

National Assembly for Wales
Research paper

Unconventional Gas: shale gas and coal-bed methane

March 2015

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March 2015

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Unconventional Gas

1. Shale gas and coal-bed methane

Shale gas and coal-bed methane (CBM) are often referred to as unconventional gases. The principal component of both conventional and unconventional natural gas is methane. The term unconventional relates to the nature of the source, rather than the gas itself. Fossil fuels are formed from the decomposition of organic material buried in sediment over long periods of time under increased temperature and pressure. Shale gas and CBM are unlike conventional natural gas in that they are extracted from the source rock in which the gas formed (shale and coal respectively), rather than a reservoir rock.

In the US shale gas has made a significant contribution to energy production, increasing from 2% of total US energy production in 2000 to 14% in 2009. In 2020 it is expected that shale gas will account for more than 30% of total US energy production. In the UK unconventional gas exploration is still at an early stage, with no current commercial production.

1.1. Unconventional gas from shale

Shale gas is gas which is trapped in the pore spaces and fractures within shale rock. It is often referred to as 'tight gas' because the shale source rock has a lower permeability than conventional gas reservoirs, making the gas more difficult to extract. Because of the difficulties in extracting shale gas a combination of horizontal drilling and hydraulic fracturing or 'fracking' techniques are used.

Horizontal drilling. Shale gas wells are initially drilled vertically, usually to depths of at least 1.5 km. Once the shale is reached drilling moves horizontally along the layer of rock in order to extract the maximum amount of gas. Horizontal drilling can extend up to 3 km.¹

Hydraulic fracturing or 'fracking' is where fluids are pumped into shale or coal at high pressure. This creates fractures which make it easier for the gas to travel to the well. These fractures start at the injection well and typically extend to 100m.² Hydraulic fracturing fluid is primarily composed of water. Sand is added as a proppant to keep the fractures open and chemicals are added to improve the efficiency of the process.³ Between 25 to 75% of the injected fluid is returned to

¹ Halliburton-[fracturing 101](#) (website) [accessed 17 February 2015].

² POSTNOTE 374, [Unconventional Gas](#), 2011 [accessed 17 February 2015].

³ British Geological Survey, [A Study of Potential Unconventional Gas Reserves in Wales](#), June 2014 [accessed 17 February 2015].

the surface, where it is then stored and treated.⁴ It is possible to ‘frack’ a well several times in order to maximise gas recovery.

1.2. Unconventional gas from coal

Coal-Bed Methane (CBM) is held within the pores and fractures of coal. The most common method of extracting CBM is by pumping out water which is present within the coal seam. This lowers the pressure within the coal seam, allowing methane to flow out of the pores and fractures in the coal and into the well.⁵

Hydraulic fracturing can also be used to enhance the recovery of gas from coal seams.⁶ Other types of unconventional gas from coal include abandoned mine methane (drilling into abandoned mine workings to collect methane), coal mine methane (collecting the methane gas released during mining operations) and underground coal gasification (producing methane gas by partially combusting underground coal seams).⁷

⁴ The Royal Society and Royal Academy of Engineering, [Shale Gas in the UK, a Review of Hydraulic Fracturing](#), June 2012 [accessed 9 February 2015].

⁵ British Geological Survey, [A Study of Potential Unconventional Gas Reserves in Wales](#), June 2014 [accessed 17 February 2015]

⁶ *ibid*

⁷ *ibid*

2. The potential for unconventional gas extraction in Wales

2.1. *Shale gas reserves in Wales*

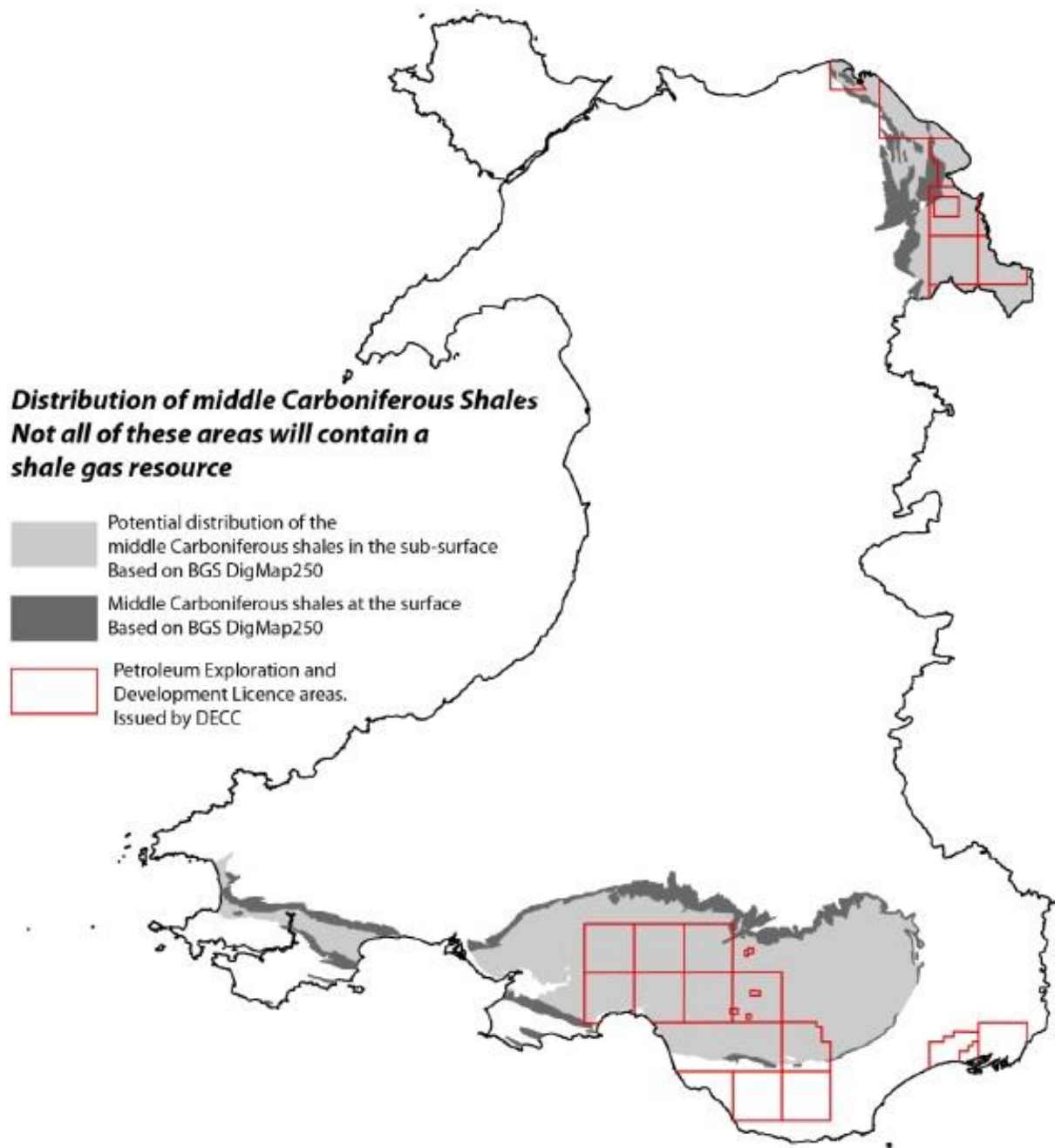
Interest in shale gas in Wales has focused on the middle Carboniferous shale underlying the coal field strata of North and South Wales (Figure 1).⁸ Additional units which may have the potential for shale gas extraction but have not been investigated in detail include early Carboniferous shale and lower Palaeozoic mudstones.⁹

There are three operational phases of an unconventional gas well site. The first is the exploration phase, where a company performs tests to see if extraction will be economically viable. This is followed by the appraisal stage, where companies decide whether to invest, and then finally the production stage. Shale gas exploration in Wales is currently in the first of the three stages, with only a few companies holding petroleum exploration and development licences (PEDLs).

⁸ British Geological Survey, [A Study of Potential Unconventional Gas Reserves in Wales](#), June 2014 [accessed 17 February 2015]

⁹ *ibid*

Figure 1. The distribution of middle Carboniferous shale with the potential to hold shale gas and the location of PEDLs issued by DECC following the 13th Licensing round in 2008.¹⁰ Details of the licences awarded after the 14th licensing round will not be made public until after the 2015 general election.



¹⁰ British Geological Survey, [A Study of Potential Unconventional Gas Reserves in Wales](#), June 2014 [accessed 17 February 2015]

The 2012 Welsh Affairs Committee Inquiry¹¹ into shale gas heard evidence from consultants working for Eden Energy who estimated that parts of South Wales could have shale gas reserves of 34 trillion cubic feet (tcf), of which 12.8 tcf was recoverable. The report stated that “If correct, the amount is equivalent to four years of the UK's gas consumption”.¹²

However, the committee highlighted the need for more data on potential shale gas reserves in Wales, stating:

There is a lack of data regarding the amount of shale gas in Wales. It is therefore difficult to estimate the extent of shale gas resources in Wales and the potential impact shale gas may have on the UK's dependence on imports.¹³

The Committee also heard evidence from industry representatives and academics who estimated that it could take between 5 to 15 years to establish commercial production of shale gas in Wales.¹⁴ Although a number of sites in England have been granted planning permission for exploratory drilling for shale gas, as of March 2015 there are only two sites which have been granted permission to use hydraulic fracturing. Both licences are held by the company Cuadrilla for sites in Lancashire. In 2012 planning permission was granted to the operator Coastal Oil and Gas for exploratory drilling for shale gas at sites in the Vale of Glamorgan¹⁵ and Bridgend¹⁶.

2.2. Coal-bed methane reserves in Wales

The legacy of coal mining in Wales means there is extensive data on the distribution and thickness of coal seams in the South Wales and North Wales coalfields (Figure 2). This data is held by the British Geological Survey (BGS) and the Coal Authority. A study¹⁷ carried out by the BGS proposes that the South Wales coal field has the best resource potential, with average methane content estimates of 22 m³/tonne.

¹¹ House of Commons Welsh Affairs Committee. [Energy Generation in Wales: Shale Gas](#). First report of session 2014-15, June 2014 [accessed 10/2/15]

¹² *ibid*

¹³ *ibid*

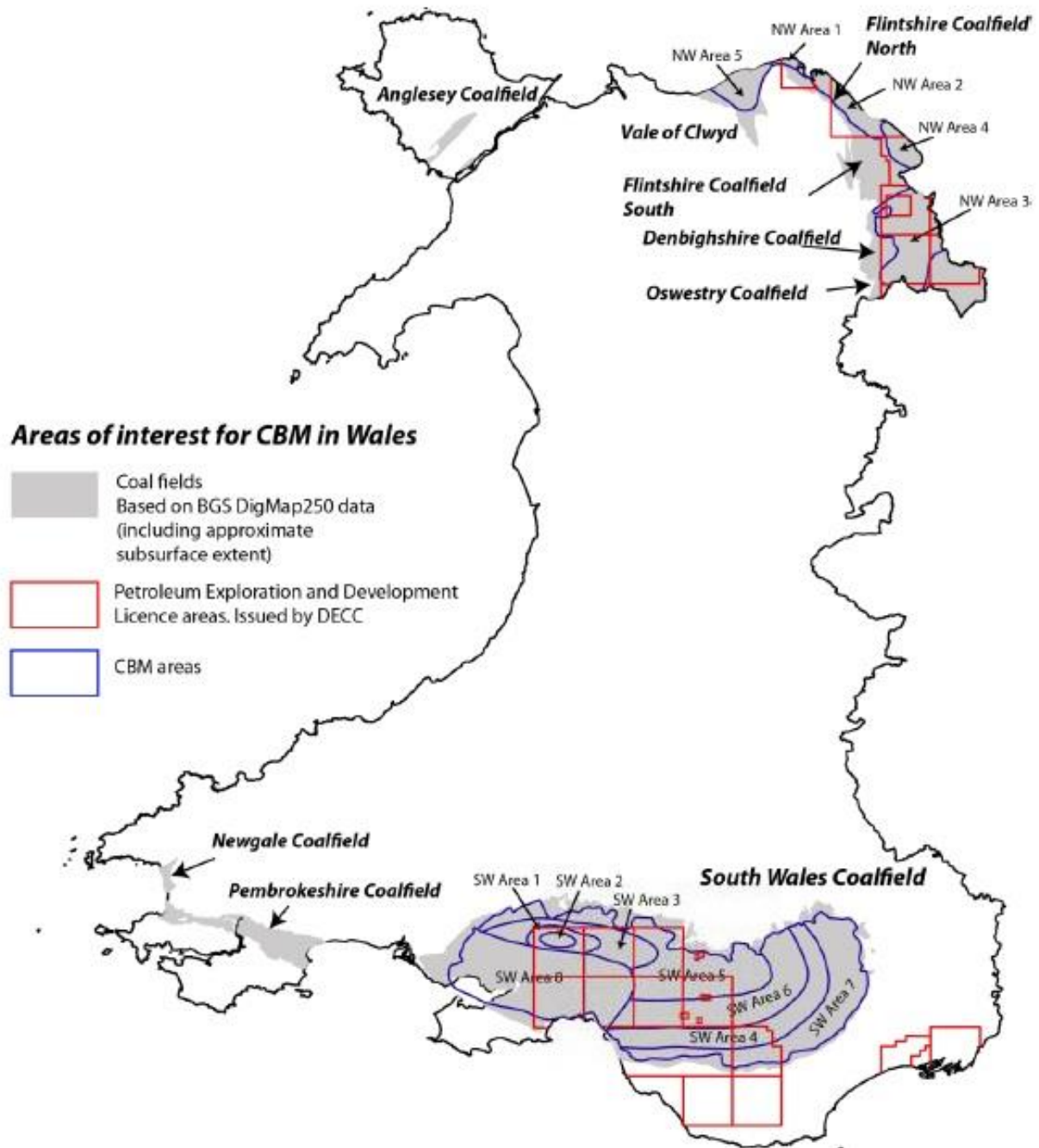
¹⁴ *ibid*

¹⁵ Vale of Glamorgan Council [Planning Portal](#) (website) [accessed 5 March 2015].

¹⁶ Bridgend Council [Planning Portal](#) (website) [accessed 5 March 2015].

¹⁷ Jones et al. [UK coal resource for new exploitation technologies](#), November 2004 [accessed 17 February 2015].

Figure 2. Areas of interest for CBM exploration and the location of PEDLs issued by DECC following the 13th licensing round in 2008.¹⁸ Details of licences awarded after the 14th licensing round will not be made public until after the 2015 general election.



¹⁸ British Geological Survey, [A Study of Potential Unconventional Gas Reserves in Wales](#), June 2014 [accessed 17 February 2015]

To date, there has been limited development of CBM in the UK. There has been exploration at sites in Carlisle and the East Midlands and production at two pilot sites; Airth in Scotland and Cheshire in England.¹⁹ Prior to its closure in 2008, coal mine methane was captured and utilised at Tower mine in South Wales as a by-product of mining operations. This generated 6.5 MW of electricity which was sold back to that National Grid.²⁰ In Wales, sites in Wrexham²¹, Bridgend²², Neath Port Talbot²³, Swansea²⁴, Rhondda Cynon Taff²⁵ and the Vale of Glamorgan²⁶ have so far been granted planning permission for exploratory drilling for CBM.

¹⁹ House of Commons Welsh Affairs Committee. [Energy Generation in Wales: Shale Gas](#). First report of session 2014-15, June 2014 [accessed 10/2/15]

²⁰ Jones et al. [UK coal resource for new exploitation technologies](#), November 2004 [accessed 17 February 2015].

²¹ Wrexham Council [Planning Portal](#) (website) [accessed 5 March 2015].

²² Bridgend Council [Planning Portal](#) (website) [accessed 5 March 2015].

²³ Neath Port Talbot Council [Planning Portal](#) (website) [accessed 5 March 2015].

²⁴ Swansea Council [Planning Portal](#) (website) [accessed 5 March 2015].

²⁵ Rhondda Cynon Taff Council [Planning Portal](#) (website) [accessed 5 March 2015].

²⁶ Vale of Glamorgan Council [Planning Portal](#) (website) [accessed 5 March 2015].

3. Regulatory regime

3.1. *European*

The European Commission has determined that it is the responsibility of national governments to regulate unconventional gas operations.²⁷ Unconventional gas operations in Member States are applicable to a number of EU directives including: REACH, Environmental Impact, Mining Waste and Habitats directives. A 2013 European Commission report on hydraulic fracturing²⁸ examined the regulatory provisions of 8 Member States, including the UK. The report identified a number of potential regulatory gaps and legal uncertainties in national legislation. In response the European Commission published recommendations²⁹ for Member States for the application or adaptation of current legislation for unconventional gas operations. This included recommendations for environmental and planning considerations for new unconventional gas operations.

3.2. *UK licensing stage*

The ownership of all UK oil and gas rights is vested by the Crown in the *Petroleum Production Act 1998*.³⁰ Licensing is currently not devolved to Wales and is administered by **Department for Energy and Climate Change (DECC)** who issue **Petroleum Exploration and Development Licences (PEDLs)**. During licensing rounds companies are able to apply for PEDLs for blocks of land measuring 10km². The last UK licensing round was the 14th running from July to October 2014. Details of the licences awarded during the 14th licensing round will not be made public until after the UK general election in May. As of March 2015 there are 12 active PEDLs in South Wales issued to the operators: Dart, Adamo, UK gas, UK methane, Coastal Oil and Gas, Alkane Energy and Sonorex. There are 6 active PEDLs in and including areas of North Wales held by the operators: Island Gas, GP Energy and Dart. PEDLs themselves do not give consent, planning permission is also required before exploratory operations can commence.

²⁷ Official Journal of the European Union. [Commission recommendations on minimum principles for the exploitation and production of hydrocarbons \(such as shale gas\) using high-volume hydraulic fracturing](#), 2014 [accessed 10/2/15]

²⁸ European Commission, [Regulatory provisions governing key aspects of unconventional gas extraction in selected Member States](#), July 2013 [accessed 23 February 2015].

²⁹ Official Journal of the European Union. [Commission recommendations on minimum principles for the exploitation and production of hydrocarbons \(such as shale gas\) using high-volume hydraulic fracturing](#), 2014 [accessed 10/2/15]

³⁰ GOV.UK, Oil and Gas: [Petroleum Licensing Guidance](#) (website) [accessed: 10/2/15].

3.3. *Planning permission*

Planning permission is required for each of the three phases of unconventional gas exploration (exploration, appraisal and production). Planning is devolved to Wales. Applications for drilling and hydraulic fracturing also need to be approved by a number of different bodies who have the power to grant or refuse permission. This is a complex process with a number of different stages, some of which are devolved to Wales and some which are controlled by the UK Government (as shown in Figure 3).

Minerals Planning Authorities (MPA) (Unitary Authorities and National Park Authorities) may grant permission for the location of wells and well pads. They can also impose conditions to ensure the use of land is acceptable and that factors including traffic and noise, contamination risks and nature conservation are addressed. Environmental Impact Assessments (EIA) are also the responsibility of the MPA, with the MPA determining the need for an EIA on an individual site by site basis. Before planning permission is granted operators are required to submit proposals for an appropriate site restoration plan to the MPA.³¹ A planning application can be 'called-in' by the Welsh Ministers for them to make the decision, rather than the MPA. On 13 February 2015, the Minister for Natural Resources issued a new 'direction' to local planning authorities requiring them to notify him of any planning application where unconventional extraction techniques such as fracking are proposed.³² This direction only applies if an authority plans to approve the application and gives the Minister an opportunity to consider calling it in.

The Welsh Government sets national planning policy and guidance to MPAs in Minerals Planning Policy Wales (MPPW) 2001.³³ As well as MPPW, the Welsh Government provides a series of **Technical Advice Notes (TAN)** which set more detailed guidance on the policy framework for planning decisions. There have been repeated calls for the Welsh Government to issue a **TAN** relating to onshore unconventional gas operations in Wales. When giving evidence to the House of Commons Welsh Affairs Committee on Shale gas, Friends of the Earth Cymru suggested that the Welsh Government did not "want the responsibility or the accountability" in case there was local opposition to shale gas projects.³⁴ It believed that the Welsh Government had been "absolutely negligent" in terms of

³¹ DECC, [onshore oil and gas exploration in the UK: Regulation and Best practice, Wales](#), 2013 [accessed 6 February 2015].

³² [The Town and Country Planning \(Notification\) \(Unconventional Oil and Gas\) \(Wales\) Direction 2015](#), Welsh Government

³³ Welsh Government, [Minerals Planning Policy Wales](#) (2001) [accessed 4 March 2015].

³⁴ House of Commons Welsh Affairs Committee. [Energy Generation in Wales: Shale Gas](#). First report of session 2014-15, June 2014 [accessed 10/2/15]

the planning framework that they had applied to shale gas and unconventional gas.³⁵

The 2012 report by the National Assembly Environmental and Sustainability Committee on energy policy and planning in Wales³⁶ also recommended that the Welsh Government issue a new TAN for onshore unconventional gas, stating:

The Welsh Government should work with the UK Government and the other devolved administrations to produce technical guidance in the form of a new Technical Advice Note to help local planning authorities in Wales in dealing with planning applications for the exploration and extraction of unconventional gas, including applications where the use of hydraulic fracturing is proposed.

However, during a debate in the Assembly on fracking on 4 February 2015 the Minister for Economy, Transport and Science, Edwina Hart stated:

There's no intention of issuing a new technical advice note at this time. Local planning authorities do not need further guidance and are already aware of their powers in this area.³⁷

3.4. Other regulatory requirements

Natural Resources Wales (NRW) grants environmental permits. These include licences to extract and treat water from groundwater sources, such as aquifers or surface water sources, such as reservoirs. It is responsible for ensuring the appropriate treatment and disposal of mining waste and the emissions to air. Operators are required to inform NRW of all the chemicals which will be used as part of the hydraulic fracturing process.³⁸ Operators may also need to apply to NRW for European protected species licences.³⁹

The Health and Safety Executive regulates the safety of the operations and give borehole consent. It is responsible for ensuring that well casings for boreholes are designed and constructed appropriately.⁴⁰

The British Geological Survey (BGS) needs to be informed of the intention to begin drilling by licensees. Following the completion of drilling operations licensees must provide the BGS with drill cores and records.⁴¹

Other bodies which may be involved in the consent process include:

Coal Authority permission is required if operations are likely to penetrate coal seams. This applies for some cases of shale gas exploration and for all cases of

³⁵ House of Commons Welsh Affairs Committee. [Energy Generation in Wales: Shale Gas](#). First report of session 2014-15, June 2014 [accessed 10/2/15]

³⁶ National Assembly for Wales, [Energy Policy and Planning in Wales](#), June 2012 [accessed 5 March 2015].

³⁷ Plenary record of proceedings, 4th February 2015. [Plaid Cymru debate: Fracking](#) (website) [accessed 18 February 2015].

³⁸ *ibid*

³⁹ Natural Resources Wales, [European protected species licences](#) (website) [accessed 4 March 2015].

⁴⁰ DECC, [onshore oil and gas exploration in the UK: Regulation and Best practice, Wales](#), 2013 [accessed 6 February 2015].

⁴¹ DECC, [onshore oil and gas exploration in the UK: Regulation and Best practice, Wales](#), 2013 [accessed 6 February 2015].

CBM exploration. Underground coal gasification requires an additional licence under the *Coal Industry Act* of 1994, which is issued by the Coal Authority.⁴²

Hazardous Substance Authorities (Unitary Authorities in Wales) may need to provide hazardous substance consents.⁴³

The existing powers over planning and environmental permitting mean that it is possible for either the MPA, the Welsh Ministers or NRW to block a proposal for fracking in Wales if, for example, there were concerns about the environmental impact or about the substances to be used for the operation.

If planning is approved by the MPA or the Welsh Ministers and NRW issues the necessary permits, operators still need to apply to DECC for a ‘well consent’ giving final permission to drill and this may also include permission to commence hydraulic fracturing.

Safeguards in the *Infrastructure Act 2015*⁴⁴ now require the MPA and NRW to provide certain assurances before DECC can issue this consent. These assurances include the exclusion of hydraulic fracturing activity within ‘protected groundwater source areas’ and a requirement for methane levels in the groundwater to be monitored 12 months prior to any hydraulic fracturing. The final permission for hydraulic fracturing activity is therefore currently granted outside of Wales by DECC and may involve consideration of devolved areas, such as the impact on groundwater, in its decision.

DECC is also currently responsible for assessing the risk and monitoring of seismic activity as well as granting consent for the flaring or venting of gas at ground level.⁴⁵ See Section 6.3 below about proposals for further devolution.

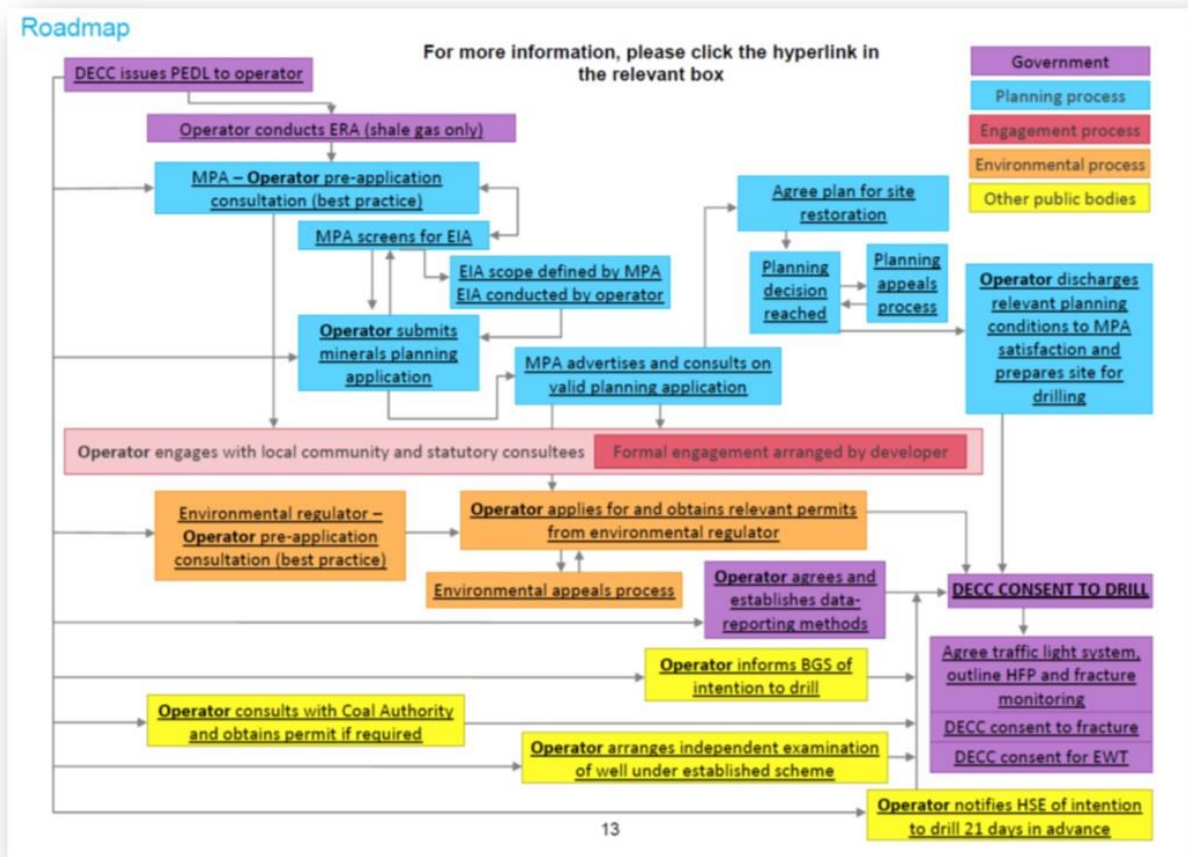
⁴² DECC, [onshore oil and gas exploration in the UK: Regulation and Best practice, Wales](#), 2013 [accessed 6 February 2015].

⁴³ *ibid*

⁴⁴ [The Infrastructure Act 2015](#) [accessed 18 February 2015].

⁴⁵ *ibid*

Figure 3. Overview of the current licensing and planning process for onshore gas exploration in Wales. ⁴⁶ Note this predates the *Infrastructure Act 2015*⁴⁷



3.5. Office for Unconventional Gas and Oil

In 2013 DECC set up the Office for Unconventional Gas and Oil (OUGO).⁴⁸ The objectives of the office include “encouraging the development of the unconventional gas and oil industry in the UK in a way that maximises the benefits to the economy by improving security of supply, creating jobs, growth and investment, and supporting the transition to a low carbon economy at the least cost.”

It is also responsible for ensuring “regulation, including the planning and permitting processes, is as simple as possible through all phases (exploration, appraisal, development and full production) while sufficiently robust to protect public safety, the workforce, and environment.”

⁴⁶ DECC, [onshore oil and gas exploration in the UK: Regulation and Best practice, Wales](#), 2013 [accessed 6 February 2015].

⁴⁷ [The Infrastructure Act 2015](#) [accessed 18 February 2015].

⁴⁸ GOV.UK, [Office of Unconventional Gas and Oil \(OUGO\)](#) [accessed 9 March 2015]

Another of the stated priorities of the OUGO is to ensure communities benefit from gas exploration in their area. When the OUGO was first set up, the Secretary for Energy and Climate Change Ed Davey said:

This new Office will help us to ensure that we can make the most of our natural resources, whilst protecting the environment, safeguarding the public and ensuring local communities feel some benefit from hosting developments.⁴⁹

3.6. *Landowner access rights*

Operators require the landowner's permission for any access at ground level. Drilling operations for shale gas typically take place at depths greater than 300m. The recently passed *Infrastructure Act 2015*⁵⁰, once fully in force, will allow companies to drill or frack beneath privately owned land without the landowner's permission.⁵¹ This also includes:

...the right to leave deep-level land in a different condition from the condition it was in before an exercise of the right of use (including by leaving any infrastructure or substance in the land).⁵²

Prior to the implementation of the *Infrastructure Act 2015*⁵³ companies were required to obtain permission from landowners before drilling and fracking could commence. The UK Government argued that the resulting legal process was costly and time consuming for shale gas companies.⁵⁴

Companies are required to inform local residents in an affected area of their intention to undertake hydraulic fracturing activities before seeking planning permission.⁵⁵ One of the 13 House of Commons Amendments to the *Infrastructure Bill*⁵⁶, which imposed a number of restrictions on fracking operations, was the requirement of operators to notify landowners or residents living near the sites on an individual basis. However, late changes to these amendments in the House of Lords replaced this condition with the requirement to notify residents by displaying and publishing notices in the relevant area.⁵⁷

⁴⁹ GOV.UK, [New Office to look at community benefits for shale gas projects](#) (website) [accessed 5 March 2015].

⁵⁰ [The Infrastructure Act 2015](#) [accessed 18 February 2015].

⁵¹ *ibid*

⁵² *ibid*

⁵³ *ibid*

⁵⁴ GOV.UK, [Government proposals to simplify deep underground access for shale and geothermal industries](#) (website) [accessed 10/2/15].

⁵⁵ DECC, [Onshore oil and gas regulation in the UK: regulation and best practice, Wales](#), December 2013 [accessed 16 February 2015].

⁵⁶ [Infrastructure Bill](#) House of Commons Amendments to Bill 892014-15 (28 January 2015) [accessed 18 February 2015].

⁵⁷ [The Infrastructure Act 2015](#) [accessed 18 February 2015].

4. Impact on local communities in Wales

4.1. Household energy prices

In the US extensive shale gas production has been linked to a fall in oil and gas prices. As a result some parts of the US have experienced up to a 40% reduction in energy prices.⁵⁸ In July 2013 The Prime Minister David Cameron claimed that in the UK fracking had:

...real potential to drive energy bills down at a time when many families are struggling with rising prices.⁵⁹

However in November 2013 Lord Browne, the chairman of the gas company Cuadrilla, argued that the UK's connection to the European gas market means that shale gas production is unlikely to reduce household energy bills.⁶⁰ Recent studies have also found that producing shale gas in Europe could be 2-3 times more expensive than in the US due to factors such as greater geological complexity of the shale formations, scarcer water resources and high infrastructure costs.⁶¹

4.2. Local jobs

The uncertainty over the potential scale of the onshore gas industry in Wales means estimates for the number of jobs which could be created vary. The Institute of Director's estimate that 74,000 jobs could be supported by a UK shale gas industry.⁶² UK Onshore Gas Ltd told the Assembly's Environment and Sustainability Committee in 2013 that "thousands of jobs could be created by a new unconventional gas industry in Wales".⁶³

However, when giving evidence to the House of Commons Welsh Affairs Committee Professor Anderson from the Tyndall Centre suggested rather than creating jobs locally staff with the existing skills would be brought in from elsewhere, stating:

When you ask the employment question, you need to ask it in the context of the local skill set that is actually there and to ask whether or not the industries that would be doing it would use that local skills set.⁶⁴

⁵⁸ BBC news, [Osborne: fracking might not slash energy bills](#), 4 February 2015 (website) [accessed 18 February 2015].

⁵⁹ *ibid*

⁶⁰ Guardian online, [Lord Browne: fracking will not reduce UK gas prices](#), 29 November 2013 (website) [accessed 18 February 2015].

⁶¹ Energy post, [shale gas: what could it really mean for Europe?](#), 16 June 2014 (website) [accessed 18 February 2015].

⁶² House of Commons Welsh Affairs Committee. [Energy Generation in Wales: Shale Gas](#). First report of session 2014-15, June 2014 [accessed 10 February 2015]

⁶³ National Assembly for Wales, Environment & Sustainability Committee [E&S\(4\)-08-13 paper 1, Shale gas and gasification – Evidence from UK Onshore Gas Ltd](#), 7 March 2013 [accessed 9 March 2015]

⁶⁴ House of Commons Welsh Affairs Committee. [Energy Generation in Wales: Shale Gas](#). First report of session 2014-15, June 2014 [accessed 10 February 15]

Education and skills policy is devolved to Wales and it was a recommendation of the House of Common Welsh Affairs Committee on shale gas that:

...the Welsh government begin to consider how employment opportunities presented by shale gas production could be maximised including an examination of the skills required by the industry and the extent to which Wales already has people with those skills.⁶⁵

4.3. *Community Benefits Scheme*

A requirement of the *Infrastructure Act 2015*⁶⁶, once it is fully in force, is that companies must put in place a scheme to compensate local communities around well sites. Prior to this UK Onshore Oil and Gas (UKOOG), the body which represents gas operating companies had already announced a voluntary ‘Community Engagement Charter’. Under this, communities near or next to shale gas sites are entitled to £100,000 per well site at the exploration stage followed by 1% of production revenues.⁶⁷ The UK Government estimates that this could amount to £5-10m per well over its lifetime.⁶⁸

4.4. *Traffic and noise pollution*

Once a site is permitted and considered to be commercially viable, the company prepares the shale gas pad and begins drilling. This phase is argued to be disruptive due to vehicles transporting materials, water and gas to and from extraction sites. DECC has estimated the expected vehicle movements for a single well site during each development stage, as seen in Table 1.

Table 1. Vehicle traffic per day for a single well site. DECC (2013).⁶⁹

Development phase	Vehicle movements/ day	Duration of vehicle movements
Exploratory drilling	14- 36	12- 13 weeks
Production development	16- 51	32- 145 weeks
Production and operation	10- 45	Dependant on well productivity

⁶⁵ House of Commons Welsh Affairs Committee. [Energy Generation in Wales: Shale Gas](#). First report of session 2014-15, June 2014 [accessed 10 February 15]

⁶⁶ [The Infrastructure Act 2015](#) [accessed 18 February 2015].

⁶⁷ UKOOG. [Community Engagement Charter Oil and Gas from Unconventional Reservoirs](#) [accessed 8 February 2015].

⁶⁸ GOV.UK. [Local councils to receive millions in business rates from shale gas developments](#) (2014) [accessed 11 January 2015].

⁶⁹ House of Lords Economic Affairs Committee. [The Economic Impact on UK Energy Policy of Shale Gas and Oil](#) (2014).

The gas company Cuadrilla has recognised that reducing traffic would be critical to the success of shale gas development in the UK.⁷⁰ Traffic management along with noise and dust levels are factors that should be considered during the planning application process by the MPA. The House of Commons Welsh Affairs Committee recommended:

The UK Government and the Welsh Government must ensure that the regulatory and planning framework gives due weight to the traffic and noise caused by commercial shale gas operations, in addition to the visual impact and other environmental risks associated with fracking.⁷¹

⁷⁰ House of Commons Welsh Affairs Committee. [Energy Generation in Wales: Shale Gas](#). First report of session 2014-15 (2014) [accessed 10 B February 2015].

⁷¹ *Ibid*

5. Environmental and geological considerations

5.1. CO₂ emissions

Wales has committed to a 40 percent reduction in total greenhouse gas emissions by 2020 (against a 1990 baseline).⁷² One of the suggested benefits of energy generation by unconventional gas is that it could help reduce the UK's carbon emissions, as it is considered by some to be a low carbon fossil fuel. According to a report prepared for the European Commission in 2012⁷³, emissions from electricity generated from shale gas are 2-10% lower than electricity generated from conventional pipeline gas located outside of Europe (in Russia and Algeria), and 7-10% lower than electricity generated from liquefied natural gas imported into Europe.⁷⁴ In a speech given to the Royal Society in 2013⁷⁵ the Secretary of State for Energy and Climate Change, Ed Davey stated that:

Gas, as the cleanest fossil fuel, is part of the answer to climate change, as a bridge in our transition to a green future, especially in our move away from coal.⁷⁶

Evidence from the Tyndall Centre to the Assembly's Environment and Sustainability Committee inquiry on energy planning in Wales⁷⁷ disputed the claim that shale gas could provide a low carbon equivalent to coal in the future:

Given continuing growth in global energy demand it is likely that any additional fossil fuel resources that are exploited will be used in addition to existing resources. Without significant pressure to reduce GHG emissions, it is difficult to envisage that gas would substitute for coal rather than being used alongside it.⁷⁸

A recent study⁷⁹ has found that in order to avoid an average global temperature increase of greater than 2 °C, 80% of the world's known fossil fuel reserves must remain in the ground. This includes 49% of the world's known gas reserves.⁸⁰ The House of Commons Environmental Audit Committee also argued that exploiting unconventional gas could potentially conflict with the UK's commitments to reduce emissions, stating:

Ultimately fracking cannot be compatible with our long-term commitments to cut climate-changing emissions unless full-scale carbon capture and storage technology is rolled out rapidly, which currently looks unlikely.⁸¹

⁷² Welsh Government, [Climate strategy for Wales](#) (11 October 2011) [accessed 18 February 2015].

⁷³ AEA, [Climate impact of potential shale gas production in the EU: Final report](#), Report prepared for the European Commission, July 2012

⁷⁴ *ibid*

⁷⁵ UK.GOV, [The myths and realities of shale gas exploration](#), September 2013 (website) [accessed 18 February 2015].

⁷⁶ *ibid*

⁷⁷ Environment and Sustainability Committee, [Inquiry into energy planning and policy in Wales](#), Tyndall Centre written evidence, 2012 [accessed 3 March 2015].

⁷⁸ *ibid*

⁷⁹ McGlade and Elkins, [The geographical distribution of fossil fuels unused when limiting global warming to 2 °C](#), Nature Journal (January 2015) [accessed 18 February 2015].

⁸⁰ *ibid*

⁸¹ House of Commons Environmental Audit Committee. [Environmental risks of fracking](#) (2015) [accessed 12 January 2015].

The European Renewable Energy Council has argued that because shale gas is considered a ‘low carbon technology’ by the European Commission it is eligible for EU research funding through schemes such as the Horizon 2020 fund, which was previously dedicated to renewable energy projects.⁸²

5.2. *Methane emissions*

During the extraction process unintentional leaks or ‘fugitive emissions’ of methane can occur. Methane as a greenhouse gas has a potency 25 times that of carbon dioxide. The US Environmental Protection Agency estimates that fugitive methane emissions could contribute up to 30% of the total emissions associated with extraction if not correctly managed. This is double the volume normally recorded for conventional gas extraction.⁸³ A 2013 report by the Environment Agency⁸⁴ considers the risk of pollution by fugitive emissions at the exploratory stage to be low as long as well integrity is maintained to the standards of the HSE. The report predates the formation of NRW and therefore covers England and Wales.

5.3. *Seismic activity*

In 2011 during the hydraulic fracturing of a well at the Preese Hall Cuadrilla site in Lancashire an earthquake of the magnitude 2.3M_L occurred.⁸⁵ As a result operations at the site were suspended and a temporary moratorium on hydraulic fracturing was imposed. A BGS and Keele University report⁸⁶, which was funded by Cuadrilla, concluded that although the seismic event was felt around the Blackpool area no structural damage at the surface occurred as a result. The report⁸⁷ also found that the earthquake occurred due to a combination of geological factors which are rare and unlikely to occur at other well sites.

⁸² EREC factsheet. [Shale gas and its impact on renewable energy sources \(2013\)](#) [accessed 16 February 2015].

⁸³ Tyndall Centre, [Shale gas: an updated assessment of environmental and climate change impacts](#) (2011) [accessed 5 February 2015].

⁸⁴ Environment Agency, [An Environmental Risk Assessment for shale gas exploratory operations in England](#) (2013)

⁸⁵ The Royal Society and Royal Academy of Engineers, [Shale gas extraction in the UK: a review of hydraulic fracturing](#), June 2012.

⁸⁶ GFrac Technologies, BGS, Keele University, [Preese Hall shale gas fracturing review and recommendations for induced seismic mitigation](#), April 2012 [accessed 3 March 2015].

⁸⁷ *ibid*

5.4. Water abstraction

The British Geological Survey estimate that 8,650 to 25,300 m³ of water are required for the drilling and hydraulic fracturing processes used during shale gas extraction.⁸⁸ The upper limit of this estimate represents 0.07% of the total annual licensed water abstraction in Wales.⁸⁹ This water could be sourced from the public supply (the ‘mains’), a groundwater supply, or a surface water supply. The operators Coastal Oil and Gas told the 2014 House of Commons Welsh Affairs Committee that they were developing a ‘closed loop’ system to drill for and then clean and reuse water on site, but that this technology was not currently operational.⁹⁰

5.5. Water contamination

Drilling and hydraulic fracturing fluids are composed of around 0.2% chemical additives.⁹¹ The Environment Agency has stated that in England the use of hazardous substances would not be permitted where they might enter the groundwater and cause pollution.⁹² NRW has not issued any guidance on this. After drilling 25% to 75% of the hydraulic fracturing fluids are returned to the surface as ‘flowback fluids’, where they are collected, stored and then treated.⁹³ During storage there is a risk of groundwater and surface water pollution through the escape of flowback fluids.⁹⁴ A 2013 report by the Environment Agency⁹⁵ considers this to be a low risk activity **at the exploratory stage** after correct management and with current regulatory controls in place. The report predates the formation of NRW and therefore covers England and Wales.

There are also thought to be potential risks to water bodies below ground through the migration of fracturing fluids along faults or where the well itself passes through aquifers, providing a pathway for fluid migration.⁹⁶ After the *Infrastructure Act 2015*⁹⁷ hydraulic fracturing is not permitted within ‘protected groundwater source areas’. The Royal Society and Royal Academy of Engineers considers the risk of fluid migration through fractures created by hydraulic fracturing to be low. They cite studies which find the maximum height of fractures

⁸⁸ British Geological Survey, [A Study of Potential Unconventional Gas Reserves in Wales](#) (June 2014) [accessed 17 February 2015]

⁸⁹ *ibid*

⁹⁰ House of Commons Welsh Affairs Committee. [Energy Generation in Wales: Shale Gas](#). First report of session 2014-15 (2014) [accessed 10/2/15].

⁹¹ House of Commons Environmental Audit Committee. [Environmental risks of fracking](#) (2015) [accessed 12 January 2015].

⁹² *ibid*

⁹³ The Royal Society and Royal Academy of Engineers, [Shale gas extraction in the UK: a review of hydraulic fracturing](#), June 2012

⁹⁴ House of Commons Environmental Audit Committee. [Environmental risks of fracking](#) (2015) [accessed 12 January 2015].

⁹⁵ Environment Agency, [An Environmental Risk Assessment for shale gas exploratory operations in England](#) (2013)

⁹⁶ House of Commons Environmental Audit Committee. [Environmental risks of fracking](#) (2015) [accessed 12 January 2015]

⁹⁷ The [Infrastructure Act 2015](#) (website) [accessed 18 February 2015].

created by hydraulic fracturing to be less than 600m, not extending into the shallower depths where groundwater exists.⁹⁸ Well integrity is stated in the report as the most important factor in minimising groundwater contamination.⁹⁹

5.6. Protected areas

The *Infrastructure Act 2015*¹⁰⁰ restricts hydraulic fracturing activities within protected areas such as national parks, Areas of Outstanding Natural Beauty and Sites of Special Scientific Interest. However, hydraulic fracturing and drilling can still potentially take place beneath protected areas providing the well site is located outside of its boundaries. The impact on protected areas should also be considered by the MPA when deciding on a planning application.

⁹⁸ The Royal Society and Royal Academy of Engineers, [Shale gas extraction in the UK: a review of hydraulic fracturing](#), June 2012.

⁹⁹ *ibid*

¹⁰⁰ The [Infrastructure Act 2015](#) [accessed 18 February 2015].

6. Moratoria

6.1. Globally

A number of European countries currently have moratoria on hydraulic fracturing operations. These include France (since 2011), Bulgaria (since 2012), The Czech Republic (since 2012), Luxemburg (since 2012) and the Netherlands (since 2013). In the US two states, Vermont and New York, have placed bans on hydraulic fracturing activities citing the risk to drinking water supplies. In February 2015 the German government announced a draft law which would allow commercial shale gas extraction at depths greater than 3 km, ending a moratorium which has been in place since 2011. The proposed law is currently beginning legislative passage with a plenary vote in the Bundestag expected in May 2015.¹⁰¹

6.2. UK

Between 2011 and 2012 a temporary moratorium was put into place in the UK following seismic activity resulting from hydraulic fracturing activity at the Preese Hall site near Blackpool (see section 5.3). Earlier this year following an agreement to devolve the licensing of fracking operations to the Scottish Government, a moratorium on fracking consent in Scotland was announced. The House of Commons Environmental Audit Committee recently called for a moratorium on fracking in the rest of the UK. This call was rejected during the final stages of the passage of *Infrastructure Act 2015*¹⁰² through Parliament.

6.3. Further devolution of powers

On 4 February 2015 the Assembly voted in favour of a Plaid Cymru motion¹⁰³ during a plenary debate on Fracking:

Regretting the decision to allow fracking companies to drill beneath Welsh homes without permission from property owners.

The motion¹⁰⁴ also called for the full devolution of energy and on the Welsh Government:

To do everything in its power to prevent fracking from taking place in Wales until it is proven to be safe in both an environmental and public health context.

¹⁰¹ The Guardian, [Germany moves to legalise fracking](#), 14 February 2015 (website) [accessed 18 February 2015].

¹⁰² The [Infrastructure Act 2015](#) [accessed 18 February 2015].

¹⁰³ Plenary record of proceedings, 4th February 2015. [Plaid Cymru debate: Fracking](#) (website) [accessed 18 February 2015].

¹⁰⁴ *ibid*

On 27 February 2015 the UK Government announced the outcome of the St David's Day process, including that onshore oil and gas licensing should be devolved to Wales.¹⁰⁵ This will require new primary legislation and the date of implementation will be decided by the next UK Government.

¹⁰⁵ UK Government, [Powers for a purpose, Towards a Lasting Devolution Settlement for Wales](#), February 2015 [accessed 5 March 2015].