

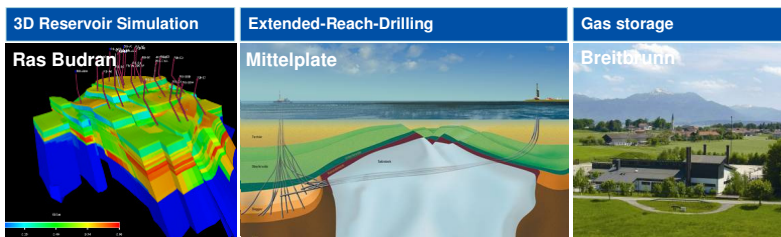
Overview about the RWE Dea CCS-Project

Workshop on Sub-Seabed Carbon Dioxide Storage
UBA, Berlin, 17.06.2008

Siegfried Vennekate
RWE Dea (CO₂ -R&D Coordinator)



RWE Dea: Know-how made in Germany

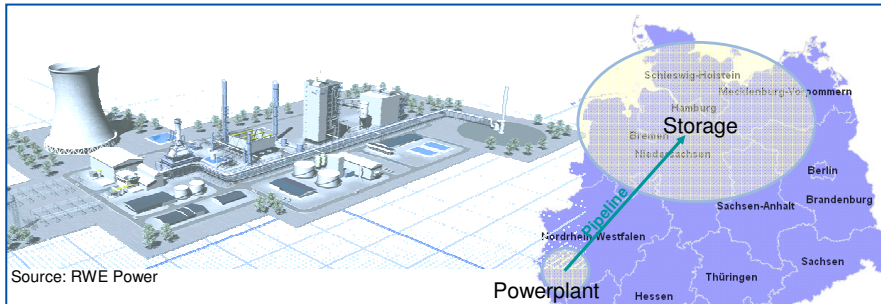


Technical Expertise

- Know-how about modern E&P-Technologies from Formation-Evaluation, geostatistic modeling, Prediction of uncertainties up to dynamic Reservoir Modeling
- Laboratory for advanced Geosciences, Core analysis, Production chemistry including Stimulation and Development of drilling fluid
- Extended Reach Drilling / Multilateral Drilling
- Operations offshore and within sensitive ecologic Environment
- High-pressure and high-temperature Drilling
- Multi-Frac-Technology
- Operator of grand volume gas storage installations



Status RWE IGCC-CCS -Projekt

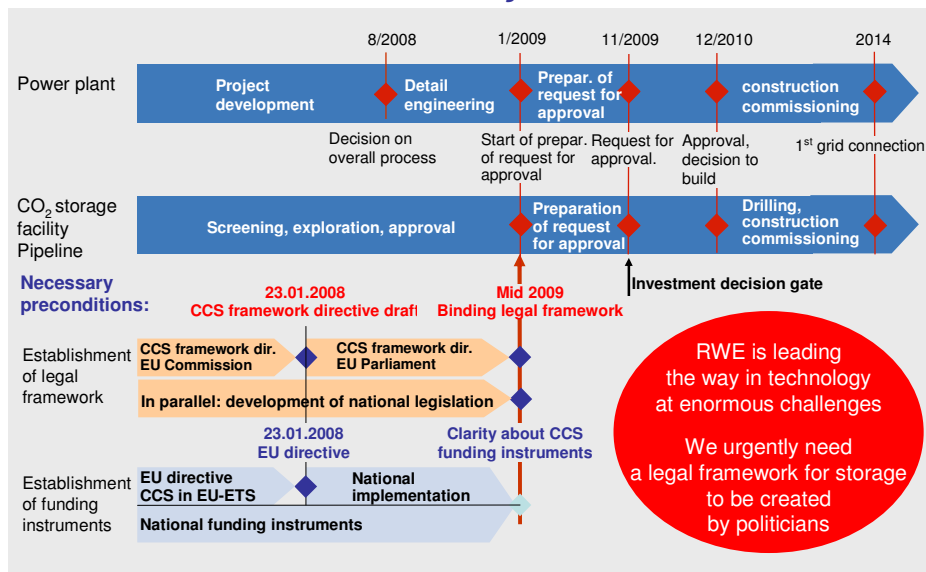


- Base technology: IGCC (Integrated Gasification Combined Cycle); CCS (CO₂ Capture and Storage)
- Fuel: preferred Lignite
- El. capacity: 450 MW_{gross}; 330 MW_{net}
- Efficiency target: 35%
- CO₂-Storage: 2,6 MM to/a in depl. Gas reservoirs or deep saline formations
- Commissioning: By 2014; Scheduled: 40 Years lifetime



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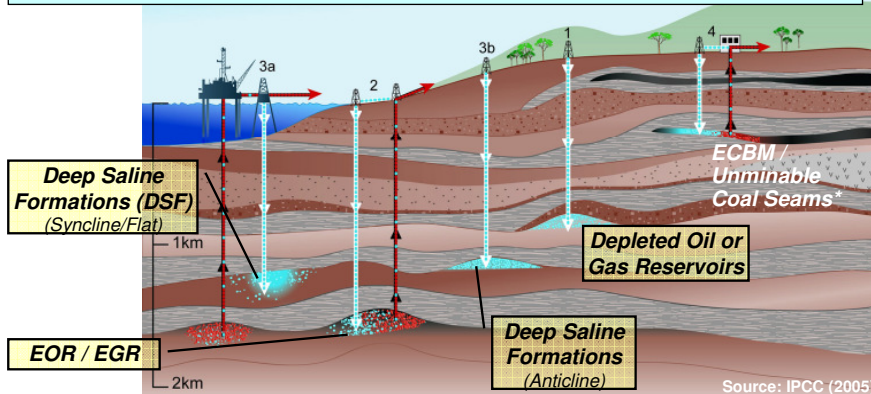
Preconditions for timely Realization of the IGCC CCS Project



CO₂ Storage Options

Site Selection Criteria:

Storativity:	Sufficient Storage
Injectivity:	Thick, continuous storage formation
Containment:	Continuous, high quality caprock **
Depth:	> 1000 m, to ensure non-gaseous state of CO ₂



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* Not feasible for RWE's project
** or other highly reliable trapping mechanisms

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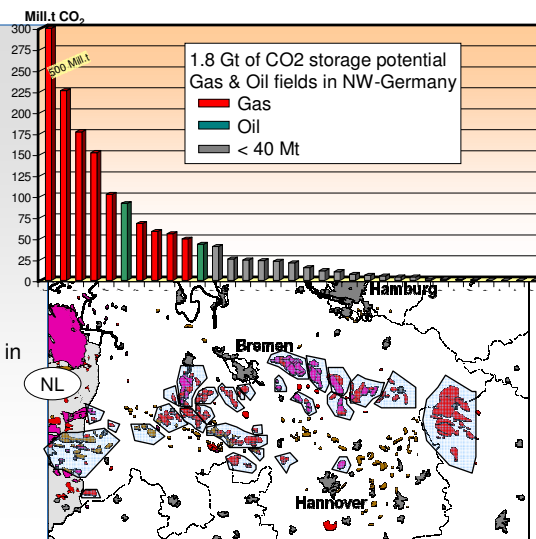
Oil & Gas Fields: Selection Criteria

For Assessment of Potential:

- Small, adjacent reservoirs may be combined into clusters
- Capacity, (at least) cluster capacity has to be above 40 Mt CO₂
- Depth: below 1000 m
- Gas Fields: no H₂S
- 1.8 Gt of CO₂ storage potential identified, thereof 0.5 Gt in Altmark gas province and 4% in appropriate oil reservoirs

For Assessment of Project:

- Ownership
- Maturity



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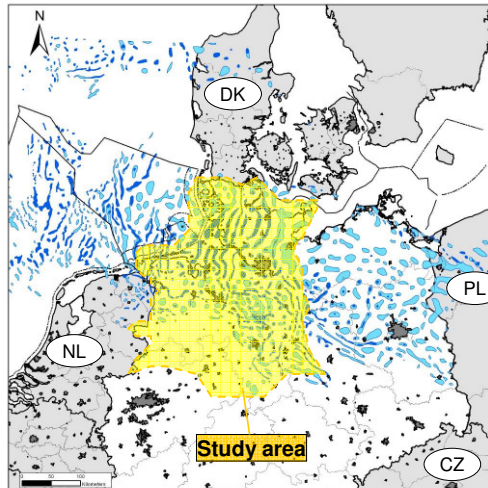
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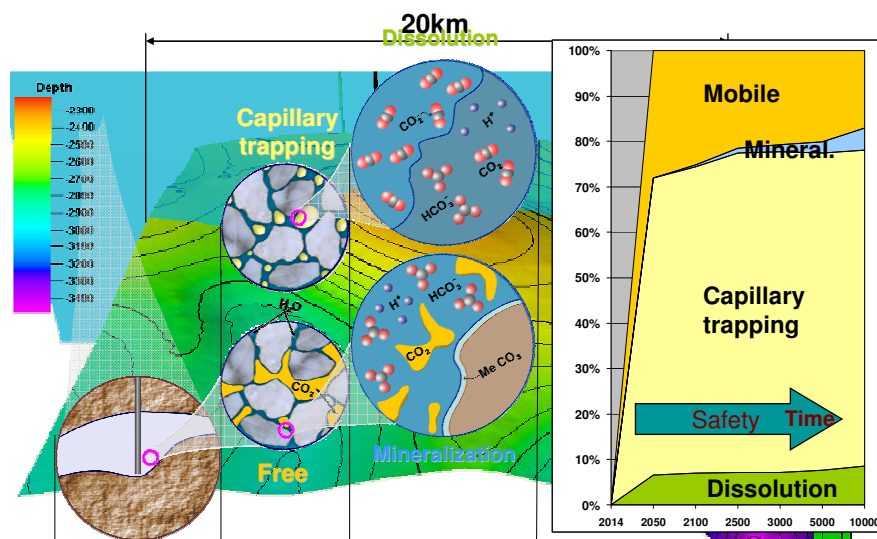
Deep Saline Formations: Selection Criteria and Assessed Potential

- Depth = 1000..4000 m
- No faults in area, halite as seal preferred
- Capacity Factor:

Anticlines	30%
Synclines/Flat areas	20%
- Preferred System: Anticline/Syncline - Combination
- Single local Capacity ≥ 100 Mt CO₂
- Pore Volume Injected $\leq 0.1..0.7\%$ of the hydraulic system
- Intermediate result of potential approx. 3.8 Gt storage in NW-Germany (onshore + close to shore)



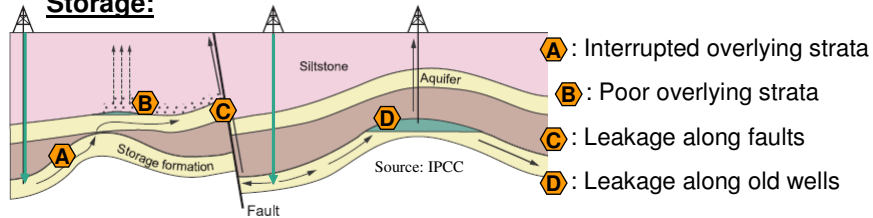
CO₂ -Storage Mechanisms



CO₂ can be stored underground over the long term!

Challenges

Storage:



Operational challenges:

- Magnitude of operated volume
- High concentration of CO₂ in subsurface
- Injection operation without production
- Abandoned and old wells, if existing

Non-technical challenges:

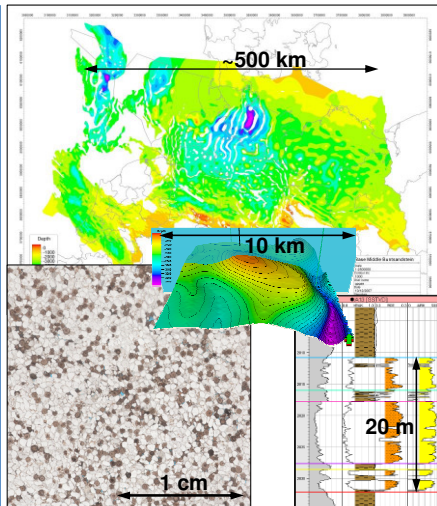
- Public acceptance (local and general)
- Regulatory framework



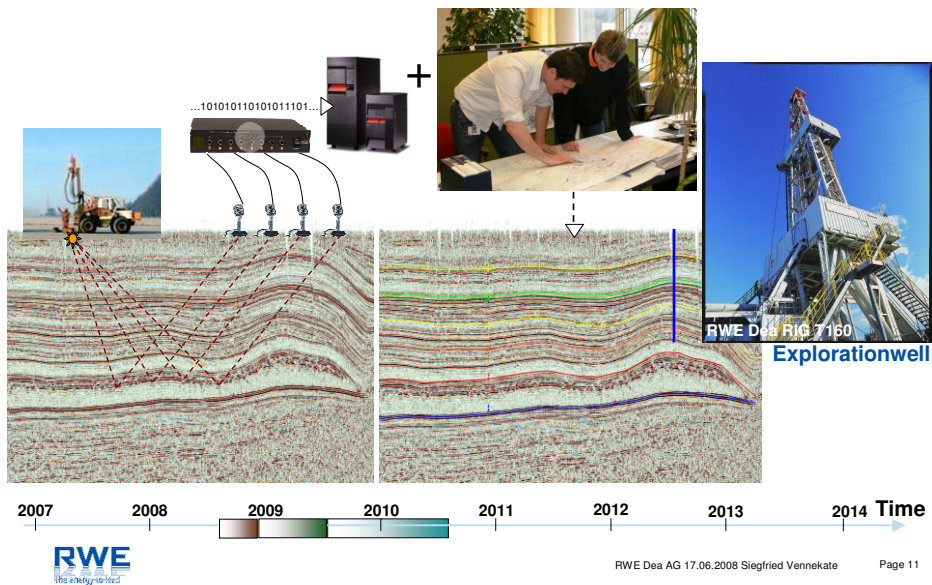
- ➡ The challenges are well-known and manageable.
- ➡ The storage of CO₂ underground is a valid option for the following decades.
- ➡ Transport of CO₂ via pipeline is a well known technical practice in the USA since 1971
At least 2500 km in operation without *any* severe accidents

Preinvestigation

- Data situation
 - Regional maps
 - Logs of wells
 - Seismic sections
 - Personal expertise
- Modeling of regional and local storage and caprock
- Optimization and selection of sufficient exploration area
- Participation in appropriate R&D-Projects

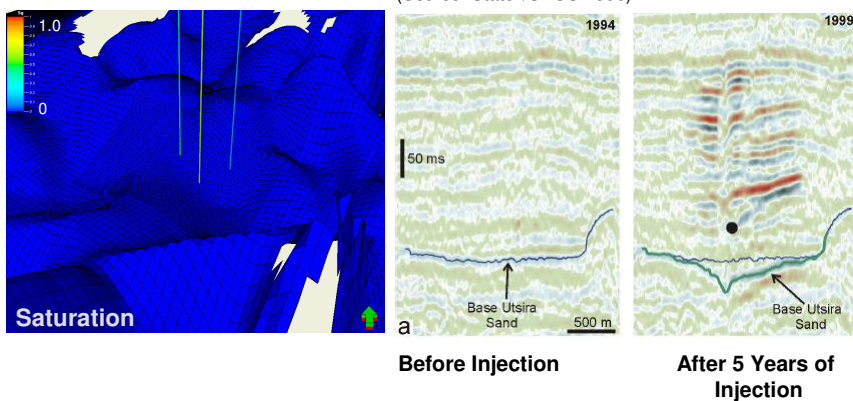


Methodology of Exploration

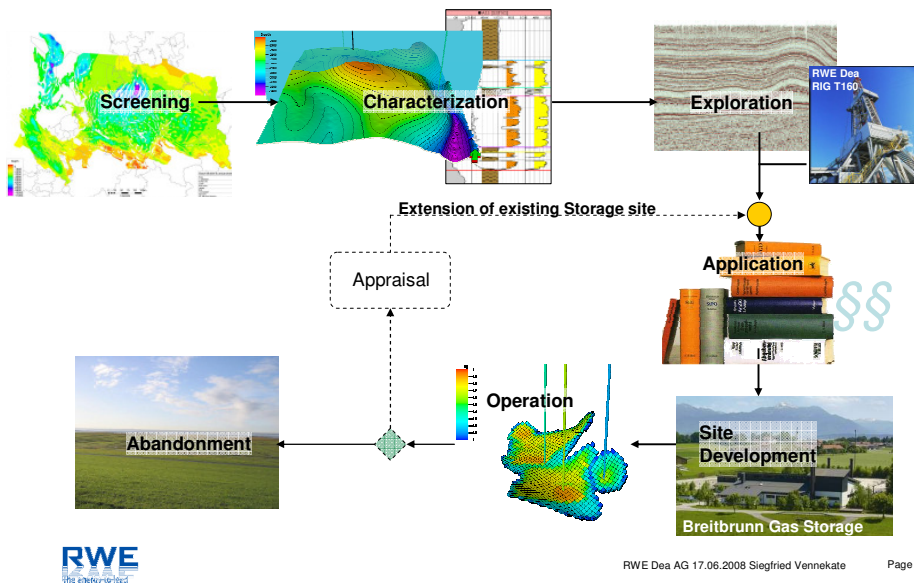


Storage Operations and Monitoring

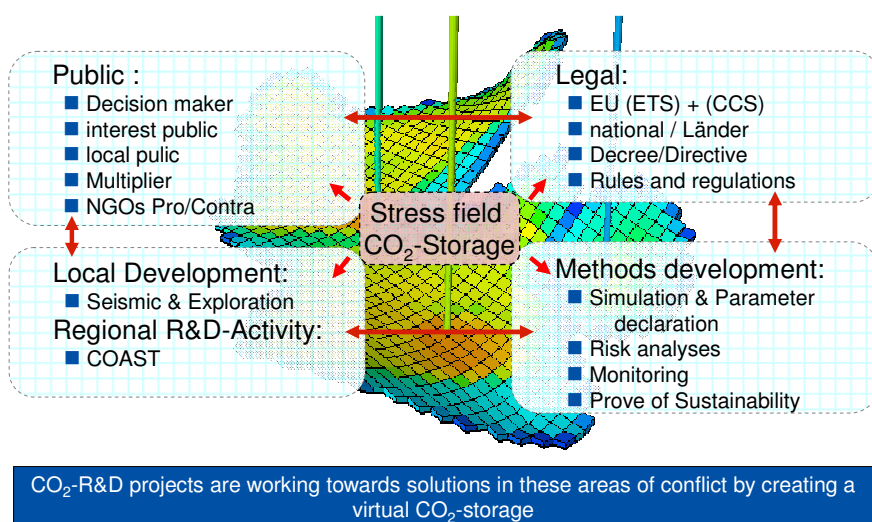
Seismic Monitoring: Sleipner
(Source: Statoil/SACS 2006)



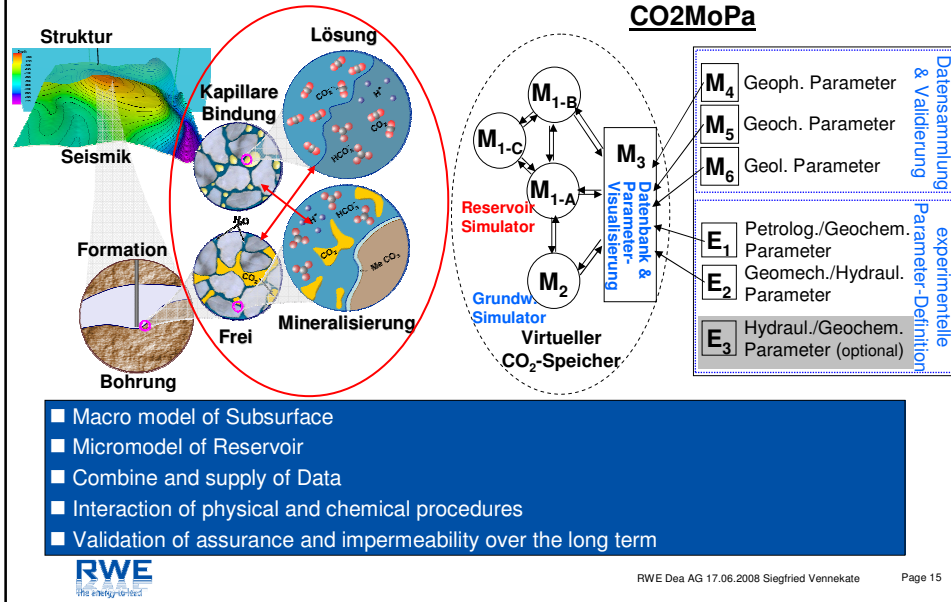
Life Cycle of an Industrial CO₂ Storage Site



Areas of Conflict



Research Method: Virtual CO₂-Storage



Two mayor R&D Projects of RWE (1)

CO2 MoPa (2008 -2010)

Modeling and Parameterisation of CO₂ Storage in Deep Saline Formations for Dimension and Risk Analyses

- > Numerical models to investigate the behaviour of CO₂ phases in the deep subsurface
- > Collection and validation of rock parameters to model CO₂ behavior in the deep subsurface
- > Geochemical and geomechanical laboratory experiments on rocks from storage formation
 - **Budget:** of 4.8 Mill. € is shared by BMBF (Geotech. Program) and 6 Energy Companies (50:50 %)
 - **RWE Dea share:** 0.675 Mill. €

Project started in Jan. 2008, Kick-off took place 25th. April 2008

Two mayor R&D Projects of RWE (2)

BMBF Lighthouse Project COAST (CO2 Aquifer Storage) **in Connection with the IGCC-CCS Project of RWE (Duration: 2009 -2011)**

> Comprehensive program with 6 subprojects and around 30 institutes

- | | |
|--------------------------------------|--|
| ■ Seismics: | Communication between Reservoir/Aquifer and Surface Structure |
| ■ Geology, rock mechanics: | Prognosis of tensions, fracture networks, possible reservoir leakage |
| ■ Chemistry, petro physics: | Kinetic and chemical control of processes in CO2-Brine-rock-system |
| ■ Reservoir technology: | Developing of advanced methods for reservoir simulations |
| ■ Completion&Cementation: | Stability of casing/cement installation, developing of multi-barrier systems along well bores and well abandonment |
| ■ Monitoring, Environment: | Seismic CO2 plume measurement, possible leakage detection methods |

> **Coordination:** BGR, **Industrial partner:** RWE Dea,

> **BMBF budget:** 15 mill. € over three years.

Project in final definition phase, Start expected January 2009



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Thank you for your attention!

Any questions ?



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