

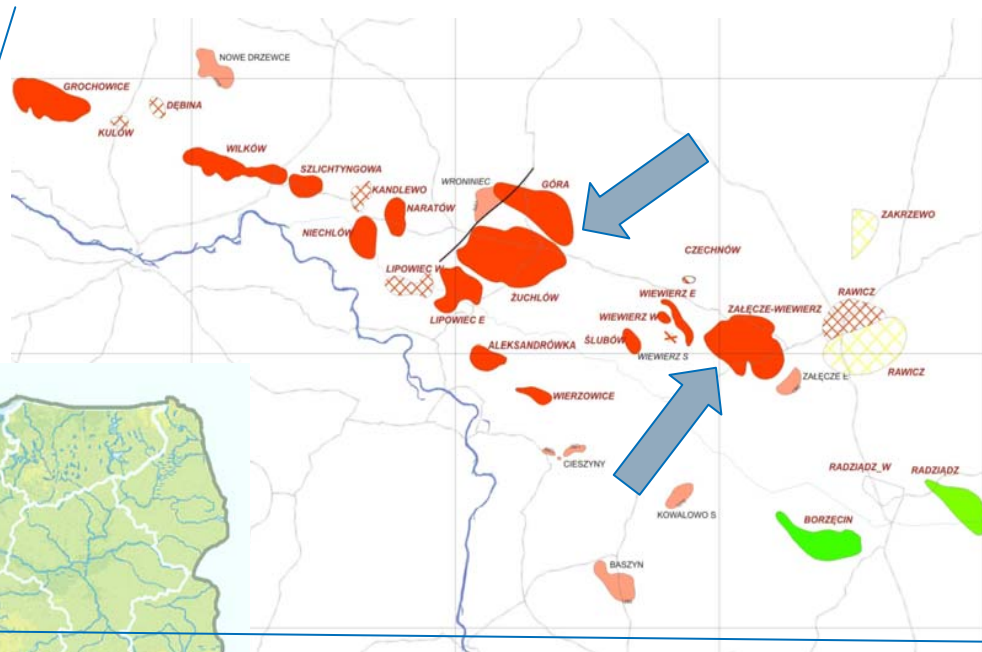


Characterisation of European CO₂ storage

Onshore gas reservoirs in Poland Załęcze & Żuchłów

Marcin Mazurowski
PGNiG

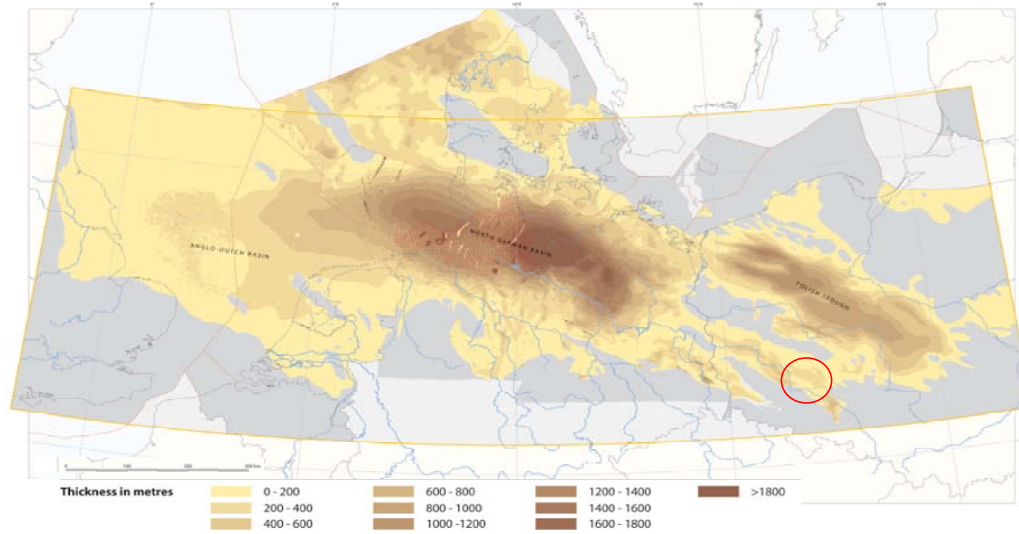
Location of the investigation area



Załęczce & Żuchłów are depleted gas fields in south - western Poland ca. 60 km north of Wrocław and ca. 100 km south of Poznań

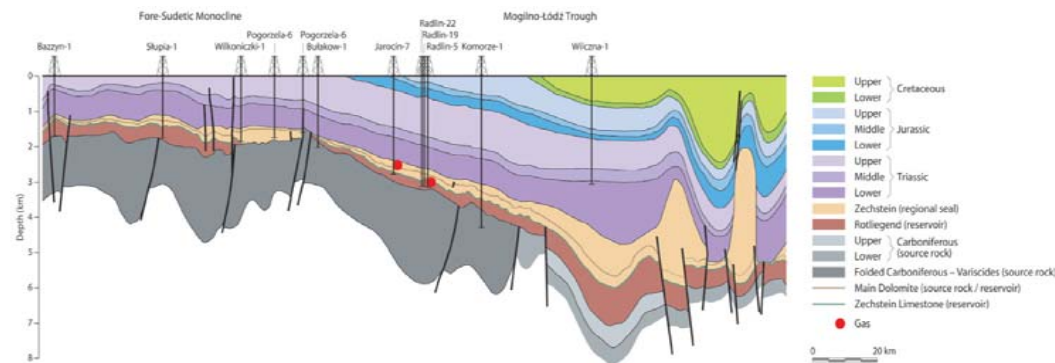
This site is also representative of sites in the Polish Lowland which offer a series of natural gas reservoirs with CO₂ storage potential

Overview of the Polish site



Location of Zalecze - Zuchlow Area within the Southern Permian Basin (Doornenbal et al. 2010)

- Zalecze and Żuchłów site is located in sedimentary basin being marginal part of the Southern Permian Basin
- Sandstones of the Upper Rotliegend together with overlaying Zechstein Limestones form reservoir



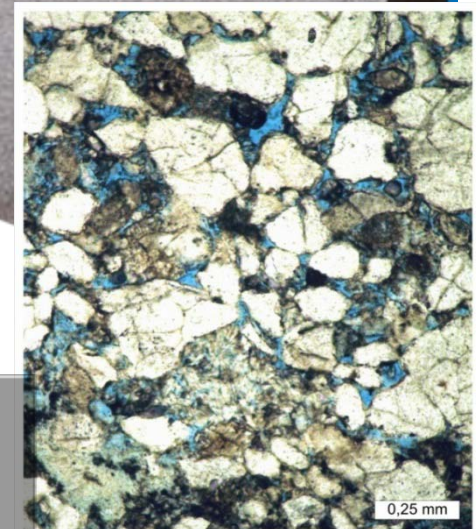
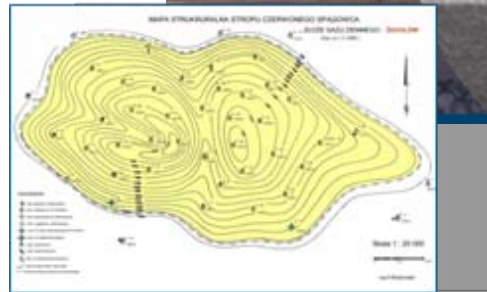
Regional section through the Fore Sudetic Monocline - ca. 15 km SE from Zalecze gas field without Cenozoic deposits

Caprock is composed of Zechstein evaporates

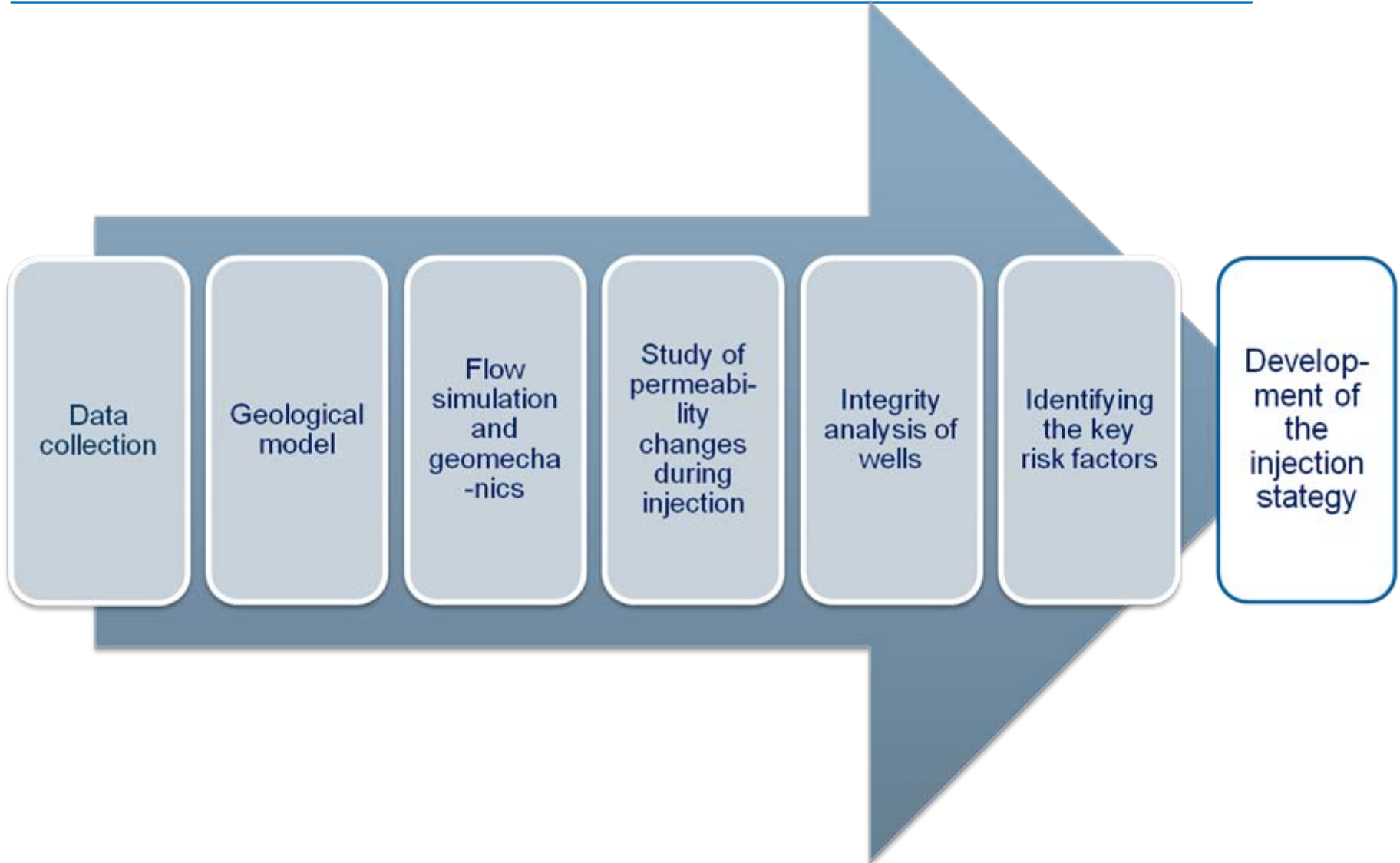
Overview of the Polish site

■ Storage complex scale

- Depth: ca 1300 m
- Gas reservoir thickness ca 130 m
- Thickness of the geological structure ca 160 m
- Area:
 - Załęcze: 20.3 km²
 - Żuchłów: 25.8 km²
- Volume:
 - Załęcze – 22 bln m³
 - Żuchłów – 25 bln m³



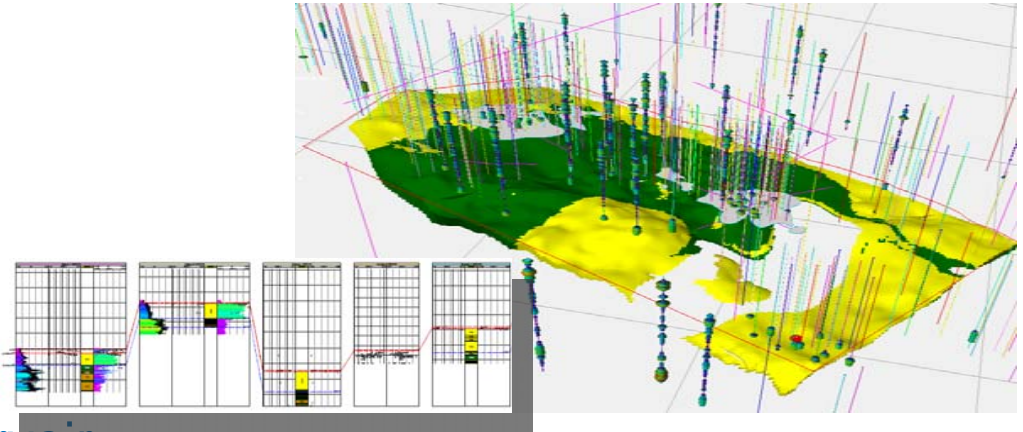
Research to investigate specific scientific elements



Geological (static) modeling

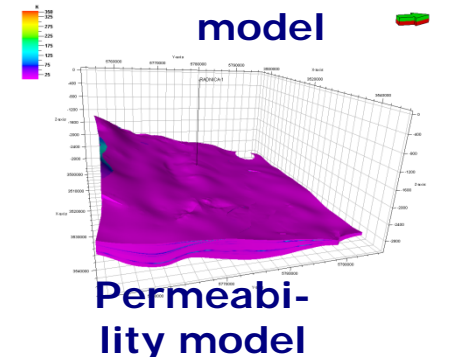
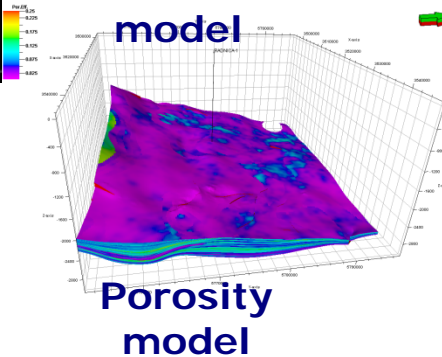
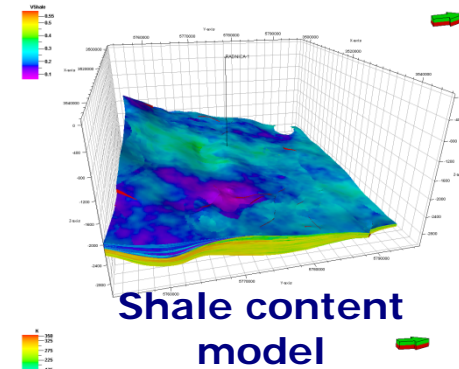
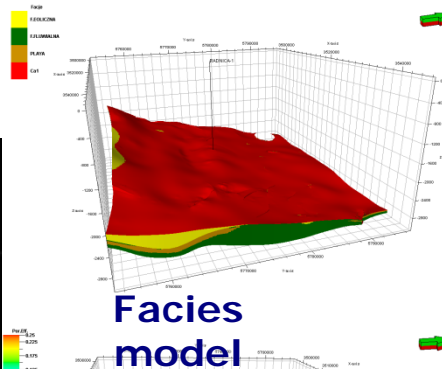
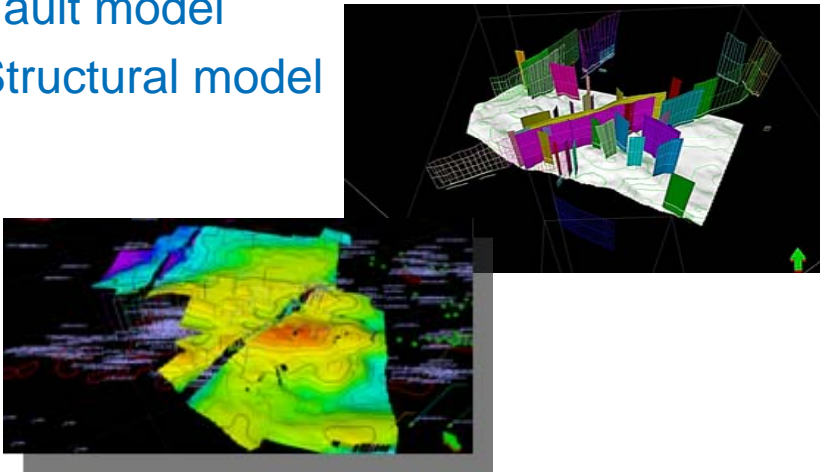
Data collection and verification

- 237 wells data collected
- 26 most important wells data reinterpreted
- Geophysical data reinterpreted
- New stratigraphic interpretation



3D static model at basin and reservoir scale

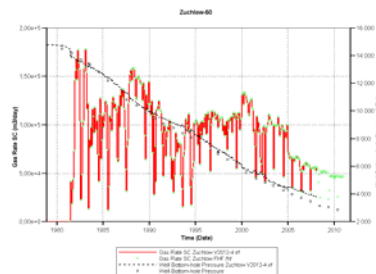
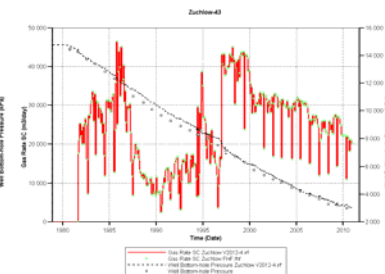
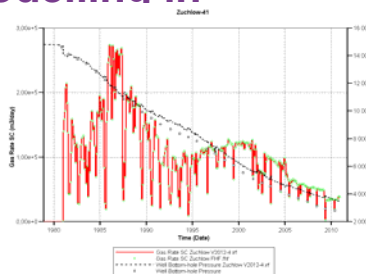
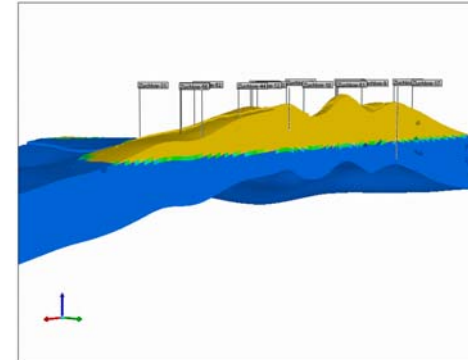
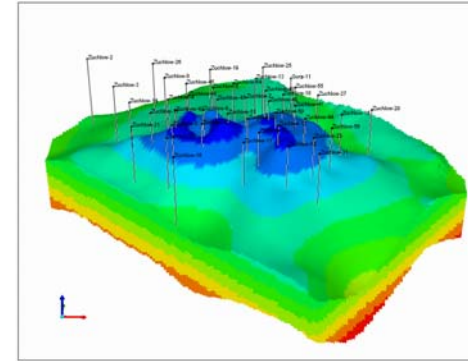
- Fault model
- Structural model



Flow simulation and elements of geomechanics



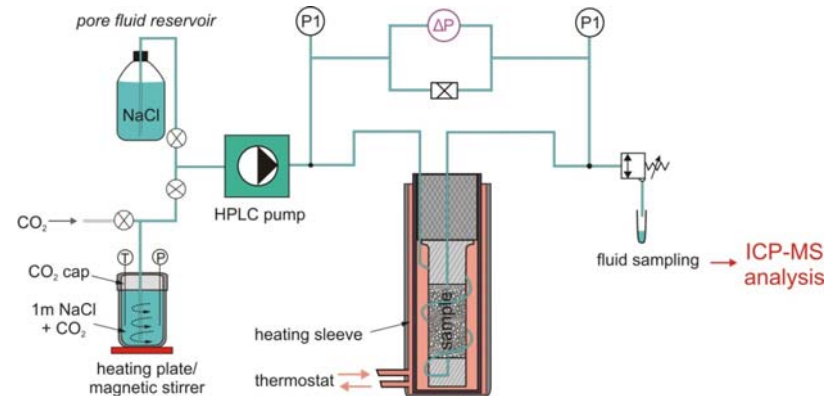
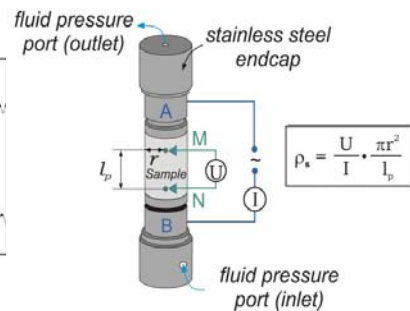
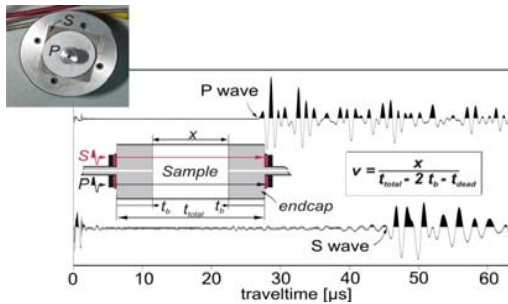
- The mechanical integrity of the top seal under injection conditions (fracturing)
- The fault seal integrity after full cycle of blow-down and repressurization
- The mechanical integrity of the reservoir rock and the impact of stress changes on porosity and permeability of the reservoir rock
 - simulation model including history matching and pressure distribution in regional and reservoir scale.
 - poroelastic deformation and stress changes in fault zones in regional scale.
 - detail geomechanical modelling in reservoir scale.



Study of permeability changes during injection / reactive flow simulation



- Laboratory tests to reproduce the experimental core flooding with a numerical simulator
 - the core characterisation
 - reactive percolation experiments
- Simulations of the pore structure changes resulting from dissolution mechanisms
 - history matching of reactive core flooding experiments to fit parameters that control the changes of porosity/permeability
 - pore network modelling and percolation simulations
 - in macroscopic and microscopic scales



Integrity analysis of all existing wells

- Analysis of the integrity of existing wells
 - present technical state and further possible impact of CO₂ injection
 - Data from construction and reconstruction works made in past
- Experimental tests of well cementation
- Simulations of the effect of CO₂ injection on abandoned existing wells
- Prediction of potential leakage

Identifying the key risk factors with FEP and scenario analysis



- Analysis of the relevant system features, events and processes (FEP) to assess the performance of the Załączce & Żuchłów storage system
 - the qualitative assessment of potential risks will use a database tool of FEPs
 - online database and questionnaire
- Define potential site evolution and major CO₂ release scenarios
 - the approach is based on the three major CO₂ release scenarios (well, fault and seal) from where the relevant risk factors and associated scenarios are identified

