British Geological Survey Gas-In-Place Resource Assessment of the Bowland Shale

SUMMARY

This study is the first to integrate all the existing seismic data, geological analyses and samples from wells to form a full picture of the extent and prospectivity of the Bowland-Hodder shale formation in northern England. Over 15,000 miles of seismic data were integrated with BGS outcrop and fault mapping, well data, historical and newly-commissioned laboratory studies to identify the potential volumes of shale gas in the Bowland-Hodder formation. The report also summarises the methodology used in calculating this gas-in-place assessment.

The study provides the first regional maps and cross-sections to show the extent of the upper and lower shale gas plays together with the estimated thickness of gas-mature shale. This will provide investors, operators and regulators with an indication of where to target future exploratory drilling, which will be required to determine the extent of the commercially recoverable gas.

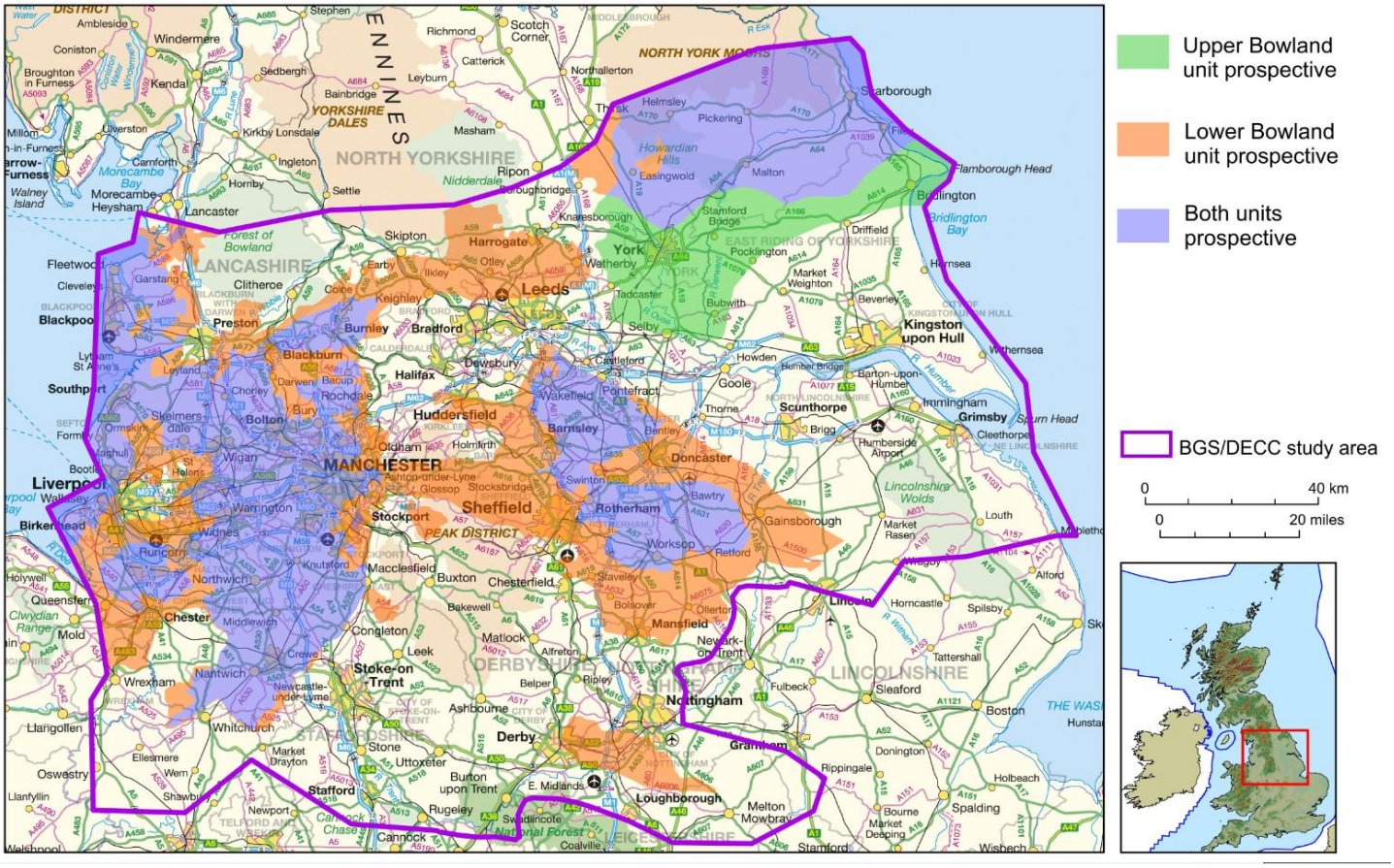

Fig 1. BGS/DECC study area

SHALE GAS RESOURCE (gas-in-place)

BGS have used a 3D geological model and a statistical simulation to estimate the amount of gas that is physically contained in the rock – in this case, the Bowland shale (see Appendix A of the report for more details). There are a number of resource classifications, BGS uses one of these, the **Gas-In-Place (GIP)** which is an estimate of the total amount of gas that is trapped within the shale rock. Table 1 lists the BGS's GIP estimates.

- There is a 50% chance that the true value will lie above the central estimate (and 50% that it lies below)
- There is a 10% chance that the true value will lie below the low and 10% chance it will be above the high estimate.

Bowland-Hodder GIP	Low		Central		High	
	tcf	tcm	tcf	tcm	tcf	tcm
Upper Unit	164	4.6	264	7.5	447	12.7
Lower Unit	658	18.7	1065	30.2	1834	51.9
TOTAL	**822**	**23.3**	**1329**	**37.6**	**2281**	**64.6**

Table 1. BGS gas in place estimates. tcf = trillion cubic feet; tcm= trillion cubic metre

The Upper Unit (see green and purple areas in Fig. 1): Organic-rich it is typically up to 500 ft (150 m) thick, and is distributed over a large area. Similar to some of the shale plays in North America.

The Lower Unit (*see orange and purple areas in Fig. 1):* It is harder to estimate the resource in the lower unit shale because there have been few wells this deep, but it is considerably thicker and reaching 10,000 ft (3000 m) in the deepest part of the basins.

SHALE GAS RESERVES (the amount of gas that may be produced)
In the absence of further information, which we do not have for the Bowland formation, it is not possible accurately to predict reserves (i.e. that will be technically and commercially produced) from a knowledge of GIP. This is because:

- **Geological factors:** We do not have sufficient understanding of the geology and the rates at which wells will flow to make a reasonable reserve assessment.

- **Commercial factors:** We do not have experience of the costs of production for example, obtaining access to areas for drilling pads; engineering technology; operating costs; planning permission and gas price.

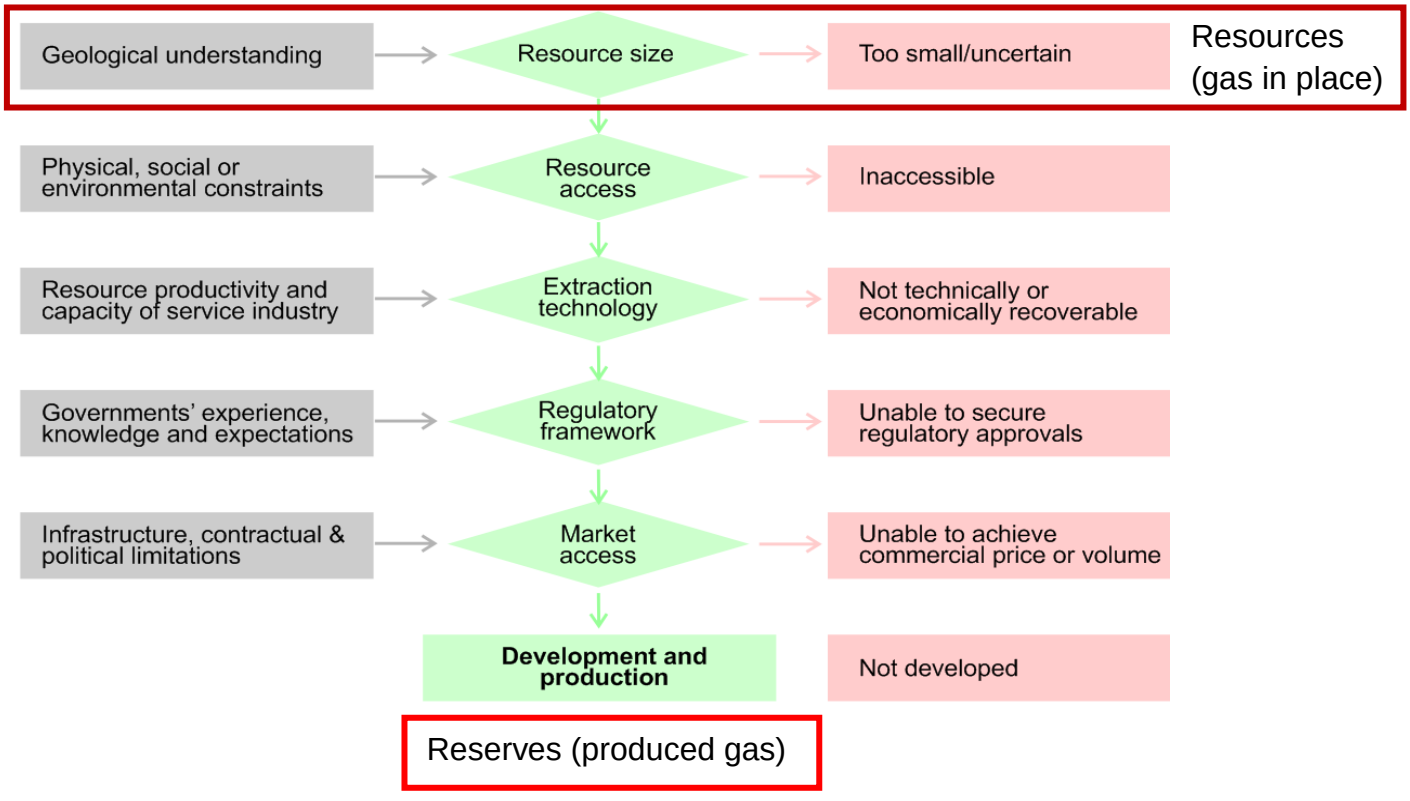

Fig 2. Factors determining the viability of natural gas developments (IEA, 2011, "Are we entering a Golden Age of Gas?"