The Jänschwalde CCS Demo Project in Germany

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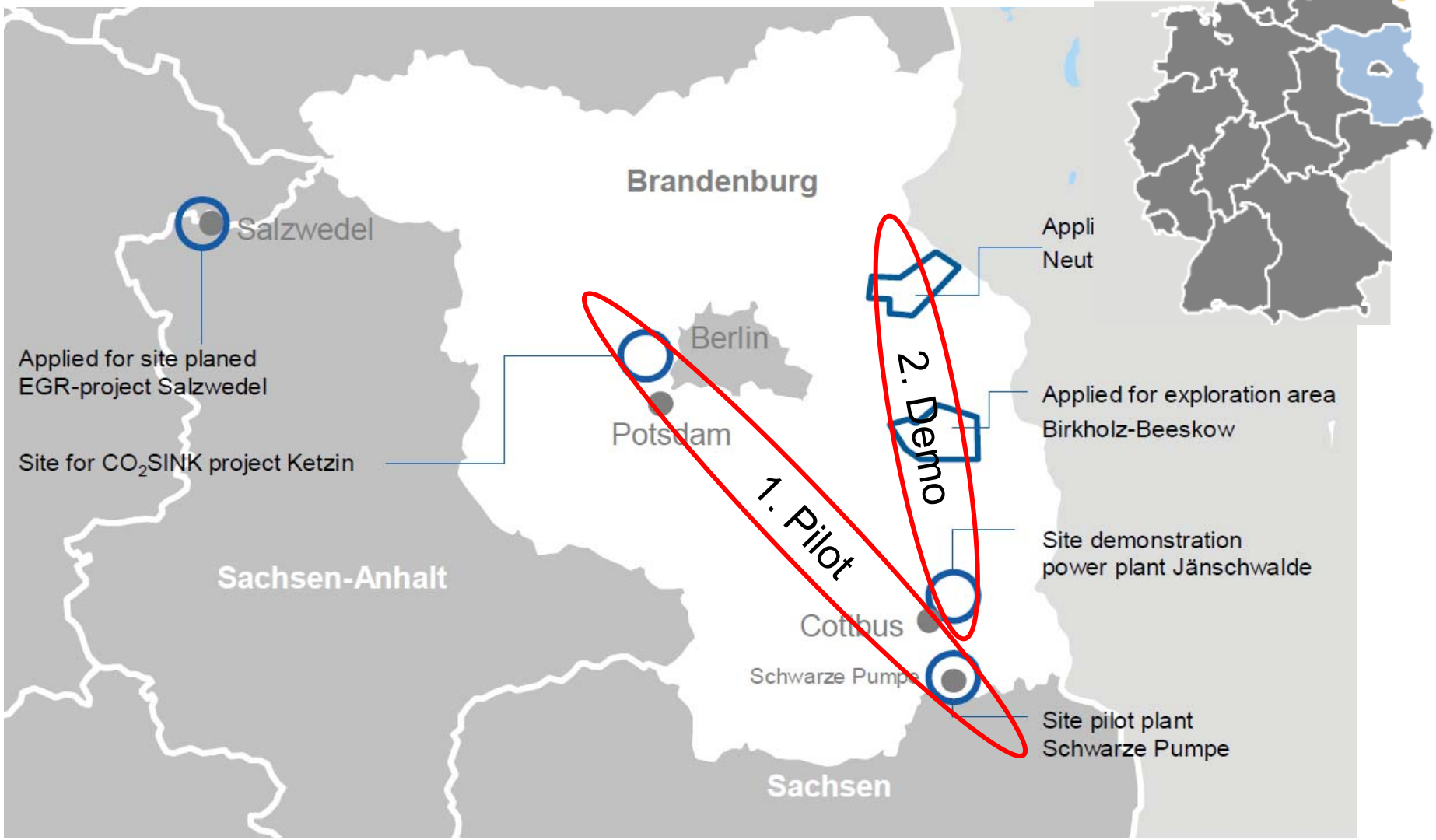
Vattenfall: A Leading European Energy Company

- Europe's 5th largest generator of electricity and the largest producer of heat
- Net sales 2008: EUR 15,041 million
- Vision: To be a leading European energy company
- Operations in Sweden, Finland, Denmark, Germany, Poland, the Netherlands, Belgium and the UK with a total of 7.4 million electricity customers and 5.6 million network customers
- Electricity: generation, transmission, distribution and sales
- Heat: production, distribution and sales
- Gas: distribution and sales
- Energy trading and lignite mining
- 39,000 employees
- Vattenfall AB is wholly owned by the Swedish state

CCS activities in Germany



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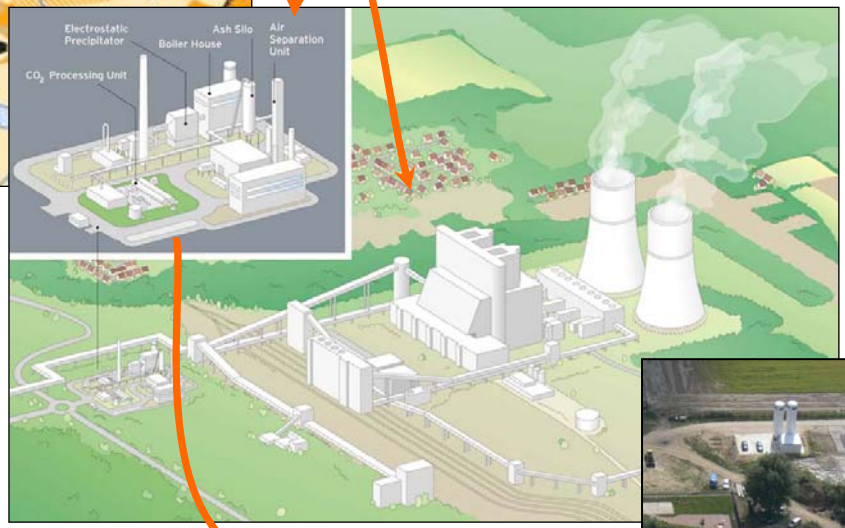
1. CCS Value Chain: Pilot Schwarze Pumpe

The Welzow-Süd Lignite Mine

The Schwarze Pumpe Power Plant 1600 MW



The Schwarze Pumpe Oxyfuel Pilot Plant 30 MW

04 May 2011 the GFZ stored at Ketzin for the first time captured CO2 from a power plant – the Schwarze Pumpe Pilot

The Ketzin CO2 storage test site

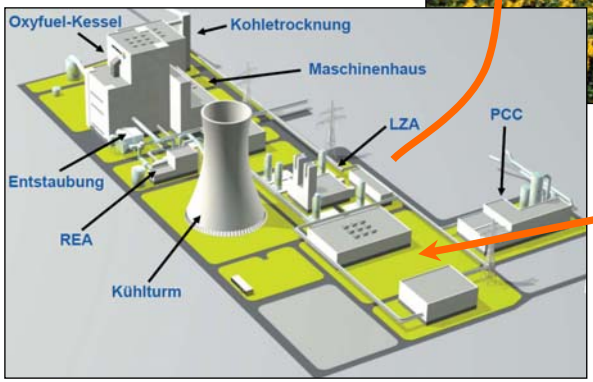
CO2 transportation by truck

2. CCS Value Chain: Demo Jänschwalde

The Birkholz &
Neutrebbin candidate
storage sites

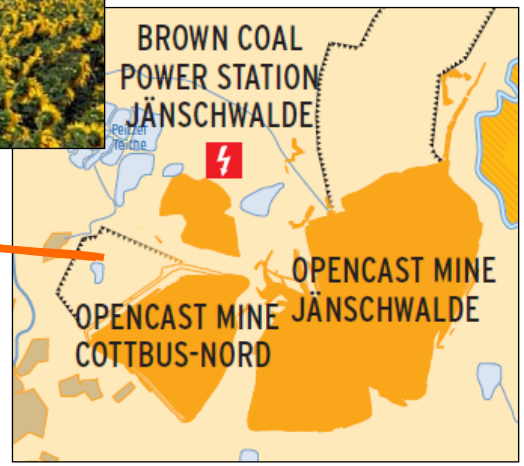
The Jänschwalde Power Plant 3000 MW

Pipeline transportation:
~ 1,7 Mton CO2/y



The Oxyfuel (250 MW) &
Post-combustion (50 MW)
CO2 capture blocks

The
Cottbus-Nord
& Jänschwalde
Lignite Mines



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The Jänschwalde Power Plant

- Jänschwalde toady consists of 6 blocks of 2 boilers and 500 MWe each, fired with locally mined lignite
- Both Oxyfuel and Post-combustion technologies are investigated, replacing one of the blocks
- Integration of lignite coal drying technology
- Base load operation with flexible load range (50 to 103%) for best possible integration of renewable Energy
- High system availability (≈ 97%)
- Total investment about 1,5 billion €, of which € 1.2 billion capture, 0.3 billion transportation and storage)
- Support from the European Programme for Energy Recovery (EEPR), with up to 180 million €
- NER 300 application submitted

Candidate storage sites identified from comprehensive screening

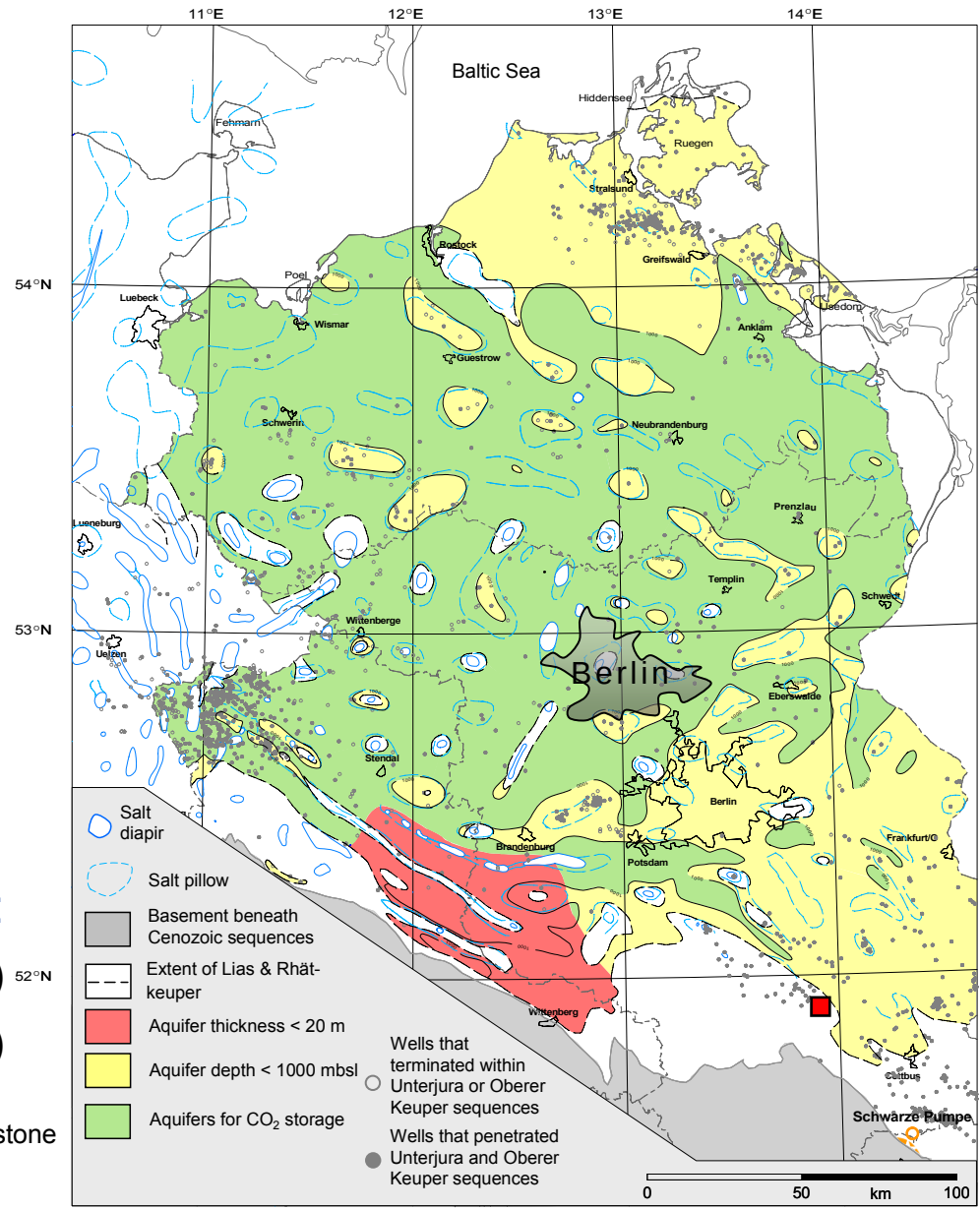
Storage site screening basis 2003

- Eastern part of the North-German Basin
- Mesozoic & Caenozoic sandstones
- Open aquifer & closed structures
  - Depth: 900 to 4000 m
  - Thickness of reservoir > 20 m
  - Porosity > 20%
  - Suitable cap rock
- Storage capacity
- Tectonically little disturbed structures
- Avoid conflicts with existing use

Brandenburg:

i) Structure Birkholz (50 km)

ii) Structure Neutrebbin (140 km)



The Birkholz & Neutrebbin structures

- Storage horizon: Sandstones of the Middle Buntsandstein Formation at 1600 m depth
- Area of structural closure ~ 98 km^2
- Porosity 14-18%,
- Permeability 450-600 mD
- Cap-rock: Several hundred meters of mudstone
- Indicator horizon
- Total volume to be injected 50-100 Mton CO_2 (base-case).
- Duration (base case): 25 years 2015-2030

Exploration programme:

i) 3D Seismic survey

ii) Exploration wells

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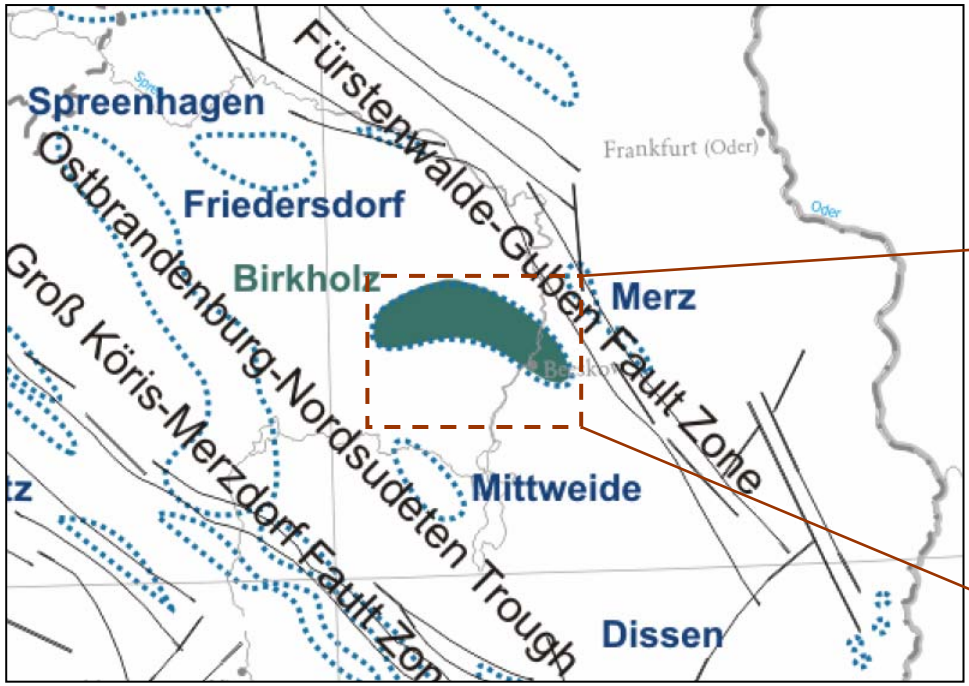
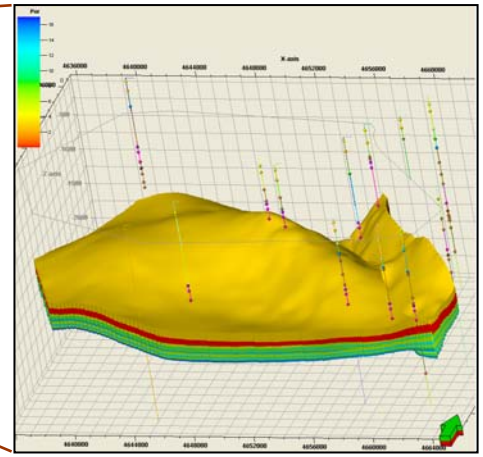
The Birkholz structure

Reservoir models established based on existing data





Regional reservoir model

Site reservoir model

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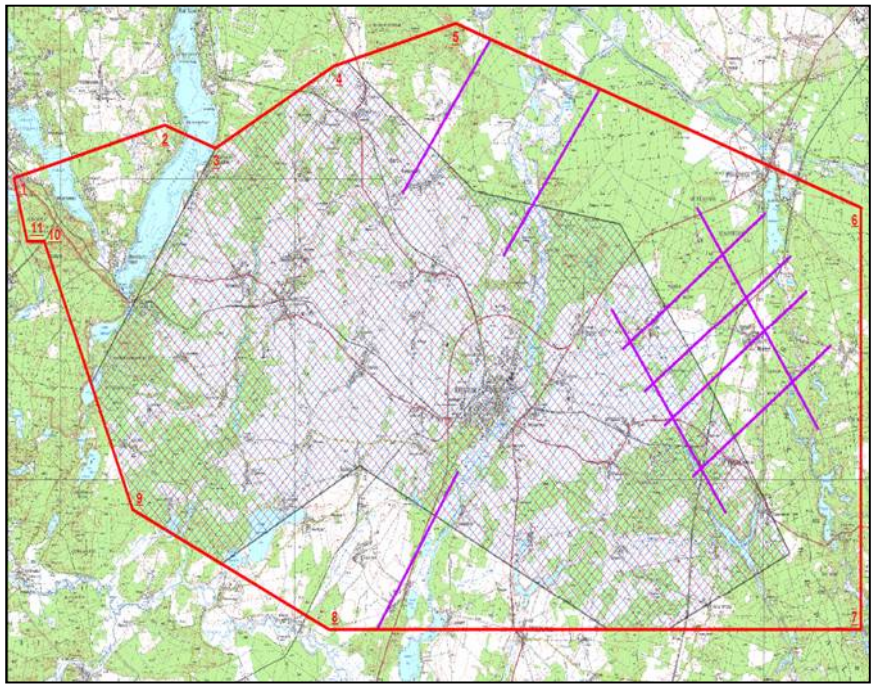
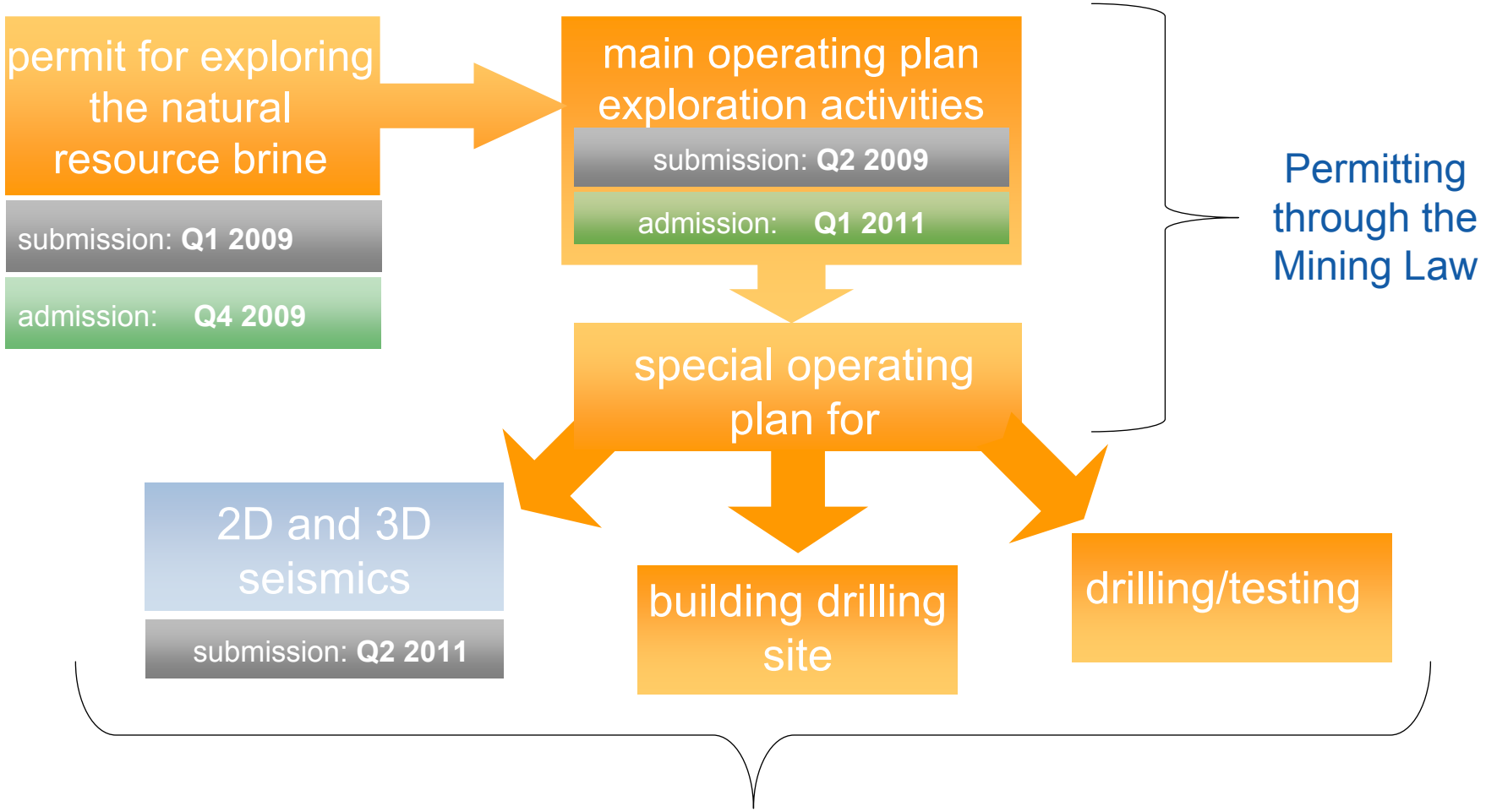
The Birkholz structure



Birkholz Site Characterisation

- New seismic campaign underway:
  - 3D coverage 300 km^2
  - 2D infill-lines extending over regional faults
- Exploration wells:
  - 3-4 drillings, to be reused as injection and monitoring wells
  - Coring & casing program
  - Testing program on rock properties, and volume & integrity properties
- Exploration originally planned to start in 20009

The exploration permitting procedures



Will require implementation of the German CCS law

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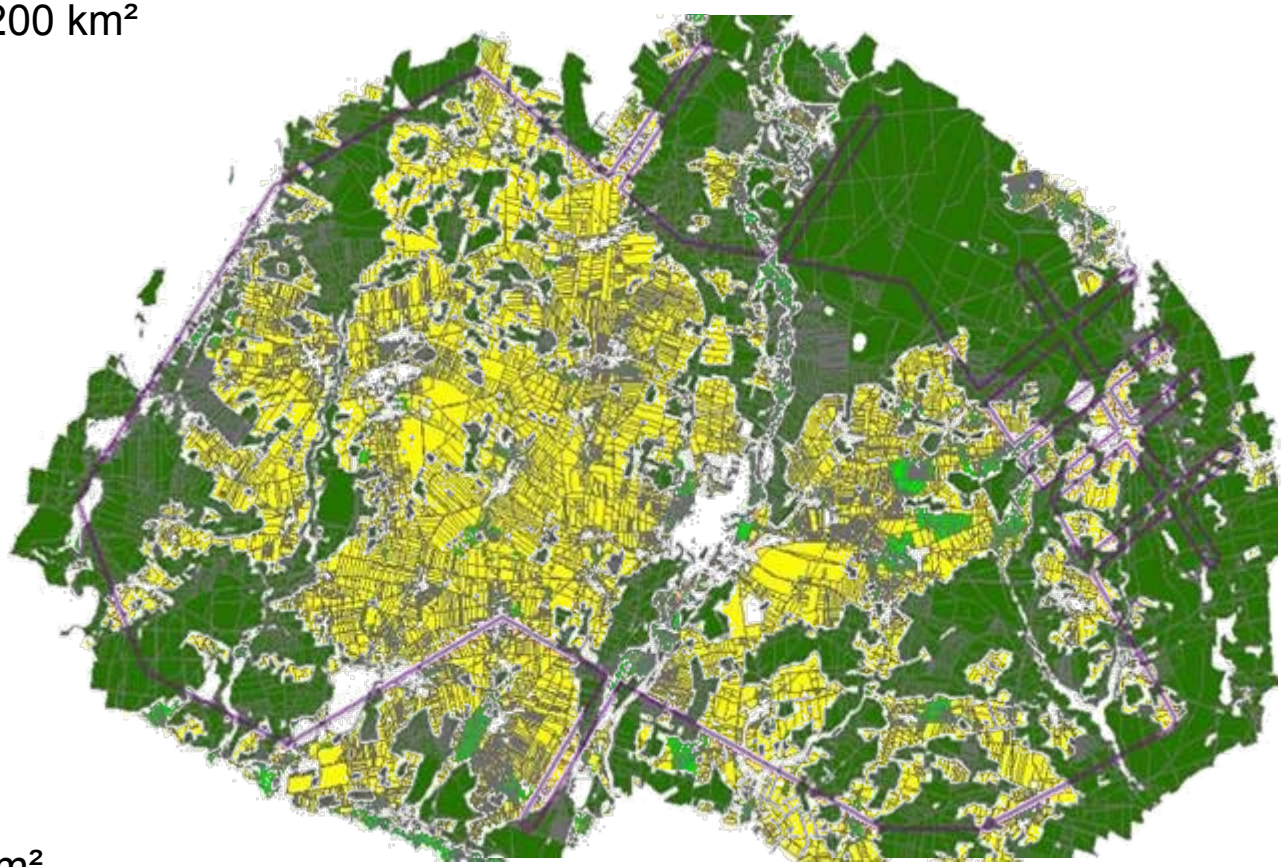
Characteristics of the Exploration Area: Types of Use

Exploration area: ca. 330 km²

Agricultural use: ca. 200 km²



Forestry use: ca. 100 km²

Other uses (waters; buildings): ca. 50 km²

Quality Assurance

Project development following guidelines and recommended practices

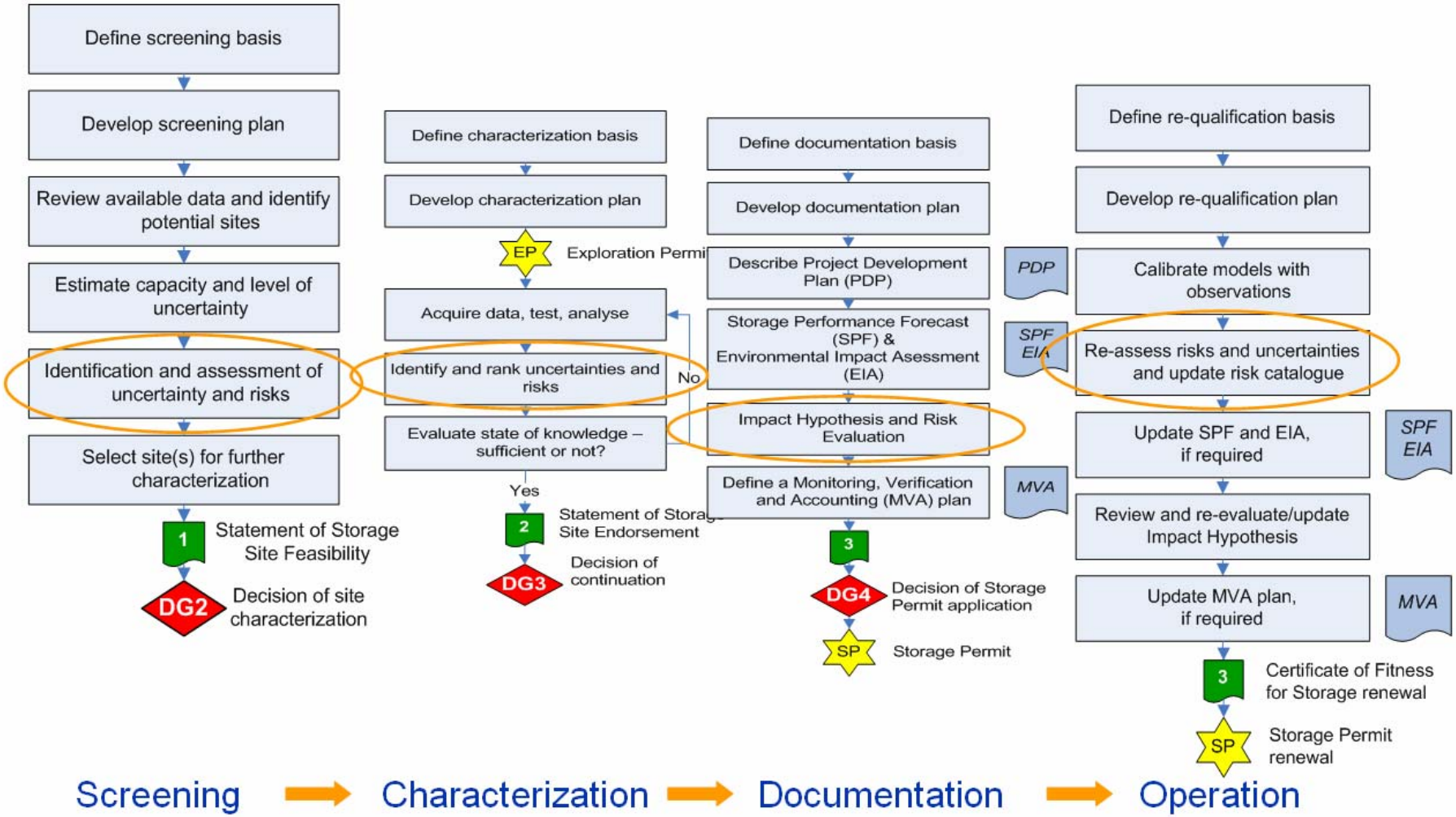
Phase I completed
Phase II ongoing

Nearly completed

Completed

CO2QUALSTORE Risk Management Approach

Structured what if checklist – A group-based identification of hazards



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Demo: Key Challenges

Permits

- Implementation of directive

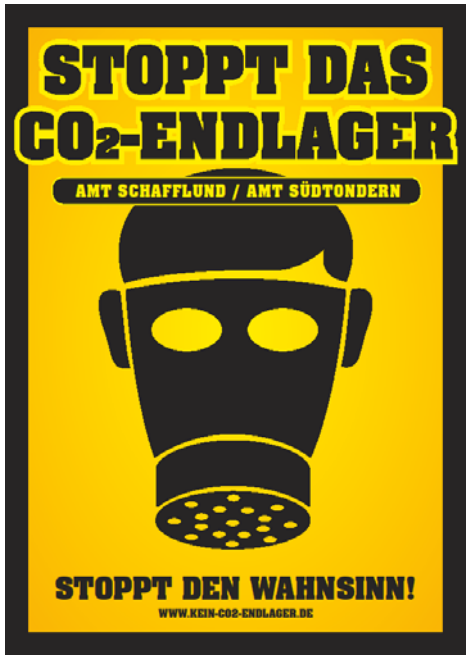
Financing

- Demo cost of €1.500 million
- EEPR + NER300 may cover up to 50% of incremental cost
- Up to €1.000 million for MS, Vattenfall and possible partners

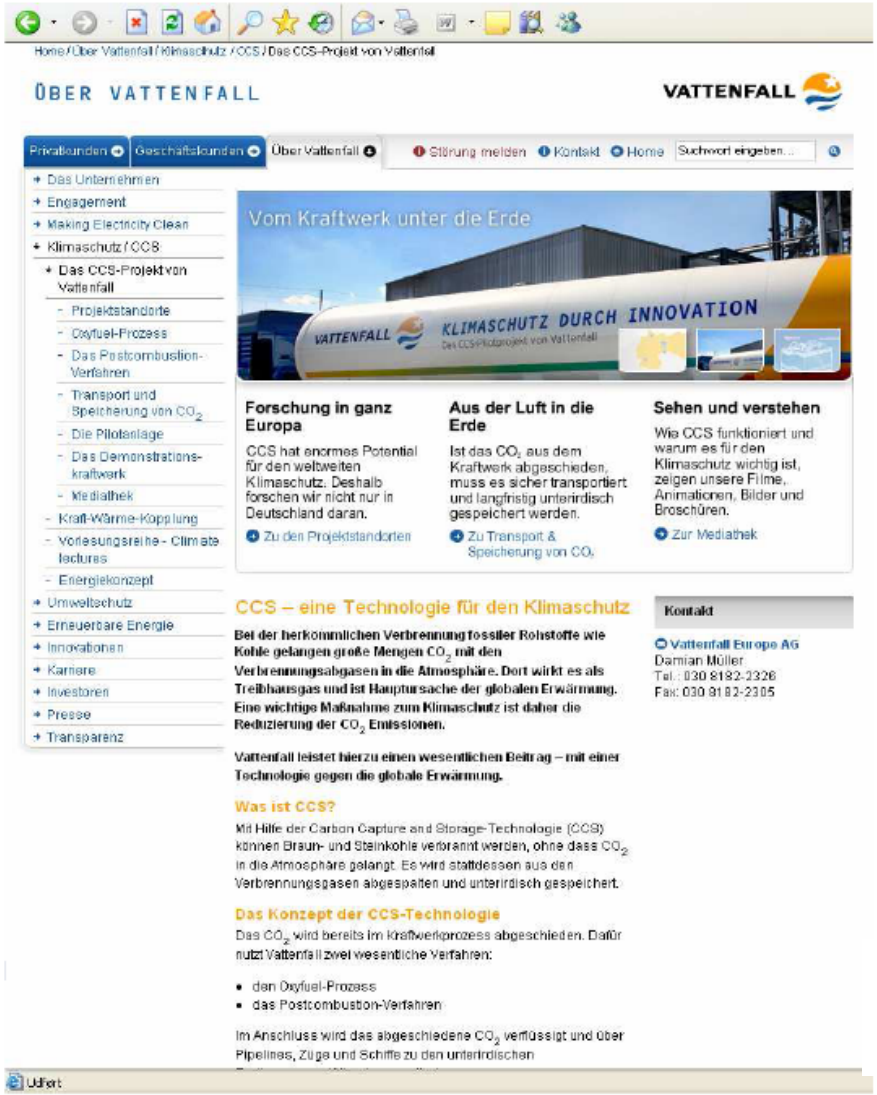
Awareness & Acceptance

- Massive need to increase level of general awareness
- CCS should be integral part of national energy plans
- Building trust in local areas and develop models for co-ownership

Local Opposition against the Project



Public outreach activities



Brochures

Public meetings

Exhibitions

Information Centre

Expert Presentations

School visits

Pilot plant tours

Documentary film (in progress)

Rovering exhibition and direct mail shot

Website: www.vattenfall.de/ccs