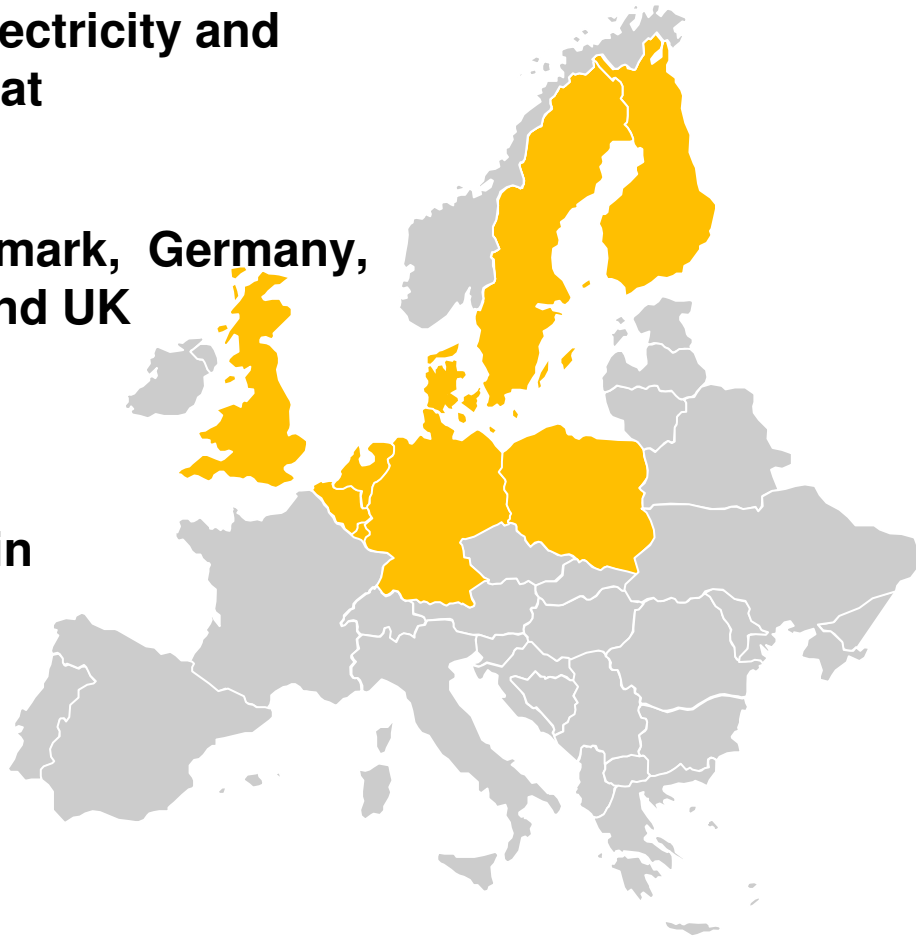
Clean Coal for Europe
Making CCS Work

Dr. Hartmuth Zeiß
Chairman of the Managing Directors
Vattenfall Europe Mining & Generation

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



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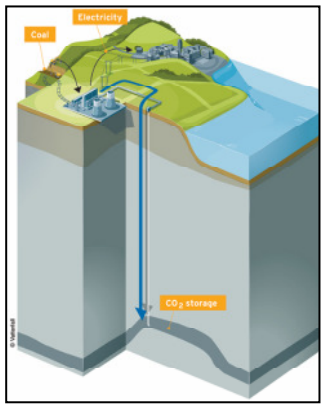
Various Technologies – One Strategy

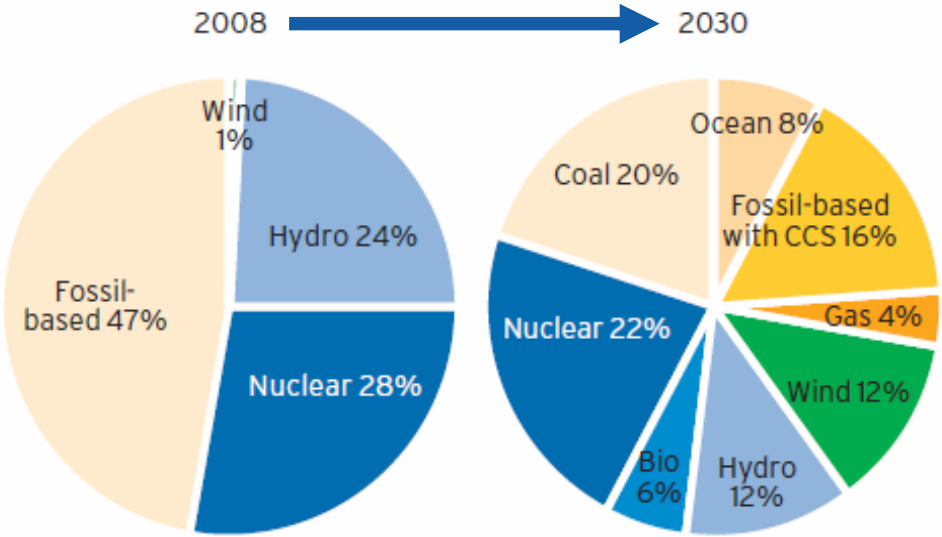
Wind Energy

Biomass



CCS

Nuclear



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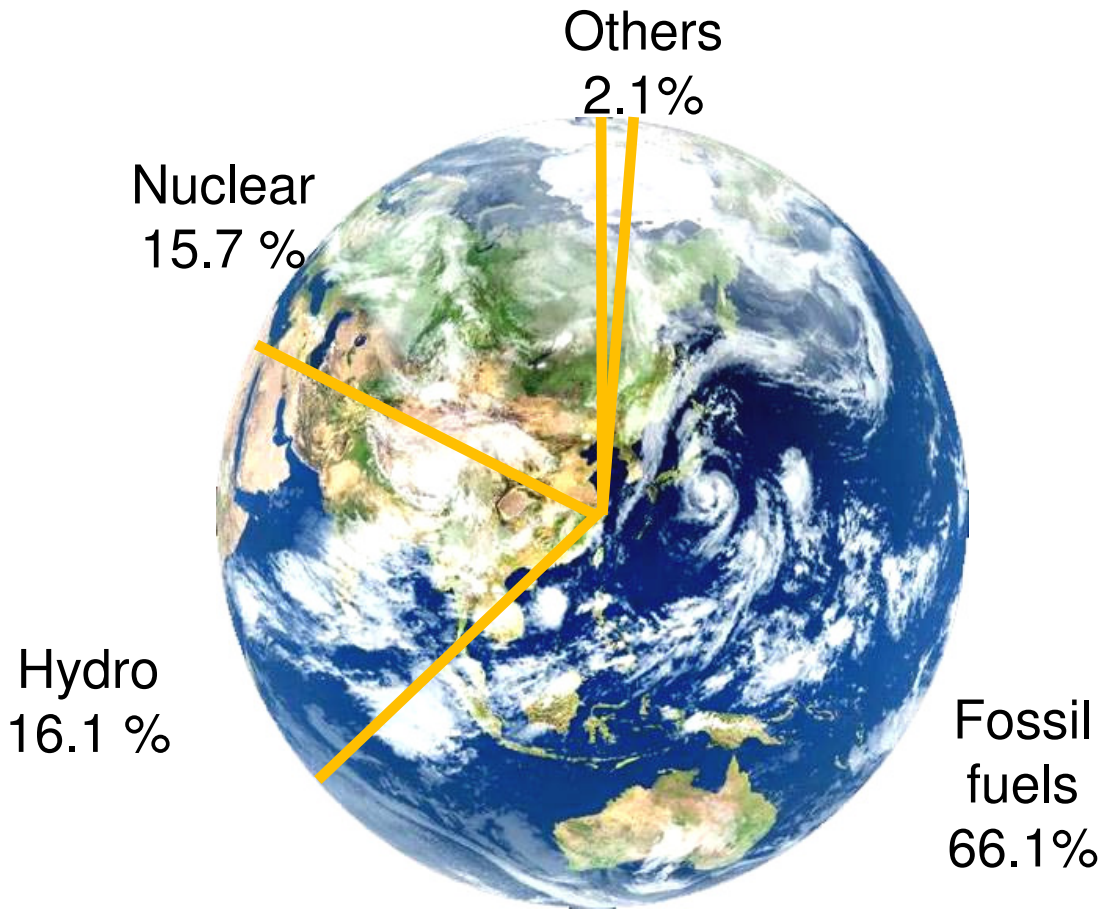
CCS – A Global Perspective

- The world will not stop using fossil fuels.
- Coal is the one fossil fuel which combines the greatest potential with the strategic optimum
- CCS is **THE** key technology for developing a CO_2 lean energy system based on the reality of fossil fuels – especially coal

global electricity supply - 2008



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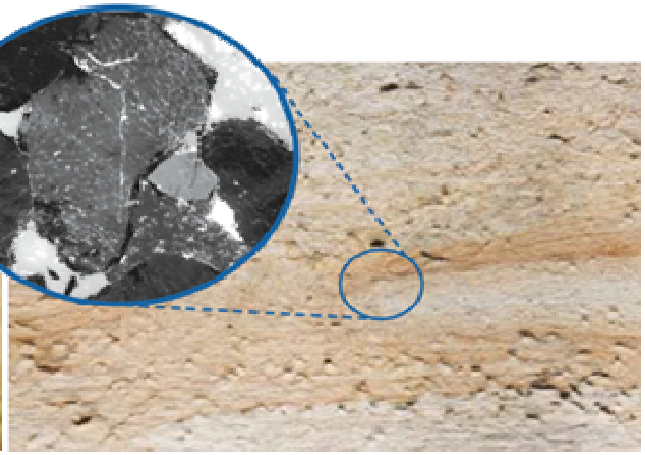
Developing CCS

Capture
CO_2 Sequestration

Transport
CO_2 Pipeline

Storage
Geological Storage



Target: Parallel development of technology for carbon dioxide capture and storage.

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Roadmap for implementing carbon capture

Feasibility studies

2001

- Theoretical studies

Test rigs:
0.1 – 0.5 MW_{th}

2004

- Research
- Fundamental principles
- Combustion characteristics

Pilot plant:
30 MW_{th}

2008

- Demonstration of the entire process chain
- Interplay of components
- Validation of results gathered with the test rigs
- Investigation of scale-up criteria

Demonstration plant:
300 MW_{el}

2015

- Verification and optimisation of the selected components
- Risk mitigation
- Proof of commercial operability (subsidising still required for this step)

Commercial-scale PP:
500 - 1000 MW_{el}

2020

- Economic ally viable and competitive power plant concept
- No subsidies needed

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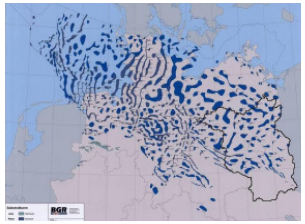
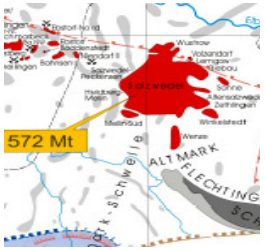
Roadmap for implementing carbon storage

Feasibility studies

Screening

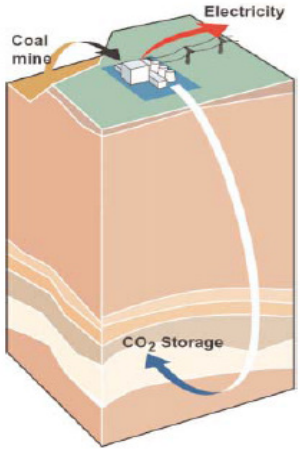


Pilot phase
EGR / CO_2 injection of 100,000 t



Demo phase for storage
CO_2 injection of >1 m t

Commercially viable concept



2001

- Theoretical studies
- Ongoing R&D injection projects (Sleipner, In Salah)

2004

- Screening
- Research
- Fundamental principles
- Pipeline model computations

2010 / 2011

- Altmark project
- Demo: EGR
- Demonstration of the full process chain
- Operating experience with injection
- Research

2015

- East Brandenburg aquifer project
- 1st step: repository exploration
- Qualification of reservoir structures
- Opening-up of the reservoir
- Pipeline construction
- Operation over 15 – 20 yrs

2020

- Economically viable and competitive transport and storage infrastructure

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The CCS pilot plant: Successful testing of CO_2 capture

Facts and figures:	
Capacity:	30 $MW_{thermal}$
CO_2 capture rate:	> 90%

Results of operation:	
Operating hrs since Sept. 2008:	6,000 hrs
CO_2 quantity captured:	3,100 t

- The CCS pilot plant serves the purpose of testing CO_2 capture according to the Oxyfuel process.
- The obtained results of operation meet the expectations regarding CO_2 capture.
- Further potential for technical optimisation is available, and is being tested continuously.

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CCS-Demonstration Project Jänschwalde

Capture → **Transport** → **Storage**

Block G (Oxyfuel)

Capacity gross:	250 MW
Capacity net:	167 MW
Production:	1.3 TWh
Efficiency net:	36%
Coal consumption:	1.5 mill. t
Emission total:	1.4 mill. t
Emission captured:	1.3 mill. t
Capture rate:	93%

Block F (PCC)

Capacity gross:	534 MW
thereof PCC	50 MW
Capacity net:	494 MW
Production:	3.5 TWh
Efficiency net:	36%
Coal consumption:	4.1 mill. t
Emission total:	3.9 mill. t
Emission captured:	0.4 mill. t
Capture rate:	10%
Capture rate (treated flue gas):	90%

Birkholz

Distance:	60 km
Storage capacity:	up to 100 mill. t
Storage type:	Saline formation

Neutrebbin

Distance:	130 km
Storage capacity:	up to 100 mill. t
Storage type:	Saline formation

Altmark (owned by GDF)

Distance:	300 km
Storage capacity:	~450 mill. t
Storage type:	Gas reservoir

Two capture technologies as part of demo plant

Three alternative storage locations being explored in parallel

ccsnetwork.eu
*connect *construct *share

European Energy Programme for Recovery

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The CCS power plant: Advancing the concept

Previously: **Retrofitting** unit F:

- Oxyfuel 250 MW
- PCC 125 MW

Now: **New unit**:

- Oxyfuel 250 MW

Retrofitting unit F:

- PCC 50 MW

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Advancing the concept - Key results of the technical modifications

	Previous concept	Current concept
Efficiency (Oxyfuel)	28 %	**36 %**
CO_2 emissions per kWh		
- Oxyfuel	145 g/kWh	78 g/kWh
- PCC (rel. to treated flue gas)	149 g/kWh	107 g/kWh
Captured CO_2	2.7 Mt/a	1.7 Mt/a

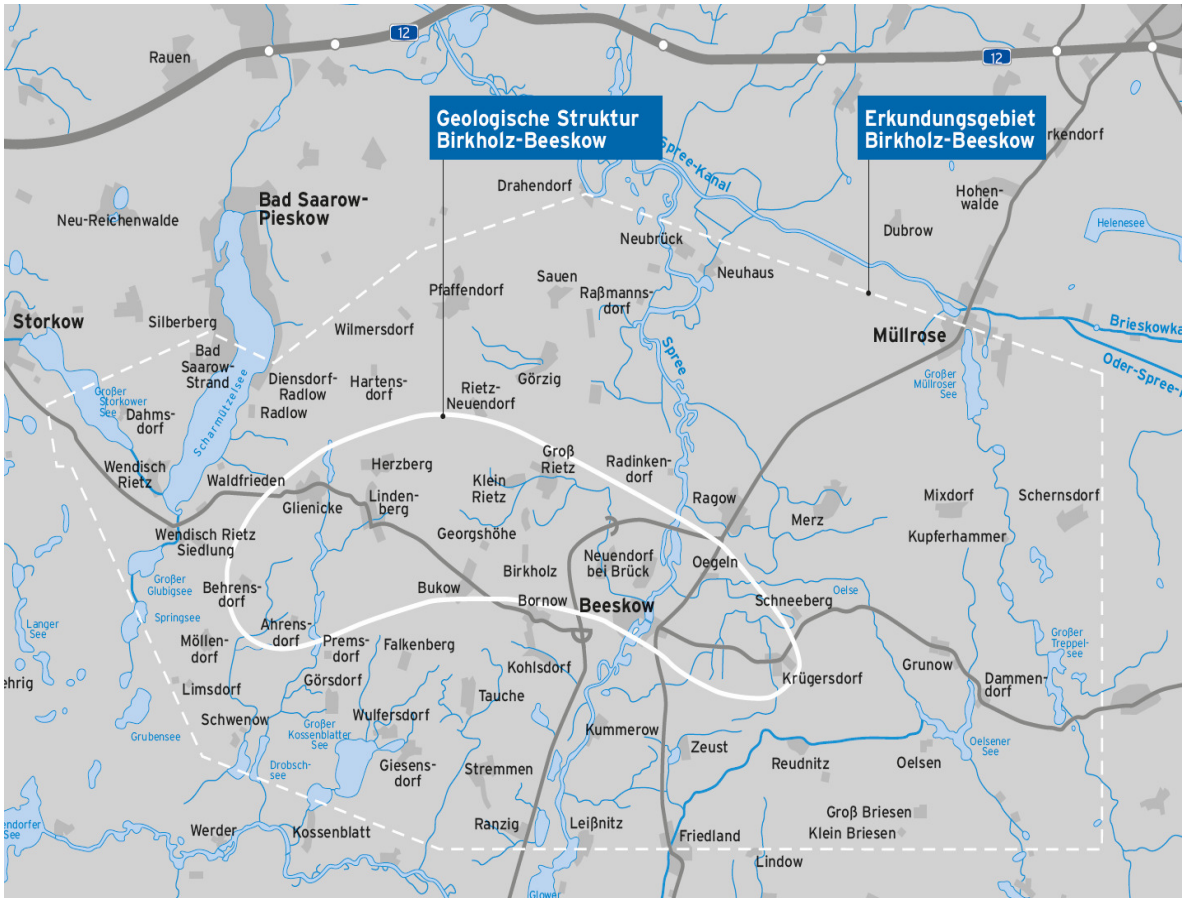
Use of best practice in power plant technology

- *highest possible power plant efficiency for a CCS demo plant*
- *lowest possible CO2 emissions per kWh:* Oxyfuel less than 25% of BAT gas-fired power plant)

Status of storage reservoir exploration

Status Birkholz-Beeskow:

- Permits for exploration of the Birkholz-Beeskow and Neutrebbin storage structures have been received.
- Main plan for operations, and special plan for seismic operations, submitted for Birkholz-Beeskow to authority LBGR.
- Main plan for operations currently in the phase of public participation.



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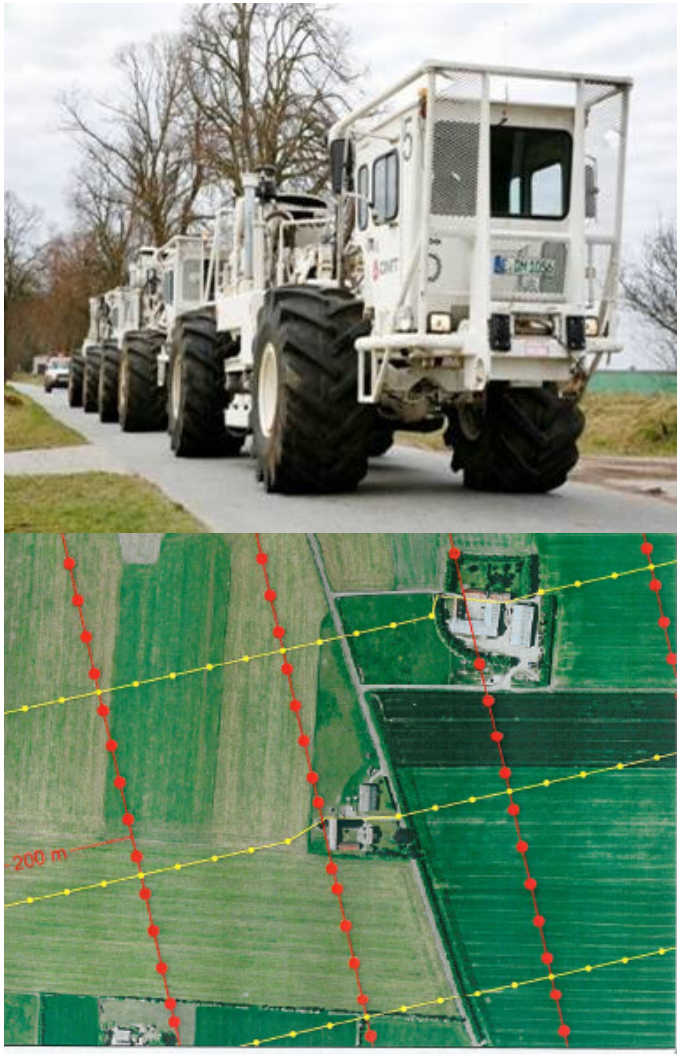
Next step: exploring the geological formation

Vattenfall needs to explore the potential storage sites

- to be able to evaluate the suitability of the geological formations;
- to be able to answer open questions on a valid basis;
- as an essential step towards a permit procedure for later CO_2 storage.



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Transposition of the EU Directive into German law

- CCS Directive is an element of the EU's "Green package"
- Publication of the "Green package" in the EU Gazette on 05 June 2009
- **Enforcement of the Directive** after 20 days, i.e. on **25 June 2009**
- **Deadline for transposition** of the Directive into national law: **after two years**

- The EU CCS Directive must have been transposed into national law by 25 June 2011
- CCS bill presented on 14 July 2010 (joint press conference of the Federal Ministries for the Environment and Economics)
- To be followed by a reconciliation process in the parliament (final decision in Q1 2011)
- Law can be enforced in summer 2011 at the earliest

Preconditions for implementing the project

Implementation of the CCS demo project in the German state of Brandenburg

Subsidies

Legal Framework

Public Acceptance

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Public Acceptance: Dialogue and Transparency

DIALOGUE

- Community information office opened 07 / 2009
- Regular information events on CCS
- Regional contacts programme (regular talks with regional political and media stakeholders)
- Regular talks with regional associations (“regulars‘ table“)
- Regional Advisory Board (initiator State of Brandenburg; sort of “social dialogue”)

TRANSPARENCY

- Extensive distribution of info materials
- Telephone hotline for community questions
- Regular newsletter on project progress
- Placement of information ads

We take people‘s fears in connection with CO2 storage seriously.

We fully rely on open and direct communication with the public.

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Conclusion:

- CCS is one of the technologies with crucial importance for **climate protection from a sustainability angle.**
- Germany – specifically **Brandenburg** - and Vattenfall are among the **technology leaders, but losing momentum**.
- **The development of CCS will sustain important industries**, and the resulting value creation and employment situation.
- Major **prerequisites** to its successful rollout are an investment-friendly **legal framework and political support**.

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Thank you for your attention!

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