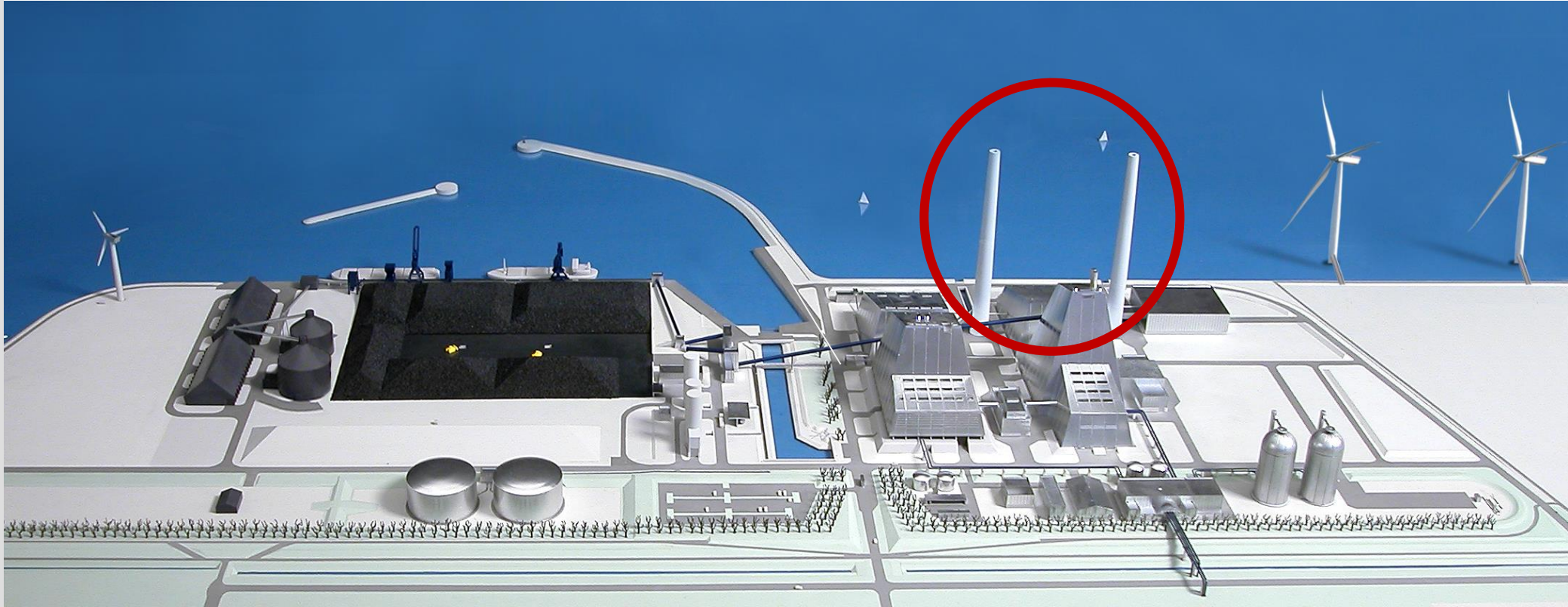
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# The flue gas cleaning process

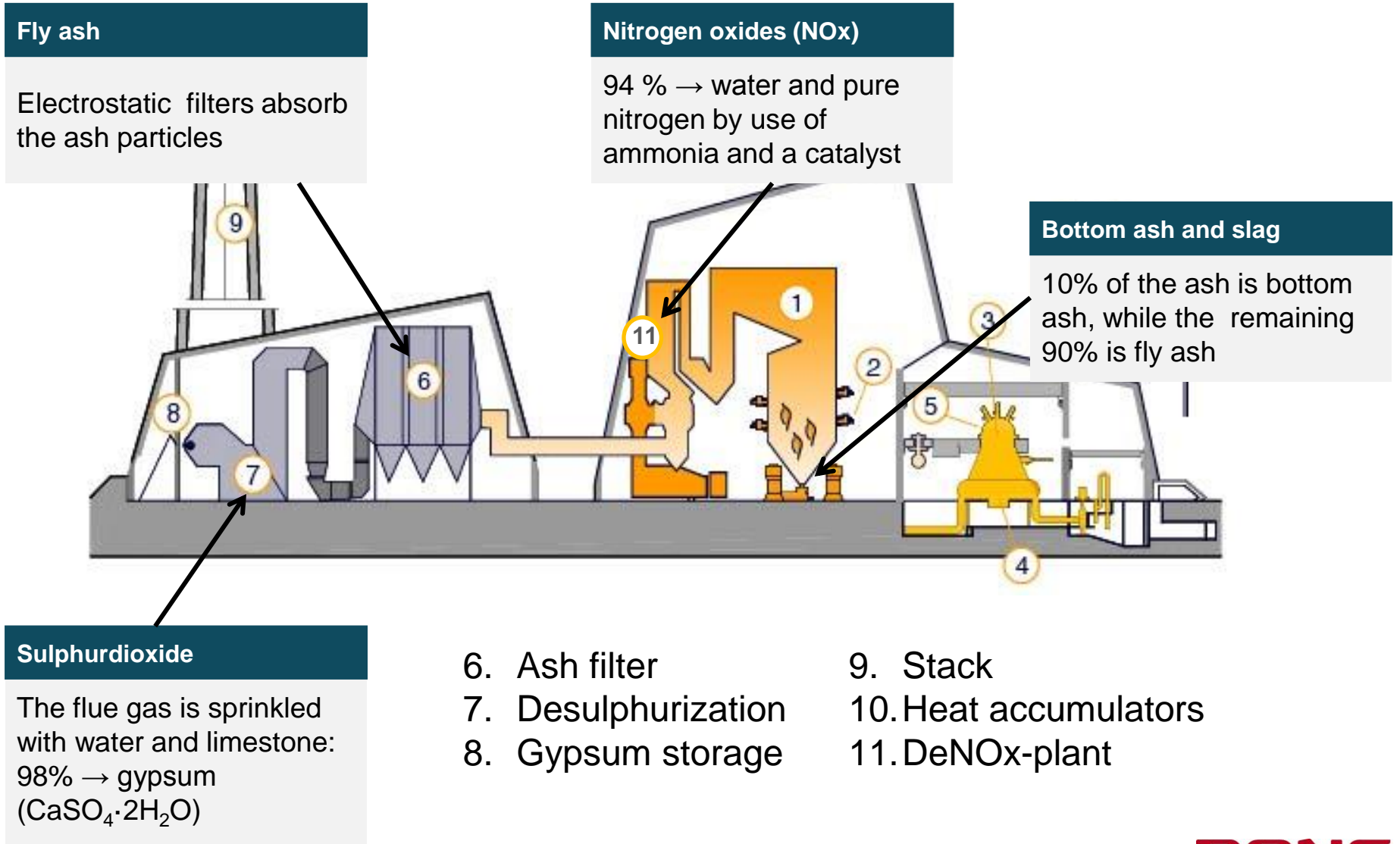
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## Safety on the guided tour

- **Everyone must wear helmets with safety goggles in our process plant**
- **Closed, flat shoes replace safety shoes**
- **Audio equipment is handed out**
- **Ear plugs are handed out**
- **Please stay close to the DONG Energy staff during the tour**
- **Please don't touch any parts of the process plant during the tour**

**NB: Lifts must not be used in case of evacuation**

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# Use of wood pellets decreases CO<sub>2</sub> emissions significantly compared to coal

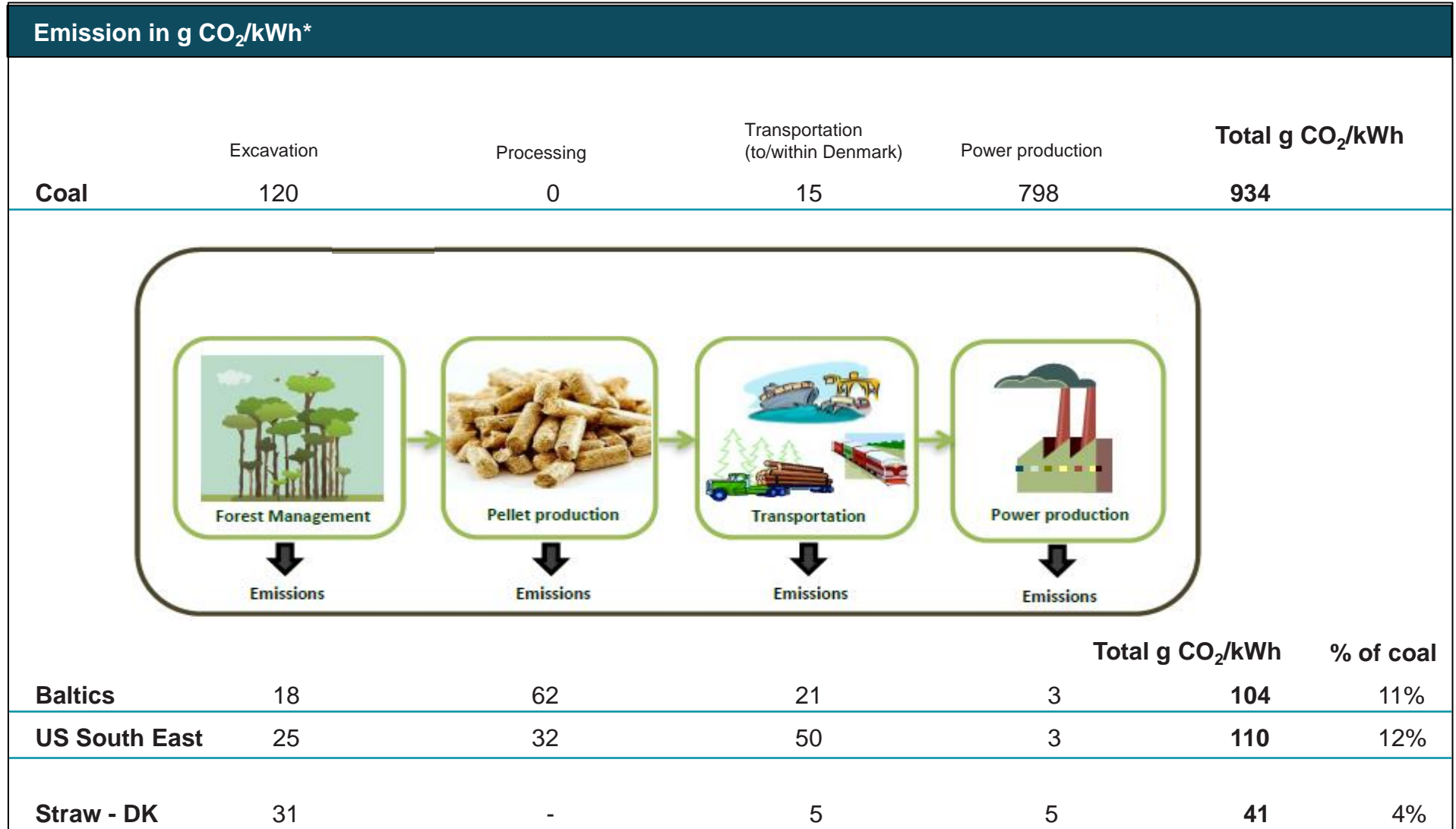
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\* Based upon LCA perspective  
Source: LUBA Project WP1, 2012

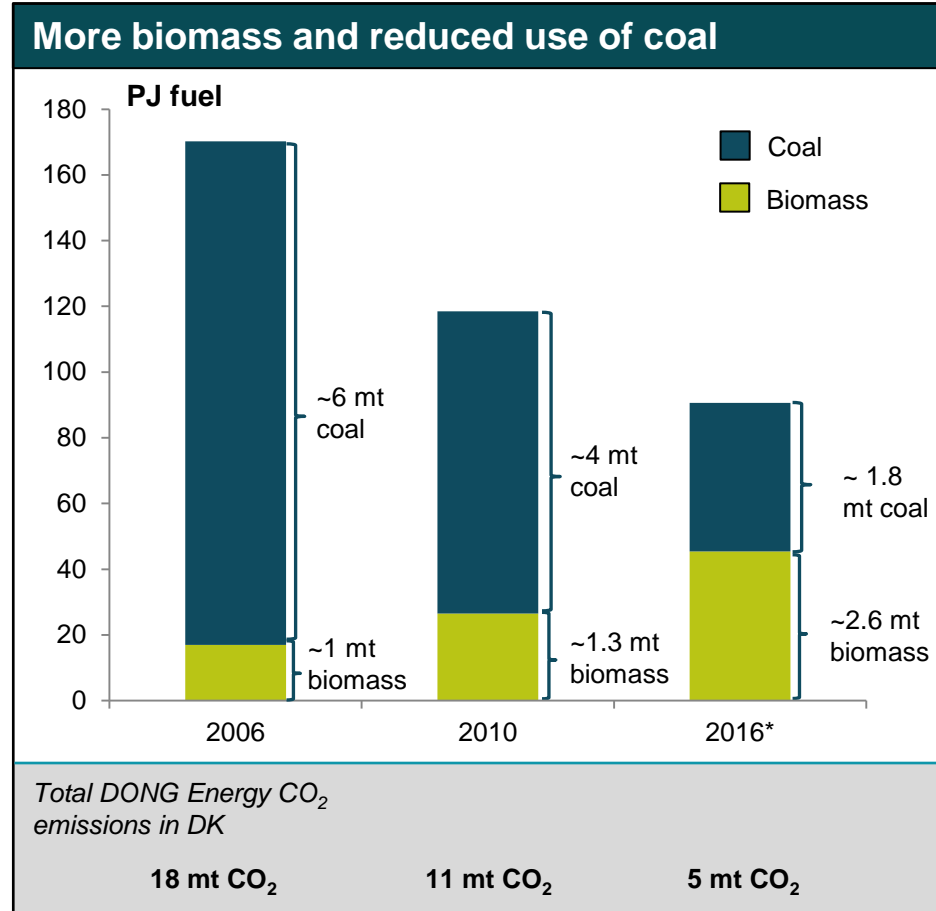
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# Background for Biomass in Danish Power Plants

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- **Energy policy agreement June 1986**

In 1995: 450 MW<sub>el</sub> CHP on domestic fuels, like straw, wood, waste, biogas and natural gas.

- **Biomass agreement June 1993**

In 2000: 1.2 million tonnes of straw and 0.2 million tonnes of wood chips shall be used for power production.

- **Biomass agreement July 1997**

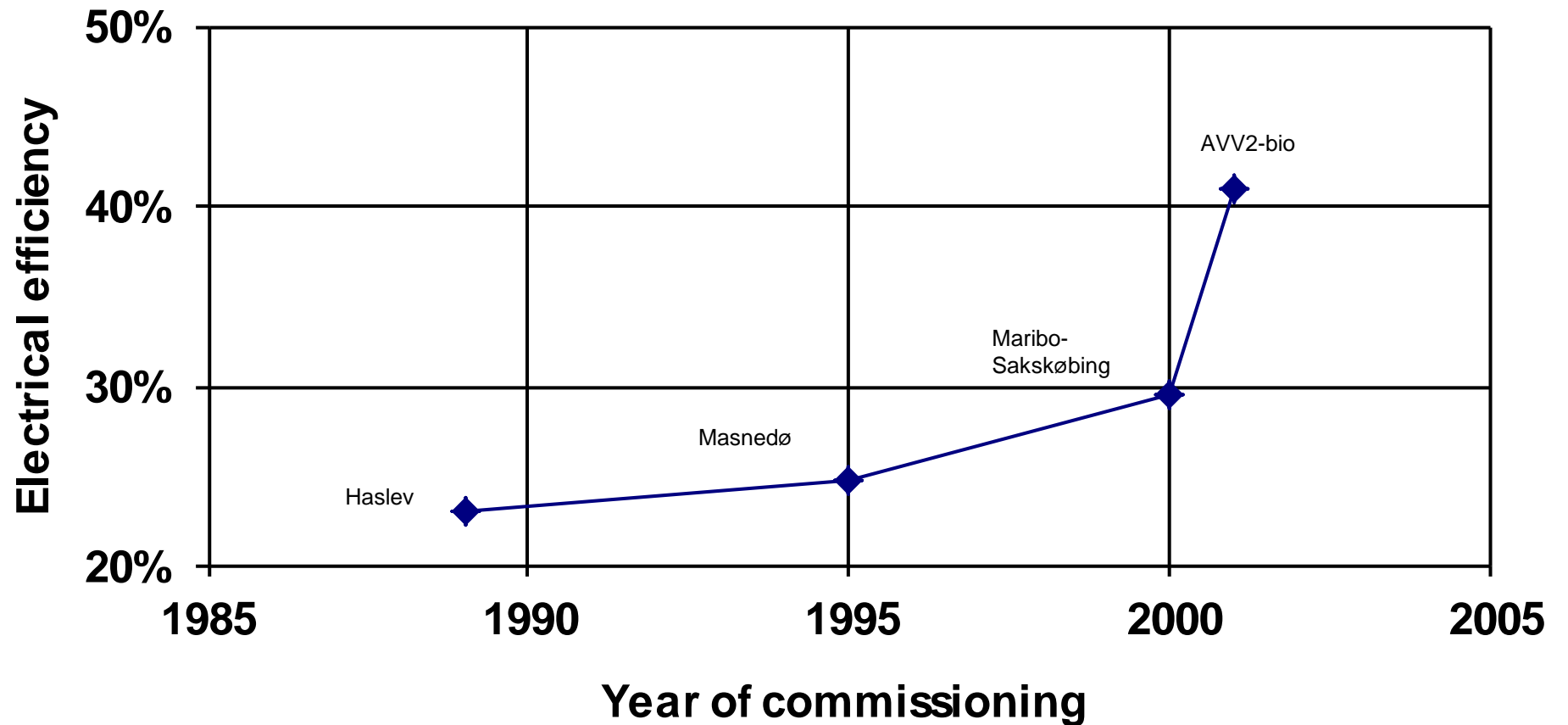
In 2000: 1.0 million tonnes of straw, 0.2 million tonnes of wood chips and a mix of straw, wood chips and willow chips equal to 19,5 PJ/year, shall be used for power production.

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# Development in electrical efficiency on straw-fired plants



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# Operational Characteristics in 2013

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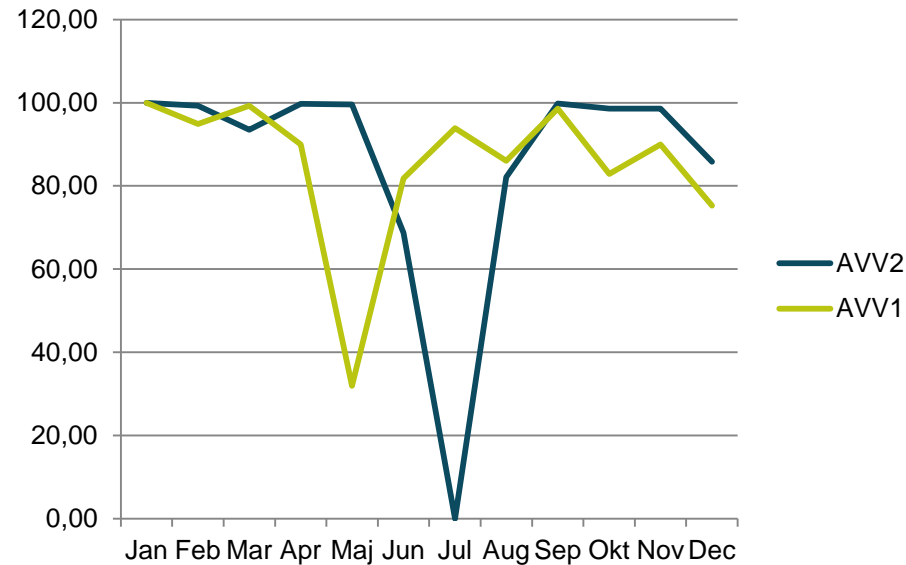
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## Seasonal variations in availability (%) (2013)



- Average availability at 85% for both AVV1 and AVV2
- Unplanned outage amounted to 10% of total running time at AVV1 and 4% at AVV2 in 2013
- AVV1 had a total of 29 start/stops in 2013 and AVV2 had 49 start/stops in the same year

# Principles of Heat Agreements

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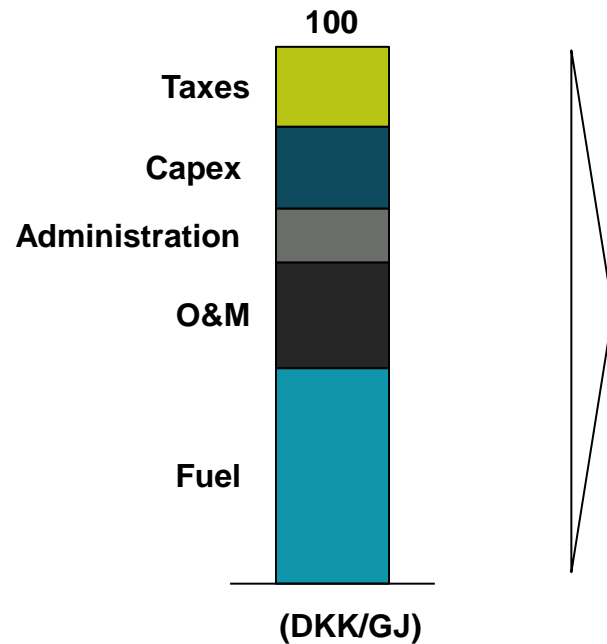
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Illustrative breakdown of heat tariff



- Danish heat market is extremely regulated
- The Danish Heat Act dictates that the end-user can only pay for 'reasonable and necessary' heat production costs, no mark-up or fee can be invoiced
- There is a long standing tradition of long term (>10 y) heat contracts between Thermal Power (heat provider) and district heating companies like VEKS (heat offtaker)
- Fuel and other cost advantages of joint heat and power production is shared between heat provider and heat offtaker through cost allocation principles as described in the long term heat contracts
- Cost allocation principles and tax levies creates monetary incentives for Thermal Power to be in the heat business

# Byproducts

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## Gypsum

The amount of gypsum is depended on the content of sulphur in the fuel.

### Full load

- Unit 1: Approx. 3 ton gypsum pr. hour
- Unit 2: Approx. 0,1 ton gypsum pr. hour



## Fly ash

Fly ash from coal is used in the cement- and concrete industry.

### Full load

- Unit 1: Approx. 9 ton fly ash pr. hour
- Unit 2: Approx. 5 ton fly ash pr. hour

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## Employees at Avedøre Power Station

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Approx. 120 employees

- **Marine engineers**
- **Operation assistants**
- **Engineers**
- **Workmen**
- **Harbour specialists**
- **Administrative personnel**
- **Canteen- and cleaning personnel**

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