Quick Maturation of Carbon Storage Site in Oman by Leveraging Data From Hydrocarbon Development and Global Low-Carbon Initiative

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Abstract

Petroleum Development Oman (PDO) has an ambitious plan to reduce the CO2 emission toward net zero in 2050 which is aligned with country net zero by 2050 vision. A mid- and long-term strategy has developed that has several carbon abatement and removal staircases that aim for projects with both cost and carbon competitiveness. In synergy, Shell together with Government of Sultanate of Oman are developing options for a separate downstream gas project in which Shell could produce and sell low-carbon products and support the development of blue hydrogen in Oman. Therefore, maturing a reliable and safe carbon storage site is key enabler to PDO, Shell and GOSO aspiration.

This paper describes a streamlined approach in maturing a CO2 storage site in clastic saline aquifer in Oman from scratch up to Shell/PDO SELECT phase decision gate where a final concept identified for project execution in two years. This is enabled by the availability of excellent quality subsurface data including long term injectivity from hydrocarbon development in Block 6. The global experience in executing similar low carbon projects by Shell and coupled to PDO local basin mastery has minimise the time spent in maturing comparable size projects.

The rock sequences of Oman include thousands of metres of extensive clastic formations with hydrocarbon has been actively prospected by PDO in Block 6 since the first exploration well in 1956. Block 6 was screened for safe carbon storage across four main pillars: Capacity, Containment, Transport & Injectivity and Monitoring & Remediation. At the onset of the storage project, key decisions were taken on type of CO2 storage (saline aquifer, depleted hydrocarbon fields) and type of reservoir (clastic, carbonate). From then on, adopting the existing play-based exploration approach to screen a wide area by overlaying multiple risk maps including reservoir properties, sealing potential, depth, wells, and faults results in several frontrunner storage sites. These frontrunners were then studied in further details for three of the four pillars; Capacity, Containment and Transport & Injectivity. The frontrunner storage sites were selected based on an index of favourable criteria which includes both subsurface and surface parameters. One of the criteria are the availability of subsurface data from exploration & appraisal activities and most importantly the long term sustained water injection from the water disposal wells targeting the same formation. The wealth of data together with corporate mastery of the basin enables multiple subsurface realisations to be built to assess the feasibility of storing CO2. A frontrunner site codenamed Area F was selected from the described workflow and an ensemble of subsurface realisations were built with multi-scenario modelling work-flow adopted from hydrocarbon development. In parallel, the downstream low carbon project has identified several potential CO2 source locations and matured multiple development concepts to transport of the CO2 to Area F.

The streamlined workflow provides a structured methodology to quickly screen a wide area known for hydrocarbon prospectivity for maturing CO_2 storage sites.

Unlike the hydrocarbon development ultimate recovery, the capacity probabilistic distribution of a site to store carbon is dependent on two dimensions; CO_2 footprint or plume extent and injectivity. A simple methodology to re-define the Low and high ends for CO_2 storage capacity has been used for the project.