

Midland Valley of Scotland Summary

The Midland Valley of Scotland has a long history of oil and gas exploration. The West Lothian Oil-Shale Formation was the birthplace of the oil-shale industry in the 1850s with over 100 oil-shale companies active by 1900 in extracting oil by heating the shale in retorts, where it outcrops at the surface. (Note that this is a completely different technology from oil or gas drilling, more akin to coal mining).

The British Geological Survey, commissioned by the Department of Energy and Climate Change, has studied the shales of the Midland Valley of Scotland. The total volume of prospective shale in the Midland Valley of Scotland was estimated based using a regional 3D geological model generated using seismic mapping, integrated with borehole, coal mining and outcrop information.

The results of the analysis show resources of shale gas and shale oil in place. The range of total in-place oil resources for the Carboniferous shale is 3.2 - 6.0 - 11.2 billion bbl (421-793-1497 million tonnes) and range of total in-place gas estimate is 49.4 – 80.3 – 134.6 tcf (1.40 – 2.27 – 3.81 tcm).

It should be emphasised that these 'oil-in-place' and 'gas-in-place' figures refer to an estimate for the entire volumes of hydrocarbons contained in the rock formation, the resource, not how much can be recovered. This methodology is similar to that used in the resource assessment for the previous BGS reports of the Bowland and Weald shales, but the uncertainty in the Midland Valley of Scotland is compounded as there are fewer historic wells and seismic lines to provide data. Further, the geology of the basin includes thinner shale packages mixed in with volcanic rocks, faults and abandoned deep coal mine workings which make it more complex and are likely to limit where wells can be drilled.

In simple terms, the resource estimate for any shale gas or shale oil play is the amount of gas or oil in the ground (some or all of which might never be produced), while the reserve estimate is a more speculative measure which describes the amount of gas or oil that might be able to be extracted. It takes into account non-geological constraints including technology, economics and the commercial risk operators are prepared to take.

Without substantive data from drilling and production rates, figures for reserves cannot be reliably estimated. In time, the drilling and testing of new wells in the Midland Valley of Scotland will give an understanding of achievable, sustained production rates.

The Midland Valley of Scotland contains four prospective Carboniferous shale units (see Figure 1) containing organic -rich mature shale at suitable depths; the Limestone Coal Formation, Lower Limestone Formation, West Lothian Oil-Shale Formation and Gullane Formation. The Midland Valley has a complex basin composition with carboniferous aged strata mixed in with volcanic rocks.

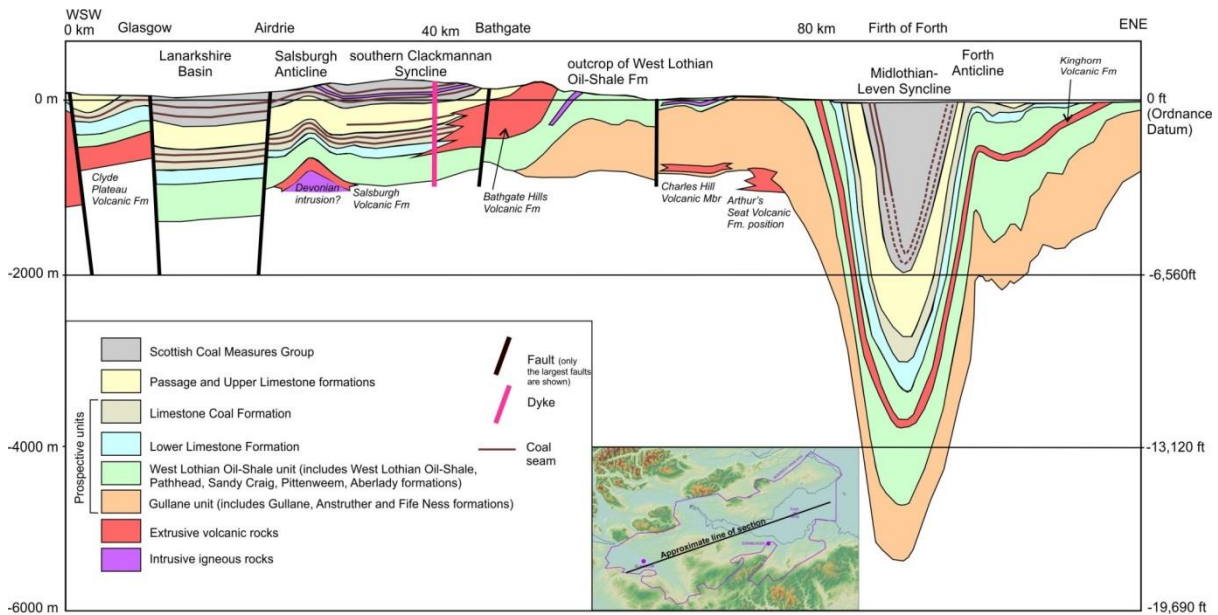


Figure 1 Schematic cross-section across the Midland Valley of Scotland to illustrate some of the main geological features. Note the significant vertical exaggeration x10.

As a result of significant burial, uplift and erosion, the Carboniferous shales are mature for oil generation from shallow burial depths of a few hundred metres or less over parts of the MVS study area, and gas-mature shales occur at depths from about 2,300 ft below the surface. These are shallow maturity depths when compared to those of the Bowland shale, Jurassic shales of the Weald and many commercial plays in the USA, which adds to the uncertainties about production potential.

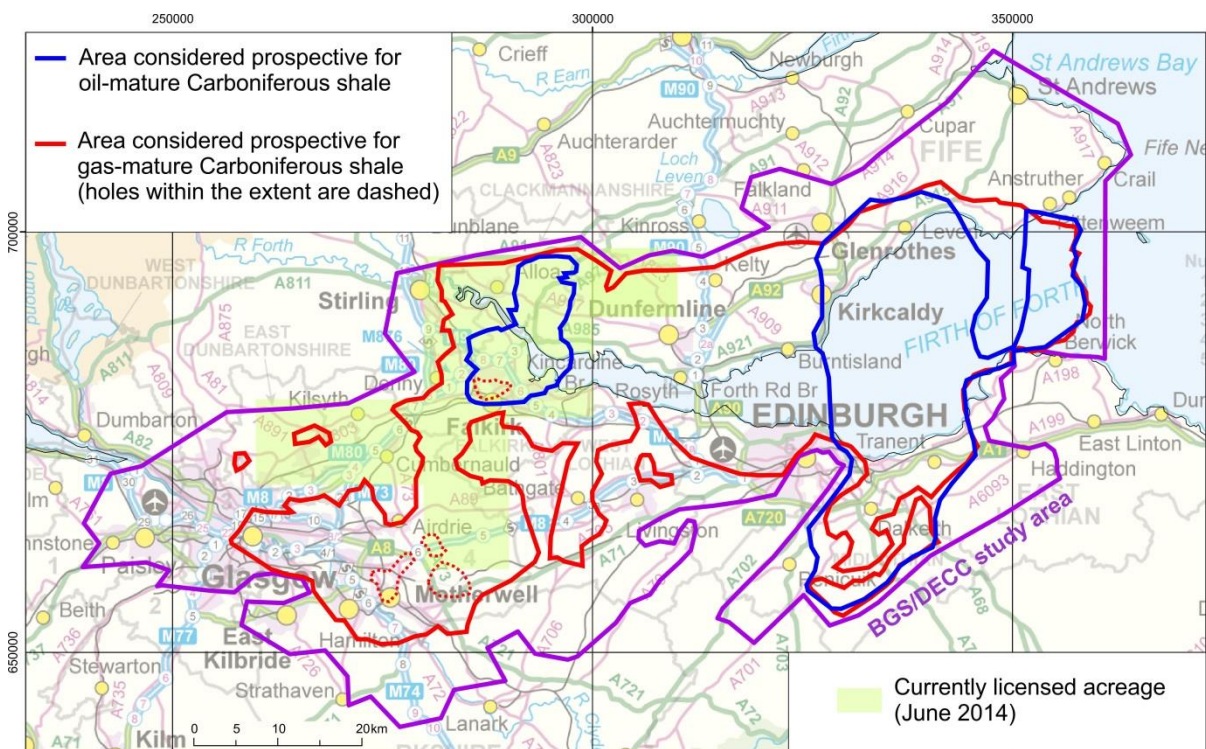


Figure 2 Summary of areas considered prospective for shale gas (red) and shale oil (blue) in detail study area (purple) with current licensed acreage shown in green.

This is the third detail BGS report summarising the background geological knowledge and resource assessment of the UK's shale gas basins. These are creating preliminary in-place resource calculations for three study areas in Britain (Figure 3).

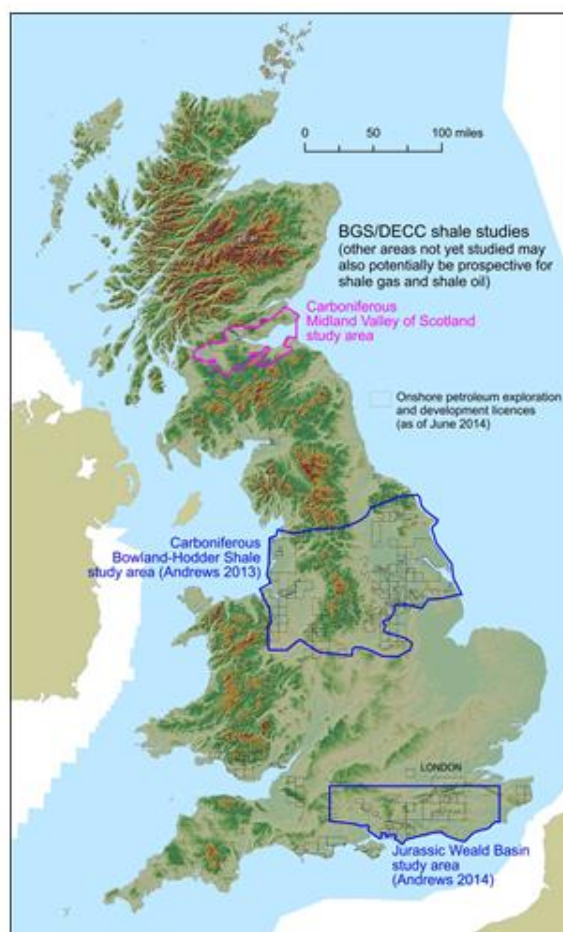


Figure 3 Location of the DECC/BGS study areas, area of the Strategic Environmental Assessment underway for future licensing and the currently licensed acreage. Other shale gas and shale oil plays may exist.

The first study, published in June 2013, reviewed the Bowland-Hodder shales across Northern England, which covers 11 counties in the North of England. The central scenario estimates there is likely to be some 40 trillion cubic metres (1,300 trillion cubic feet) of shale gas in the ground.

The second study of the Jurassic shale of the Weald Basin in southern England, published in May 2014 concluded that is unlikely to be any shale gas potential, but there could be shale oil resources in the range of 2.2-8.5 billion barrels of oil (290-1100 million tonnes) in the ground, reflecting uncertainty until further drilling is done. A reasonable central estimate is 4.4 billion barrels of oil (591 billion tonnes).

For further information on the Midland Valley of Scotland study and other DECC-commissioned BGS shale studies see <https://www.gov.uk/oil-and-gas-onshore-exploration-and-production#onshore-reports>.