



CO₂ Enhanced Oil Recovery from the Residual Zone – A Sustainable Vision for North Sea Oil Production

Jamie Stewart, Stuart Haszeldine, Mark Wilkinson, and Gareth Johnson

SCCS, School of Geosciences, University of Edinburgh, Scotland, United Kingdom (jamie.stewart@ed.ac.uk)

This paper presents a 'new vision for North Sea oil production' where previously unattainable residual oil can be produced with the injection of CO₂ that has been captured at power stations or other large industrial emitters. Not only could this process produce incremental oil from a maturing basin, reducing imports, it also has the capability to store large volumes of CO₂ which can offset the emissions of additional carbon produced.

Around the world oil production from mature basins is in decline and production from UK oil fields peaked in 1998. Other basins around the world have a similar story. Although in the UK a number of tax regimes, such as 'brown field allowances' and 'new field allowances' have been put in place to re-encourage investment, it is recognised that the majority of large discoveries have already been made. However, as a nation our demand for oil remains high and in the last decade imports of crude oil have been steadily increasing. The UK is dependent on crude oil for transport and feedstock for chemical and plastics production. Combined with the necessity to provide energy security, there is a demand to re-assess the potential for CO₂ Enhanced Oil Recovery (CO₂-EOR) in the UK offshore.

Residual oil zones (ROZ) exist where one of a number of natural conditions beyond normal capillary forces have caused the geometry of a field's oil column to be altered after filling [1]. When this re-structuring happens the primary interest to the hydrocarbon industry has in the past been in where the mobile oil has migrated to. However it is now considered that significant oil resource may exist in the residual zone play where the main oil column has been displaced. Saturations within this play are predominantly close to residual saturation (S_r) and would be similar to that of a water-flooded field [2]. Evidence from a number of hydrocarbon fairways shows that, under certain circumstances, these residual zones in US fields are comparable in thickness to the conventional oil. The application of CO₂EOR to ROZ enables a significant contribution to a field's recoverable reserves [3]. This work identifies for the first time the plays of geological conditions that create naturally occurring residual oil zones in the United Kingdom Continental Shelf. We present a screening workflow to identify such zones and a methodology for assessing the resource potential and CO₂ storage capacity for a number of different fields. Lastly we examine the economic consequences on CO₂ storage of the incremental oil produced, and the carbon balance life-cycle.

[1] Melzer, S., Koperna, G., Kuuskraa, V. 2006. The Origin and Resource Potential of Residual Oil Zones. SPE Annual and Technical Conference, San Antonio, Texas, Society.

[2] Koperna, G., Melzer, S.L., Kuuskraa, V. 2006. Recovery of Oil Resources From the Residual and Transitional Oil Zones of the Permian Basin.. SPE Annual Technical Conference, San Antonio, Texas. Society of Petroleum Engineers.

[3] Advanced Resources International, 2005. Assessing Technical and Economic Recovery of Residual Oil Zones. U.S Department of Energy.