This briefing considers some of the issues surrounding the extraction of unconventional gas in Scotland, which is currently subject to a moratorium, and has attracted a significant amount of scrutiny in recent months.
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INTRODUCTION

This briefing provides an introduction to some of the key issues surrounding the controversial topic of onshore unconventional gas extraction in Scotland, which is currently subject to a moratorium, pending further research and a public consultation.

Key sources of information include:

- Scottish Environment Protection Agency (SEPA): Shale Gas and Coal Bed Methane
- Scottish Government: Onshore Oil and Gas
- Oil and Gas Authority/Department of Energy and Climate Change: Oil and Gas Licensing Rounds
- British Geological Survey (BGS): Shale Gas
- Friends of the Earth Scotland (FoES): Unconventional Gas and Fracking

Unless otherwise stated, the information contained in this briefing can be found on these websites.

WHAT IS UNCONVENTIONAL GAS?

The terms ‘conventional’ and ‘unconventional’ describe the type of rock reservoirs where natural gas is found and the way in which the gas is extracted. There is no chemical difference between natural gas extracted from conventional and unconventional methods, which tends to be primarily composed of methane. The main types of unconventional gas (UG) in the UK are:

- **Shale gas** as the name suggests, is natural gas trapped within shale\(^1\) beds. Reservoirs of this gas are often located at depths greater than 1,000m; it has not yet been extracted offshore.
- **Coalbed methane** (CBM) is natural gas found within coal seams that have not been worked because the coal is too deep or poor quality. CBM can be as shallow as 300m but is typically around 800-1,000m in depth, any deeper and the gas becomes more difficult and expensive to extract. CBM has been developed onshore and offshore.
- **Underground coal gasification** (UCG) differs significantly from CBM or shale, as it targets coal seams which then undergo an induced thermal reaction to generate syngas – a mixture of hydrogen and carbon compounds. UCG generally targets coal seams that cannot be accessed by traditional means and are typically at depths greater than 500m (some reports saying 1,000 – 3,000m). UCG can be done onshore or offshore. The environmental and regulatory regimes that govern UCG also differ significantly from CBM or shale, and are not considered in detail in this briefing.

Natural gas from unconventional sources is intrinsically more difficult to extract than from conventional reservoirs. However it is becoming increasingly commercially viable due to advances in drilling and well-site technology.

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\(^1\) A sedimentary rock rich in hydrocarbons.
**HOW IS UNCONVENTIONAL GAS EXTRACTED?**

Conventional gas reservoirs are typically accessed by drilling a small number of near vertical wells which the gas flows into. Sometimes the gas extraction is enhanced by horizontal drilling, or by pressurising the reservoir.

Gas in **shale beds** is accessed by drilling a much greater and deeper number of wells from one site (termed ‘directional’ drilling) often with a significant horizontal component. Once these wells are drilled, gas production can be stimulated by an established technique called hydraulic fracturing (fracking). SEPA states that this:

> Involves pumping water via a borehole into the source rock at high pressure so that the rock fractures and releases the trapped gas. This water also contains a small percentage of sand (~5%) to prop open the resulting micro-fractures, and chemicals (<1%) to improve efficiency of the operation. Hydraulic fracturing normally takes place in shale formations 1-2 km below the surface.

Depending on the geology of the coal seam, there are two options for **coalbed methane** extraction. If the seams are thin, and already naturally contain fractures, or fracture very easily, well designs are adapted to maximise gas extraction by established drilling and pumping techniques – known as **dewatering** - which drains the water from the seam, reducing the pressure and allowing the gas to flow. These wells and the sites above ground are neither designed for, nor capable of using, hydraulic fracturing techniques.

If the seams are thicker, or deeper, and fracture less easily, then hydraulic fracturing may be required to release the gas. However, this is likely to require more horizontal wells to be drilled, as dewatering wells are not designed for fracting. FoES reports that in “Australia the industry estimates that up to 40% of coalbed methane wells end up being fracked”.

**Underground Coal Gasification** (UCG) gasifies the coal in-situ. Boreholes are drilled some distance apart on the seam, injecting water/oxygen mixtures down one pipe, igniting and partially combusting the coal and extracting the syngas through the other pipe.

The exploration and potential exploitation of a major new hydrocarbon resource, in particular the use of fracting, has attracted considerable global scrutiny in recent years. The use of the term fracting is also often used synonymously to reference shale gas, and by association other sources, like CBM. However, whilst this might be convenient, and popular, it is not always correct to associate hydraulic fracturing with UG extraction.

**HOW MUCH IS THERE IN SCOTLAND?**

BGS (DECC 2014) states:

> In simple terms, the resource estimate […] is the amount of gas or oil in the ground (some or all of which might never be produced), while the reserve estimate is a more speculative measure which describes the amount of gas or oil that might be able to be extracted.

There are currently no official reserve estimates; to determine reliable estimates, flow rates must be analysed for a number of wells over at least two years. Further, estimates will be determined by many non-geological factors including costs, engineering, supply chain and access restrictions due to environmental and planning issues. Without reserve estimates the commercial scale of gas extraction cannot be forecast. There is therefore a notable lack of information about UG reserves in Scotland and the UK as a whole, and an extensive exploration
phase would be needed before a realistic assessment of potentially recoverable assets is possible.

There are numerous coalbed and shale deposits in Scotland, the BGS notes (DECC 2013a) that a “proven petroleum system exists in the Midland Valley" [of Scotland, which may also] harbour more discoveries”. DECC (2013b) also notes that the Orcadian Basin of Caithness, Orkney and Shetland islands has potential. In 2013 DART Energy (a company which formerly sought planning permission for CBM extraction at Airth near Stirling) published site specific estimates for CBM of 0.26 – 0.4 billion cubic metres (bcm), this amounts to 0.06 – 1% of DECC’s central estimate for remaining recoverable UK gas reserves of 408 bcm (DECC 2015).

In 2014 BGS (DECC 2014) published a study of the shales of the Central Belt, and estimated that the total volume of in-place gas in the Midland Valley of Scotland ranged from 1,400 – 3,810 bcm, with a central estimate of 2,270 bcm – albeit with a degree of uncertainty due to relatively complex geology and a limited amount of good quality seismic and borehole data. The resources of West Lothian are considered to make the largest contribution to this estimate. For comparison, the Bowland-Hodder shale formation in northern England, has a central gas in place estimate of 37,600 bcm (DECC 2013c).

Whilst these figures might appear to be high compared to the estimate for remaining recoverable UK reserves (408 bcm), it must be stressed that it is not known how much can be commercially produced due to the many non-geological factors outlined above.

Although UCG was first trialled in the UK in the 1950's, there are no realistic resource estimates available.

**HOW IS EXTRACTION CURRENTLY REGULATED?**

In the UK, all rights to the nation’s petroleum resources are held by the State; however, the Government can grant licences that confer exclusive rights to “search and bore for and get” petroleum over a limited area and for a limited period. Petroleum Exploration and Development Licensing (PEDL) rounds are therefore held whereby bids are assessed on their ability to “optimise exploitation of the UK’s petroleum resources”. To date, 14 onshore licensing rounds have taken place, however the latest did not include Scotland.

Gaining a PEDL is the first stage in a complex permissioning system for UG extraction, and it should be noted that a PEDL does not mean that extraction is, or will take place; only that a license has been issued which confers exclusive rights to a company to start the process of applying for further licenses/permissions to explore, as set out below.

Sections 47 – 49 of the Scotland Act 2016 devolve the process of managing PEDL in the Scottish onshore area to the Scottish Government. These powers do not include licensing for underground coal gasification, which is covered by powers reserved to the UK Coal Authority. While the administration of licences would be matters for the Scottish Parliament, the taxation of oil and gas would remain reserved. Managing licences would raise a small amount of revenue for the Scottish Government, but revenue from the oil and gas industries is chiefly raised from taxation. These powers have not yet been commenced, and will be by order of the Secretary of State for Scotland in due course – it is probable that secondary legislation for these powers would come before the Scottish Parliament’s Economy, Jobs and Fair Work Committee.

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2 Stretching from Girvan to Greenock in the west, and Dunbar to Stonehaven in the east.
3 In the UK, the Crown holds the right to gold and silver, and the State to oil, petroleum and natural gas - landowners hold only the remaining mineral rights.
The current sequence of authorisation is set out in the following diagram (it is not yet known how this will change following the commencement of s47-49 of the Scotland Act 2016), which shows the way an application to explore for UG would be examined by all the agencies, e.g. an operator would always seek a PEDL before applying to the local authority for planning permission to construct a borehole, and to construct and install above ground buildings and machinery. The environmental and planning process can be applied in parallel, but work cannot commence until all permissions are in place:

SEPA’s [website](http://www.environmentality.co.uk) sets out in more detail their role, and that of other agencies in relation to the regulation and monitoring of e.g. emissions to air/groundwater, seismic activity, chemicals, and wastewater.

In relation to CBM, the Coal Authority needs to provide “prior written authorisation” for any “activity which intersects, disturbs or enters any of the Authority’s coal interests”. For UCG, an operator will need to gain a Coal Authority rather than a PEDL licence.

Permission must also be sought, and a legal agreement reached with the landowner.

**ARE THERE CURRENTLY LICENCES IN PLACE?**

At present, no operators in Scotland have an authorisation from SEPA that allows them to inject fracturing fluid. There are, however, two active PEDL licences, as follows:

**PEDL 133:** In March 2015 Ineos Upstream Ltd, an arm of the company which owns the refining and petrochemical complex at Grangemouth, bought this license area from DART/IGas (Ineos 2015). The majority of operations were centred around Airth near Falkirk. With over 16 test CBM wells drilled, the project was the most advanced UG development in the UK. DART had also applied for planning permission for a further 22 CBM wells at 14 new and two existing sites, as well as a central gas and water treatment facility near Airth; these sites were spread across Falkirk and Stirling Council areas, and the application was submitted to both Councils.

Previous and proposed activities did not include hydraulic fracturing, although Coal Bed Methane Ltd, a previous operator used the technique in this area nearly 20 years ago. DART proposed to use the dewatering technique, as explained above.

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4 Under the Water Environment (Controlled Activities) Regulations 2011 (known as a CAR).
Following the non-determination of the planning application by both local authorities, DART appealed to Scottish Ministers, and a Public Inquiry was held in March 2014, and the following October Scottish Ministers called in the application (Scottish Government 2014).

PEDL 162: 80% owned by Ineos, and 20% by Reach CSG a site operates at Deerdykes near Cumbernauld, and has planning permission for a gas exploration and production facility to extract CBM. An authorisation for the construction of one investigatory borehole was issued by SEPA in March 2014. There are no proposals to hydraulically fracture this borehole.

Full details on these projects can be found on the relevant SEPA webpage.

UCG Licenses: Cluff Natural Resources hold conditional Coal Authority licenses in the Firth of Forth, but have not yet applied for specific planning and environmental permissions. They planned to use directional drilling techniques from an onshore base to access coal seams under the Firth. In January 2016 Cluff announced that it would stop all expenditure relating to the project (BBC News 2016a).

In January 2015 a moratorium was announced on the granting of planning consents and CAR Licenses for all unconventional oil and gas developments. A further moratorium in October 2015 included consents for UCG, and is considered in more detail below.

ARE THERE ENVIRONMENTAL IMPACTS?

There are a number of potential environmental impacts associated with unconventional gas exploration and production, however their scale and effect are the subject of significant debate. Some of these impacts may also be associated with conventional oil and gas activities, as well as other industries. The three main areas potentially affected are:

Water environment – contamination and depletion of surface and groundwater may occur, for example:

- During drilling, dewatering and hydraulic fracturing operations.
- As a result of poor borehole construction, uncontrolled disposal of solid and liquid waste (potentially including naturally occurring radioactive material), and uncontrolled abstraction of water.

Seismic activity – Stimulated during hydraulic fracturing operations.

Air and Climate Change – Through fugitive emissions (escaped gases) that impact air quality and influence climate (i.e. the greenhouse gases, carbon dioxide CO₂ and methane CH₄).

Under the Climate Change (Scotland) Act 2009, SEPA has a duty to consider how Scotland can reduce its greenhouse gas emissions from regulated business and industry. As well as contributing to climate change, fugitive emissions have the potential to impact on human health and the environment.

SEPA states:

If these areas are left unmitigated, there may be adverse effects to, for example: human health, the function and biodiversity of surrounding ecosystems, water resources, agriculture, buildings and infrastructure, and climate.

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5 Other LA areas covered by PEDL 162 include Falkirk, East Dunbartonshire and West Lothian.
DID POLLUTION OCCUR IN THE US?

Anecdotal instances of pollution (mostly water contamination) in America received prominence through a film called Gasland (2011), and some states and cities (e.g. New York and Maryland) have put in place moratoria on hydraulic fracturing (Keep Water Safe 2015). The Royal Society and Royal Academy of Engineers (2012) noted differences in practice between the UK and North America, particularly in relation to the quality and extent of cementing and well casings. An Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources (EPA 2015) noted that 25,000-30,000 new wells were drilled and hydraulically fractured annually from 2011 – 2014, and there were 151 known cases in which fracturing fluids or chemicals spilled on or near a well pad, with a median volume of 1,600l per spill. Causes included equipment failure, human error, failure of container integrity, and others (e.g. weather and vandalism), with the most common being equipment failure - more than 30% of the spills were from fluid storage units.

As a result, it appears that both state and federal level policies have become more stringent, with many new regulations e.g. in relation to drilling, casing, cementing, testing, monitoring and plugging of oil and gas wells, as well as protection of water supplies (EPA 2016, GEOEXPRO 2014). Nevertheless, companies in this area appear to be exempt from key pieces of legislation like the Safe Drinking Water Act, the Clean Air Act, and the Clean Water Act (Earthworks 2011).

WHAT DOES THE SCOTTISH GOVERNMENT MORATORIUM COVER?

The Scottish Government (2015a) announced a moratorium on unconventional oil and gas in January 2015, the following October it announced a further moratorium (2015b) on underground coal gasification. The second moratorium also revised the original moratorium to allow for permissions to be granted for the “drilling of boreholes solely for the purpose of core sampling”.

Scottish Ministers issued two Directions (Scottish Government 2015c & 2015d) to SEPA “to refer to them for their determination any application under the regulations for an authorisation to carry on any controlled activity in connection with” unconventional oil or gas development and underground coal gasification. Neither moratoria include “the drilling of boreholes solely for the purpose of core sampling”.

Alongside these moratoria, an “extremely thorough and wide-ranging examination of the potential impacts of unconventional oil and gas” was announced, supporting “the Scottish Government policy of taking a precautionary, robust and evidence-based approach to this technology”. Ministers published (Scottish Government 2015b) a research and public consultation programme, as follows:
The SNP Manifesto (2016) states that:

Unless it can be proven beyond any doubt that there is no risk to health, communities or the environment, there will be no fracking or UCG extraction in Scotland.
IS A JUDICIAL REVIEW POSSIBLE?

On 1 June 2016 a Scottish Parliament debate was held on “Taking Scotland Forward: Environment, Climate Change and Land Reform” (Official Report 2016). The subject of unconventional gas, and whether the current moratoria should be upgraded to an outright ban was discussed. Some Members suggested that if this were to happen, the Government’s decision could be subjected to a judicial review and a judge ultimately deciding whether the technique could be used. The SNP argued that robust evidence was needed to defend a judicial review, hence the research and public consultation programme outlined above. A Labour Party motion calling for an outright ban was passed by 32 votes to 29 due to the SNP abstaining and the Greens and Liberal Democrats supporting Labour. This however is not binding.

Brian Taylor (BBC News 2016b) explored the issues raised, and stated:

[…] ministers want to head off any possibility of a legal challenge in the shape of a demand for a judicial review from those who favour fracking, perhaps most notably the owners and operators of the petro-chemical complex at Grangemouth.

He further recognised that a decision to ban hydraulic fracturing “would only be taken after ministers have the shield of scientific advice - should, indeed, it point in that direction”.

Judicial review is primarily concerned with the process or legality of official decision making, rather than the substance of the decisions themselves. Consequently, an action for judicial review is not equivalent to a statutory right of appeal which may involve examination of the merits of a decision. Even after a successful action for judicial review, the decision maker may be able to make the same decision again, so long as it does so in a lawful way and following the correct process. Historically, courts have been reluctant to allow their role to impinge on complex political judgements.

The rules on ‘standing’ determine who may bring an action for judicial review. The previous law on standing in Scotland was widely criticised and was changed by the UK Supreme Court in 2012. The current test requires that the person or body raising an action has ‘sufficient interest’ to do so. This new test helps those seeking to represent a public interest, such as the protection of the environment.

The court may also permit interventions in court proceedings by third parties (‘interveners’). These are becoming more common. They involve third parties providing written or oral arguments on key legal issues relating to the case. So, for example, a public interest body could become an intervener in a judicial review action raised by another person or organisation. Traditionally, the grounds of judicial review have been divided into three main categories:

- That the decision maker acted unlawfully (‘illegality’).
- That the decision was made using an unfair procedure (‘procedural impropriety’).
- That the decision was so unreasonable as to be irrational (‘irrationality’ or ‘unreasonableness’).

There are also grounds based on breaches of EU law and breaches of ‘Convention rights’ – that is to say the rights protected by the European Convention on Human Rights which have been incorporated into UK law. A person raising a judicial review action can be exposed to considerable financial risk. The costs of engaging lawyers to present this type of case can be significant. It is also the usual practice for the losing party in a civil court case to be responsible for paying the winning party’s legal expenses in relation to the case, as well as their own. On the other hand, where the person or organisation raising the action is acting in the public interest, a court may grant a ‘protective expenses order’. This protects them, at least to some extent, from the normal rule relating to legal expenses. The court’s approach in this area is still developing.
At present, judicial review actions in Scotland mainly relate to immigration and asylum issues, prisons, and, to a lesser extent, the planning system. At present, judicial review actions tend to be concentrated in policy areas where the stakes are very high for those litigating; there are gaps in the available alternative remedies or those litigating have access to significant financial resources to do so.

WHAT PARLIAMENTARY SCRUTINY AND OTHER RESEARCH HAS TAKEN PLACE?

Unconventional gas has been discussed as part of broader debates and inquiries in the Scottish Parliament, but never scrutinised in detail.

At Westminster, the Environmental Audit Committee (EAC) carried out an inquiry into the Environmental Risks of Fracking in late 2014. The report (EAC 2015) states that:

Any large scale extraction of shale gas in the UK is likely to be at least 10-15 years away. It is also unlikely to be able to compete against the extensive renewable energy sector we should have by 2025-30 unless developed at a significant scale.

The EAC further called for a temporary ban on exploration on the grounds that it is “inconsistent” with climate change targets, only a very small fraction of the possible gas deposits will be burnable, and that “an extensive range of uncertainties” remained over water and air pollution risk.

The Energy and Climate Change Committee (ECCC) (2013) carried out an inquiry into the Impact of Shale Gas on Energy Markets. This made 20 conclusions and recommendations, and held some common ground with the EAC’s report, including that there was a need for a “social license” and community acceptance for this industry, and that community engagement was paramount. Both committees also concluded that communities who are affected by shale gas development should expect to receive, and share in, some of its benefits. The ECCC considered that policies “on flaring and venting of methane should be reviewed in light of the study in order to ensure that fugitive emissions […] are kept as close to zero as possible”, the EAC stated that venting “of methane emissions is not acceptable. Full containment of methane must be mandated in all fracking permits and permissions”.

Several studies have been undertaken to assess the potential risks to the environment and human health, some of these are set out below.

In June 2012 the Royal Society and The Royal Academy of Engineering (2012) published a Review of Hydraulic Fracturing. Key conclusions are summarised as follows:

- Health, safety and environmental risks can be managed effectively as long as operational best practices are implemented and enforced through regulation.
- The risk of fractures propagating from shale formations to reach overlying aquifers is very low provided that extraction takes place at depths of many hundreds of metres or several kilometres. More likely causes of possible environmental contamination include faulty wells, and leaks and spills associated with surface operations.
- Ensuring well integrity must remain the highest priority to prevent contamination. The probability of well failure is low for a single well if it is designed, constructed and abandoned according to best practice. Disclosure of the constituents of fracturing fluid is mandatory in the UK. Ensuring, where possible, that chemical additives are non-hazardous would help to mitigate the impact of any leak or spill.
- Concerns have been raised about seismicity induced by hydraulic fracturing. The UK has lived with seismicity induced by coal mining activities or the settlement of abandoned
mines for a long time. British Geological Survey records indicate that coal mining-related seisimicity is generally of smaller magnitude than natural seisimicity and no larger than 4 ML. Seismicity induced by hydraulic fracturing is likely to be of even smaller magnitude. There is an emerging consensus that the magnitude of seisimicity induced by hydraulic fracturing would be no greater than 3 ML (felt by few people and resulting in negligible, if any, surface impacts).

- Monitoring should be carried out before, during and after shale gas operations to inform risk assessments. Methane and other contaminants in groundwater should be monitored, as well as potential leakages of methane and other gases into the atmosphere.
- An Environmental Risk Assessment (ERA) should be mandatory for all shale gas operations. Risks should be assessed across the entire lifecycle of shale gas extraction, including risks associated with the disposal of wastes and abandonment of wells. Seismic risks should also feature as part of the ERA.

In October 2013, Public Health England (2013) published a Review of the Potential Public Health Impacts of Exposures to Chemical and Radioactive Pollutants. This states that:

The current evidence indicates that the potential risks to public health from exposure to the emissions associated with shale gas extraction are low if the operations are properly run and regulated.

Where potential risks have been identified in the literature, the reported problems are typically a result of operational failure and a poor regulatory environment. Therefore good on-site management and appropriate regulation of all aspects from exploratory drilling, gas capture and the use and storage of fracking fluid is essential to minimise the risk to the environment and public health.

In July 2014, the Scottish Government’s Expert Scientific Panel on Unconventional Oil and Gas (2014) reported. Their key conclusions are summarised as follows:

- There could be positive economic impacts from the development of an unconventional oil & gas industry, in terms of jobs created, taxes paid and gross value added. The scale of the impact in Scotland is subject to debate and may only become clear once development is underway. Lack of infrastructure, such as drilling rigs, could have an impact.
- Suitable petrochemical feed-stocks from the North Sea are declining, in particular ethane and other light hydrocarbons. The potential availability of these feed-stocks from unconventional oil and gas resources in Scotland could have a beneficial impact on Scotland’s petro-chemical industry in the long term.
- When viewed in the context of the factors that have supported coal bed methane and shale gas development in other countries, it seems likely that unconventional gas could be developed in Scotland at scale. This is particularly true, given Scotland’s domestic oil and gas supply-chain industry, and Scotland’s longstanding experience in other extractive industries such as coal mining, shale oil, and conventional oil and gas.
- There are a number of technical challenges associated with unconventional hydrocarbon extraction, though it is the Expert Scientific Panel’s view that none of these are insurmountable. The technology exists to allow the safe extraction of such reserves, subject to robust regulation being in place.
- The impact of unconventional oil and gas resources in Scotland on the Scottish Government’s commitment to reduce greenhouse gases is not definitive. There could be minimal impact from unconventional hydrocarbons if they are used as a petrochemical

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6 Local Magnitude.
feedstock, but lifecycle analysis of an unconventional hydrocarbon industry is required to inform the debate, and provide a clearer view on the impact of their development.

- The regulatory framework is largely in place to control the potential environmental impacts of the production of unconventional oil and gas in Scotland, although there may be gaps to address.
- The high population density of those parts of Scotland most likely to host significant unconventional oil and gas resources would be a challenge for any form of re-industrialisation, and will thus be so for any future unconventional oil and gas industry.
- The development of any new industry is likely to impact society - detecting and alleviating negative impacts, and enhancing positive impacts, is complicated unless careful planning of how to identify impacts is undertaken.
- Public concerns around unconventional oil and gas development include concerns about technical risk such as water contamination, public health and seismicity, but also wider issues such as social impacts on communities, effect on climate targets and trust in operators, regulators and policymakers.
- Many of these social (and environmental) impacts can be mitigated if they are carefully considered at the planning application stage. Added to which, there are already considerable legislative safeguards to ensure such impacts are not realised.
- Early consultation with communities is vital to identify potential impacts on the community, to scope potential benefits and develop plans to mitigate the impacts and enhance the benefits.
- Public engagement is necessary for the development of unconventional oil and gas resources in Scotland and there is a growing body of evidence showing that sustained and meaningful community engagement has beneficial outcomes for communities, operators and policymakers.

In August 2014 ClimateXChange (2014) (Scotland’s climate change research and policy centre) published a Life-Cycle Assessment of Greenhouse Gas Emissions from Unconventional Gas in Scotland. This states:

The key factors influencing the lifecycle emissions of unconventional gas in Scotland are:

- Methane that could escape when the borehole is being prepared for gas production, or servicing a borehole during production.
- The impact of building associated infrastructure (such as drilling platforms, pipelines and roads) in areas with peat soil. This is because peat soil holds carbon which will be released when the soil is removed or drained when preparing the land for being built on.
- Fugitive methane emissions that escape from valves and pipes, which are difficult to capture.

There are potentially significant opportunities to mitigate greenhouse gas emissions by:

- Avoiding unconventional gas exploration and development on peatland. Emissions could also be reduced by avoiding areas of deep peat, minimising the area of land to be built upon, and maximising the number of boreholes at each well pad.
- Applying Best Available Techniques to capture and use the methane, thereby preventing it from being emitted to the atmosphere. These techniques should be applied at the exploration and production stage.
- Improving equipment performance and rigorous monitoring for early leak identification and intervention.
In July 2016 the UK Government’s independent advisers, the Committee on Climate Change (CCC) published a report on the Compatibility of UK Onshore Petroleum with Meeting the UK’s Carbon Budgets (2016). The CCC states that:

The implications for greenhouse gas emissions of shale gas exploitation are subject to considerable uncertainties, both regarding the size of any future industry and the emissions footprint of production. This uncertainty alone calls for close monitoring of developments.

Furthermore:

The UK regulatory regime has the potential to be world-leading but this is not yet assured. The current regime includes important roles for the Health and Safety Executive and the relevant environmental regulators […] which will need to be managed seamlessly. Onshore petroleum exploitation at scale would have unique characteristics in the UK. This may ultimately necessitate the establishment of a dedicated regulatory body. It certainly requires that a strong regulatory framework is put in place now.

The CCC considers that the exploitation of shale gas by hydraulic fracturing on a significant scale is not compatible with UK climate targets unless three tests are met:

1. **Well development, production and decommissioning emissions must be strictly limited.** Emissions must be tightly regulated and closely monitored in order to ensure rapid action to address leaks.

2. **Consumption – gas consumption must remain in line with carbon budgets requirements.** UK unabated fossil energy consumption must be reduced over time within levels the CCC has previously advised to be consistent with the carbon budgets. This means that UK shale gas production must displace imported gas rather than increasing domestic consumption.

3. **Accommodating shale gas production emissions within carbon budgets.** Additional production emissions from shale gas wells will need to be offset through reductions elsewhere in the UK economy, such that overall effort to reduce emissions is sufficient to meet carbon budgets.

There are also potential implications of UK shale production for global emissions, namely:

- **Lifecycle emissions of tightly regulated domestic shale gas against imports.** The overall emissions footprint of UK shale gas, if tightly regulated, is likely to be broadly similar to that of imported gas. Tightly regulated domestic production may provide a small emissions saving when displacing imports of liquefied natural gas.

- **Impact on the global energy system.** Increased UK production of fossil fuels could affect global emissions, depending on the extent to which this displaces coal, displaces low-carbon energy or leads to increased fossil fuel consumption.

DECC’s response (2016) to this report states that “regulations are not required”, and believes:

[...] that there is a clear need to explore and test our shale resource to better understand the potential shale gas reserve. As such, the Government agrees with the CCC’s conclusion that uncertainty exists, and that exploration is required to determine the potential of both the size of a UK shale industry and its associated emissions footprint. The CCC report states that emissions associated with exploration are “generally small”. The Government agrees with the view in the report that “appropriate emission mitigation techniques should be employed where practical” during the exploration phase.

The Guardian (2016) summarises some of the commentary on the report and DECC’s response.
The CCC is expected to send advice to the Scottish Government on “Unconventional Oil and Gas” during the summer of 2016. This is not expected to differ significantly to the advice above.

**SOURCES**


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