Clean coal from a Vattenfall perspective

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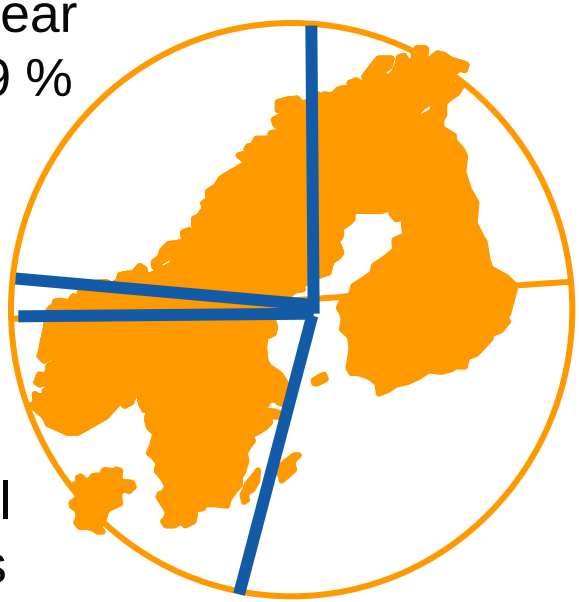
Vattenfall in brief

- Europe’s fifth largest generator of electricity and the largest producer of heat
- Net sales 2009: SEK 205 bln
- Operations in Sweden, Finland, Denmark, Germany, Poland, the Netherlands and the UK with a total of 6 Million customers
- Electricity: generation, transmission, distribution and sales
- Heat: production, distribution and sales
- Energy trading and lignite mining
- Consulting and contracting activities in the energy sector
- More than 40,000 employees

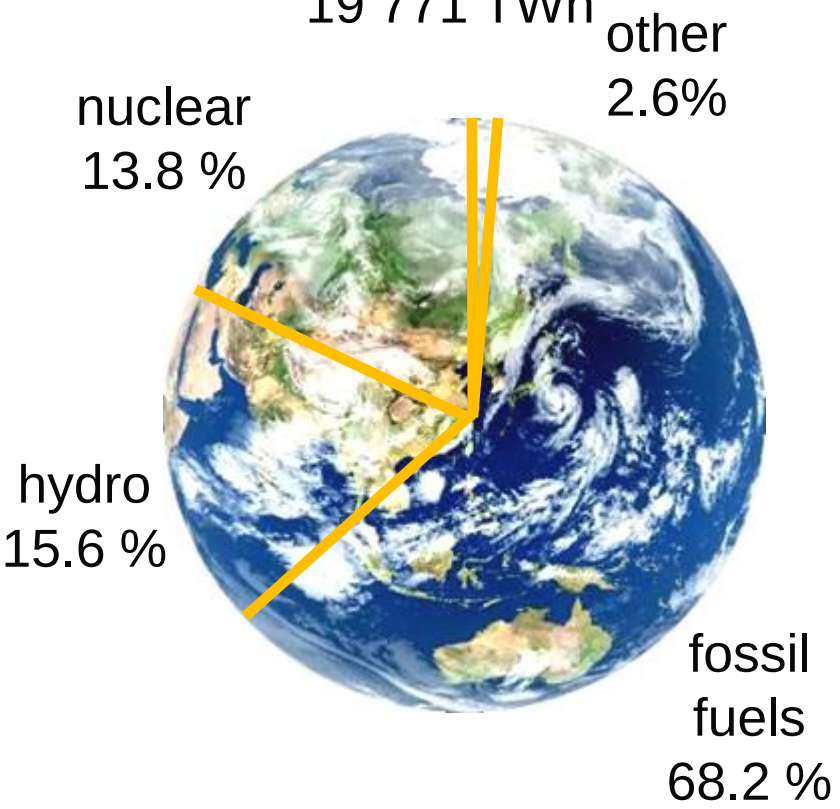
The reality of electricity generation

Contribution of primary energy to nordic and to global electricity production

Nordic Countries
397 TWh



Globally
19 771 TWh



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Coal fired plants in Denmark

Nordjyllandsværket (NJV)	
Capacity	656 MW
Heat supplied annually	927 GWh
Electricity supplied annually	2320 GWh
Employees	109
Fuels	Coal, (Oil)

Amagerværket (AMV)	
Capacity	422 MW
Heat supplied annually	1203 GWh
Electricity supplied annually	1229 GWh
Employees	118
Fuels	Coal, Biomass (Oil)

Fynsværket (FYV)	
Capacity	679 MW
Heat supplied annually	2139 GWh
Electricity supplied annually	2008 GWh
Employees	160
Fuels	Coal, Biomass, (Oil, natural gas)

Coal fired power plants in CE

The Neatherlands

Hard coal

- Buggenum
- Hemweg 8

Germany

Hard coal

- Rostock
- Tiefstack
- Wedel
- Reuter West
- Moabit
- Bille
- FHW Neukölln

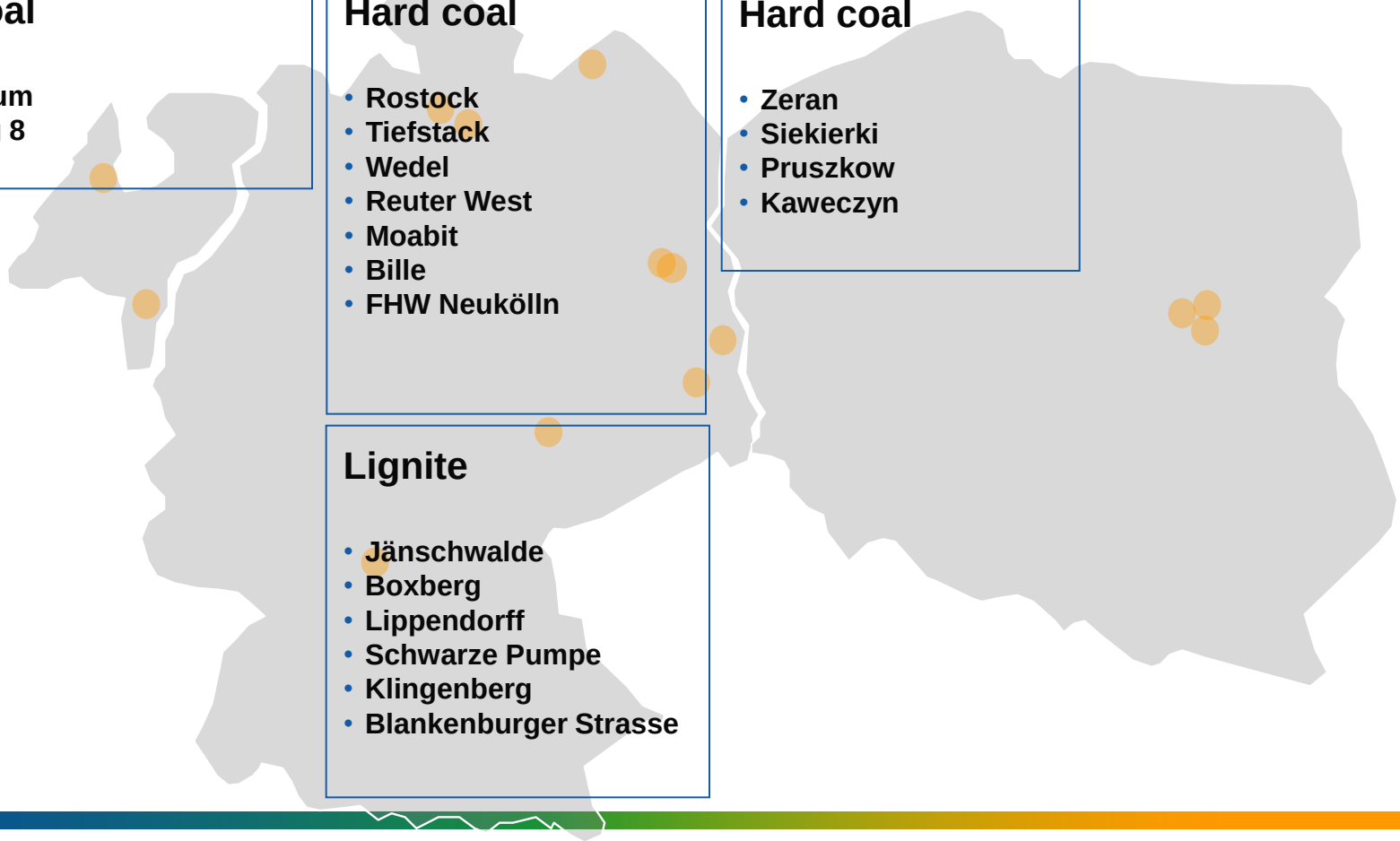
Lignite

- Jänschwalde
- Boxberg
- Lippendorff
- Schwarze Pumpe
- Klingenberg
- Blankenburger Strasse

Poland

Hard coal

- Zeran
- Siekierki
- Pruszkow
- Kaweczyn



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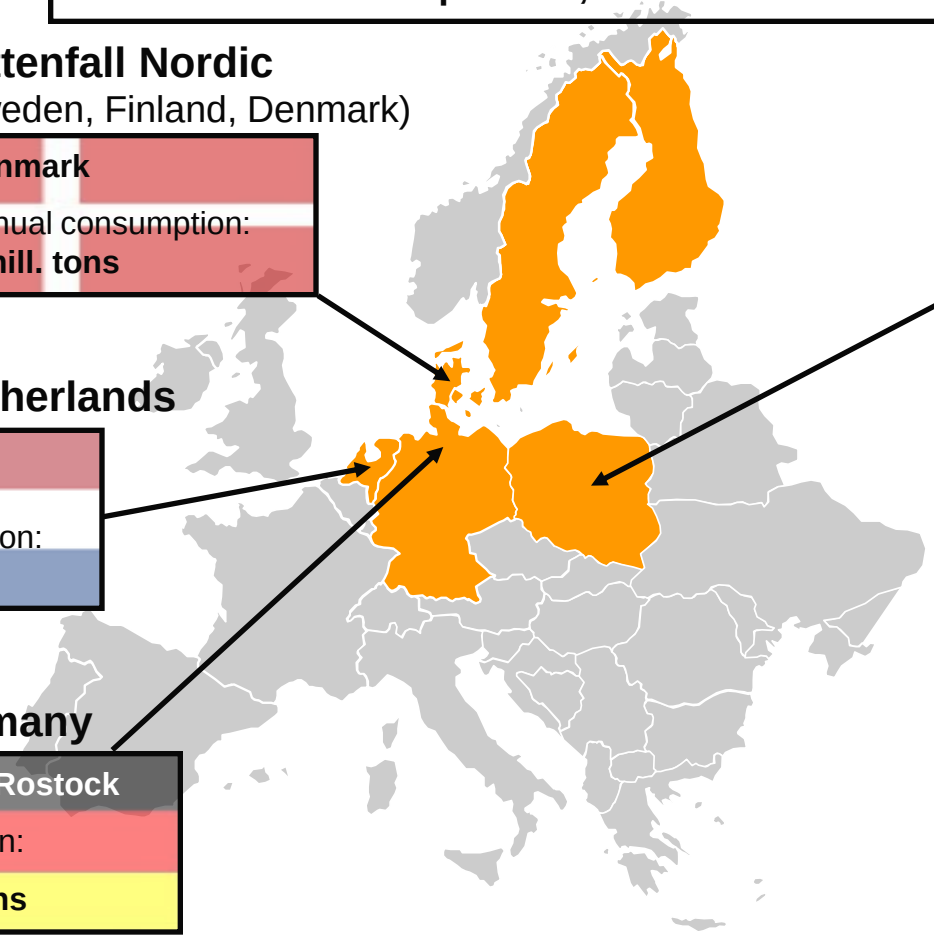
Hard Coal consumption in Vattenfall

Total annual consumption 11,5 million tons



Vattenfall Nordic
(Sweden, Finland, Denmark)

Denmark

Annual consumption:
3 mill. tons

Vattenfall Poland

Warsaw

Annual consumption:
3 mill. tons

Vattenfall Netherlands

The Netherlands

Annual consumption:
1,5 mill. tons

Vattenfall Germany

Hamburg, Berlin, Rostock

Annual consumption:

4 mill. tons

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Characteristics of Vattenfall's hard coal supply

- Mainly spot purchase
- No own coal mines
- Fuel flexibility (blends of many coal qualities, switching between fossils and biofuels)
- Flexibility in handling different coal in our coal yards
- Only purchase for consumption
- UN Global Compact is respected

Making Electricity Clean

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MAKING ELECTRICITY CLEAN

Making electricity clean

- Vattenfall's climate vision:
  Climate neutral operations by 2050
  Climate neutral in Nordic by 2030
- Climate goals integrated in business strategy
- Substantial investments in renewable energy sources, nuclear power and CCS (Carbon Capture and Storage)
- New fields of application in which electricity can replace fossil energy (e-mobility)
- Long-term profitable growth needed to realise vision

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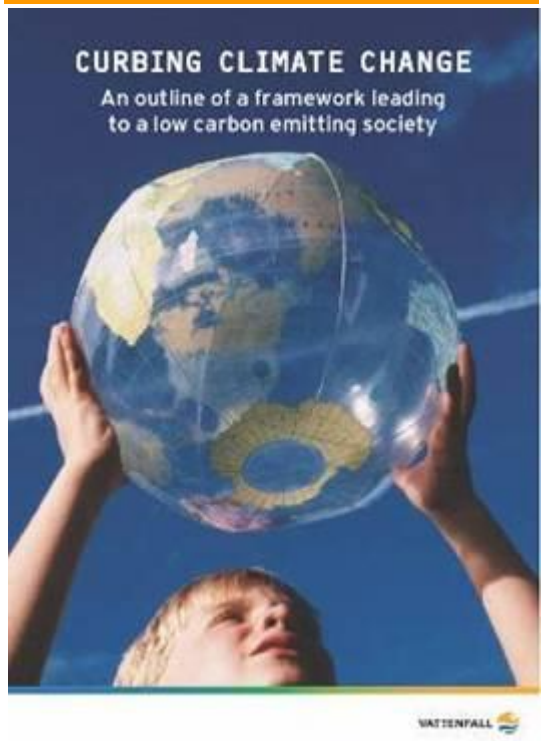
We will meet the CO_2 challenge on broad front

World wide co-operation



Globat emission trading system

Energy efficiency

600.000 customers received a low energy light bulb

Energy production

The "CO_2-neutral" power plant

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Roadmap to realisation

Conceptual investigations

Test rig

0.1 – 0.5 MW_{th}

< €3 million

Pilot plant

30 MW_{th}

€ 70 million

Demo plant

300 – 700 MW_{th}

> € 1,5 billion

Commercial concept:

~ 1000 MW_{th}

2001

- Theoretical studies

2004

- Research
- Basic principles
- Combustion characteristics

2008

- Demonstration of the process chain
- Interaction of components
- Validation of basic principles and scale-up criteria
- Long term characteristics
- Non-commercial

2013 – 2015

- Verification and optimization of the component choice, the process and reduction of risks
- Must be commercially viable incl. subsidies

2020?

- Competitive on the market at that time
- No subsidies

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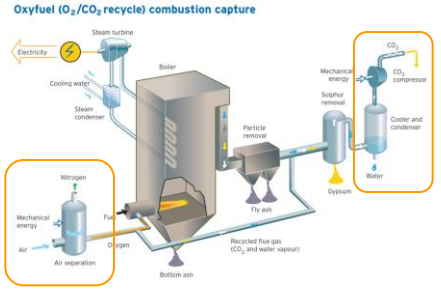
Capture technologies

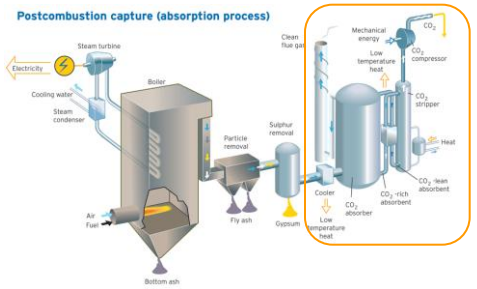
Oxyfuel combustion

Fuel is combusted in pure Oxygen instead of air



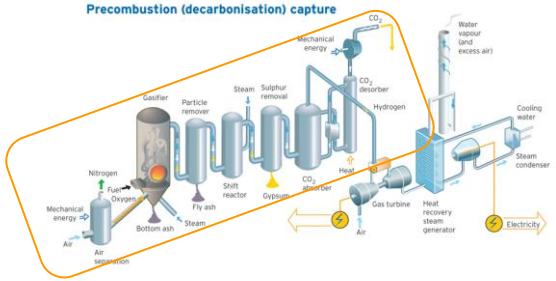
Postcombustion

CO_2 is removed from the flue gas after combustion



Precombustion

Carbon is removed from the fuel before combustion



Vattenfall does not favour any technology

The best is if all technologies become commercially viable

New technique compared to conventional power production

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Schwarze Pumpe

Oxyfuel pilot plant (30 MWth)

Inaugurated in September 2008

First test period will last for at least three years, 2009 – 2011

Combustion with lignite, tests with bituminous coal start in 2012

Different firing modes:

- **Variations of O_2 concentration in oxidant**
- **Variations in O_2 supply in the burner**
- **Variations in recycle rate**

End of 2009:

Operating hours	**5100 h**
Operating oxyfuel hours	**3300 h**

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Jänschwalde power plant - CCS demo

- **Both Oxyfuel and Postcombustion technologies will be investigated**
- **Jänschwalde today consists of 6 units of 2 boilers and 500 MW_e generator each**
- **Fired with lignite from an open cast mine close by**
- **“Double-demo” when unit F is both retrofitted with Postcombustion and a new Oxyfuel boiler is added**
- **Demo plant ready about 2015**
- **Options for CO_2 storage are under investigation**
- **180 mln Euro subsidies from EU**

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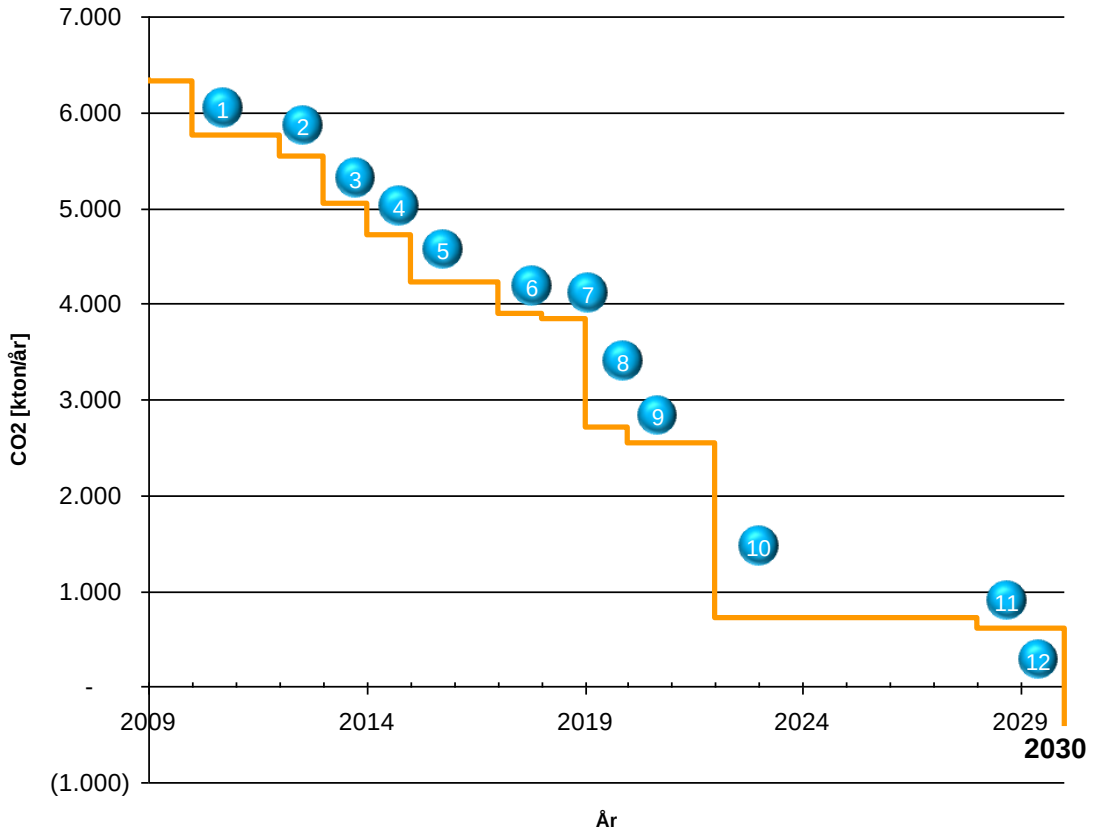
Vattenfall Nordic - CO_2 neutrality in 2030



Activities:

1. AMV1 100% bio
2. Bio co-combustion Uppsala KVV NJV2, Shutdown
3. Maxbio AMV3 Phase 1 (20%), Helsingør and Hillerød, 100 % bio
4. Maxbio NJV3 Phase 1 (20%)
5. Maxbio FYV7 (40%)
6. Maxbio NJV Phase 2 (40%)
7. Vanaja new bioboiler
8. AMV3 100% biomass or CCS
9. Uppsala without peat
10. CCS NJV (Coal and Biomass)
11. Myllykoski 100% bio
12. FYV7 100% biomass or CCS

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There is a future for coal in Europe....

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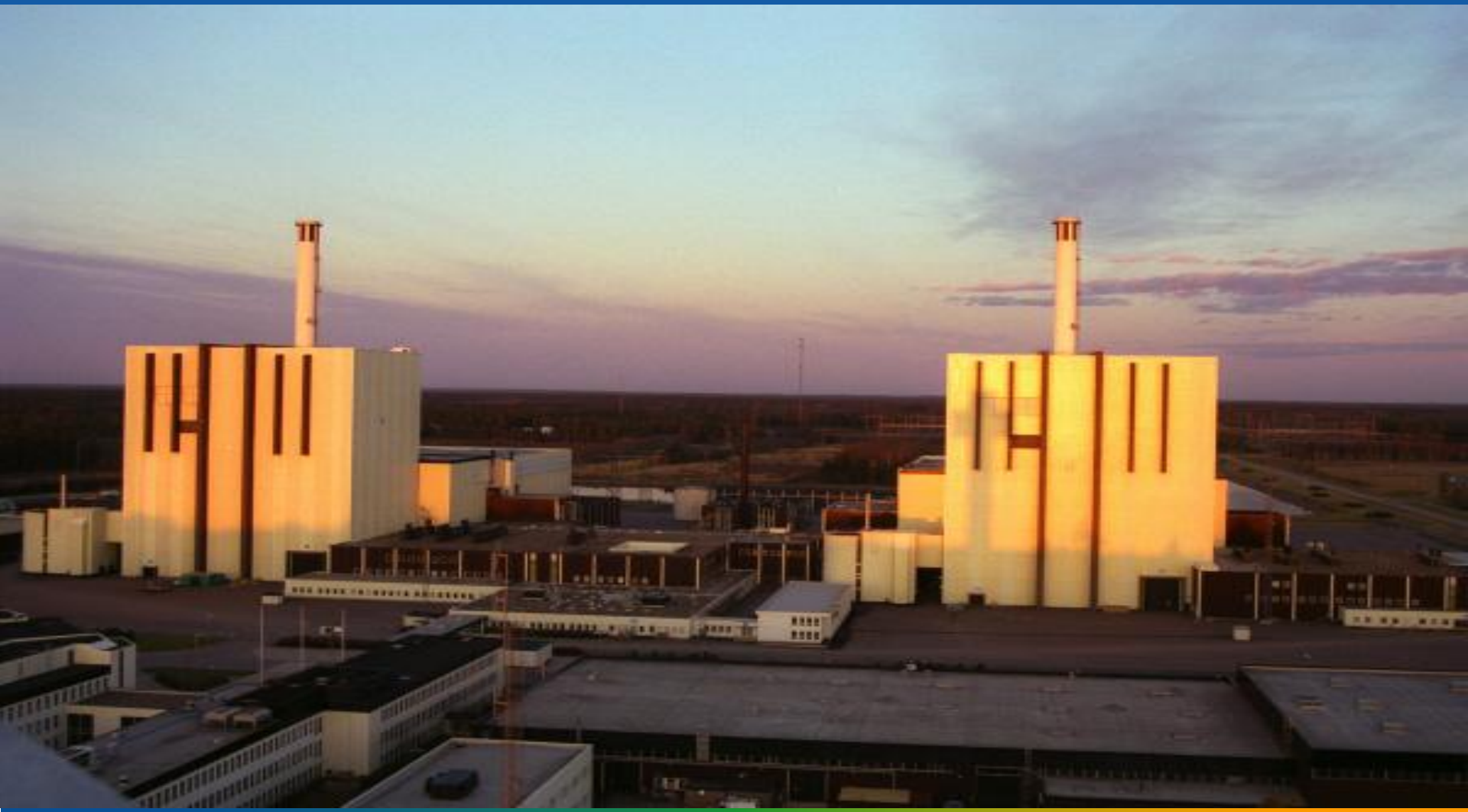
Thank you!



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