

Paper Number: 3496

The Pilot Site Ketzin, Germany - Lessons Learnt on CO₂ Storage

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The pilot site Ketzin, 25 km west of Berlin, represents Europe's first onshore research project related to the geologic storage of carbon dioxide. First investigations on assessment and characterisation of the pilot site started in 2004. This period was followed by a development phase of the storage site in which drillings and baseline measurements were carried out. Between 2008 and 2013 (operational phase), 67 kt of CO₂ were successfully stored into an Upper Triassic sequence of fine to medium grained sandstones (*Stuttgart Formation*) in a depth between 630 to 650 m below ground surface. Static and dynamic numerical modelling accompanying the entire CO₂ storage site life cycle shows a good agreement with field observations [1].



Two tanks for intermediate storage of CO₂ with a capacity of 50 tons each were used during the operational phase (2008 – 2013) (Photo: GFZ).

Another key topic of paramount importance was the development of an effective multi-disciplinary monitoring programme using permanently installed and frequently applied technologies such as:

- time-lapse 3D seismic surveys
- geoelectric measurements
- borehole monitoring (p, t)
- chemical analysis of $\delta^{13}\text{C}$, DIC, and pH
- measurement of soil CO₂ flux

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By means of seismic and geoelectric methods, it was demonstrated that the CO_2 plume and its lateral and vertical propagation can clearly be imaged in the deep underground.

The injection (operational) phase was followed by the so-called post-closure phase which is the currently active phase. One of the main tasks in this phase is the successive abandonment of all five wells and the recultivation of the site for future use. The final milestone of the post closure phase defines the retransfer of responsibility and liability from the operator (GFZ) to the mining authority of the German Federal State of Brandenburg (LBGR) after the integrity of the storage complex has been demonstrated. In this context, three high level criteria are of primary importance in order to ensure a safe and long-term storage of CO_2 : a) no detectable leakage, b) the observed behaviour of the injected CO_2 conforms to the modelled behaviour and c) the storage site is evolving towards a situation of long-term stability. Provided that these criteria are fulfilled and the approval for site abandonment has been granted, the final post-transfer phase is reached. This in turn means that we are able for the first time ever to demonstrate the complete life-time cycle of a CO_2 storage site, from the assessment of the storage complex up to the post-transfer phase.

Summing up, after 12 years of intensive research one of the key results is that geological storage of CO_2 at the Ketzin pilot site is feasible, it is running safely and reliably and no danger to humans or the environment has been observed so far. [2].

References:

[1] Kempka, T and Kühn, M (2013), Numerical simulations of CO_2 arrival times and reservoir pressure coincide with observations from the Ketzin pilot site, Germany, *Environ Earth Sci* (70) 3675-3685

[2] Kühn, M et al. (2014) In: *Carbon Capture, Storage and Use, Technical, Economic, Environmental and Societal Perspectives*, Kuckshinrichs & Hake, J F (Eds), Safe Operation of Geological CO_2 Storage Using the Example of the Pilot Site in Ketzin., Springer, 127-143

