ITEM FOR CONSIDERATION AND DECISION

UNCONVENTIONAL HYDROCARBON RESOURCES UNDERLYING THE COTSWOLDS AONB

Summary: This report attempts to find a way through the minefield of fact, claims and counter claims to provide an understanding of the unconventional hydrocarbon resource underlying and around the Cotswolds AONB and its prospectivity.

Recommendation: That the report is noted and the situation kept under review.

Officer ref: Mark Connelly, Land Management Officer. (01451 862006)

Background

Unconventional hydrocarbons refer to gas and oil from unconventional sources trapped in rocks deep underground instead of in a conventional reservoir where oil and gas has migrated in permeable rock such as sandstone or limestone capped by shales or other hard rocks. Advances in drilling and wellsite technology and increases in wholesale prices for oil and gas now make production from the less permeable unconventional formations commercially viable.

Of principal interest is gas, particularly shale gas. Exploration of unconventional gas is at an early stage in the UK and there are currently no commercially active sites. Exploratory drilling and test hydraulic fracturing (‘fracking’) has taken place in Lancashire and further exploration famously in Balcombe, Sussex.

The British Geological Survey (BGS) recently estimated there may be 1,329 trillion cubic feet of shale gas. At a 10% recovery rate this would supply 10% of Britain’s gas needs for over 30 years. This may require 2,500 to 3,000 wells in 250 to 300 sites of around 1.5ha each. In the USA, each site or pad has up to 8 wells on 2-3ha. The productive life of a well is suggested to be up to 30 to 50 years after fracking. However, the average lifespan of fracked gas wells in Texas is around 8 years. Wells can be re-fracked up to 10 times.

Sources of unconventional gas are shale gas, Coalmine Gas, Coalbed Methane and Underground Coal Gasification

Onshore exploration of gas is controlled through Petroleum Exploration and Development Licences (PEDL) issued by the Government. A PEDL allows a company to pursue a range of oil and gas exploration activities subject to normal drilling/development consents, planning permission and rights of access. Permission of the Coal Authority is also required by licensees wishing to drill through or enter coal seams for methane. The last (13th) Onshore Licensing Round was in 2008. The next round is due in 2014.
About half of Britain including the entire Cotswolds AONB sits above geology with potential for unconventional gas. However, not all this geology will be productive.

Fracking has become an emotive issue with concerns about earthquakes, methane in water supplies and environmental impacts.

**Resources of unconventional gas**

**Shale gas**

Shale gas is a natural gas extracted directly from shale and mudrocks. The gas is held in fractures, pore spaces and adsorbed on to the organic matter contained in shale and mudrock.

The most common way to extract shale gas is by cracking the rock using hydraulic fracturing (‘Fracking’). Fracturing fluid, a combination of water and chemicals, is pumped at high pressure into the rock to create narrow fractures that allow the gas to flow into the well bore and to surface. These chemicals make up less than 1% of the total fluid used.

Once the fractures have been created, small particles, usually sand, are pumped into the fractures to keep them open when the water is taken back up the well.

**Coalbed Methane (CBM)**

As with shale gas, hydraulic fracturing is used to extract gas from unworked, undisturbed coal seams via boreholes drilled from the surface. Prior to gas production, the coal seam must be dewatered to lower the pressure allowing the release of gas. The pumped water may need an extraction licence and treatment.

**Underground Coal Gasification (UCG)**

Underground Coal Gasification (UCG) involves the gasification of the coal in-situ by drilling boreholes into the seam, injecting water/oxygen mixtures down one pipe, igniting and partially combusting the coal and extracting the gasification products (known as syngas) through the other pipe. It produces a mixture of gases, (mostly carbon monoxide, carbon dioxide, hydrogen and methane) that can be processed to provide fuels for power generation, vehicle fuels and chemical feed-stocks.

It is UK Government policy that carbon capture and storage (CCS) will be required if the syngas is used for power generation. However, at the present time, if the syngas is used for other purposes such as producing vehicle fuel then CCS will not be required.
Coal Mine Methane (CMM)

Coal Mine Methane is extracted from worked or abandoned mines traditionally as a safety measure. Methane is released by the coal and collects in the voids left by coal extraction. CMM has no relevance to the Cotswolds.

Underlying geology of the Cotswolds

The Cotswolds AONB comprises or overlies three rock types with potential for unconventional gas:

- Lias – outcrop (on the surface) and subcrop (buried)
- Oxford Clay outcrop
- Coal

See maps 1 and 2 (To follow - currently being prepared by BGS)

Prospectivity of the Cotswolds

Shale Gas

Jurassic Lias lies underneath the Oolitic limestone of the Cotswolds but also outcrops at the base of the scarp and in northern parts of the AONB. The Lias includes the oil shales found at Kilve on the Somerset coast and the test borehole near Balcombe in Sussex, but the lias associated with the Cotswolds is described as immature\(^1\) for gas i.e. not enough time, pressure and heat to mature the Lias for gas production.

The Oxford Clay outcrop is also described as immature.

Oxfordshire-Berkshire Coalfield

The area of the AONB within Oxfordshire and the eastern edge of Gloucestershire around Stow-on-the-Wold overlies the Oxfordshire-Berkshire Coalfield.

Coalbed Methane

No coal has been mined from this Coalfield. The methane content is low making the coal to be considered as unprospective for Coal Bed Methane\(^2\).

Underground Coal Gasification

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\(^1\) The Unconventional Hydrocarbon Resources of Britain’s Onshore Basins – Shale Gas  
\(^2\) Mineral resource Information in Support of National, Regional and Local Planning – Oxfordshire  
http://www.bgs.ac.uk/mineralsUK/planning/resource.html
Areas of the Oxfordshire-Berkshire Coalfield have potential for Underground Coal Gasification (UCG). These areas include the coalfield south of Banbury and east of Witney. Large areas of the coalfield have unverified potential due to the lack of deep boreholes, however, the areas to the west of Oxford are known to have poor potential for UCG\(^3\).

**Bristol and Somerset Coalfields**

Adjacent to the Cotswolds AONB in the Severn and Avon vales lie the Bristol and Somerset coalfields.

**Coalbed Methane**

A borehole at Priston southwest of Bath and about 2½ miles west of the AONB boundary at Combe Hay found two coal seams that meet CBM criteria. The coalfields, however, are considered to have very limited potential for CBM as they contain low volumes of methane\(^4\).

**Underground Coal Gasification**

Examination of boreholes indicate there is no UCG potential in the Bristol-Somerset coalfields. Three seams, however, meet the thickness criteria locally and other thick coals may be present in the deeper parts of the coalfield\(^5\).

**Petroleum Exploration and Development Licences (PEDL)**

To date no PEDLs have been obtained for the Cotswolds AONB. A group of four PEDLs have been awarded immediately to the south west of the AONB. One of the licences clips the AONB at Upton Cheyney and Kelston but this is coincidental as the focus of the licence is the Somerset Coal field.

Bath and North East Somerset Council received a planning application for a borehole to test coal for methane production North West of Keynsham in 2012. The application was withdrawn.

The next round of Onshore Licensing is due in 2014. The area of Britain available to bidders includes all suitable geology including the Cotswolds.

\(^3\) UK Coal Resource for New Exploitation Technologies, Final Report  
http://www.bgs.ac.uk/downloads/start.cfm?id=1712  

\(^4\) Mineral Resource Information in Support of National, Regional and Local Planning – Somerset  
http://www.bgs.ac.uk/mineralsUK/planning/resource.html  

\(^5\) UK Coal Resource for New Exploitation Technologies, Final Report  
http://www.bgs.ac.uk/downloads/start.cfm?id=1712
**Impacts of prospecting and extraction**

**Landscape**

There is potential damage to both the character and tranquillity of the Cotswolds particularly during the exploration of a site. This could be for around two years, after which the well is either sealed or capped for gas extraction and the majority of the site restored leaving just the wellhead within a smaller compound, although to maintain gas production re-fracking may be necessary up to every 4-5 years. Infrastructure will also be required to collect the gas and pump it into the national grid.

Wells are in production 24 hours a day. Consequently noise and light pollution are of concern

**Water demand**

The process of fracking requires huge quantities of water. Figures range between 20,000 - 5 million gallons per frack depending on depth and extent of drill, rock type and lifetime of the well. This would be a serious issue for the Cotswolds which is a major aquifer, particularly as a supply of water for the south-east of England. Most of the Cotswolds is classed as ‘no water available’ within the various Catchment Abstraction Management Strategies and lack of water availability could be a constraint on fracking.

**Ground water contamination**

Potential contamination of ground water comes from two sources; the injected water carrying chemical additives and the released gases. Contamination from injected water is most likely from poor well casings and their cements or from leakages at the surface whilst contamination from released gas seems to be more associated with fracking for coal bed methane which is at a relatively shallow depth and closer to the water table. Fracking for shale gas tends to be at great depth, up to several kilometres, beyond any ground water aquifer.

**Flow-back liquid**

Approximately 40% of the injected water and chemicals used in a frack return to the surface as Flow-back. Flow-back contains the chemicals used in fracking and can contain a wide range of contaminants picked up from the fracked rock. These can include methane, carbon dioxide and hydrogen sulphide, trace elements such as mercury and arsenic, naturally occurring radioactive materials and volatiles such as
benzene. The amount of dissolved material varies widely. Flow-back is collected and stored on site for treatment or re-use.

**Vehicle movements**

Figures from the USA suggest approximately 1000 vehicle movements to complete a well.

**Regulation**

A UK Petroleum Exploration and Development Licence (PEDL) issued by DECC in competitive licence rounds, grants exclusivity to an operator in the licence area. The licences do not give consent for drilling or any other operations. To drill a well, the operator also requires:

- An access agreement with the landowner
- Consent from the Coal Authority if the well encroaches on coal seams
- Planning permission from the minerals planning authority (County or Unitary Council)
- Notification to the Environment Agency who will advise the operator on any requirements under various Water Acts and Environmental Permitting Regulations.
- A Consent to drill from DECC
- Notification to the Health and Safety Executive of well design and operation plans

PEDL have an initial term of 6 years during which exploration is carried out. Licences can then be extended for 5 years to enable further activity including exploration and extended for a third term of normally 20 years to allow for extraction.

**Community benefits**

Where fracking takes place, the UK oil and gas industry, working through a Community Engagement Charter, will provide at the exploration/appraisal stage benefits to local communities of £100,000 per well site, and at production stage a share of proceeds of 1% of revenues. The latter would be allocated approximately $\frac{2}{3}$ to the local community and $\frac{1}{3}$ at the county level.

**Likely impact on the Cotswolds AONB**

The Lias outcrop and subcrop and the Oxford Clay outcrop are described as ‘immature’ for shale gas and the underlying coal fields contain low volumes of methane. It should be noted, however, that the resources underlying the Cotswolds are relatively
unexplored. Other areas of the Country contain much higher potential for extracting gas and are likely to be the focus for gas prospecting and extraction. The landscape impact of such sites will be helpful in determining the likely short and long-term effects on the Cotswolds AONB where exploration is being considered.

**Conclusion**

From information available at present officers consider that the Cotswolds AONB and its setting can probably be seen as at low risk. However, this is a topic for which new evidence and guidance is forthcoming and will need to be kept under review.

**Supporting Documents:**

None – Maps 1 & 2 currently being prepared by British Geological Survey