ULTimateCO2 : A FP7 European Project dedicated to the understanding of the long term fate of geologically stored CO2

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Although the technical feasibility of CCS has been proven with the development of small-scale pilot sites that draw on oil and gas industry experience, the EC Directive on the Geological Storage of CO2 requires operators to demonstrate that the long-term fate of the CO2 in the reservoir will ensure permanent containment. Other stakeholders, notably the general public and their representatives, seek answers to questions on the behaviour and impact of the injected CO2: “What will happen to the CO2?”, “Will it leak from the chosen reservoir?”, “Will it stay underground?”, “For how long?”. Such questions, at whatever level, can only be answered convincingly through a better understanding of a chain of complex physical and chemical processes. This requires a significant increase in scientific knowledge beyond the state-of-the-art since, unlike other domains, we do not currently have experience to draw on for this new technology.

The European Commission has selected the ULTimateCO2 project for funding under its FP7 R&D 2011 program. ULTimateCO2 will assess the long-term CO2 storage behaviour in terms of efficiency and security. The project is dedicated to studying the main physical processes needed to develop a better, quantitative understanding of the long-term geological storage of CO2, namely: (i) reservoir trapping mechanisms, (ii) sealing integrity of fractured and faulted caprock, and (iii) leakage through interfaces in the well vicinity. The research programme will comprise laboratory experiments, numerical modelling application and development, field data implementation and review of natural and industrial analogue evidence. Close collaboration with the NER300 candidates and EEPR demonstration sites will underpin all investigation with relevant supply of data industrial context. ULTimateCO2 will define a set of recommendations that will enable both regulators and operators to demonstrate that site specific long-term site performance will lead to permanent and safe CO2 containment. This will enable robust storage and allow clear conditions to be established for post-closure liability transfer.

The four-year ULTimateCO2 programme comprises seven work packages (see Figure)

WP1 concentrates on overall coordination of the project, ensuring the link between the consortium and the European Commission, overseeing collaboration with the other associated participants (Advisory Board), monitoring progress and deliverables, managing cooperation and data exchange between participants and reporting to the EC.

WPs 3, 4 and 5 are focused on understanding the three main aspects determining CO2 long term confinement efficiency and impacts on surrounding areas.

WP3 improves the understanding of fundamental long-term physical and geochemical processes. This include the rates and relative importance of SDRM (structural, dissolution, residual and mineral) trapping at reservoir scale, and addresses the influence of minor constituents that may be contained within the CO2 stream. This is evaluated through experimental and modelling applications at planned CO2 storage demonstration sites. Static geological modelling and dynamic reservoir simulation is conducted to underpin much of the consideration of long-term reservoir containment. Experiments are conducted to assess (i) the long-term residual trapping efficiency in sandstone samples containing residual concentrations of CO2 (ii) the potential impact of impurities such as SOX, NOX, H2S, O2 and (iii) the Fe release in sandstone reservoir rocks, as induced by acid gases co-injected with CO2.

WP4 focuses on the long-term caprock sealing integrity, including the effects of discontinuities, such as faults or fracture networks and considering the influence of fluid-rock interactions. In order to ascertain the sealing capacity of potential geologically 'weak points' in the caprock, a number of factors must be considered: i) fault and fracture network characteristics and their thermo-hydro-mechanical behaviour, ii) effects of chemical degradation on the mechanical and transport properties of intact and faulted caprock, iii) sealing efficiency of caprocks in response to long-term changes in basin conditions, iv) consequences of long-term coupling between these processes. As such, this work package incorporates a combined approach of observation, experimental testing and modelling to deal with each of these identified aspects.

WP5 is dedicated to the understanding of the chemical and mechanical processes affecting the long-term sealing integrity of the near-wellbore zone. The damaging due to drilling of the near-well caprock zone, as well as the quality of the placement of the cement plug and sheath can play a major role in determining the available migration pathways. The loss of bonding between different materials can cause annular pathways along the interface between casing, cement and caprock. Furthermore, uncertainties prevail concerning the range of permeability for cement and caprock degraded by chemical fluid-rock interactions and the effects of impurities in the fluid phase, as well as how porosity and permeability evolve over long time scales.

WP2 is aims at integrating the results of the detailed study of these abovementioned three main aspects (WPs 3, 4 and 5) to assess the long-term impacts of geological storage at the basin or regional scale. The value of such modelling is to study (i) brine displacement induced by CO2 injection into a deep saline formation, (ii) fault reactivation induced by CO2 injection into a compartmentalized depleted gas reservoir, and (iii) CO2 leakage from deep saline

formations to fresh groundwater through abandoned wells. Modelling will integrate field data from CO2 storage demonstration sites to provide test cases.

WP6 is dedicated to uncertainty assessment, and supports all the other work packages by providing them with a framework for addressing the confidence that can be placed on the long-term extrapolation of identified processes, and numerical simulation results.

WP7 will disseminate the project results to various selected target audiences. Clear recommendations will be established on the basis of the scientific results and these will be made available for storage projects, thus enabling site-specific evaluation of the long-term fate of geologically stored CO2.

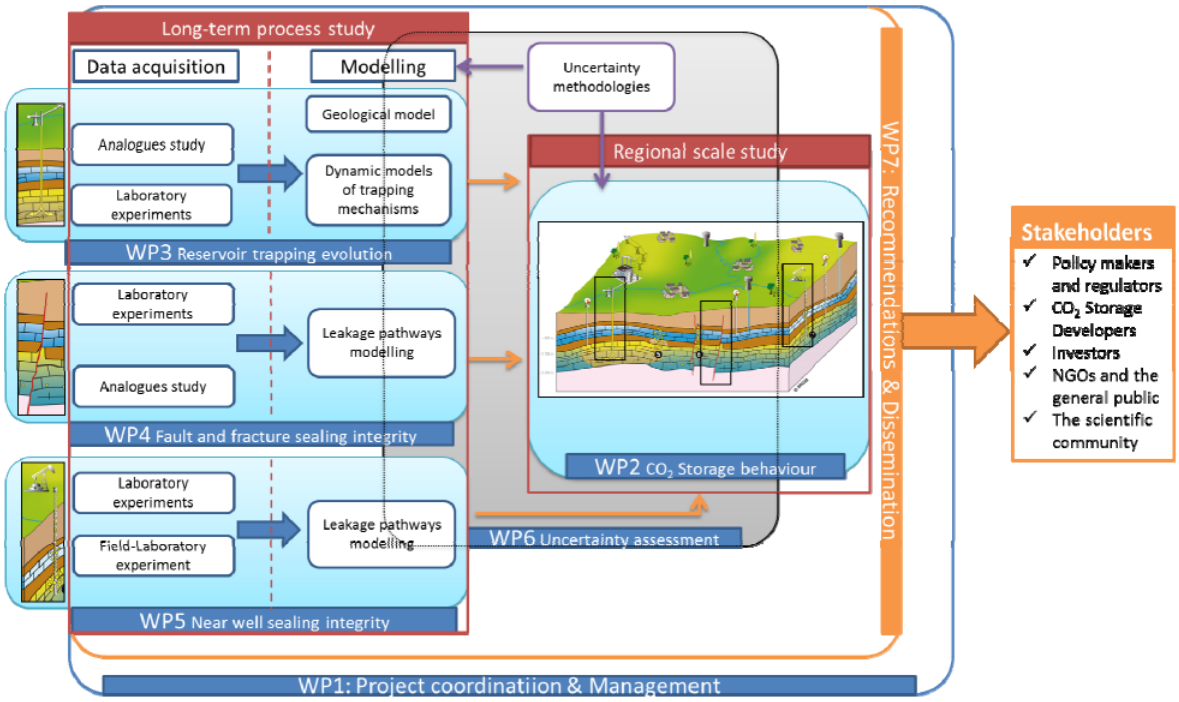

Figure 1 : Graphical presentation of the ULTimateCO2 project