

BGS response to Scottish Government consultation on onshore oil and gas

The British Geological Survey (BGS) is a world leading applied geoscience research centre, which provides objective and authoritative geoscientific data, information, and knowledge to inform government on the opportunities and challenges of the subsurface environment.

BGS provided geoscientific datasets, reports and maps to Government, industry and regulators applicable to conventional oil and gas exploration for tens of years. The BGS Hydrocarbon Team was restructured in 2020 to provide subsurface knowledge for the energy transition in carbon capture and storage, energy storage and geothermal.

In line with the evidence-gathering process of this consultation, two topics are covered:

1. Summary of published geological information on the conventional oil and gas prospectivity onshore* Scotland.

(*onshore in oil and gas licensing terms includes the inshore waters in the Firth of Forth, Firth of Clyde, Solway Firth, Sea of Hebrides and Minches etc.)

Onshore in Scotland, a proven petroleum system exists in the Midland Valley of central Scotland. Here, Carboniferous oil shale, carbonaceous mudstone and coals deeply buried within basins form hydrocarbon source rocks that reached thermal maturity levels of the oil and gas windows (Underhill et al. 2008; Monaghan 2014; Dean, 2018). Trapping structures have been tested with exploration wells drilled over many years from the Central Coalfield to Fife and Midlothian, starting with the West Calder well in 1919 (Pye and Brown, 2002; Dean 2018). Oil and gas shows and discoveries within the wells were most commonly in sandstone reservoir rocks of the Strathclyde Group. This accords with observed seeps at surface, demonstrating a functioning petroleum system (Underhill et al. 2008). Examples from wells drilled in the late 1980s – early 1990s include oil shows in the Milton of Balgonie 1 well, gas in Bargeddie 1, and waxy oil recovered in the Firth of Forth 1 well. At Milton of Balgonie, oil was encountered within the Lower Limestone Formation, however upon testing, the well yielded just ½ barrel of oil. The oil was waxy and close to its pour point, thus proving uneconomical to exploit (Underhill et al. 2008). At Bargeddie 1, gas was encountered in the West Lothian Oil-Shale Formation and initial well tests produced 360 mcf/d. Further tests resulted in the production of 7.3 mmscf of gas before the reservoir was nearly depleted (released Bargeddie well report).

The most significant onshore site for conventional onshore oil and gas production was the D'Arcy-Cousland anticline (Hallett et al. 1985), where drilling commenced in 1919 and production finally ceased in 1965 having produced 6.4 million m³ of gas and c. 30 000 barrels of oil.

Devonian lacustrine sediments of Caithness, Orkney and Shetland along with Jurassic mudstones form potential and proved hydrocarbon source rocks offshore in the Moray Firth. The exhumed petroleum system occurs onshore in Orkney with good exposures of oil-stained aeolian and fluvial Devonian sandstones (Brown et al. 2018). The Jurassic hydrocarbon system was tested onshore by the Sutherland No 1 well in 1980 and Devonian strata by the Tain well in 1988, but no commercial development resulted.

Recent reassessment of the Jurassic and potential Paleozoic petroleum systems of inshore basins of western Scotland (Sea of Hebrides, Minch, Larne, Portpatrick) concluded that whilst the elements of a working petroleum system are proved in some locations, there is a low probability of commercially sized petroleum accumulations (Fyfe et al., 2020, 2021). Studies

of the western inshore basins are hampered by a lack of data, for example there are no offshore wells in the Firth of Clyde.

Other onshore (land) areas of Scotland are not understood to have the appropriate geology to be prospective for oil and gas.

In summary, this geological account of oil and gas onshore Scotland highlights (i) the small amount of production that occurred onshore in the central Scotland up to 1965 (ii) subsequent conventional oil and gas exploration wells in central Scotland did not result in development and production in the late 1980s–early 1990s (iii) evidence for oil and gas prospectivity in other onshore areas and inshore waters of Scotland is limited.

2. Data for the energy transition

A set of legacy borehole and well data, along with associated test and analytical data exists from previous oil, gas and coal bed methane exploration and production activities onshore Scotland. This data is extremely useful in consideration of the subsurface for the energy transition. It represents millions of pounds spent in drilling up to over 2 km deep. However accessing this data is currently problematic (i) it is only available from data release agents (ii) wells that were not within active oil and gas licence blocks at the time powers were devolved to Scotland in 2018 are not included on the [Scottish Government viewer](#), plus no wells are shown in Scotland on the [North Sea Transition Authority onshore viewer](#). This data is therefore difficult for many users to source and use. BGS holds copies of many of these well records for its work, but under the current licence and ownership terms cannot share this information publicly.

In addition, there are a small subset of legacy onshore hydrocarbon (including coal bed methane) wells that have not been decommissioned. This infrastructure has the potential to contribute to energy transition studies of the subsurface (e.g. Watson et al., 2020)

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