



Geological characterization of Italian reservoirs and numerical 3D modelling of CO₂ storage scenarios into saline aquifers

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The research activities carried out by the Environment and Sustainable Development Department of RSE S.p.A. aim to evaluate the feasibility of CO₂ geological sequestration in Italy, with particular reference to the storage into saline aquifers.

The identification and geological characterization of the Italian potential storage sites, together with the study of the temporal and spatial evolution of the CO₂ plume within the caprock-reservoir system, are performed using different modelling tools available in the Integrated Analysis Modelling System (SIAM) entirely powered in RSE. The numerical modelling approach is the only one that allows to investigate the behaviour of the injected CO₂ regarding the fluid dynamic, geochemical and geomechanical aspects and effects due to its spread, in order to verify the safety of the process.

The SIAM tools allow:

- Selection of potential Italian storage sites through geological and geophysical data collected in the GIS-CO₂ web database;
- Characterization of caprock and aquifer parameters, seismic risk and environmental link for the selected site;
- Creation of the 3D simulation model for the selected domain, using the modeller METHODRdS powered by RSE and the mesh generator GMSH;
- Simulation of the injection and the displacement of CO₂: multiphase fluid 3D dynamics is based on the modified version of TOUGH2 model;
- Evaluation of geochemical reaction effects;
- Evaluation of geomechanic effects, using the coupled 3D CANT-SD finite elements code;
- Detailed local analysis through the use of open source auxiliary tools, such as SHEMAT and FEHM.
- 3D graphic analysis of the results.

These numerical tools have been successfully used for simulating the injection and the spread of CO₂ into several real Italian reservoirs and have allowed to achieve accurate results in terms of effective storage capacity and safety analysis. The 3D geological models represent the high geological complexity of the Italian subsoil, where reservoirs are generally not so extended and well shaped and often crossed or bounded by faults. The modelled reservoirs are located in both on- and off-shore sites and include sandy or carbonatic aquifers. The injection is performed through one or more horizontal or vertical wells, with a rate that is in accordance with the CO₂ production rate of referential industrial projects, among which the ENEL CCS-Porto Tolle project is one of the six CCS demonstration projects supported by the European Energy Programme for Recovery (EEPR) by the European Commission.