



Department  
of Energy &  
Climate Change

# Developing Onshore Shale Gas and Oil – Facts about ‘Fracking’

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## Developing Onshore Shale Gas and Oil – Facts about ‘Fracking’

Shale gas and oil could provide the UK with greater energy security, growth, jobs and tax revenue. The Government is encouraging safe and environmentally sound exploration to determine our shale potential. The UK has a strong regulatory regime for exploratory activities but we continuously look to improve it.

### Why do we need gas?

A third of UK energy demand is met by gas. In 2012, around a quarter of the gas used in the UK was used to produce electricity, a fifth by industry, and around 40% to cook our food and heat our buildings.<sup>1</sup> As we use less coal in the next 10-15 years for electricity generation, gas will help fill the gap alongside renewable and nuclear electricity, helping the UK reduce carbon emissions. We forecast that in 2030, the UK’s gas consumption will be around the same level as it is today. We will continue to need gas for many years.

In 2003, we were a net exporter of gas. But North Sea production is declining and now we are a net importer. By 2025 we expect to be importing close to 70% of the gas we consume, assuming we do not develop shale.<sup>2</sup>

The UK has invested in facilities to make sure gas is easy to import. There have been no major interruptions to gas supplies in recent history, but we cannot be complacent. To secure our energy supply we must maximise UK production of fuels we need, including gas, increase generation from renewables and new nuclear and then use our energy more wisely.

Shale development could also support the economy. The Institute of Directors estimated that UK shale gas production would be a net benefit to public finances, could attract annual investment of £3.7 billion and support up to 74,000 jobs directly, indirectly and through broader economic stimulus.

### How shale gas extraction works

“Conventional” oil and gas deposits (such as in the North Sea) are contained in permeable rocks, such as sandstone. Shale gas is essentially the same as North Sea gas (i.e. mostly methane) but is trapped in impermeable shale rock. Enlarging or creating fractures in the rock by hydraulic fracturing (or ‘fracking’) enables shale gas to flow. The fracking technique has been used in the UK for many years with conventional deposits. Over 2 million wells have been hydraulically fractured worldwide, mostly in North America<sup>3</sup>.

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<sup>1</sup> Digest of UK Energy Statistics 2013 [www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes](http://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes)

<sup>2</sup> DECC [www.gov.uk/oil-and-gas-uk-field-data](http://www.gov.uk/oil-and-gas-uk-field-data)

<sup>3</sup> Hydraulic fracturing 101, King, George E (2012), Society of Petroleum Engineers

Like other oil and gas exploration or production, a well is drilled and several stages of metal pipes (“casing”) are set in concrete within the well, to seal it and prevent contamination of surrounding groundwater. A well for shale gas will usually go down vertically to the shale layer and then run horizontally along it.

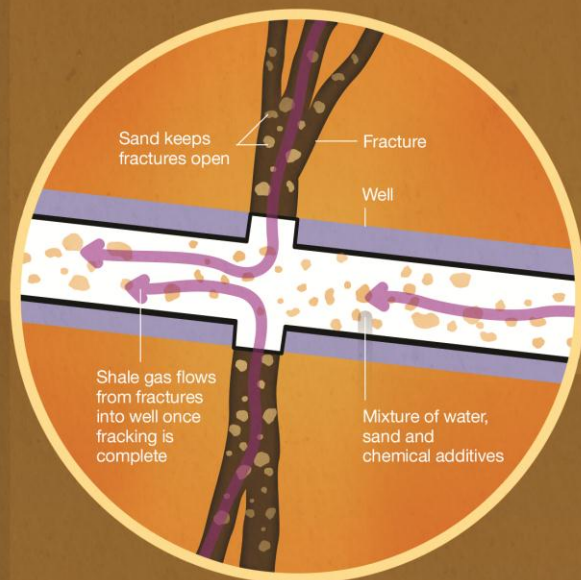
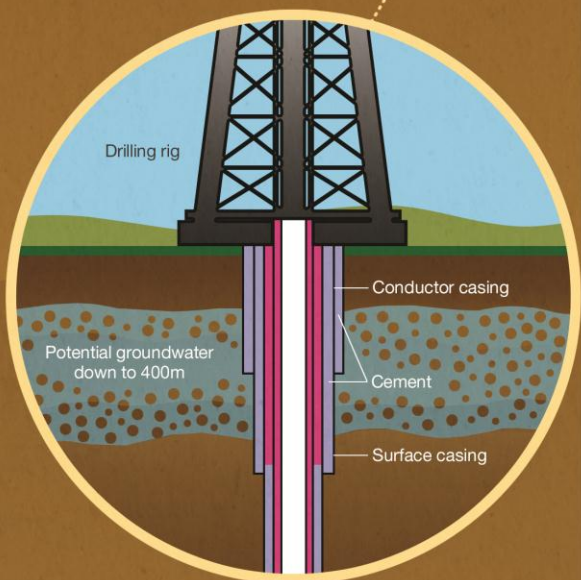
For shale oil or gas, the rock is then fractured by injecting water at high pressure, an established technique for conventional oil and gas, but used more intensively for shale. Small particles (usually sand) are pumped into the fractures to keep them open when the pressure is released, so gas can flow into the well. 98-99% of the mixture is water and sand. Small quantities of chemicals are normally added to improve efficiency, for example by reducing friction. In the UK, operators must show the Environment Agency that all such chemicals are non-hazardous in their intended application.

Once the rock is fractured, some of the fluid returns to the surface, where it is sealed in containers before treatment. The gas or oil can then flow through the well to surface operations which separate and process the gas or oil. If oil is recovered, it will be taken to an oil refinery or petrochemical plant. Exploration occurs for only a short time and any gas discovered at that stage is likely to be flared, but if a gas well goes into commercial production it will be connected to the country’s network of gas pipelines.

# What is shale gas and fracking?

Pad size is 2 hectares – 100\*200m

Potential groundwater down to 400m



Intervening layers of rock stop fracking fluids / gas from escaping

## Shale gas rock

Shale rock in the UK is present at all depths, but gas only starts to be produced between 1500m-4200m and the rock can be up to 3000m thick in some areas.

## Where might shale gas and oil be produced?

British Geological Survey (BGS) studies suggest the areas with most potential for shale gas exploration are where existing conventional gas has been found. Significant parts of the UK have no shale rock.

The BGS published a study of the Bowland Shale of the Pennine Basin in the North of England, which estimated the “gas in place” of that area alone as 1,300 trillion cubic feet. Other areas with relevant shale rock include the Kimmeridge Clay of the Weald Basin in Surrey and Sussex, and the Oil-Shale Group of the Midland Valley, or central belt, of Scotland. The BGS is conducting a study of the Weald deposits and plans to do so in the Midland Valley.

Little drilling or testing has taken place in Britain’s shale deposits, so it is not yet possible to estimate how much shale gas or oil may be practically and commercially recoverable.

## How do operators get permission?

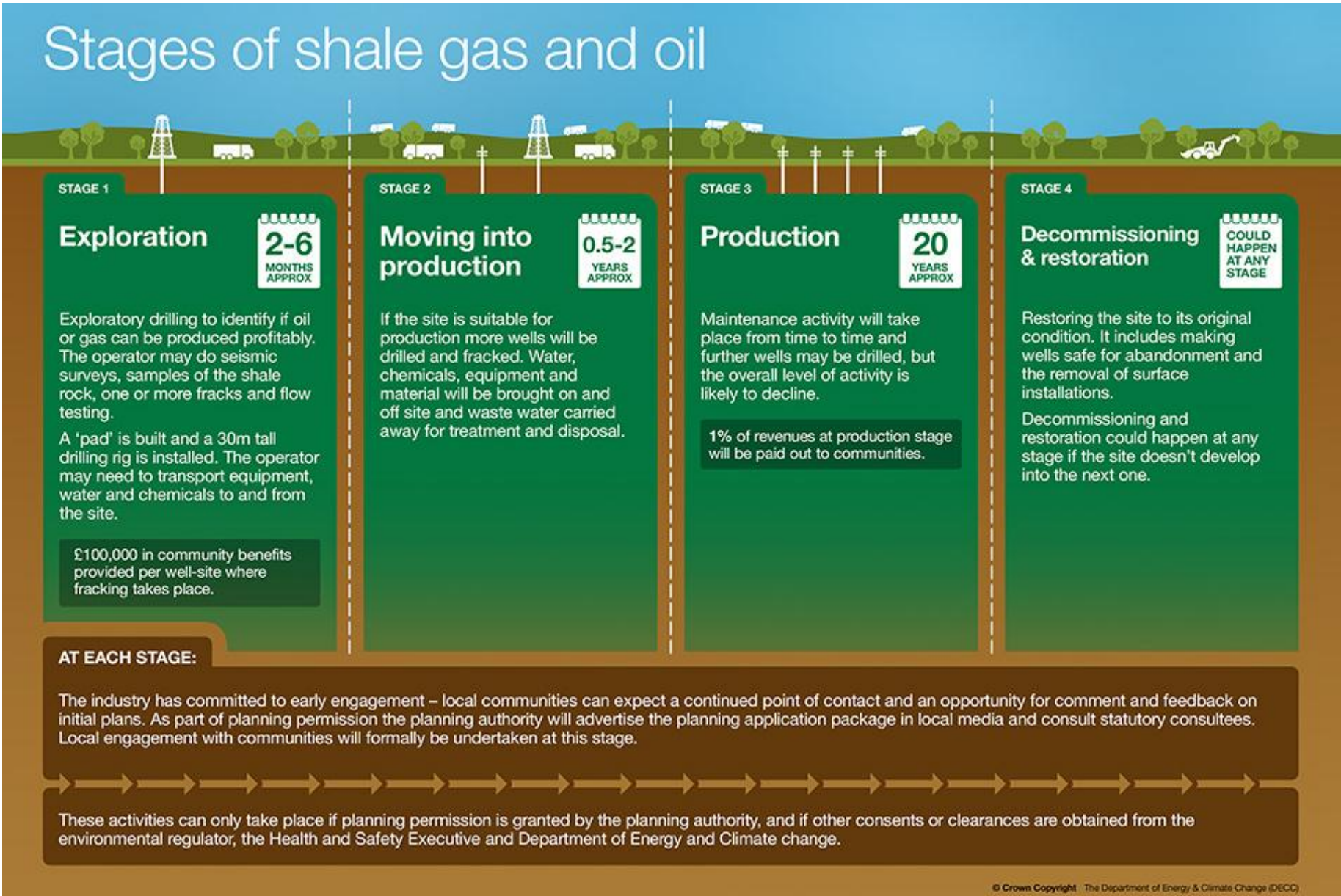
There are currently around [176 licences for onshore oil and gas in the UK](#). These are formally referred to as Petroleum Exploration Development Licences. DECC plans to conduct a new round of onshore licensing (the 14<sup>th</sup>) in 2014, and is conducting the necessary Strategic Environmental Assessment.

Licences themselves do not give consent for drilling, hydraulic fracturing or any other operations. Operators then need:

- Landowner(s) agreement
- Planning permission, which may require an environmental impact assessment
- Permits from Environment Agency, Natural Resources Wales, or the Scottish Environment Protection Agency
- Their plans are examined by the Health and Safety Executive, and an independent competent person reviews the well design
- Consent for drilling or production from the Department of Energy and Climate Change



Exploration & development



## How are communities consulted?

The shale oil and gas industry has set out a Community Engagement Charter. This includes a commitment to engage with communities early at each stage and in advance of any application for planning permission.

Public consultation is part of every application for planning permission to conduct oil and gas activities. Planning permission is required for each stage of the process (exploration, appraisal and production) and must be publicised. Planning authorities consider the impacts of any proposed development, including on the natural or historical environment or human health, such as by noise, dust, visual intrusion, transport of contaminated materials from the site and traffic.

Each planning application must be publicised by site display and in local newspapers. Application information must also be available on the relevant local authority website. This must include a section on how interested people can submit representations about the application, giving a period of at least 14 days.

## How do communities benefit?

Communities that host energy sites, from wind developments to unconventional gas and oil, should see a clear local benefit. The industry has come forward with a scheme of community benefits including:

- at exploration/appraisal stage, providing £100,000 in community benefits per well-site where fracking takes place
- at production stage, paying 1% of revenues to communities. Industry estimates this could provide £5-10m per well, spread over 25 years, but mostly in the first 10.

## Will sites be safe?

The UK has over 50 years of experience of regulating the onshore oil and gas industry nationally. More than 2,000 wells have been drilled onshore during that time. Operators are responsible for the safety of workers and the public within and immediately near their site. The Health and Safety Executive checks operators' plans, assesses engineering designs and reports, and inspects sites when appropriate to ensure they are meeting the requirements of the relevant legislation.

The Royal Society and the Royal Academy of Engineering concluded in a recent review<sup>4</sup>:

*"... the health, safety and environmental risks associated with hydraulic fracturing (often termed 'fracking') as a means to extract shale gas can be managed effectively in the UK as long as operational best practices are implemented and enforced through regulation."*

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<sup>4</sup> *Shale gas extraction in the UK: a review of hydraulic fracturing* June 2012 Royal Society & Royal Academy of Engineering



## Might this affect public health?

Public Health England assessed the risk to human health of extracting shale gas in an October 2013 report. They evaluated available evidence on issues including air quality, radon gas, naturally occurring radioactive materials, water contamination and waste water. They concluded that “the risks to public health from exposure to emissions from shale gas extraction are low if operations are properly run and regulated.”

## How does this affect the environment?

### Will water be contaminated?

The risk of water contamination is low provided operations follow industry standards and obey the regulations. Extraction takes place well below the aquifers that provide drinking water. The environmental regulator (Environment Agency in England, Natural Resources Wales or the Scottish Environment Protection Agency) works with the Health and Safety Executive to ensure the well is constructed to a high standard to protect aquifers and drinking water supplies. We are confident that the regulatory system will continue to provide robust protection of surface water and groundwater.

Chemicals used in drilling and frack fluids are assessed case-by-case by the environmental regulator for hazards. The operator must prove any chemicals they want to use are not hazardous in that application. Fluids returning to the surface through the well are categorised as mining waste, so the operator must obtain an environmental permit for their disposal (from the relevant environmental regulator) and have an agreed waste management plan in place.

The environmental regulator will assess the risks posed by the operations and decide whether they can be permitted. If groundwater contamination is possible, either directly by drilling fluids, frack fluids or indirectly by a substance disturbed by the borehole or fracking, the authority may find the environmental risk unacceptable and not permit activity.

The water and shale industries have, through Water UK and the UK Onshore Operators Group, signed an agreement to work together to identify, watch and manage risks to water quality, including waste water processing.

### Do we have enough water?

Fracturing rock for shale gas and oil is likely to use large volumes of clean water, though the amount is not exceptional compared with other industrial or leisure activities. The volume will depend on the site, but operating a shale gas well for a decade would typically use a similar volume to that needed to water a golf course for a month.<sup>5</sup>

Water companies will assess the amount of water available before agreeing to supply an operator. If the operator applies for a licence to extract water themselves, it will be granted by the environmental regulator only where a sustainable water supply is available. Water UK and industry have also agreed to cooperate on water demand, reuse and management.

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<sup>5</sup> *Gas works? Shale gas and its policy implications* Moore/Policy Exchange, 2012

## How are risks of earth tremors managed?

DECC paused the use of hydraulic fracturing for shale gas in the UK in 2011 after 2 tremors occurred in the Blackpool area. It carried out a careful assessment, drawing on recommendations from independent experts, a public consultation, and the Royal Society/Royal Academy of Engineering review.

In 2012 DECC introduced measures to control seismic risks (earth tremors). Operators have to assess the location of any relevant faults before planning fracking operations for shale gas or oil. They must submit to the Department of Energy and Climate Change the plan of operations, starting with small test fractures before main operations and install real-time monitoring systems. Operators must stop and investigate if they detect tremors above the normal range.

## How will air pollution be controlled?

Licences require operators to minimise the release of gases. Environmental permits and planning permissions may require monitoring or impose further limits. When it can't be economically used, natural gas must be 'flared' to reduce its global warming emissions. Natural gas may only be 'vented' – released into the air – when necessary for safety.

## Shale and climate change

The UK is legally committed to cutting greenhouse gas emissions by at least 80% by 2050, and to meeting renewable energy targets by 2020. Gas is the cleanest fossil fuel and has half the carbon footprint of coal when used to generate electricity<sup>6</sup>. So Britain will continue to need gas as part of a diverse energy mix, including renewable sources, which takes us to a low carbon future.

Our system of carbon budgets requires that any additional emissions from production would need to be offset elsewhere in the economy to ensure the UK remains on track to meet its 2050 goals.

Last September Professor David MacKay (the DECC's Chief Scientist) and Dr Timothy Stone wrote a report on potential greenhouse gas emissions from UK produced shale gas. They concluded that the overall effect of UK shale gas production on national emissions is likely, with the right safeguards, to be relatively small. Indeed emissions from the production and transport of UK shale gas would likely be lower than from the imported Liquefied Natural Gas that it could replace.

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<sup>6</sup> *Potential Greenhouse Gas Emissions Associated with Shale Gas Extraction and Use* September 2013 MacKay & Stone, DECC

## Need more information?

### Shale potential

The British Geological Survey has information on shale gas and groundwater on its website, including information on the national methane baseline study.

### Shale processes

The Department of Energy and Climate Change, Environment Agency (England), Scottish Environment Protection Agency and Health and Safety Executive have worked with the UK Onshore Operators Group to agree best practices for onshore shale gas wells. The UK [Onshore Operators Group’s UK Onshore Shale Gas Well Guidelines](#) provide a description of the Hydraulic Fracturing Programme.

### Industry’s commitment to communities

The onshore oil and gas industry body, the UK Onshore Operators Group has committed companies to engage with local people, residents and other stakeholders in their Community Engagement charter.

### Regulation

The Environment Agency and Health and Safety Executive have published an agreement that explains their joint approach to the regulation of unconventional oil and gas developments.

The Scottish Environment Protection Agency has more information on environmental regulation in Scotland.

[Natural Resources Wales](#) has more information on environmental regulation in Wales.

### An overview of the risks and how they can be managed

[Shale gas extraction in the UK: a review of hydraulic fracturing](#) June 2012 Royal Society & Royal Academy of Engineering

### Public health

Public Health England’s report <https://www.gov.uk/government/news/shale-gas-extraction-emissions-are-a-low-risk-to-public-health> and radon map for England and Wales.

### Shale and climate change

A [recent study](#) by DECC’s Chief Scientist looked at the potential greenhouse gas emissions from shale gas production and discusses its compatibility with global climate change targets.

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