

# FRACKING

## A REPORT ON THE RISKS AND BENEFITS ASSOCIATED WITH THE PROPOSED EXPLORATION FOR OIL AT LOWER STUMBLE, BALCOMBE



COMMISSIONED BY  
BALCOMBE PARISH COUNCIL  
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# INTRODUCTION

There is a layer of rock some 790 metres (2,600 feet) below Balcombe that contains oil. It is thought to be most unlikely that it contains a significant quantity of gas.

Cuadrilla Resources Ltd has a licence to explore for oil in the Balcombe area. Two years ago it applied for, and was granted, planning permission to create a new exploratory oil well at Lower Stumble, Balcombe, where exploration previously took place in 1986. The site is on the east of the road from Balcombe to Cuckfield, about half a mile south of Balcombe station. The location is identified on the map on the front cover of this report.

The purpose of this report is to provide Balcombe residents with factual information about the key risks, possible impacts and benefits of the proposed exploration for oil at the Lower Stumble site.

The key risks are:

- Contamination of the environment
- Seismic events (earthquakes)
- Materials brought to the surface

The possible impacts are:

- Traffic through the village
- Noise
- Light pollution
- Visual intrusion

Although Balcombe Parish Council may have little influence on future decisions on the extraction of oil in the Balcombe area, it has decided to address residents' concerns in the following ways. Firstly, it will obtain as much reliable information as possible about the fracking process. Secondly, it will share this information with Balcombe residents and seek their views. And finally, it will pass on these views to the relevant authorities.

The Parish Council has set up a working group which has been asked to carry out the first of these tasks. The group consists of four members of the Parish Council and six other Balcombe residents with relevant expertise and/or experience.

The group has researched the process of oil exploration and extraction involving fracking and has prepared this report on the basis of information gained from sources that include the Department for Energy and Climate Change (DECC), the Environment Agency (EA), Cuadrilla Resources Ltd (Cuadrilla) and others. It is prepared in good faith based upon information obtained and on the personal experience and professional expertise of the members of the group. It offers no opinion and is delivered in a wholly neutral manner. No member of the group has any personal interest, financial or otherwise, in either the proposed exploration at the Lower Stumble site or in Cuadrilla.

Documentation on which this report is based, including a list of questions put to Cuadrilla and the answers received, is being published on the Balcombe website: [www.balcombevillage.co.uk](http://www.balcombevillage.co.uk)

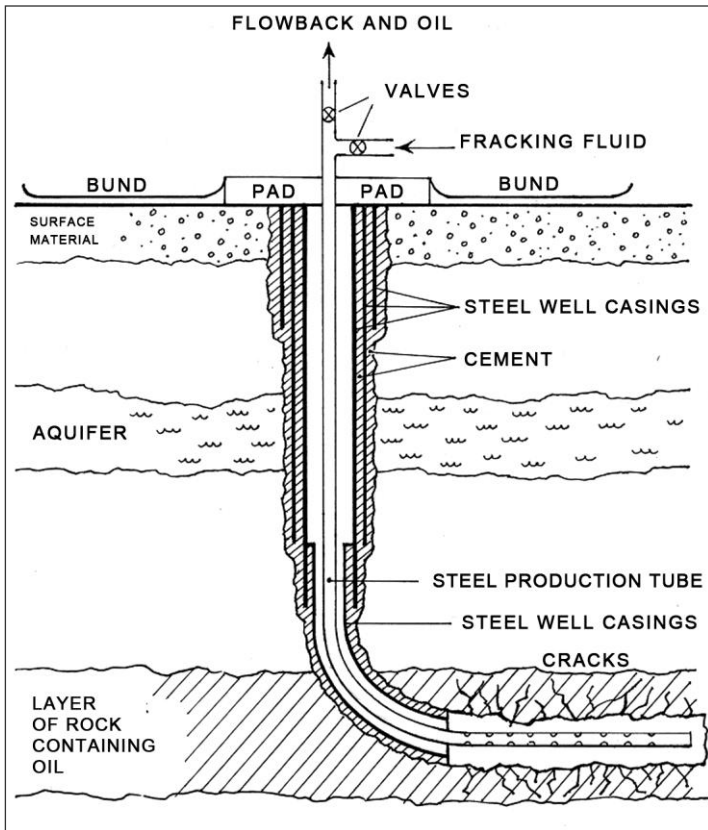
## WHAT IS FRACKING?

Hydraulic fracturing, commonly referred to as “fracking”, is the use of a pressurised fluid, usually water with sand and other additives (see page 6), to open cracks in a layer of rock to release oil or gas trapped within the rock.

## HOW IS A WELL CREATED?

The design and construction of any well created in the UK must be approved by the Health & Safety Executive (HSE).

Diagram of a typical well (not to scale)



### Site Preparation

The drilling rig is erected on a concrete pad surrounded by a large impervious (liquid-proof) membrane called a bund. This is designed to capture any spilt fluids, and to hold them until they are removed. At the Lower Stumble site the pad and the surrounding bund have already been constructed.

## **Drilling Down**

In accordance with current practice, a drilling bit is attached to a section of drill pipe which rotates. As the bit descends into the ground, additional sections of drill pipe are added to form a “drill string”. Drilling mud (a mixture of water and the mineral barite) is pumped down the drill string to cool and lubricate the bit. It returns to the surface carrying the drilling debris. The drilling mud can be reused after the removal of the debris.

Once the drill bit has cut through the soil and loose surface material to a level above the aquifer (the layer of rock containing the water that is extracted for domestic and other purposes), it is withdrawn and a steel casing (typically 60 cm diameter) is installed. Cement is then pumped out of the bottom of this casing, from where it travels upwards, filling any space between the outside of the casing and the surrounding ground.

When this has been completed the diameter of the bit is reduced for drilling through the aquifer to a level below it. A smaller casing is then installed. Any space outside the smaller casing and between the two casings up to ground level is filled with cement. As the depth is further increased, the diameter of the bit and the casing are further reduced, and again the space outside the casing and between the casings up to ground level is filled with cement. A well at the Lower Stumble site would have at least two layers of steel casing and two layers of cement between the production tube and the aquifer.

## **Turning the Corner**

At an appropriate depth the direction of drilling starts to change from vertical to horizontal through a large radius curve. The horizontal section of the well is located within the layer of rock that is thought to contain oil. As soon as the direction of drilling begins to change from vertical, the drill string can no longer rotate and the bit is then driven by a turbine.

Once the drilling is complete and all the steel casings are installed and sealed with cement, the steel production tube (usually about 10 cm in diameter) is inserted from ground level to the far end of the horizontal part of the well.

The well is then completed by making holes in sections of the horizontal part of the production tube. This is done either by shooting jets of water containing an abrasive additive, or by firing steel pins using explosive charges.

Oil may then flow from the rock layer, through the holes in the production tube and up to ground level, probably assisted by a pump.

## **Fracking**

It is likely that the flow of the oil will be increased significantly by fracking. A fluid – usually water containing sand and chemical additives – is pumped at high pressure down the production tube and into the rock layer where it opens up cracks. This releases more of the oil contained within the rock. If included in the fluid, grains of sand lodge in the cracks and hold them open.

## **THE STORY SO FAR**

In 1986 Conoco drilled an exploratory well at the Lower Stumble site. Oil was found but the quantity was not considered worth extracting with the techniques available at the time. The well was, therefore, plugged and abandoned.

In July 2008 the DECC awarded Petroleum Exploration and Development Licences for areas in Lancashire and West Sussex to Cuadrilla, one of which is for an area that includes the Lower Stumble site. During the period of this licence (initially 6 years), Cuadrilla – and only Cuadrilla – can apply for permission to drill an exploratory well anywhere within the licence areas.

The Lower Stumble site is owned by Balcombe Estate. It has been leased to Cuadrilla, initially for 3 years, ending in September 2013.

In January 2010 Cuadrilla applied to West Sussex County Council (WSCC) for planning permission to “upgrade the existing stoned platform and drill an exploratory borehole for oil and gas exploration at Lower Stumble”. WSCC carried out the statutory consultation with various parties, including the EA, Network Rail and Balcombe Parish Council, and none of these parties expressed significant concerns. In April 2010 WSCC granted planning permission, subject to conditions, that include restrictions on hours of working, noise levels and lighting, and the eventual restoration of the site.

In September 2010 Cuadrilla carried out the work of upgrading the existing stone platform, since when there has been no further activity at the site. Cuadrilla states that, currently, it has no plans to drill a well at the site. It is a condition of planning permission that all work on the site is completed within three years from the date on which work commenced, i.e. by September 2013.

## **WHAT HAPPENS NEXT?**

If Cuadrilla wishes to drill (and probably to frack) an exploratory well at this site, it must first consult the EA and the HSE. These organisations have powers to prevent or halt operations if they have any concerns about environmental contamination, safety, or any other aspect of the operations. In addition the EA will require Cuadrilla to apply for permits for certain activities, such as storage on site and disposal of used fracking fluids.

Cuadrilla must then obtain specific consent from the DECC. Before issuing consent the DECC will check that the EA and the HSE have both been consulted, and that neither has objections.

On 16<sup>th</sup> April 2012 the DECC published a report, prepared by independent experts, on the seismic events that occurred in 2011 at Cuadrilla’s site at Preese Hall in Lancashire. This report contains recommendations on the conditions under which future activities involving fracking should be permitted, both at Preese Hall and elsewhere in the UK. These recommendations are subject to a six week public consultation.

If or when the DECC does grant specific consent, Cuadrilla will be authorised to drill an exploratory well, subject to any conditions imposed by the DECC, the EA or the HSE.

Depending on what is discovered from the exploratory well, Cuadrilla may then decide to take the next step towards oil extraction. This would involve applying for new planning permission from WSCC, and repeating the process of consultation and consents, as described above.

Although other companies would probably become involved, as partners, in any development of the site that follows the exploratory well, it is Cuadrilla's stated intention to continue as the operator.

## **WHAT ARE THE RISKS ASSOCIATED WITH PROPOSED EXPLORATION FOR OIL AT THE LOWER STUMBLE SITE?**

Risk is a combination of how likely it is that something undesirable will happen and the consequences if it does. Risk cannot be eliminated but it can be managed to reduce both the likelihood of an undesirable event occurring and the consequences which might follow.

### **RISK 1: CONTAMINATION OF THE ENVIRONMENT**

Is it possible that some of the fluid used for fracking could enter the local environment and contaminate our domestic water supplies? Cuadrilla says that the fluid that it would use for fracking at the Lower Stumble site would consist of:

- 99.75% water and sand
- 0.125% hydrochloric acid (a cleaning agent)
- 0.075% polyacrylamide (a lubricant)
- 0.050% a biocide (to prevent biological clogging)

Both polyacrylamide and biocides contain toxins that are hazardous. In concentrated form these materials require special handling.

Most of the water supplied by South East Water comes from underground layers of water-bearing permeable rock (aquifers) via boreholes and wells. This water is also used to replenish South East Water's two main storage reservoirs at Arlington and Ardingly. Enquires to both South East Water and the EA have failed to establish the exact source of Balcombe's domestic water supplies.

Immediately below the aquifer is an impermeable layer of rock through which liquids cannot easily pass. The location of the layer of oil-bearing rock at the Lower Stumble site is such that fracking would take place more than 500 metres (1,600 feet) below the aquifer.

However, there are two cases where fracking fluid might enter the groundwater. The first is where the well casing passes through the aquifer. Provided the well casing is correctly designed and properly constructed, this ought not to happen. The report to the DECC on the seismic events at Cuadrilla's Preese Hall site does refer to some deformation of the well casing as a consequence of the seismic events.

However it notes that the integrity of the casing was not affected and that no leaks or contamination occurred. Cuadrilla has stated that at the Lower Stumble site the aquifer would be separated from the production tube, through which the fracking fluid runs, by at least two layers of steel casing and two cement barriers.

The second place where fracking fluid might enter the groundwater is on the site at ground level if a spill or leak was to occur. The bund (the impervious membrane surrounding the well) is designed to contain any spilt liquid and should prevent it from entering either the ground below the site or the streams that run close to the site.

The EA would be responsible for monitoring the drilling, fracking and operation of the well for any contamination of the environment. In addition, Cuadrilla has stated that it will monitor the local environment and, in particular, the streams above and below the site, for any sign of contamination.

## **RISK 2: SEISMIC EVENTS (EARTHQUAKES)**

Will fracking at the Lower Stumble site cause seismic events that might cause damage to the infrastructure or property?

The report to the DECC confirms that the seismic events that occurred in 2011 at Cuadrilla's site at Preese Hall were caused by the fracking. However it is extremely rare for fracking to cause a significant seismic event (there are only 3 documented cases from over a million fracked wells), and on the occasions it has done so the effects have been minimal with no recorded damage.

The best known measurement of the size of seismic events is the Richter scale. This is a (base 10) logarithmic scale which means that the recorded movement in an event of magnitude 2 is ten times that in an event of magnitude 1, and the recorded movement in an event of magnitude 3 is one hundred times that in an event of magnitude 1. A guide for schools provides the following examples of the effects of low magnitude events:

Magnitude 2 – Causes ripples on small ponds; doors swing slowly

Magnitude 3 – You may notice it if you are sitting still; hanging objects swing

Magnitude 4 – Buildings may shake, rather as if a heavy truck is passing

The events at Preese Hall had magnitudes of 2.3 and 1.5. Each year the British Geological Survey records between 200 and 300 seismic events with a magnitude greater than 1 in the UK. The most recent local seismic event of significance was in Chichester in November 2011 – this had a magnitude of 1.7, and no damage was reported. Two earthquakes that caused extensive damage in 2011 were those in Christchurch, New Zealand (magnitude of 6.3) and in Japan (magnitude of 8.9).

For fracking to cause a seismic event the well must be close to a critically stressed fault in the earth's crust, which is also permeable and which, if it does fail, will do so seismically. Although there are many ancient faults in the rocks around Balcombe, the relative rarity of seismic events in the area recorded by the British Geological Survey suggests that they are not critically stressed.

Geologists estimate that biggest seismic event that fracking could cause at the Lancashire site would have a magnitude of about 3. The historical record of seismic events in Sussex compared to that in Lancashire suggests that the largest induced event in Balcombe would be less than at Preese Hall.

During drilling and fracking the DECC will require and ensure that Cuadrilla monitors, continuously, for seismic events using an approved technique, and stops work, immediately, if any activity is detected that exceeds a set magnitude (the report to the DECC recommends that this magnitude should be 0.5).

### **RISK 3: MATERIALS BROUGHT TO THE SURFACE (FLOWBACK)**

Are there dangers to people and/or the environment from the materials brought to the surface following fracking?

During the fracking process, fluid is pumped down the production tube at high pressure. Once the cracks in the oil bearing rock layer have been opened the pressure is removed and between 20 and 80% of the fluid used for the fracking returns to the surface. In addition a proportion of any water that was encountered within the rock (known as “produced water”) will come to the surface. This produced water is likely to contain material from the rocks, dissolved over a considerable period of time.

The liquid that comes back to the surface (known as “flowback”) is therefore a mixture of fracking fluid, produced water and any material dissolved or collected during the process.

The materials that are present in the flowback will depend on the composition of the rock that is fracked. However, these will normally include salts and heavy metals and, sometimes, NORMS (naturally occurring radioactive materials). The geology of the Balcombe area is such that it is unlikely that there would be significant NORMS in the flowback at the Lower Stumble site. However, the salts and heavy metals make the flowback potentially hazardous to both people and the ecosystem, and its handling and disposal must be carefully controlled.

Flowback can be either disposed of away from the site, or treated on site and recycled.

At present Cuadrilla’s plans are not sufficiently advanced for it to identify its proposed method of processing the flowback at the Lower Stumble site. Any proposed method of disposal must be approved by the EA but will probably involve transport to an industrial processing plant as was done with the flowback from Cuadrilla’s Preese Hall site. Treatment, on site, for recycling would involve the temporary storage of quantities of the materials removed from the flowback. However, this would reduce the number of road tankers visiting the site.

Cuadrilla states that it uses double skinned tanks with containment trays to hold flowback on site, but spills could occur, particularly when flowback is transferred from the well to these tanks or from the tanks to road tankers. The bund round the well head is intended to contain any spilled flowback, and it includes a sump from which any spilled flowback can be recovered.



# POSSIBLE IMPACTS ON LIFE IN BALCOMBE

## Traffic through the village

The number of vehicles travelling through the village has been counted on several occasions in recent years, and is about 10,000 vehicles per day. The number of vehicles per hour varies through the day with the largest number in the morning rush hour. On the London Road vehicles passing the school amount to about 4,000 per day. Using national statistics about 200 of these will be Heavy Goods Vehicles (HGV).

The estimated numbers and types of vehicles associated with the exploration well were set out in an appendix to Cuadrilla's planning application. This indicates that there will be between seven and eleven weeks of activity, with the largest vehicles being those delivering and collecting the drilling rig to and from the Lower Stumble site. The extra light vehicle traffic will amount to approximately 30 vehicles per day added to the existing 3,800. The extra HGV traffic is expected to be 30 vehicles per day during the most active two weeks, and an average of 10 vehicles per day for the remainder of the period, to be added to the existing 200 per day.

The HGV traffic would consist of vehicles to deliver equipment, and tankers to deliver water, chemicals and fuel, and to remove the flowback and any oil that has been extracted.

While a well is being fracked, a large quantity of water is needed. This is usually brought to site by road tankers, although a water main supply could be used if one was available. Once the fracking is completed the only routine HGV traffic to and from the site should be that required to remove the oil that has been extracted.

Should the Lower Stumble site go into production, the volume of HGV traffic would depend on what is found in the exploration stage, the number of wells on the site and from where the water for fracking is sourced.

Figures supplied by Cuadrilla suggest that a reasonable estimate for this site is a total of between 300 and 600 HGVs for drilling and fracking each production well. If each production well takes 6 weeks to drill and frack, 600 HGVs would equate to an average of 100 per week or 20 per working day. This is comparable with the traffic for the exploration well but over for a longer period. If production wells are created on the Lower Stumble site, there will be perhaps one tanker per well visiting the site each day to collect the oil.

## Noise

In accordance with Government policy, it is a condition of planning permission at this site that noise emission (measured at the nearest residential properties) must not exceed 55 decibels between 7.30am and 6.30pm from Monday to Friday, and between 8am and 1pm on Saturday. At all other times it must not exceed 42 decibels. The only exception is when drilling is in progress 24 hours per day, but even then the sound level must not exceed 42 decibels between 10pm and 7am.. When drilling is in progress, other than in an emergency, Cuadrilla is prohibited from withdrawing or reinserting the drilling string, installing a casing or placing cement in the well between 10pm and 7am.

To put these sound levels in context:

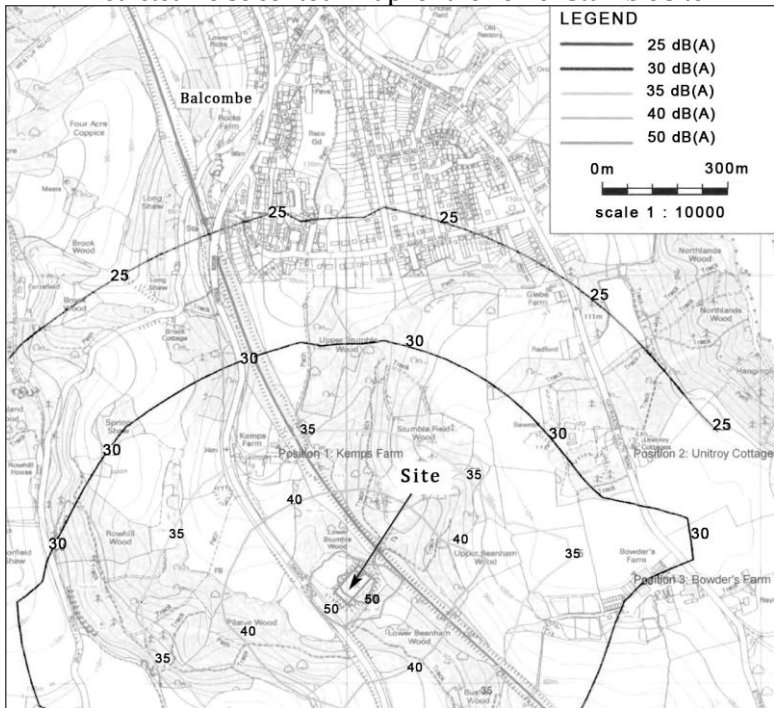
40 decibels = the sound of a refrigerator

50 decibels = the sound of moderate rainfall

60 decibels = conversation, or the sound of a dishwasher

Cuadrilla carried out a survey of current noise levels at various distances from the site and provided predictions of noise levels for both construction and exploration activities at various times of day and night, as part of its application for planning permission. The predicted noise contour map, reproduced below, indicates that no Balcombe residents should experience noise levels at night in excess of 42 dB.

Predicted noise contour map for the Lower Stumble site



The drilling phase is likely to take four to six weeks. Once this has commenced, it is a condition of planning permission that Cuadrilla undertakes another survey of noise levels to confirm that it is complying with the noise restrictions set out above.

## Light Pollution

While drilling is in progress the rig will be illuminated at night for safety reasons. Cuadrilla has stated that lighting will be positioned so as to be as unobtrusive as possible to nearby residents. The main lights, which will be attached to the drilling rig structure, will face downwards and will be screened by trees. Although the well is not expected to produce a significant quantity of gas, if any is produced it will

probably be burnt (flared) on site. Cuadrilla states that this would normally be carried out during daylight hours to minimise the impact.

### **Visual Intrusion**

The site is well screened by trees but visual intrusion will be at its highest while the drilling rig, which is approximately 30 metres (100 feet) high, is in position. The rig, which will be in place for up to six weeks and will be removed once drilling is complete, will probably be visible from some properties on the south side of the village, the road and the railway. If the exploration is successful and Cuadrilla wishes to further develop the site, it is expected that a landscape assessment would be undertaken and that further screening and landscaping would be required as a condition of planning permission.

## **WHAT ARE THE BENEFITS?**

### **To the United Kingdom**

While the debate continues over the alternative future sources of energy, maintaining our living standards depends on access to energy. Techniques such as fracking increase the access to oil and gas which more conventional drilling techniques do not permit, thus releasing for commercial production previously uneconomic wells.

Politically, in an uncertain and turbulent world, the benefits of domestic sources of energy are self-evident. Moreover, increasing domestic supply may lower the costs of energy which could have a positive impact on the UK economy.

### **To the residents of Balcombe**

In general terms, it appears that there will be no direct benefit to Balcombe from oil production at the Lower Stumble site. It would not increase local employment as modern drilling techniques necessitate the use of specialists who are brought in as required. It may be the case, under current planning legislation, that a condition of further planning permission will require certain infrastructure contributions to be made by Cuadrilla or any successor, but they are likely to be nominal at best.

## **OTHER RELEVANT QUESTIONS**

### **How much water is used when a well is fracked?**

This depends on the depth and length of the well. Fracking some wells might require more than 20 million litres of water. Cuadrilla estimates that fracking an exploratory well at the Lower Stumble site would require about 7.5 million litres of water, but it has not yet established the source of this water. Although it is usually more convenient to use fresh water, it is possible to use sea water.

### **Who owns any oil that is discovered at Lower Stumble?**

Ownership of all oil and gas under the land area of Great Britain is vested in the Crown. The Government grants licences that confer exclusive rights to “search and bore for and get” these materials.

## **Is there any danger to the local railway infrastructure?**

The main railway line runs close to the Lower Stumble site, while the Ouse Valley viaduct and Balcombe tunnel are both nearby. It has not proved possible to establish Network Rail's policy in response to seismic events. As stated earlier in this report, the worst case seismic event that can be foreseen as a consequence of fracking at the Lower Stumble site would have a magnitude of 3 on the Richter scale. Countries that do experience significant earthquakes (e.g. US and India) only have guidelines for railway operations following an earthquake that has a magnitude greater than 5 (100 times greater than 3).

## **If the oil at the Lower Stumble site is found to be worth extracting, how many more wells would be drilled and where?**

This will depend on the flow capacity of the oil-bearing rock. A typical number of wells at one location might be eight, with their horizontal sections fanning out in different directions within the layer of oil bearing rock. The distance between locations will depend on the length of the horizontal sections of the wells. If the horizontal section of each well is 1.5 km (approximately 1 mile) long, then the minimum distance between adjacent locations would be 3 km (approximately 2 miles).

## **How relevant to the UK in general, and to Balcombe in particular, are the reports of pollution and illnesses that are said to have occurred in some parts of the US as a consequence of fracking?**

They certainly give rise to important questions that must be considered and answered. However, the UK has a regulatory regime governing the extraction of oil and gas, controlled by the DECC, the EA and the HSE. This is stricter than that which has existed in the US to date. Some practises that have been employed when wells have been fracked in the US will not be permitted in the UK.

## **What attitudes are other countries taking to fracking?**

Shale gas has become an increasingly important source of energy in the US. Currently about 40,000 new wells are being drilled each year, and most of them fracked, to extract gas from the dense shale rock. Some commentators have suggested that by 2020 shale gas will provide half the natural gas requirements of North America.

Within Europe, France and Bulgaria have banned fracking. Some countries, South Africa for example, have declared temporary moratoriums on further fracking while the risks are investigated, while others permit it to be carried out with varying degrees of regulation.

THIS REPORT HAS BEEN APPROVED BY  
NINE OF THE TEN MEMBERS OF THE WORKING GROUP