

earthquakes are 100 times more likely to occur now than in 2008 in areas subject to fracking and wastewater disposal.’

- d) **Waste** is generated from drill cuttings and from flowback water – all of this requires careful disposal and adds to management issues.
- e) Air pollution and the associated impact of extraction of a fossil fuel are cited as a significant disadvantage of shale gas extraction. It is largely constituted of methane, which is a potent **greenhouse gas**. Some gas is flared if it is uneconomic to recover. This is preferable to venting as it reduces greenhouse gas emission by 80%. The process of Green Completion – a technology that separates the gas from other elements – means that any emissions occurring when the frack fluid is returned to the surface are kept to a minimum. A combination of flaring and green completion is said by government to reduce emissions by 95%. Most CO₂ emissions are derived from the final use of the gas as a fuel and not through the fracking process. The UK has access to carbon capture technology and has invested hugely in its development, but its use is restricted by cost. Public Health England also referred to potential radon release in a recent study (2013). They believe this could contaminate both air and water. The US congress commissioned a report that suggested that 650 fracking ingredients held chemicals that are potential carcinogens.
- f) Trucks, generators, and other associated machinery and infrastructure will create **dust, noise, and safety issues**. Vehicle emissions are of course dependent upon the distance from any materials, including water supply.
- g) In addition to these contentious problems there have been observations made about **the number of wells required at one site**. Fracking wells are grouped together into one small site, reducing surface land use by up to 90%. Many wells are required, as gas does not seep from one area to another, since the shale in which it is found is impermeable. According to anti fracking campaign group Frack Off in 2013, which states its interest as an extreme energy action, ‘Well spacings of 8 wells per square mile (or even higher) are common in the US and Australia, where large areas have been coated in wells and supporting infrastructure. Over 45,000 shale gas wells and 55,000 coal-bed methane (CBM) wells have been drilled in the US and over 5,000 CBM wells in Australia.’ However, keeping all wells in one specific area may reduce the need for access roads. Objections to a site in North Yorkshire, within a national park, cited that fracking could lead to ‘the industrialisation of the countryside!’

Where Is Fracking to Take Place?

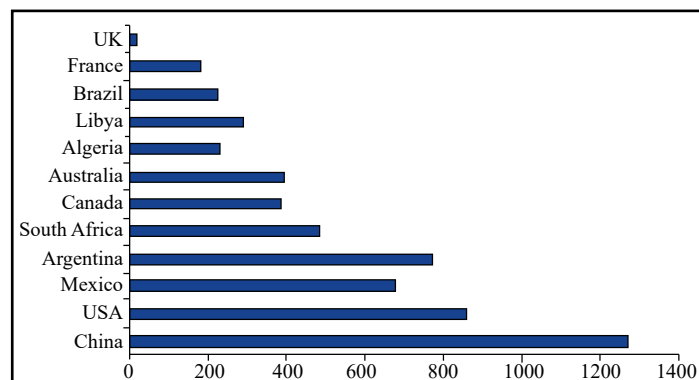
Shale gas ‘plays’ (i.e. areas of recoverable reserves) are spread all over the world, but as yet only the USA has engaged in full scale commercial extraction.

UK experience in this field is subsequent to its development as a technology in the USA and Canada. As can be seen from the accompanying graph, the national recoverable reserves are considerably less than many other countries. Outside of the USA, shale gas is produced at a commercially viable level only in China and Argentina. Obstacles to development include many of issue already alluded to and can be classified into four main categories:

economic environmental social technological



Figure 4 World Recoverable Shale Gas Resources (trillion cu ft)



Data was not available for some countries (e.g., Russia) so this is not a definitive list (*USEIA 2011a; Bickle et al. 2012*). Fracking has already been banned or suspended in some EU nations including France, Germany, and the Netherlands, as well as in Scotland and Wales.

UK

The BGS (British geological survey) has produced a survey of regions with significant reserves of shale gas:

1. The Bowland shale of the Pennine basin.
2. Kimmeridge clay of the Weald in Surrey and Sussex.
3. Oil-shale group in the Midland Valley of Scotland.

The following website allows access to maps of UK oil and gas exploitation sites:

<https://www.gov.uk/oil-and-gas-onshore-exploration-and-production>



Shale Gas Exploration. Near to Hundred End, Lancashire, Great Britain © Copyright [KA](#) and licensed for [reuse](#) under this [Creative Commons Licence](#).

In 2013 there were 176 Petroleum Exploration Development licences out for onshore oil and gas in the UK. A licence is not sufficient to allow drilling, as there are planning permissions and a range of permits from the Environment agency, the Health and Safety Executive, and the DECC. Applications have been submitted for sites in Lancashire, Yorkshire, and Nottinghamshire. Lancashire County Council rejected the plans put forward for 2 sites in June 2015, but the company concerned, Cuadrilla, appealed, and the drilling will go ahead. According to the CPRE, a small number of planning applications to explore for shale gas and oil were made, including for sites in Sussex and Lancashire.

Anti-fracking protests took place in Balcome in the High Weald AONB in West Sussex, where one company, Cuadrilla, had been given permission to carry out exploration using conventional techniques, rather than fracking. Two other applications for exploration by Celtique Energy – at Wisborough Green, just outside the South Downs National Park, and at Fernhurst (in the national park) were turned down. The former mainly because of concerns about disruption from lorries to and from the site, and the latter because the necessary exceptional circumstances to justify drilling within the National Park could not be demonstrated.

In May 2016, North Yorks planning committee agreed to plans to frack a site near Kirby Misperton by Third Energy and it is anticipated it will start drilling next year. Campaigners against Fracking anticipate challenging the decision. However, a viability test, lasting approximately 7 weeks, will be undertaken at the site, and full extraction will take place for 9 years if it proves economically and technologically possible.

The Daily Telegraph reported that the UK would have 68 gas wells in the next 5 years and at least 14 of the new sites are expected to be fracked.

Some of the designated areas include the North York Moors and the Peak District **national park**. Rigs are banned on the surface of the parks but drilling is allowed horizontally underneath park land from outside of the protected areas, as MPs voted for this in December 2015.

One County: Hampshire

Hampshire has a long history of extracting conventional oil and shale, but shale gas is regarded as unconventional as it is not formed in traditional trapped reservoirs.

Typically, the shale gas lies at far greater depths than conventional gas and thus the level of viable reserves in the county is, as of yet, uncertain, although the BGS has suggested massive reserves lie beneath Hampshire. Reports in 2014 pointed at approximately 4.4 billion barrels worth of oil under the Weald Basin.

Oil and gas resources are located in many parts of Hampshire, including within Hampshire’s two national parks – the New Forest and The South Downs.

However, extraction has not traditionally taken place within the boundaries of the New Forest National Park. There is one permitted site for conventional extraction at Avington, within the South Downs, but the site was exploited prior to the designation of national park status. Elsewhere, conventional fields were exploited at Stockbridge (north of Winchester) Humbly Grove, near Alton and Horndean. See source 12 for maps

In 2013, the local paper the Daily Echo reported that 8 licences had been granted (though the county report/study concludes that there is no shale oil or gas exploration occurring in Hants at present).

In the south of Hampshire, resources are located in various locations:

- North of Southampton, stretching east from North Baddesley to the A3051 at Fairthorne.
- North of Winchester, from Kings Worthy west almost to Stockbridge.
- Further north, reaching from Chilbolton west to Ampport.
- East of Winchester, underneath Hampage Wood.
- Stretching west from Hinton, in the New Forest.
- From east of Fareham, stretching further east.
- East from the Hambleton area (two licences).

It is unlikely that all the sites would be fracked, even if drilling went ahead, because many have the potential to generate conventional gas instead.

In July 2013, the then UK Prime Minister David Cameron claimed that, “fracking has real potential to drive energy bills down”, presumably assuming that it would thus have populist appeal. It may be thought that the Paris agreement on climate change would focus minds as countries try to limit the global temperature increase to 1.5 °C. To achieve this, some scientists have suggested that zero emissions will be required by between 2030 and 2050. This is an indication that the energy policies must aim for radical reduction of greenhouse gas emissions.

A report by the Committee on Climate Change, a statutory body that advises ministers on keeping greenhouse gases in legal limits, has stated that 3 conditions should be met if climate change targets are to be met:

- Shale gas production must displace imports rather than augment use,
- Methane leaks must be dealt with,
- Greenhouse gas emissions in other areas of industrial production should be cut in order to compensate for the impact of shale gas on the atmosphere .

However, as indicated in the introduction to this study, it has become clear that fracking will remain a highly contentious practice. Much of the literature related to fracking is highly charged in content and some claims made about its impacts have been severely contested on both sides of the debate. The fact that, as yet, there are no operating wells in the UK and that the 2 experimental ones have been suspended is indicative of the current uncertainty around the industry.

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Acknowledgements;

This Geo Factsheet was researched and written by Sue Chamberlain, a teacher in Hampshire. Curriculum Press, Bank House, 105 King Street, Wellington, TF1 1NU ISSN 1351-5136