# Characterizing the Subsurface: A Key to a Successful Energy Transition in the Middle East

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## Abstract

Demand for hydrocarbons is predicted to remain substantial for several decades to come, with the Middle East a key source of supply. However, many of the fields in the Middle East are mature, and it is known that greenhouse gas emissions double with every 25% increase in cumulative production of oil or 50% cumulative production of gas. The energy transition will drive operators to hold carbon efficient portfolios with a focus on advantaged hydrocarbons (those with the lowest $CO_2$ emissions per barrel of oil equivalent). This will be supported by the implementation of large-scale geological storage of $CO_2$ to reduce atmospheric emissions. Both the identification of advantaged hydrocarbons and the screening for $CO_2$ storage locations requires an understanding of subsurface complexity, including lithological heterogeneity, and resulting porosity and permeability variations. Geothermal energy and hydrogen storage also require rapid and plausible subsurface characterization, hence this is a key challenge to be overcome by geoscientists working in the Middle East energy industry.

To address this issue, we demonstrate a workflow utilizing data science approaches and stratigraphic modeling that allows reservoirs to be rapidly ranked in terms of their relative advantage. The techniques can also be integrated into a workflow for screening and ranking carbon storage capacity per unit volume, to assess depleted fields and saline aquifer storage units that are data lean because they lie outside the main petroleum system fairways. The variation in storage resource values can be mapped both spatially and stratigraphically, highlighting an optimal storage fairway. By using a consistent methodology for characterising the subsurface a valid relative ranking of assets and potential storage units to be created. Moreover, many of the important input parameters can be calculated and rapidly predicted from log data, accelerating the process of assessment.