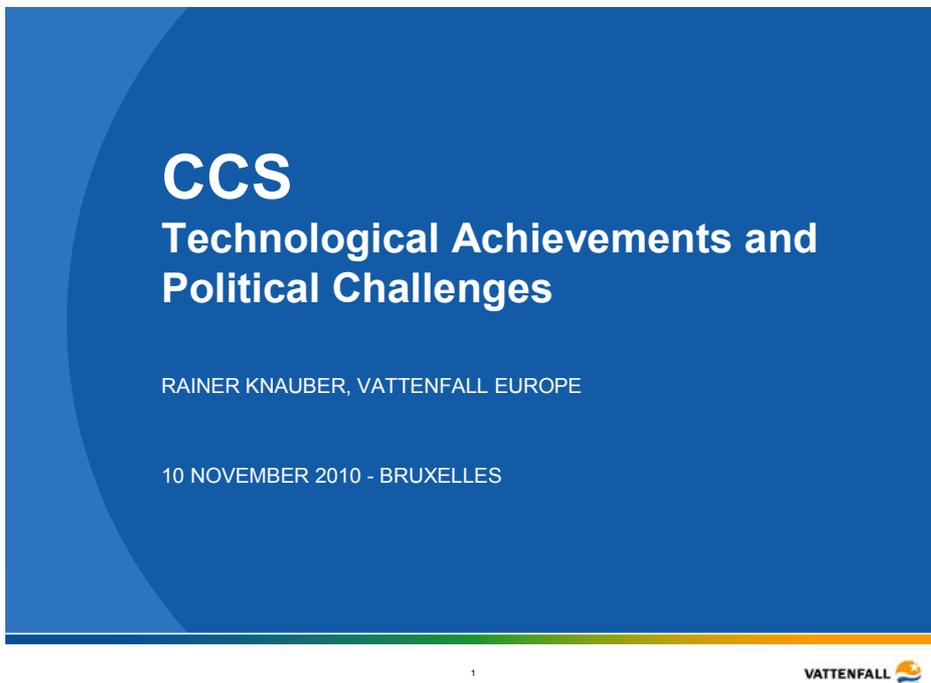


## **CCS – Technological Achievements and political Challenges**

Ladies and Gentlemen - and if I may be so bold to say: Dear Friends of Sustainable Coal!

It is my distinct pleasure to be here today and I am very much obliged to Euracoal and especially to Dr. Ehler for inviting me to this Round Table on Coal.

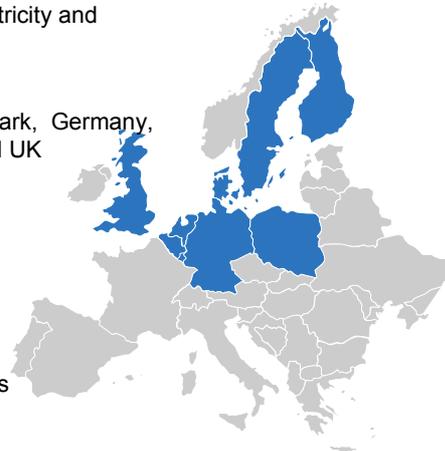


I would like to share with you some of our experiences with CCS and I would like also invite you to join me in a stock-taking of the “Technological Achievements and Political Challenges” of this key climate technology.

Allow me to start with a few facts about Vattenfall, our climate strategy and CCS roadmap.

## Vattenfall: a European energy company

- Europe's fifth largest generator of electricity and the largest producer of municipal heat
- Net sales 2009: 19.85 billion €
- Operations in Sweden, Finland, Denmark, Germany, Poland, the Netherlands, Belgium and UK
- 7.4 million electricity customers
- 5.6 million network customers
- Business along the entire value chain
- 40,000 employees
- 100 % owned by the Swedish state
- Core businesses: Electricity, Heat, Gas



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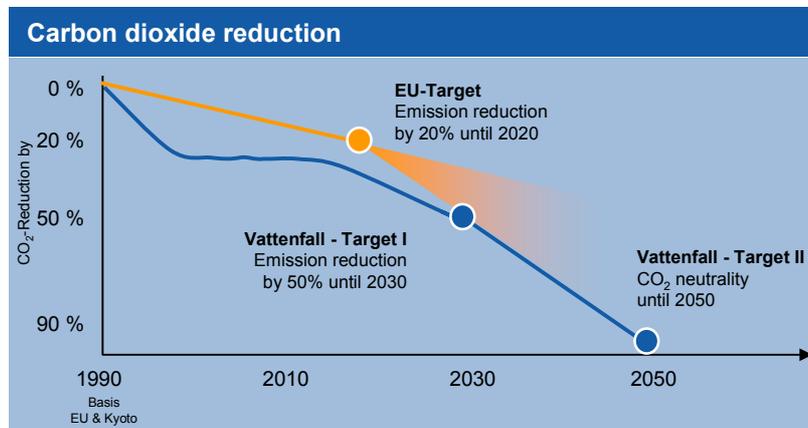
Let's start with some key figures:

We are the No. 5 company in Europe for electricity production and No. 1 for municipal heat production.

In 2009, about 40,000 employees in eight countries served 7.5 million electricity customers and 5.6 million network customers in our three core businesses: electricity, heat and gas.

We face a very diverse energy mix in each country and thus are accustomed to work within very diverse business environments, markets, and socio-political settings. So, naturally, the role of coal also differs in our respective markets.

## Vattenfall's target: climate neutral by 2050

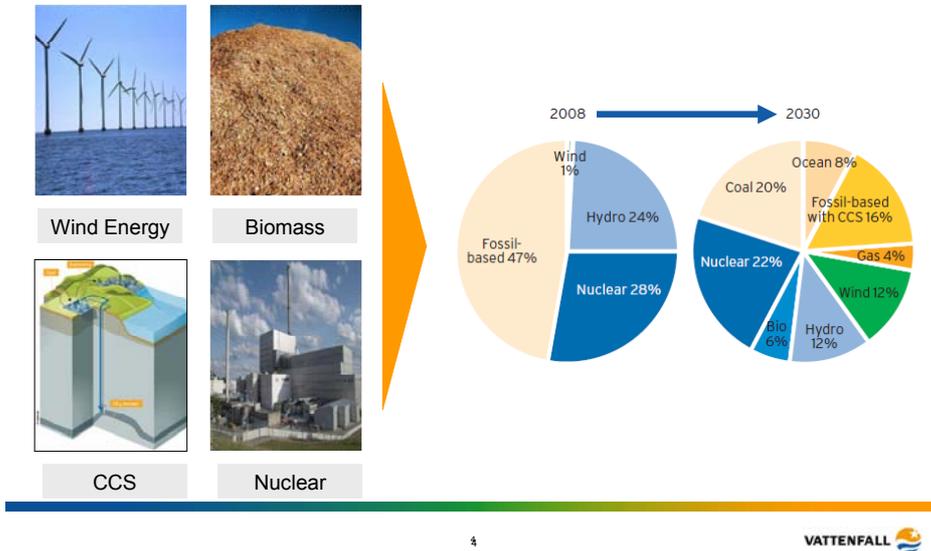


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Being a major operator of coal-fired power plants, Vattenfall is also a major emitter of greenhouse gasses, notably CO<sub>2</sub>. As of today, the Vattenfall group emits about 90 million tonnes CO<sub>2</sub> annually, of which about 70 million tonnes result from our German business. This makes us certainly part of the Climate Change Problem – but we are fully committed to become a part a the Climate Change solution as well. Our stated mission is to halve our CO<sub>2</sub>-emissions by 2030 and become “climate-neutral” by 2050.

## Various technologies – one strategy



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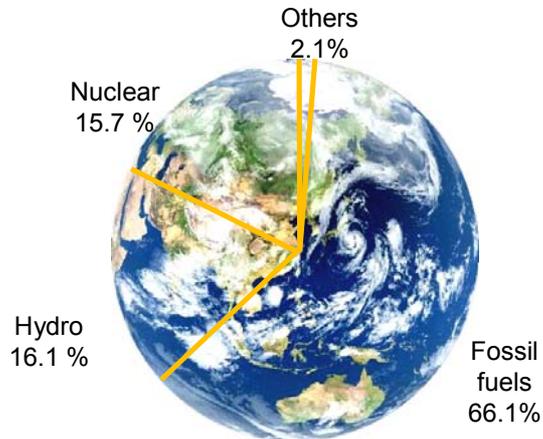
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To achieve this ambitious goal, we will have to make use of every suitable technology and explore various pathways. We believe in a robust portfolio approach and a broad energy and technology mix. Contrary to many published opinions, I am fully convinced that our energy future will not be characterised by a monoculture, but by diversity. I would even argue that more diversity will be vital for the resilience of our industry and society and that we should avoid as much as possible to do “technology picking”. We cannot know today where technological progress will lead us. There is no silver bullet.

## Why do we need CCS?

- The world will not stop using fossil fuels.
- Coal is the one fossil fuel which combines availability with cost-efficiency
- CCS is **THE** key technology for developing a CO<sub>2</sub> lean energy system based on the reality of fossil fuels – especially coal

Global electricity supply - 2008



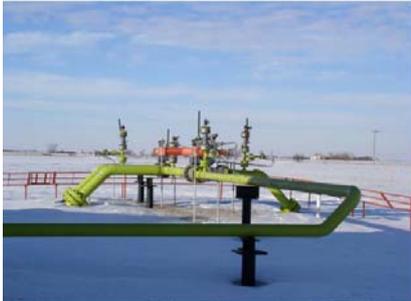
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Having said that, I have to admit that – with today's knowledge – CCS is practically the only short-to-mid-term technological solution to radically reduce the CO<sub>2</sub>-emissions from burning fossil fuels (and to reduce the process-based emissions from many other industries such as steel and concrete, as well).

Outside of Europe, Coal has been the fastest growing energy source of the last decade. And as much as one might wish: renewable energies and efficiency gains just will not be enough to keep up with demand. Globally, and this is undisputed by so diverse yet highly respected institutions such as the IEA and the IPCC, CCS is crucial to meet any reasonable climate targets.

## Does the technology work?



Weyburn: picture of a transfer pipeline for distribution; transport pipeline 1.50 meter under surface

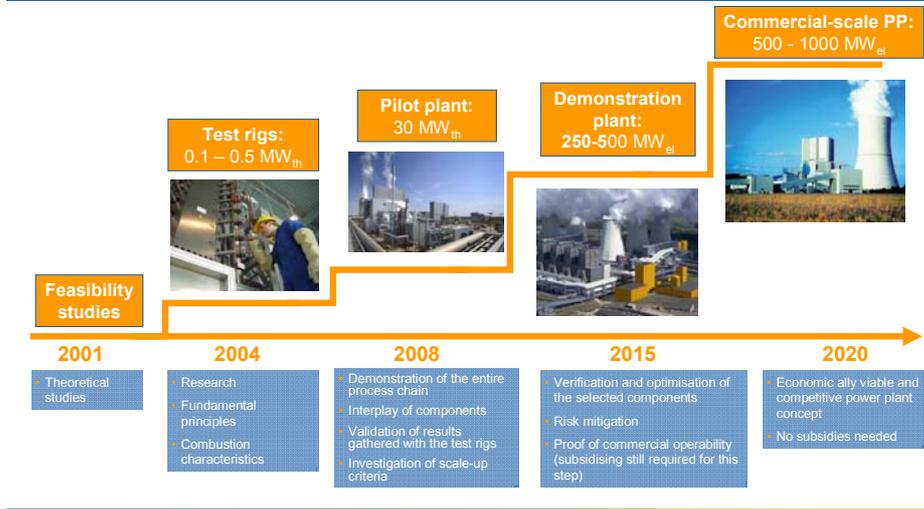
- CO<sub>2</sub> capture for many decades in industrial processes
- 3100 km CO<sub>2</sub> pipelines in USA transport 30 m. tonnes per year
- Sleipner (Norway) since 1996; approx. 12 m. tonnes of CO<sub>2</sub> in the Utsira formation
- CO<sub>2</sub>SINK-project Ketzin: start 2004; Vattenfall partner of the research project led by Geoforschungszentrum Potsdam; 40,000 tonnes CO<sub>2</sub> stored
- Pilot plant Schwarze Pumpe: since 2008; demonstration of the entire process chain; approx. 5,000 tonnes CO<sub>2</sub> captured

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This slide lists just a few examples of successful CO<sub>2</sub>-transport and storage projects. I feel very confident in stating that the technological issues of the entire CCS chain – capture, transport and storage – either have been proven or are in a very advanced state of validation.

## Roadmap for implementing carbon capture



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Our company has been on a decade-spanning journey of CCS R&D. We have recently and successfully entered the stage where you move out of the laboratory into the real world. It has always and right from the start been our aim to verify and optimise this technology and to make a substantial contribution to the full commercialisation of CCS.

## The CCS pilot plant: successful testing of CO<sub>2</sub> capture



### Facts and figures:

Capacity: 30 MW<sub>thermal</sub>  
CO<sub>2</sub> capture rate: + 90 %

### Results of operation:

Operating hrs since Sept. 2008: 8,000 hrs  
CO<sub>2</sub> quantity captured: 5,000 t

- The CCS pilot plant serves the purpose of testing CO<sub>2</sub> capture according to the Oxyfuel process.
- The obtained results of operation meet the expectations regarding CO<sub>2</sub> capture.
- Further potential for technical optimisation is available, and is being tested continuously.

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Since our Pilot Plant at Schwarze Pumpe opened up operations in September 2008, we obtained invaluable insight into running an industry-sized oxyfuel plant. Some of you might have visited the site, and those of you who have not, please accept my invitation to do so. It is definitely worth a visit!

I am very proud to be able to say that the results obtained from this pilot so far have not only met but exceeded our expectations. And we will continue our research work for at least three more years, even expanding the original project by inviting new partners.

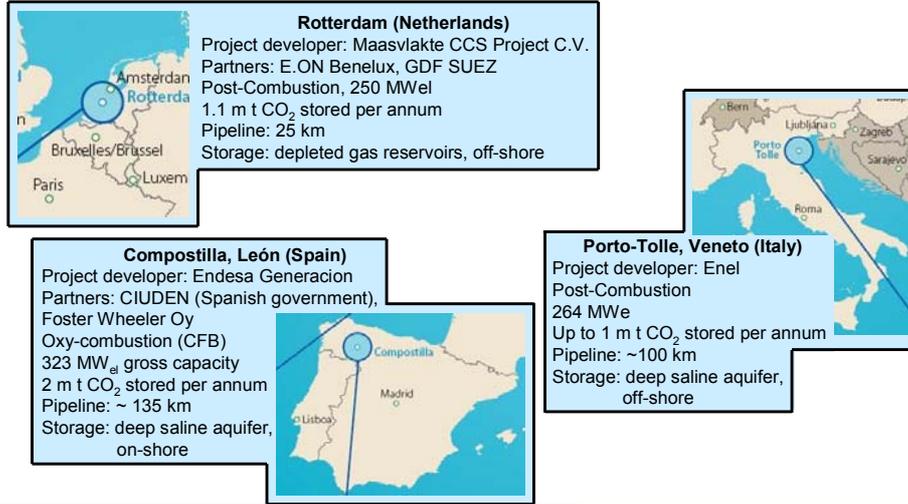
## Locations of European CCS projects under EEPR



Europe has been essential in promoting CCS as a climate technology.

We are truly grateful for all the support provided by many European institutions, especially by the General Directorate for Energy and – of course – by members of the European Parliament (*such as Dr. Ehler, Mr. Glante, others who are present!*).

## CCS projects under EEP



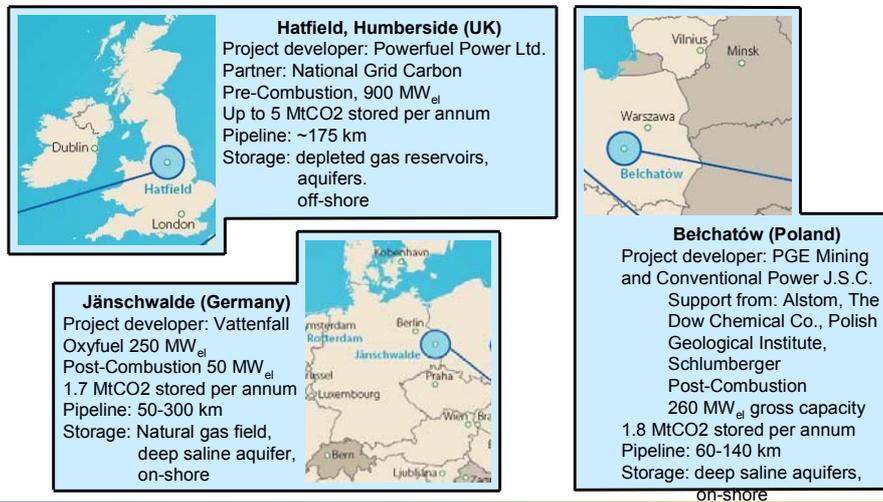
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The EEP was elementary in paving the road for CCS, and the six demo projects who were successfully competing for this funding are – at least as far as I can see – all on track to become the initial lighthouse projects of their countries.

As you can see in this slide and the following one, the six EEP-projects cover the entire technological range and seek to make use of all potential geological storage sites.

## CCS projects under EPR



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As of today and to the best of our knowledge, all projects proceed according to their respective EPR grant agreements. Which, of course, does not exclude the possibility of delays and changes in the specific technological concepts. I think this is not something completely out of the ordinary but rather typical for the sort of large-scale first-of-a-kind projects we are dealing with.

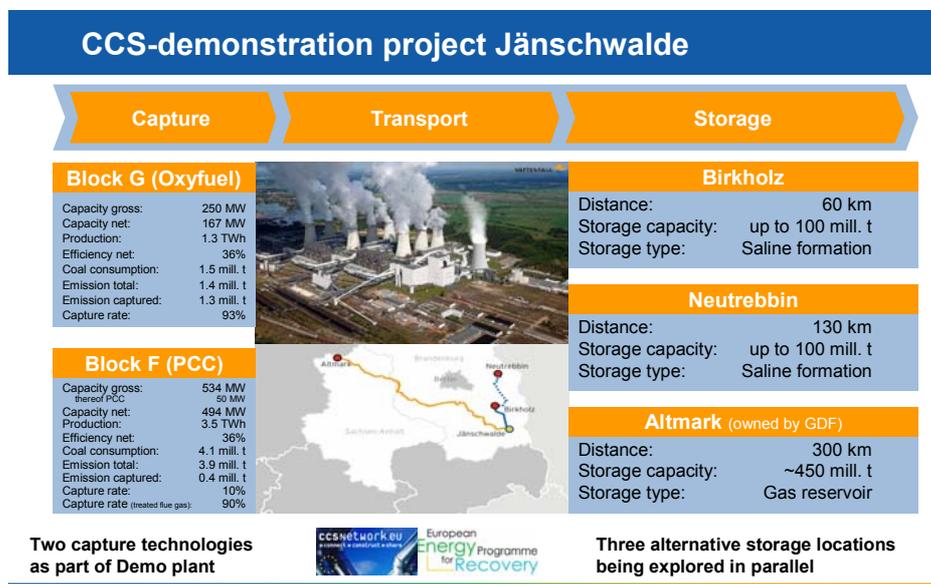
Unfortunately, we have all heard and read about a number of planned CCS projects which during the recent month's have been postponed or even cancelled. Without being able to give an in-depth analysis of the reasons behind these decisions, we have to admit that the economic, financial and political landscape has not improved over the past two years. The market-outlook for electricity is – all in all – not to bright – at least from the producer's point of view. The political framework – the transposition of the EU-Directive – is still lacking in

many countries – and we will come back to this issue later.

Also, I regret to have to say, financial support schemes and proposals seem to shift and change shape rather more often and far more substantially than one has hoped for - another factor of uncertainty in an increasingly risky business environment.

And last but not least the uncertainty about the future of climate policy and carbon markets adds to a picture where caution is guiding the hands of many investors.

Having said that, I can nevertheless assure you that we are willing to face these challenges and uncertainties and continue with our Jänschwalde project.



We chose our power plant site at Jänschwalde in the State of Brandenburg, where – today – we generate about 22 TWh annually on the basis of lignite,

providing enough electricity to serve 5 million people. With an installed capacity of 3.000 Megawatt, Jänschwalde is Vattenfall's largest power plant site in Germany.

We plan to use two capture technologies: post-combustion capture and oxyfuel, with an added capacity of 300 MW, making use of best practice in today's power plant technology, aiming at the highest possible efficiency for a CCS demo: at least 36 per cent electrical net efficiency.

We also hope to achieve the lowest possible CO<sub>2</sub>-emissions per kilowatt-hour: markedly less than 100 grammes of CO<sub>2</sub> per kilowatt-hour. This translates into less than 25 % of BAT for a state-of-the-art natural gas-fired power plant. A remarkable fact for a lignite plant!

For storage purposes, three alternative locations are being explored in parallel, each of which has the potential to store at least the amount of CO<sub>2</sub> necessary for the expected lifetime of the demo plant.

## Challenge # 1: public perception

- Political support and public acceptance → you cannot enforce CCS
- Citizen movements at the exploration sites against survey and research
- Regional Advisory Council initiated by Brandenburg Ministry of Economy to include all stakeholders in a dialogue on how to proceed



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The issue of storage leads me directly to the two major challenges.

Number one is the issue of public perception.

This is a moment to be self-critical. We – as an industry – have far too long addressed CCS primarily from an engineer's point of view. And from the point of view of an engineer, this is not rocket science. So we were pretty confident that we would be able to deliver. Perhaps we were over-confident. Because we have severely underestimated the socio-political aspects of CCS and CO<sub>2</sub>.

Neither CCS nor CO<sub>2</sub> are well-known to the general public. We did extensive social research only to find out that people tend to be rather weak on the knowledge-side but amazingly strong when it comes to having an opinion.

So when it comes to public acceptance and political support, we do face a huge challenge. I am sure we will find time to elaborate on this issue later on.

On the upside, we also see substantial efforts in this field: serious efforts to reach out to the public, especially in the regions concerned.

A very good example for this public outreach is the Regional Advisory Council initiated by the Brandenburg Ministry of Economy. This council encompasses all relevant stakeholders of the region where the exploration is intended to take place. The explicit aim is to include all concerned parties in a dialogue about how to proceed with the exploration and permitting process. Transparency and accountability are the twin core values in this outreach and I can only hope that this appeals to the reason of all concerned parties.

I will come back to this in a minute but allow me to firstly address the second challenge: legal framework.

## Challenge # 2: legal framework

- CCS investment decisions need legal and regulatory clarity asap
  - Transposition of EU Directive still missing in most states
- Widespread deployment post 2020 depends both on legal framework and global carbon/climate policy
  - Shape of Post-Kyoto and carbon markets highly uncertain
- German CCS-law pending

Draft version shows a need for action:

### Timetable

- Extensive and time-consuming licensing procedures, lack of instruments for acceleration
- Downstream powers to issue ordinances delay legal certainty
- Validity of the law limited to storage applications filed until 31 December 2015

### Costs

- Total costs of financial security and after-care incalculable, especially in view of the development of emission allowance trading

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It might sound commonplace to you, but investments on the scale of a CCS demo plant do need a reliable legal and regulatory framework.

On the EU level, legal issues have been formidably addressed by the CCS Directive. And we are truly thankful for this.

Alas, the transposition of this Directive in the member states is regrettably lagging behind.

We also face more uncertainties than ever when it comes to the market environment for CCS. Without going too much into the details I think it's only fair to say that the future of a legally binding global climate regime and carbon markets still lies very much in the dark. And I can't see it getting much brighter these days.

For time's sake I'll skip most of what I would have to say about the German CCS law. I would only like to state that we see considerable room for improvement. At

least if the German Government is still serious about having a CCS demo plant being built in Germany.

Ladies and Gentlemen, Please allow me some final remarks.

The business environment for all major investments has become tougher and – at least this is my personal reading - especially unfavourable for large-scale, capital-intensive, socio-politically exposed technologies.

Having said that, it is also very clear to me that the European challenges of „Security of Supply“ and „Competitiveness“ set within a high-price and carbon restricted scenario will not be manageable without coal & CCS. Of course, if climate policy miraculously faded away from the agenda, the picture would be entirely different - but let us focus on more robust assumptions.

My point is: politics and society at large are not prepared for this kind of debate. For many years, we have been told post-industrial stories, which have contributed to a widespread mentality of NIMBY – not in my backyard. Such a mentality is not compatible with industrialised countries – and a strong Europe - which want to stay competitive in an irreversibly globalised economy.

Thus, Ladies and Gentlemen, the future of coal power in Germany and Europe will tell us a lot not only about the future of energy policy but also about the future of industrial policy in general.

**Thank you very much for your time!**