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Geological CO_2 storage – safe and reliable

CCS research success from the pilot site Ketzin, Germany…

Anthropogenic emissions of carbon dioxide (CO_2) into the atmosphere have a significant impact on the Earth's carbon cycle. As part of the global effort to reduce climate change, the geological storage of CO_2 has been accepted as a method for total reduction of emissions. In Germany and worldwide, geological storage capacities are expected to be sufficient for several decades. Carbon dioxide can be captured from sources such as large-scale industrial facilities (energy, steel, cement or chemical) and transported to long-term storage sites in deep saltwater-bearing aquifers. The storage site must be free of potential leakage pathways. To this end, extensive monitoring programmes need to be carried out. The Ketzin pilot site in Germany, an example of such a programme, has shown CO_2 storage on a research scale to be safe and reliable. Geophysical monitoring provides a measure to locate very small amounts of CO_2 within the reservoir. Further, coupled processes are fully understood in the way that computer simulations coincide very well with the field observations. For the midterm future we are planning to set up Ketzin as a large-scale research and training infrastructure for operating, monitoring and modelling CO_2 storage.

Ketzin pilot site in Brandenburg, Germany

The geological storage of CO_2 is studied near the town of Ketzin, just west of Berlin. The targeted reservoir formation in around 650m depth (Fig. 1) is porous sandstone, which is widely present in the North German Basin.

The Ketzin site is situated above a geological dome structure (anticline). The reservoir sandstone is overlain by shaly cap rocks of massive thickness. These cap rocks, together with the anticlinal structure, ensure controlled and limited migration of the CO_2 (Fig. 1).

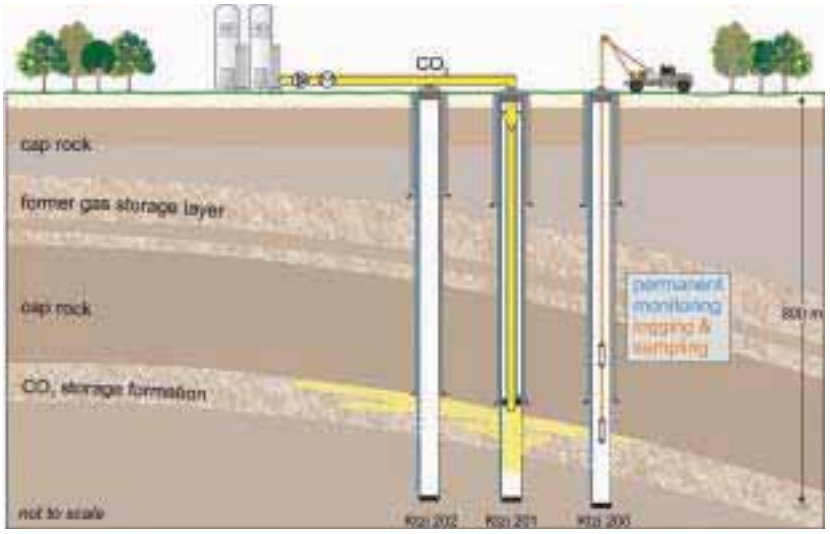

Fig. 1: Schematic of the Ketzin anticline (dome structure) with three wells. Migration of CO_2 is indicated (yellow) within the reservoir beneath the caprock

Until 2004, natural gas was seasonally stored in a shallower sandstone formation at about 280m depth (Fig. 1). The Ketzin anticline is therefore well studied. Based on these existing data as well as new exploration research from recent projects, three additional wells have been drilled for the CO_2 storage operation to depths of about 800m. One of these wells (Ktzi 201) serves as an injection and monitoring well, while the other two (Ktzi 200 and Ktzi 202) serve solely as observation wells for monitoring the injection and the subsurface migration of the CO_2 (Fig. 2).

Since June 2008, food grade CO_2 has been injected via the injection well. As of April 2011, the injected cumulative mass was about 48,000 tons of CO_2. The injection runs smoothly and safely.

Since 2004 when the project started, the pilot site has received significant funding from the German Federal Ministries of Education and Research (BMBF) and Economics and Technology (BMWi) as well as from the European Commission (FP6 and FP7).

Geoscientific progress

The scientific knowledge gathered at the Ketzin site is mainly derived from the geophysical and geochemical monitoring programme, which is among the most modern and comprehensive worldwide. Central to this programme is a combination of techniques such as geoelectrics, seismics, temperature and pressure monitoring as well as fluid and gas sampling, and also different methods with variable temporal and spatial resolution within the respective techniques. In particular, the results of the seismic and geoelectric measurements allow the tracing of the subsurface CO_2 migration in very small amounts at the Ketzin site. The monitoring programme is complemented and accompanied by computer simulations. In accordance with the EU directive about CCS – Carbon Capture and Storage – we accomplished groundbreaking results in showing that the observed behaviour of the injected CO_2 conforms to the simulated behaviour and that there is no detectable leakage.

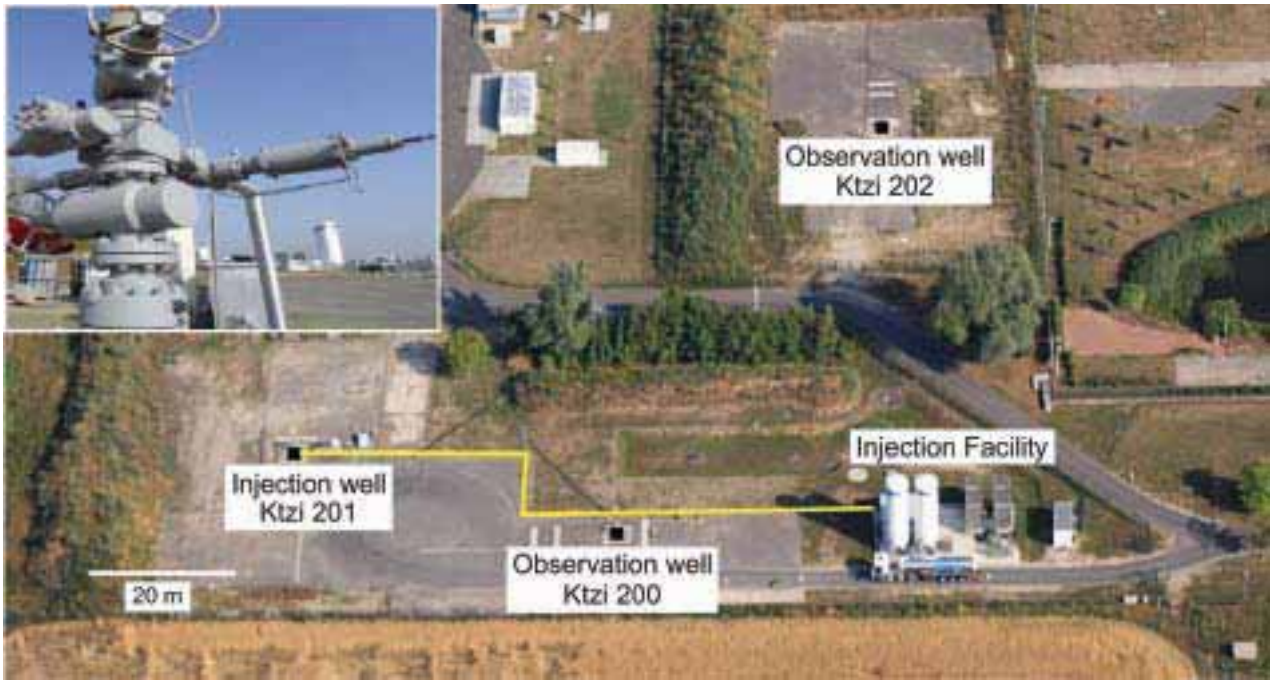

Fig. 2: Aerial view of the Ketzin pilot site displaying the injection facility, the pipeline (yellow) from the storage tanks to the injection well (Ktzi 201) and both observations wells (Ktzi 200, 50m away from injection; Ktzi 202, 112m away from injection)

Public outreach and scientific network

Public perception is a key aspect of our project. From the start, credible and transparent transfer of knowledge and information to the general public has accompanied the project, including invitation of visitor groups, organisation of workshops on CO_2 storage and the project homepage (www.co2ketzin.de). This is reflected by large and positive national and international resonance in the media. The information centre at the test site is the most important contact point. This is a cornerstone for close collaboration with stakeholders, for example policy-makers and the general public, and dissemination of knowledge.

Project partners of the GFZ include national and international universities, research centres, medium-sized companies and industry. The work at the test site is also supported by the town of Ketzin, and the regulatory authority has been involved in the project from the beginning.

Future development and added value

Our aim is to develop Ketzin in a way that provides the European research area with an unhindered access to an active CO_2 storage site, explicitly focusing on basic and applied research in the field of geological CO_2 storage. In that way we could offer a strongly required training infrastructure in this field to European students and early-stage as well as experienced researchers from academia and industry.

The operational plan is to continue with CO_2 injection, testing different injection strategies. Subsequently, development and testing of abandonment technologies and strategies are going to be performed in a joint European effort.

The Ketzin project overcomes the partly limited access of researchers from the European Research Area to active CO_2 storage sites. It allows researchers to perform experiments that may not be possible at commercial, industrial scale demonstration projects.

Implementation of CCS by 2020 requires specifically trained professionals. Based on all projects performed at the site, Ketzin will ensure the necessary state-of-the-art training.

Ketzin will notably increase the knowledge about CO_2 storage mechanisms in geological formations in all aspects. By this, the project will enable better and more reliable estimates of storage potential. Also, the pilot site will help to define additional, specific requirements for geological storage sites and support to develop a unified approach to estimate and report CO_2 storage capacity.

With the many described facets of the unique pilot site for geological CO_2 storage, Ketzin notably contributes to an improved public perception of CCS technology.

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