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The Economic Impact on UK Energy Policy of Shale Gas and Oil

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ABSTRACT

The UK's opportunity

The shale gas revolution in the United States has illustrated the economic opportunity offered to the United Kingdom by its own shale gas resources—if they can be developed successfully. We strongly support the Government in their objective to exploit these resources but believe they need to do much more to encourage exploration and get development moving.

The US experience

In the US, new production techniques using horizontal drilling and hydraulic fracturing (fracking) to release gas from shale rocks have brought abundant and growing new supplies of gas to market in a short time. Shale oil production is also growing rapidly. The US energy mix has changed fast.

The impact of shale gas on the US economy is already dramatic. Gas prices have fallen to about one-third of the UK price level. Cheap gas has displaced coal from electricity generation. Plans for new nuclear generating capacity in the US are on hold. Investment is rising fast in energy intensive industries and petrochemicals, since cheap shale gas makes "reshoring" of overseas plants economic.

The global implications

The effects of the US revolution are already being felt globally. The UK and Germany, for instance, are generating more electricity from US coal displaced by shale gas. North America is expected soon to become self-sufficient in energy and a large exporter of shale gas in the form of liquefied natural gas (LNG). Many other countries have also been alerted to the economic potential of their own shale resources and expect to develop them.

Patterns of global trade in energy seem likely to change, reducing dependence on the Middle East and Russia and promoting energy security through greater diversity of supply. The impact on prices is harder to predict. Gas prices, unlike oil prices, are regional rather than global. World price cuts on the US scale are unlikely. But abundant new shale gas supplies are bound to have a restraining effect on prices.

Economic impact of the UK's shale gas

Exploration and appraisal are urgently needed to establish the economic potential of the UK's shale gas and oil resource. Shale gas is not the answer to all the energy policy challenges facing the UK. Substantial economic benefits would however flow from successful development. It would reduce imports and help maintain security of supply. This would be especially valuable given the continuing fall in output from the North Sea and Europe's reliance on Russia, its biggest gas supplier, highlighted by the crisis in Ukraine.

Development of shale gas and oil in the UK would also generate direct employment, particularly in the North of England and be a significant benefit to the balance of payments and the Exchequer. UK produced shale gas is also likely to be cheaper than imported gas from the Middle East or elsewhere which carries the extra costs of transport and processing. If the UK does not develop its shale resources in a timely fashion, it runs a serious risk of losing the energy intensive and petrochemical industries which depend on competitively-priced energy and raw materials and which employ around 250,000 people.

The UK hesitates

The UK will certainly feel the impact of the shale gas revolution. It has its own shale gas resource. The question is whether the UK is to be a producer or simply an importer. The Government are committed to development of British shale. The Prime Minister and Chancellor of the Exchequer have announced measures to encourage it. Public concern about possible environmental and health risks, most of it unfounded, together with regulatory uncertainty, have so far delayed the exploration and appraisal needed to assess the UK's economically recoverable onshore shale gas reserves.

Public concerns in the UK

Development of shale gas in the UK cannot go ahead without public acceptance. Public concerns must be taken seriously and every possible effort made to reduce or eliminate risk and provide reassurance. We consider that the risks to human health and the environment are low if shale development is properly regulated, with the improvements we recommend. We welcome the community benefit schemes announced by the industry which, if well-targeted, could play a role in winning public acceptance. We also recommend that the industry improves its presentation and communication skills and puts across more convincingly the economic and employment gains shale development can bring to areas like Lancashire.

Regulation in the UK

The UK's regulatory framework for oil and gas exploration and production is highly regarded internationally. It is also dauntingly complex and untested by large-scale onshore development of shale. Ministers and regulators have taken measures to adapt the system. But many complexities remain, with responsibilities divided between different agencies. Industry is uncertain how the rules would apply in practice. Since the lifting in 2012 of a moratorium on hydraulic fracturing, we understand (May 2014) that the Environment Agency has not received or approved any applications for the necessary permits. There is no reason why effective regulation should not be transparent and speedy as well as rigorous. Delay is not only costly and wasteful, it can also drive investors elsewhere.

The Government need to give a stronger lead

We strongly believe that the UK should seize the opportunity offered by its shale gas resource. It could bring regional economic growth and employment, reduce dependence on imports and improve security of supply, help guard against energy shortage in future and perhaps cut prices. We are concerned that regulatory uncertainty is blocking development. The Government should make a sustained and concerted effort to get shale development moving within a robust and responsive regulatory framework. This effort needs to be directed from the top.

We recommend that:

- the Prime Minister should establish a new Committee or Sub-Committee of the Cabinet, chaired by the Chancellor, dedicated to ensuring that his commitment to "go all out for shale" is matched by action;
- the Government should streamline and improve the unwieldy regulatory structure to make it effective as well as rigorous;
- the Government should take the lead in setting out the economic benefits of shale and in reassuring the public that with proper regulation environmental and health risks of developing it are low;

- the industry should engage better with local communities, building on its community benefit schemes, ensuring that its plans are clear and well-explained, meticulously observing regulations and planning conditions and generally being a good neighbour;
- exploration, appraisal and then development of the United Kingdom's substantial shale gas and oil resources should be recognised as an urgent national priority.

The Economic Impact on UK Energy Policy of Shale Gas and Oil

CHAPTER 1: INTRODUCTION

1. In 2014, the future of shale gas in the UK hangs in the balance. America stands as an example of the huge economic impact that shale gas and oil can have. Geographic surveys suggest that Britain has substantial shale gas resources, though it is not clear what proportion could be developed commercially. Some estimates suggest that the amount of gas recoverable could be over 40 times greater than the current annual UK gas consumption. Entrepreneurial companies are ready to sink the necessary wells to establish how much of these fuels can economically be extracted. The most senior Government ministers are enthused over the prospect: the Prime Minister announced in January 2014 that the UK is "going all out for shale" as it will mean "more jobs and opportunities for people, and economic security for our country."[1] The Chancellor of the Exchequer told the Committee that he wanted "to give this industry a big boost and to get this activity going in the United Kingdom".[2]

2. But there is also considerable opposition. An anti-shale movement has developed. At the forefront are local protestors and some local authorities who are determined to protect their immediate environment. Respected bodies such as the National Trust have argued that development activity should be banned in specific areas such as National Parks.[3] Opponents cite concerns over groundwater contamination, earthquakes and even cancer. There are also worries over the impact of increased noise and traffic, particularly during the exploration stage of shale gas. Environmental organisations such as Friends of the Earth and Greenpeace have aligned with the opponents of shale gas. Their chief concern is that the development of shale gas will get in the way of a swift transition to a renewables-based future.

3. Despite a long and uncontroversial history of onshore drilling in the UK, the prospect of 'fracking'—the hydraulic fracturing of shale rock to release the gas it contains—has aroused strong local opposition. In Balcombe, Cuadrilla, a company publicly seen as the leading UK shale gas business, was forced to abandon its attempt to drill for oil because of public protests which the police were unable to contain—despite the fact that no fracking was planned. Local protest groups have already been formed to oppose Cuadrilla's plans to frack two wells at Roseacre Wood and Little Plumpton near Blackpool.[4]

4. Shale gas generates contradictory views, strongly held. The aim of this report is to stand back from the passion on both sides, and focus on the facts. We have taken evidence from a wide range of witnesses, from the most fervent

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1 See https://www.gov.uk/government/news/local-councils-to-receive-millions-in-business-rates-from-shale-gas-developments for the Prime Minister's announcement.

2 Evidence to Economic Affairs Committee, 4 February, Q 3.

3 Moore, V., Beresford, A., & Gove, B. (2014) *Hydraulic fracturing for shale gas in the UK: Examining the evidence for potential environmental impacts*, RSPB et al.

4 'Cuadrilla names fracking exploration sites in Lancashire', *BBC News*, 4 February 2014.

anti-shale campaigners to the most enthusiastic proponents. In particular, however, we have sought a wide range of the most expert advice and we have come to our best judgment from a cool appraisal of all sides of the case. Among the issues we discuss in this report are:

- How much shale gas can we expect to see produced, and what is the range of likely availability over the next few years?
- What further work is needed to establish a proper estimate of recoverable reserves including estimates of production costs? How much drilling is going to be necessary to enable the industry to make this estimate?
- Why has exploration progressed so slowly to the point that as of May 2014 only one well has been hydraulically fractured?
- What is the earliest point at which shale gas could reasonably be expected to make a material contribution to the UK's energy mix?
- What can we learn from the American shale revolution and which lessons from the US are or are not applicable in the UK?
- What impact might shale have, if exploited, in terms of jobs, energy prices, the balance of payments and security and diversity of supply?
- What are the advantages and disadvantages of exploiting shale in terms of hitting Britain's carbon emissions targets?
- Do the fears that have been raised of serious adverse consequences for health and for the environment, locally and nationally, have substance?
- Do we have a regulatory regime which is fit for purpose, both in terms of providing adequate protection against environmental risks and in terms of permitting acceptable fracking operations to proceed with due dispatch?
- Do we need arrangements to ensure that individuals and communities are properly compensated for the inevitable incursions shale development will make on local areas?
- Are the authorities and in particular the Government providing a coordinated approach to possible shale development designed to reassure the public while making possible the development of the industry? Are the Government giving a lead both in demonstrating that concerns are being managed effectively, and in explaining the positive potential benefits locally and nationally of successful shale gas development?

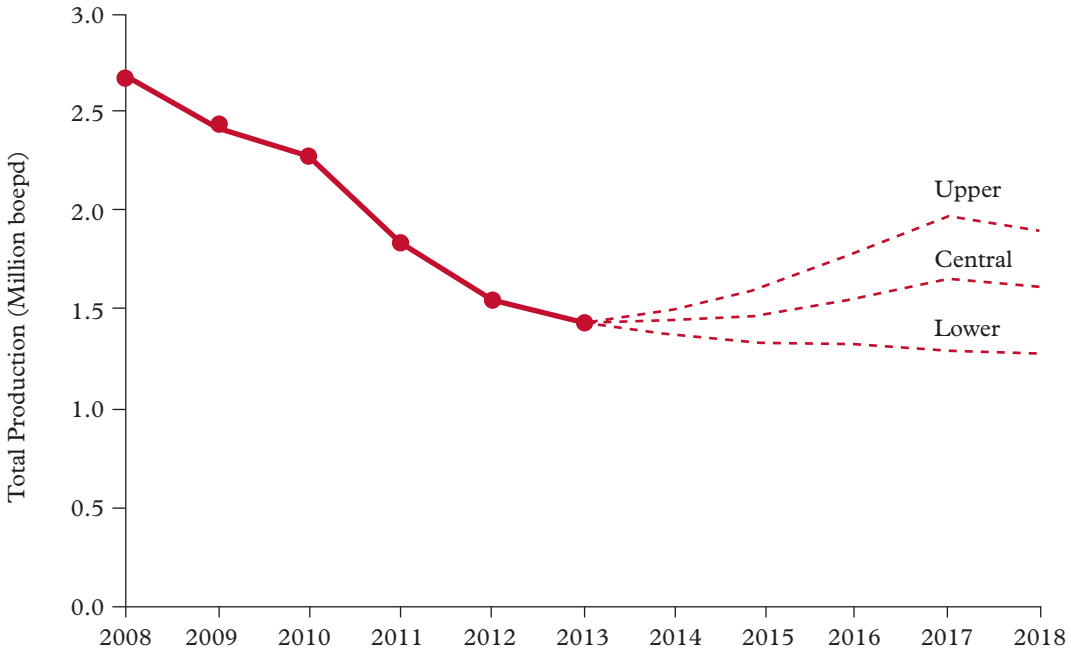
CHAPTER 2: THE UK'S ENERGY MARKET

The UK energy mix

5. The energy market in the UK is being reshaped by three distinct factors. First, on the supply side, North Sea oil and gas output is declining. Production of oil and natural gas liquids fell by 9 per cent in 2013, and gas by 6 per cent. Total output has fallen by almost 40 per cent since 2010.[5] The Government are seeking to revive output and have adopted the proposals of the Wood report for simpler regulation.[6] The industry response, however, remains uncertain. Figure 1 shows the range of DECC's production forecasts over the next five years.

FIGURE 1

North Sea Production



Source: Oil and Gas UK, DECC

Imports of both oil and gas have grown over the last decade as North Sea output has declined. Even if North Sea oil and gas production can be stabilised for a period, import requirements are likely to grow further over the next two decades.

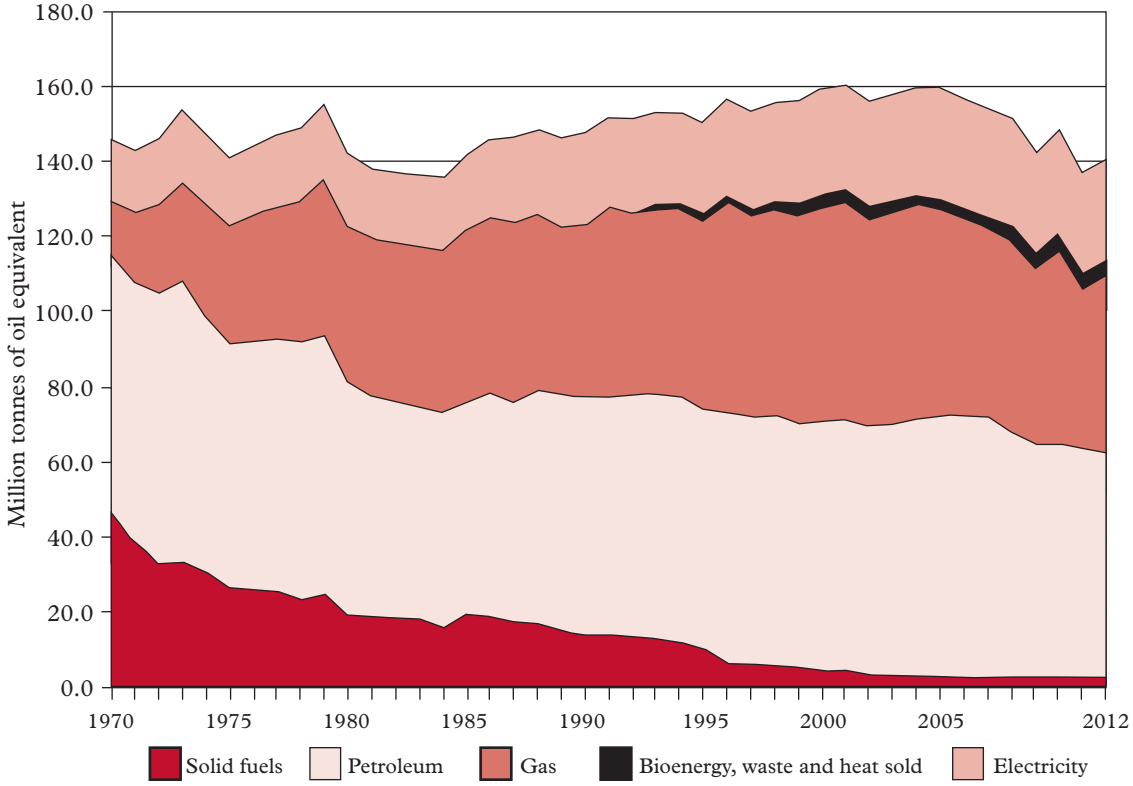
6. The second factor shaping the market is a long term shift in the UK's energy mix. The share of total energy demand provided by electricity and gas has grown as the role of manufacturing in the economy has declined. Since 1970 gas consumption has grown from 14.4 million tonnes of oil equivalent (mtoe) to 47.1 mtoe in 2012. Figure 2 shows trends in fuel consumption over the last four decades.

5 Sir Ian Wood (2014) *UKCS Maximising Recovery Review: Final Report*.

6 *Ibid*.

FIGURE 2

Final energy consumption by fuel, UK (1970 to 2012)

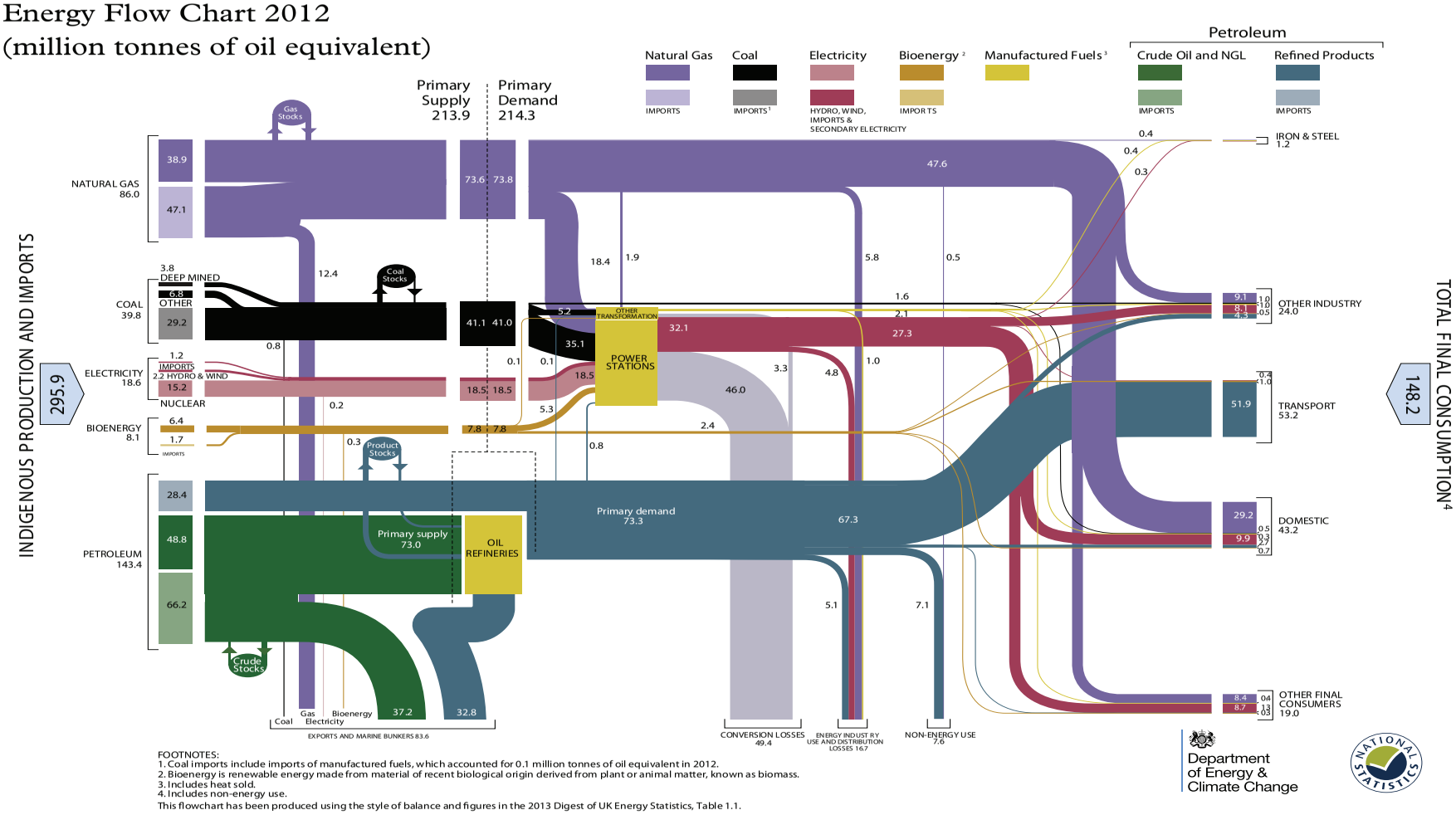


Source: DECC, ECUK Table 1.06

7. Figure 3 below illustrates the sources and uses of energy within the UK economy.

FIGURE 3

Energy Flow Chart 2012



FOOTNOTES:
1. Coal imports include imports of manufactured fuels, which accounted for 0.1 million tonnes of oil equivalent in 2012.
2. Bioenergy is renewable energy made from material of recent biological origin derived from plant or animal matter, known as biomass.
3. Includes heat sold.
4. Includes non-energy use.

This flowchart has been produced using the style of balance and figures in the 2013 Digest of UK Energy Statistics, Table 1.1.

Source: DECC, National Statistics

The impact of policy commitments to renewable and low-carbon energy

8. The third factor shaping the UK's energy mix is Government policy, including the Climate Change Act 2008 and the Energy Act 2013. This legislation reflects the UK's commitment to a long term reduction in carbon emissions by 2050 with intermediate targets for 2020, to be achieved by reduced use of coal and gas in power generation (except if carbon capture and storage technology can be used) and by supporting development of low carbon sources of supply including onshore and offshore wind power, solar, biofuels, and new nuclear.[7]

9. The development of alternative sources of energy will displace some gas. But, according to the most recent estimates from National Grid, substantial volumes of gas will still be needed over several decades for home heating and as back up supply in the power sector, where supplies from renewable sources such as wind and solar are inevitably intermittent.[8] Even if gas fired power generation is replaced over time by renewables and new nuclear, gas is likely to remain the main source of heat in the UK's economy. Mr Ken Cronin of the UK Onshore Operators' Group (UKOOG) reminded us that "Some 80% of our heat comes from gas."[9]

10. Renewables are therefore likely to complement rather than completely displace gas in the UK energy market. Natural gas remains an attractive and flexible fuel, capable of providing heat and power at a relatively low cost, thanks to advances in generation technology over the last twenty years and to the UK's established gas infrastructure including a comprehensive transmission grid with links to Europe. Gas also produces 28 per cent fewer emissions per unit of electricity produced than oil, and 45 per cent less than coal.[10] Regardless of whether the UK develops indigenous shale gas reserves, the UK is likely to be a substantial consumer of global shale gas as new supplies encourage gas-to-gas competition.

Gas prices

11. Gas prices have historically been set by long term contracts with producers—in the North Sea and elsewhere—with prices traditionally linked to movements in the international oil price. In recent years, however, this link has begun to break down and more gas is bought and sold at spot prices as the international trade in liquefied natural gas (LNG) has grown. In the short term prices have been falling, first in the US as shale gas development provided new and low cost sources of supply and more recently in Europe where gas to gas competition is undermining contracts which traditionally linked gas and oil prices. In a complex market, however, no particular trend can be guaranteed to persist.

Future price trends

12. There are widely divergent views on the future of global gas prices. A DECC report of July 2013 "Fossil Fuel Projections" argued that gas prices are

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7 The UK's climate change objectives are discussed further at paragraph 118.

8 National Grid (2013) *UK Future Energy Scenarios*.

9 Q 58.

10 DEFRA (2012) *Greenhouse house gas factors for corporate reporting*.

expected to settle at 73.8 pence per therm[11] in the 2020s, compared to 63.6 pence per therm now.[12] A second DECC report, commissioned from consultancy Navigant in 2012, estimated that 2030 prices would be in the range 50 to 80 pence per therm.[13] By contrast Professor Dieter Helm of Oxford University saw "no particular reason for believing that the gas price is going to go up in the medium term. There are quite good reasons for thinking that it is going to go down. It is abundant in supply".[14]

Costs of renewables

13. The change of the energy mix in favour of low carbon supplies as laid down by Government policy is not cost free. Hopes that the costs of renewables would fall materially as a result of large scale application have so far been disappointed, and the costs of new nuclear have risen dramatically to the point where the proposed new nuclear station at Hinkley Point will require a support price of £92.50 per megawatt hour, double the current wholesale price. The support price will be guaranteed and index-linked for 35 years after the station comes on stream. Critics of Government policy foresee a UK and European energy market locked into high cost renewables while global energy prices fall due to abundant new supplies of shale gas. Mr Peter Atherton of Liberum Capital said

> "If … in 2020 … the world is enjoying abundant and relatively cheap fossil fuels and very few of our major competitors have followed us on the decarbonisation strategy, so all the public is seeing is the costs and none of those benefits, it will be extraordinarily hard for policymakers to hold the current line on European energy policy."[15]

Electricity generation: the investment gap

14. The economics of power generation are heavily dependent on high load factors. The shift to renewable sources is not only expensive for consumers but also imposes a burden on other generators. Wind and solar power are by their nature intermittent. Constant supply of current requires back up generating capacity from conventional sources. Its limited usage can make it an unattractive investment. Professor Helm told us that once intermittent generation from sources such as solar and wind provides a substantial proportion of electricity, everything else on the system becomes intermittent as well. Gas fired capacity is used for only part of the time, undermining the economics and discouraging investment.[16]

15. Uncertainty over the economics of new conventional generating capacity and more generally about future public energy policy is discouraging investment at a time when older stations are reaching the end of their working lives or, in the case of coal fired stations, being decommissioned under environmental regulations. Viscount (Matt) Ridley, a science journalist, said, "Our policy is that, when somebody wants to make electricity, they will take the wind power

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11 A unit of heat equivalent to 100,000 British thermal units.

12 DECC (2013) *Fossil Fuel Price Projections*.

13 Rathbone, P., and Bass, R. (2012) *Unconventional Gas*, Navigant.

14 Q 117.

15 Q 199.

16 Q 125.

first and the gas second. They will only take the gas if the wind is not blowing. As a result, they are not going to build the gas plant because they cannot run it all the time."[17] OFGEM reported in 2009 that £200 billion would be needed by 2020 to ensure that capacity could meet demand.[18] More recently, the Government have estimated the electricity sector's investment needs at £110 billion over the next decade.[19] The slow pace at which that investment is proceeding is arousing serious concerns about the ability of generators to maintain sufficient supply to meet demand, particularly during periods of high use.

16. According to OFGEM's most recent Electricity Capacity Assessment report, the probability of a large shortfall requiring the controlled disconnection of customers, involving industrial and commercial sites before households, will increase from around 1 in 47 years in the last winter to 1 in 12 in 2015/16.[20] This will increase to 1 in 4 if anticipated demand reductions resulting from increased efficiency do not materialise.[21] There is a concern that inadequate capacity could lead to cuts in supply to business and industry which would have serious economic consequences.

17. Professor Helm described the situation as a "very slow-motion car crash"[22] and warned that

> "by 2015 or 2016, the capacity margin in this country will be very close to zero; in fact, I have done some numbers which suggests that it might be below zero. What is going to fill the gap in 2017, 2018, 2019 and 2020? We will be lucky if Hinkley is on the system by 2022 or 2023. More nuclear power stations are coming off between now and then. Most of the coal, through emissions control, thankfully, is being closed. There are not enough wind farms and solar panels to fill that gap in a credible way … it is inescapable that gas is a transitionary fuel and can actually make a big impact quickly."[23]

18. **There is a growing risk of power cuts in the UK as the margin of electricity generating capacity over peak demand shrinks. It reflects a lack of clarity and consistency in energy policy over many years. UK-produced shale gas could not, of course, contribute to a short term solution. Its development is a separate issue. Indigenous shale gas could, however, provide in the medium term an additional source of supply which, combined with policy changes to encourage investment in generating capacity, could help ensure that competitively priced electricity supplies are maintained at an adequate level for many years to come.**

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17 Q 153.

18 OFGEM (2009) *Project Discovery, Energy Market Scenarios*, 9 October.

19 See https://www.gov.uk/government/policies/maintaining-uk-energy-security--2/supporting-pages/electricity-market-reform for the Government's estimate.

20 OFGEM (2013) *Electricity Capacity Assessment Report 2013*.

21 *Ibid.*

22 Q 125.

23 Q 121.

Security of supply

19. In the absence of shale gas development, imports will rise. By 2030, DECC has forecast that the UK could be importing three quarters of its gas.[24] The Institute of Directors estimates the costs of such imports at £15 billion per annum.[25] The IoD report's central scenario for UK shale gas production suggests that gas imported could be reduced to 37 per cent of consumption in 2030, with the cost of imports falling to £7.5 billion which "would assist with the UK's balance of payments and support energy security".[26]

20. Some witnesses believed that even without domestic shale gas, the UK was well placed to withstand any disruption in supply. E.ON wrote that the UK is part of a "well connected and liquid market [therefore] relatively insulated from supply-side shocks."[27] Mr Richard Sarsfield-Hall said that Poyry International Consulting Engineers "did some work for the Government a couple of years ago that looked at the security of gas supply. We identified that broadly because of its diversity, it looked very secure."[28] Policy Exchange thought that arguments about energy security have "tended to be overplayed in the UK policy context."[29]

21. DECC wrote that increasing reliance on imported gas "can expose the UK to new gas supply risks, whether from geopolitical events … or from diversions of gas supplies driven by higher prices in other markets … Onshore unconventional production could mitigate these risks."[30] The Chemicals Industries Association (CIA) expressed the view that development of the UK's indigenous shale gas would "certainly" have a positive impact on security of supply, not least because, when supplies are tight, LNG shipments are always liable to be diverted from the UK to markets willing to pay a higher price.[31]

22. INEOS highlighted the strategic risks associated with import dependence on supplies from the Middle East and Russia.[32] Recent events in Ukraine and the resulting tensions between Europe and Russia demonstrate how real these risks are. Europe imports over 25 per cent of its total energy needs and over 30 per cent of its gas supplies from Russia.[33] The UK is not directly dependent on Russian supplies but in an integrated market we would not be immune from shortages or price increases across the European Union. After the US and European Union imposed sanctions on Moscow, the Minister for Energy reportedly described the situation in Ukraine as "a wake-up call to Europe of the need to develop more energy sources of all kinds. We can't be more and more dependent on imports from unstable regions … We have to develop more home grown energy like shale."[34]

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24 Taylor, C. Lewis, D. (2013) *Infrastructure for Business: Getting shale gas working*, Institute of Directors.

25 *Ibid.*

26 *Ibid.*

27 E.ON.

28 Q 16.

29 Policy Exchange.

30 DECC.

31 Chemical Industries Association.

32 INEOS.

33 BP (2013) *BP Statistical Review of World Energy June 2013.*

34 Critchlow, A. (2014) 'Fallon calls for refocus on 'homegrown' shale energy', *Daily Telegraph*, 23 March.

Compatibility with development of low carbon forms of energy

23. Concerns have been expressed by NGOs that development of the UK's indigenous shale gas resource could lead to higher carbon emissions and lock the UK into a gas based economy for longer than compatible with the Government's targets for emissions reductions. Mr Nick Molho of WWF-UK said "Our organisations are opposed to the development of shale gas in the UK mainly on grounds relating to climate change".[35] He added:

> "To the extent that those [UK] reserves are brought out of the ground and encouraged to be used in our gas power stations and gas infrastructure, the most likely scenario is that this will displace low-carbon generation … [It would be] … a very dangerous mistake to associate exaggerated hopes on the future of UK shale gas exploitation with a policy that will encourage the construction of excessive amounts of new gas infrastructure, because the most likely outcome will be a continued high dependency on imports".[36]

We address the topic of shale gas and carbon emissions more fully in Chapter 6.

24. Some witnesses took the view that exploitation of the UK's own shale gas resource would displace imported gas rather than renewable energy. Mr Dan Lewis, CEO of Future Energy Strategies, said his company's economic modelling indicated that shale gas imports would be displaced by indigenous shale gas production, while renewables and nuclear would not be displaced because of the levels of subsidy for those forms of electricity generation through the Electricity Market Reform (EMR).[37] Mr Ken Cronin of the UK Onshore Operators' Association (UKOOG) said that the renewables industry should not have any fear of shale gas development: "Shale gas will give the opportunity for a transition to enable renewable energy to become cost-competitive."[38]

25. Dr Figueira of the Office of Unconventional Oil and Gas (OUOG) explained that "in terms of decarbonising the electricity system … there will be a continued need for gas in the decarbonisation efforts".[39] Mr Cronin told us that "the facts are that we will need low-carbon forms of energy for the future … They are quite expensive at the moment, and we need to have a transition. The transition has to be gas, and it will have to be shale gas."[40]

Gas prices and energy intensive industries

26. Substitution of locally produced gas for imports could also have some effect on prices due to the added costs of processing and transporting imported LNG. Mr Dorner of the International Energy Association told us that "the cost of transporting gas is about seven times that of transporting oil on an energy-equivalent basis" and that the costs involved in transport would continue to be the main factor causing final gas prices to diverge between one

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35 Q 33.

36 QQ 43–44.

37 Q 66.

38 *Ibid.*

39 Q 179.

40 Q 62.

region and another.[41] Gas prices and the wider economic impact are discussed more fully in Chapter 5.

27. Rising energy costs pose a particular challenge for energy intensive sectors such as metals and for the petrochemicals industry, where gas is a feedstock. The International Energy Agency published a study in 2013 that showed how far European costs have risen and diverged from those in other parts of the world and warned of the risk that industries could move to areas where energy costs are lower.[42] Mr Tom Crotty of INEOS said "we have to sell our products globally. Today, the cost of energy in the UK is three times that in the US and three times that in the Middle East. They are our two major competitors for the manufacture of petrochemicals."[43]

28. **Development of shale gas in the UK on a significant scale could provide substantial benefits:**

- **enhancement of energy security through a decreased reliance on imports;**
- **an affordable bridge fuel towards renewables-based electricity generation;**
- **enable decommissioning of high-emission coal fired generating capacity;**
- **reduce the risk of gas price increases or even lead to falls in prices;**
- **reduced costs for energy intensive businesses and the petrochemicals sector that also use gas as a feedstock.**

41 Q 98.

42 International Energy Agency (2013) *World Energy Outlook*.

43 Q 89.

CHAPTER 3: THE US SHALE GAS REVOLUTION AND ITS GLOBAL ECONOMIC IMPACT

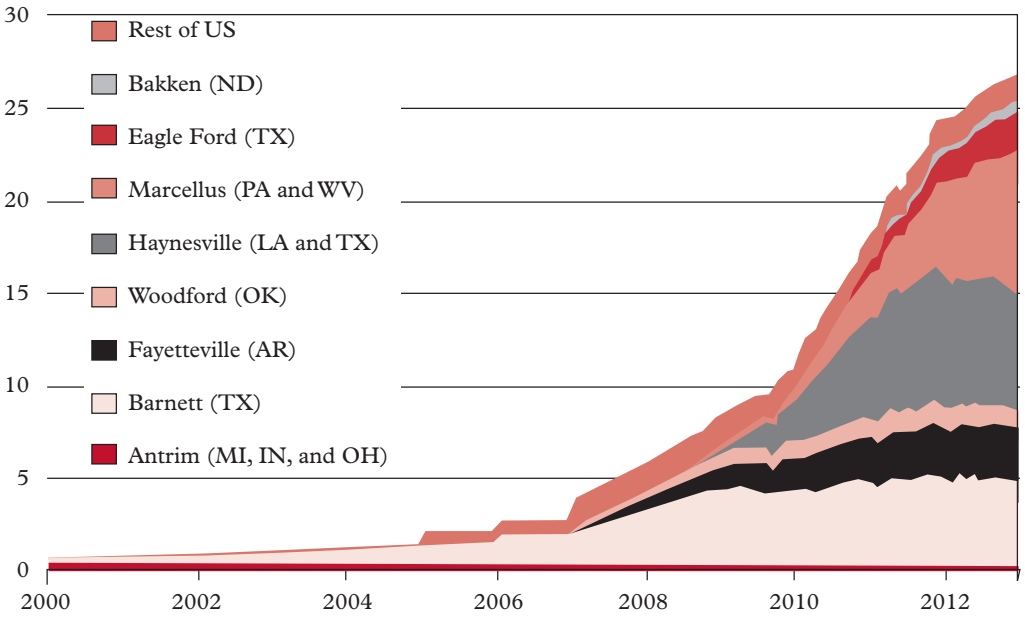
Development of shale

29. Over the last five years total gas production in the US has grown by 25%[44] and oil production by 60%—an increase in absolute terms of 3 million barrels per day. This amounts, in Professor Dan Yergin's words, to "more than the output of 9 of the 12 OPEC nations".[45]

FIGURE 4

Domestic Production of Shale Gas in the US

Shale gas production (dry) billion cubic feet per day (LCI Energy Insight gross withdrawal estimates as of January 2013)



Source: U.S. Energy Information Administration (March 2013)

30. Increased US output is thanks to hydraulic fracturing technology which has made possible the production of both shale gas and tight oil (oil trapped in shale rocks). As a result, US oil production is now at its highest level since 1989[46] and shale gas constituted 35 per cent of total US gas production in 2012.[47] These trends seem likely to continue: the US Energy Information Administration has estimated that shale gas will account for 50 per cent of total US gas production by 2040.[48] It also estimated last year that the United States would be the world's top producer of petroleum and natural gas hydrocarbons in 2013, surpassing Russia and Saudi Arabia.[49] According to

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44 Q96.

45 See http://theenergycollective.com/jessejenkins/344901/daniel-yergin-looking-back-and-forward-big-trends-energy for Dan Yergin's speech to the 2014 MIT Energy Conference on 21 February.

46 US Energy Information Administration (2014) *This Week in Petroleum*, 12 March.

47 See http://www.eia.gov/dnav/ng/ng_prod_sum_dcu_NUS_a.htm for US natural gas production figures.

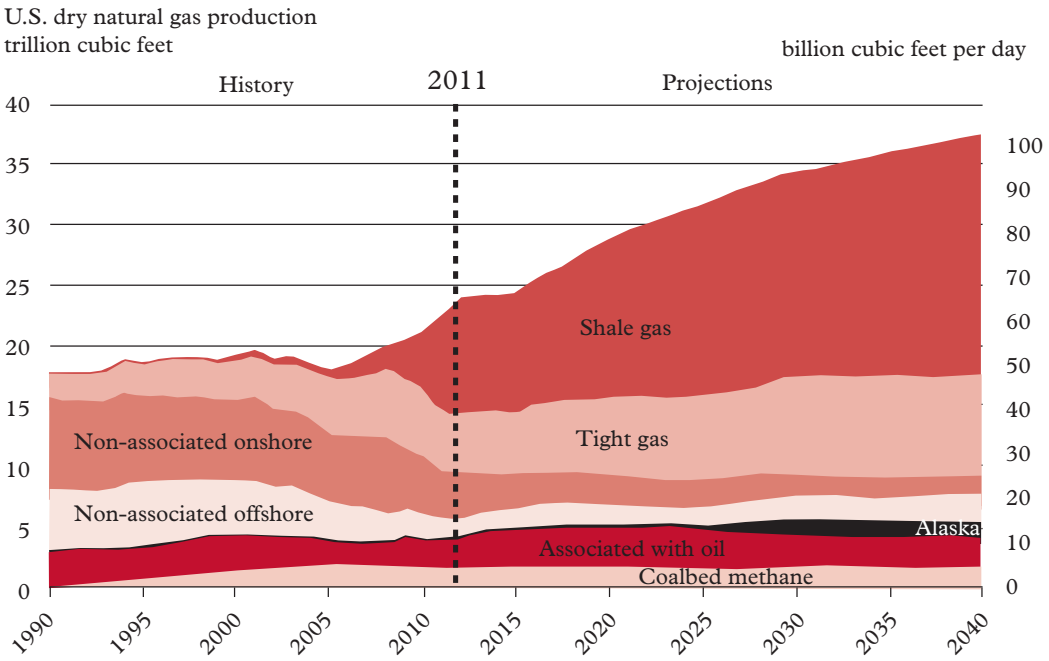
48 US Energy Information Administration (2013) *Annual Energy Outlook 2013*.

49 US Energy Information Administration (2013) 'US expected to be largest producer of petroleum and natural gas hydrocarbons in 2013', 4 October.

the latest BP Energy Outlook, North America (the US, Canada and Mexico) is expected to switch from being a net importer of energy to a net exporter in 2018.[50]

FIGURE 5

Shale gas leads growth in total gas production through 2040

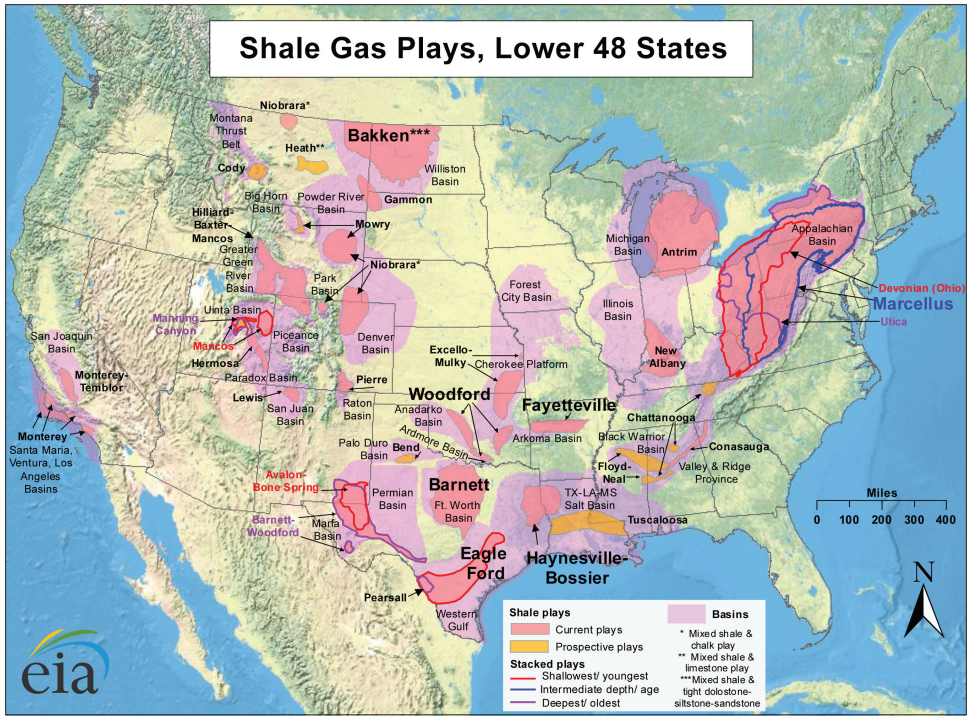


Source: U.S. Energy Information Administration (March 2013)

[50] BP (2014) *BP Energy Outlook 2035*, January 2014.

FIGURE 6

Map of US shale gas activity



Source: U.S. Energy Information Administration based on data from various published studies.
Updated: May 9 2011

Source: U.S. Energy Information Administration (May 2011)

31. Development of US shale reserves has been building over the last three decades from a very low base, as Professor Paul Stevens[51] and EDF[52] told us, with a strong acceleration after 2008. The rapid expansion of the last few years has been helped by the well established infrastructure network into which both shale gas and tight oil supplies can easily be absorbed, by an experienced and flexible oilfield service sector and by the incentives provided by a legal structure within which landowners benefit directly from development. Professor Alan Riley told us that "the land owners own the subsoil rights. That creates substantial incentives to develop. There is also a regulatory industry that is very familiar with all the technology … that gives the US immense advantages."[53]

32. Growth in production in recent years has come from use of horizontal drilling—a technology originally developed within the oil industry.[54] In 2012 for example the US completed over 45,000 oil and gas wells.[55] Of those, more than 4,000 were shale oil wells.[56] Across the rest of the world,

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51 Professor Paul Stevens.

52 EDF.

53 Q 1.

54 Wang,Z. and Krupnick, A. (2013) 'A Retrospective Review of Shale Gas Development in the United States', *Resources for the Future*, RFF DP 13–12.

55 Maugeri, L. (2013) *The Shale Oil Boom: A US Phenomenon*, Belfer Centre for Science and International Affairs, Harvard Kennedy School.

56 *Ibid.*

excluding Canada, only 3,921 oil and gas wells (both conventional and unconventional) were drilled.

33. Operators can produce commercially-prized oil and natural gas liquids (NGLs) associated with shale gas. Although the scale and speed of shale gas development led to a period of oversupply by 2011/12, with prices falling as low as $2 per million British thermal units (MMBtu),[57] and some wells were temporarily shut, overall development of the shale industry continued because of the value of the associated products. *The Economist* reported in November 2013 that gas exploration in the US was "increasingly being determined by the prices of oil and natural gas liquids. If they are high enough, energy firms will drill for these, treating natural gas as a by-product".[58]

34. Dr Chris Wright, one of the US's leading shale gas entrepreneurs, confirmed that the development of the industry had been led by smaller companies: "There were no big oil companies involved at all in the development of shale gas … It is not a game for big companies. Every rock is different; every rock you have to innovate".[59] High capital costs involved in drilling multiple wells have however led to a subsequent process of consolidation with larger oil and gas companies entering the market once shale gas resources are confirmed and investment becomes less risky, as EDF noted.[60]

35. **Shale development has transformed energy supply in the US. It is now forecast that North America (including Canada and Mexico) will be more than self sufficient in energy within a decade.**

US gas prices and industrial investment

36. US natural gas prices have fallen and have only recently begun to stabilise at a level less than the price prevailing a decade ago.

FIGURE 7

US Natural Gas Prices

Source: www.bp.com

57 US Energy Information Administration (2012), 'Average spot natural gas prices declined during the first half of 2012', 9 August.

58 (2013) 'From sunset to new dawn', *The Economist*, 16 November.

59 Q 231.

60 EDF.

37. Abundant low cost supplies of natural gas have encouraged substitution, particularly in the power sector where gas has displaced large amounts of coal, and pre-empted any renaissance of the US nuclear sector, as Mr Thierry Bros of Société Générale told us.[61] Falling energy prices are encouraging the repatriation (or "reshoring") of energy intensive businesses including petrochemicals. Mr Tom Crotty of INEOS said "There has been no new investment in the petrochemical industry in the United States for 25 years. There are now 11 major facilities under construction and another seven in the planning phase."[62] European firms are also reported to be moving production to the US.

38. According to Dr Howard Rogers of the Oxford Institute for Energy Studies, "what has rejuvenated the petrochemical industry in the US is not so much the natural gas … but the co-production of ethane, propane, butane and the higher alkanes, which are the traditional feedstock components for petrochemicals".[63] In Dr Wright's view, "the energy-cost advantage of the US [as a result of shale gas development] over China more than offsets the labour cost disadvantage in energy-intensive manufacturing."[64] Professor Riley told us that, with US gas prices at about $3.50 MMBtu against prices of $10 to $12 in Europe, the competitive advantage of the US in energy intensive sectors is now very significant.[65]

39. Shale gas and associated "tight" oil developments have contributed to the revival of the US economy after the financial crisis of 2008, providing employment and a material benefit to the balance of payments. According to an IHS report, by 2012 in the US, the unconventional oil and gas sector and energy-related chemicals activity was supporting 2.1 million extra jobs and had added $284 billion to US GDP.[66]

Global impact of the US shale gas revolution

40. The US shale revolution is also beginning to have a significant impact on global energy markets. Before 2008 the US was expected to be importing significant volumes of natural gas in the form of LNG. This gas has now been diverted to other importers in Asia and in Europe, with added supplies creating an element of gas to gas competition. With coal prices within the US reduced through competition with low-cost gas, US coal exports have increased over recent years, not least to Europe. The result has been increased coal use for electricity generation. For example, US exports of coal to the UK increased from 6.8 million short tons in 2011 to 12 million short tons in 2012;[67] coal's share of electricity generation in the UK rose from 30 per cent in to 39 per cent over the same period.[68]

41. The global impact is expected to be greater as the US and Canada open their markets and permit gas exports. By February 2014 thirteen proposals for

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61 Q 105.

62 Q 91.

63 Q 132.

64 Q 230.

65 Q 1.

66 IHS (2013) *America's New Energy Future: The Unconventional Oil and Gas Revolution and the US Economy*.

67 Figures obtained from US Energy Information Administration Quarterly Coal Reports for 2011 and 2012, see http://www.eia.gov/coal/production/quarterly/.

68 DECC (2013) *Digest of United Kingdom Energy Statistics 2013*.

LNG export terminals had been submitted and 36 applications to export domestically-produced LNG had been made to the US Department of Energy, of which 32 have been approved.[69] Mr Dan Dorner of the International Energy Agency (IEA) reported approval of a number of LNG export facilities and licences "and we are expecting more significant volumes to come forth towards the end of this decade."[70] He said the IEA have estimated that the US will be a net exporter of 50 billion cubic metres per year by 2045.[71] According to Société Générale, although "a wide variety of authorisations are needed before a liquefaction facility can be built in the US",[72] LNG exports are likely to begin as early as 2016 and the US and Canada could be exporting 67 billion cubic metres a year by the 2020s.[73]

42. In the short term US gas exports are likely to flow to Asia[74] where prices have been strong as a result of the cut back in the Japanese nuclear supply following the Fukushima disaster in 2011.[75] The gas market remains regional but is linked by the trade in LNG; falls in prices in any region are likely to affect supply and prices across the world.

43. It is not yet clear just what the long-term impact of the US shale revolution will be on global energy markets. The impact on global prices is not expected to as dramatic as in the US. Mr Dorner said

> "before 2008 the regional differentials between North America, Europe and Asia were relatively close when it came to gas prices. From 2008–09 onwards, the differential really expanded very rapidly as US gas prices stayed very, very low, while European prices, and even more so Japanese prices, increased … shale gas and the significant forthcoming quantities of shale gas in the US have made a really big difference … it is becoming a little bit more of a buyer's market when it comes to gas."[76]

In Professor Helm's view

> "The transmission mechanisms from US shale gas to world markets are many, varied, quite complicated, and typically poorly understood, so the impact of US shale gas on world gas prices is, and is likely to remain, very limited. Even if the US develops all the LNG projects that are currently in the pipeline, they are not enough to make much difference to the world price. If anyone thinks that US shale gas is about to reduce UK gas prices, the answer is that it is very unlikely."[77]

Professor Riley's view was that gas imported from the US would probably come into the UK or European markets "at around what we pay at the moment".[78]

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69 Resnik, B. (2014) 'US push for LNG exports', *LNG Industry*, 28 February.

70 Q 99.

71 *Ibid.*

72 Société Générale.

73 *Ibid.*

74 Q 205.

75 UKOOG.

76 Q 96.

77 Q 115.

78 Q 9.

Climate change and the environment

44. One important effect of shale gas development in the US has been to reduce greenhouse gas emissions by displacing coal. US emissions of carbon dioxide are now back to their 1994 levels,[79] even if a part of this gain is offset as low prices encourage other countries to use more coal.[80]

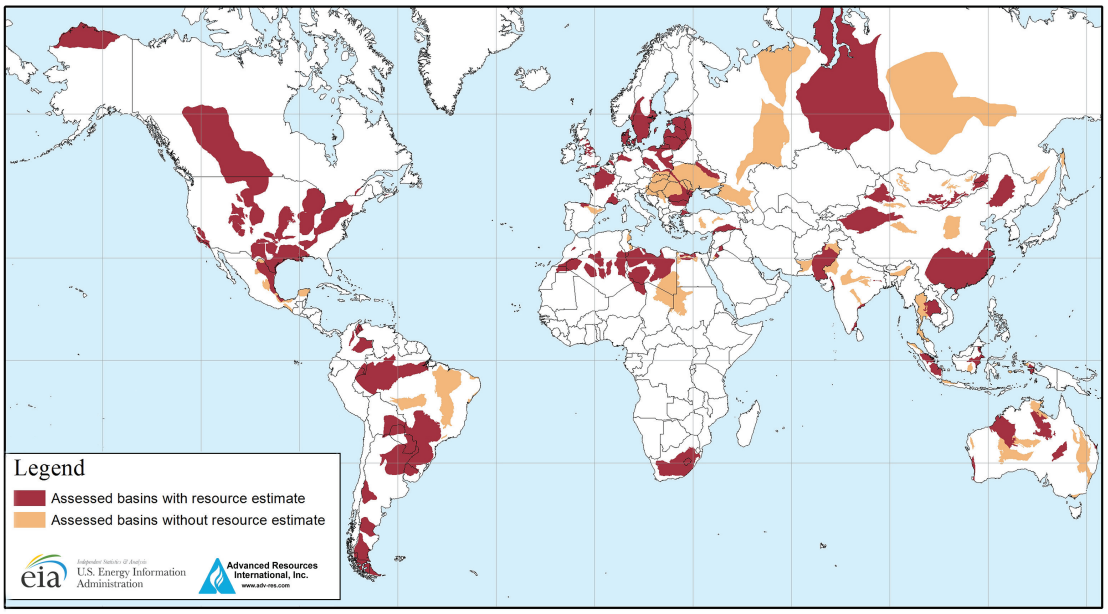
45. Shale gas development has at times been controversial. There have been high profile campaigns against specific drilling plans and against hydraulic fracking itself. Local concerns remain and in some areas fracking has been effectively halted. But the impact of anti-fracking campaigns has been limited and has not prevented rapid development of the industry across the US.

Shale gas and oil outside the US

46. The shale gas revolution which began in the United States is likely to spread throughout the world:

FIGURE 8

Map of Worldwide Basins



Source: U.S. Energy Information Administration (June 2013)

47. Few countries have the readily available services or infrastructure of the United States. Technology, however, continues to advance, making widespread development more likely. Professor Muller said "A belief by the experts in the United States is that the efficiency of fracking is going to double in the next few years and in the next 10 years will double again."[81] As Mr Graeme Smith of Shell told us "The technology is developing very rapidly … we are trying to reduce the amount of chemicals that are used and just use pure water for fracks, or indeed no water."[82]

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79 Viscount (Matt) Ridley.

80 See paragraph 40.

81 Q 47.

82 Q 100.

48. Dr Wright saw Canada as the second major source of shale gas supplies, with other countries likely to follow: "Canada will become a massive shale gas producer … China is certainly going at it hard … Argentina and Russia have tremendous quality shale rocks … Tunisia, Algeria, Turkey, Colombia, the United Kingdom and several others have what look to be very promising rocks".[83] Professor Helm agreed that shale gas development would spread beyond the US:

> "We cannot know in advance in any detail what these resources are like until we have done some drilling. Argentina … Russia … Ukraine … Algeria … Saudi [Arabia. [It would be] … a complete illusion to think that in the medium term this is a US phenomenon … The Algerian deposits look to be enormous."[84]

49. For many countries development of shale gas and tight oil offers the prospect of reducing import dependence and providing jobs, although few will be able to match the US scale of operation. The International Energy Agency have forecast that shale gas will provide around 15 per cent of global gas production by 2030, including supplies from Australia, China and Argentina as well as from the US.[85] Global production of tight oil is also expected to grow, led by the United States where the estimate of resources in place was raised last year from 35 to 58 billion barrels.[86]

50. Shale gas could have a profound impact on the strategic balance of energy trade, with possible geopolitical consequences: Professor Riley told us that "some 80% of all the oil and gas in the planet is in OPEC and Russia, and 10% in OECD counties and China … the shale gas revolution potentially implodes that ratio and changes the geo-strategic energy balance of the planet."[87]

51. **The US shale gas revolution has already had far-reaching effects but the full impact on world energy markets has yet to be seen:**

- **low US gas prices have displaced US coal to other markets and as a result, coal consumption in both Germany and the UK has risen in the last two years;**
- **reduced import requirements have diverted gas from the US and have limited price increases in the international market;**
- **US exports of natural gas are likely to have a greater effect on the patterns of global trade; so too, in the longer term, would the development of large volumes of shale gas in other countries;**
- **if developed at scale internationally, shale gas and shale oil could alter the balance of the international energy market as a whole and undermine the dominant role of energy exporters in the Middle East and Russia, as the pattern of production and trade in oil and gas is redrawn.**

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83 Q 233.

84 Q 116.

85 International Energy Agency (2012) *Golden Rules for a Golden Age of Gas*.

86 US Energy Information Administration (2013) *Annual Energy Outlook 2013 Assumptions Report*.

87 Q 1.

CHAPTER 4: SHALE GAS IN THE UK

General

52. There is nothing new about producing hydrocarbons from the United Kingdom's extensive shale deposits, as the history of the 19th century Scottish shale oil industry shows. It petered out in the 1950s because it could no longer compete in the market. There was no commercial interest in shale gas or oil because there was no technology to exploit it effectively. The picture was transformed by the shale gas revolution in the US and its spectacular success in producing abundant, cheap shale gas and oil by horizontal drilling and hydraulic fracturing. The US experience rekindled interest in the economic potential of shale in the UK.

Differences between the US and the UK

53. Shale gas development in the UK is likely in some ways to be similar to the US experience: for example concerns on environmental impact. There are also many differences of geography, experience, supply chain, regulation and public attitudes between the two countries.

Resource

54. Professor MacKay, Chief Scientific Adviser, DECC, told us "you can fit the entire United Kingdom in the Marcellus shale area in the USA alone."[88] Professor Richard Davies told us however, "the [UK] shale is … much thicker than US shales, so perhaps we will see that some of the UK wells produce more gas than the ones in the United States."[89]

55. In June 2013, the US Energy Information Administration (EIA) estimated the US's technically recoverable shale gas resources as 665 trillion cubic feet (tcf).[90] It also quoted an alternative estimate by Advanced Resources International (ARI), an energy consultancy, of 1,161 tcf.[91] (The EIA explain that technically recoverable resources represent the volumes which could be produced with current technology, irrespective of prices or production costs).

56. There is only one current figure for the UK's shale resource, the British Geological Survey's (BGS) central estimate of 1300tcf gas in the ground in the Bowland shale basin.[92] Forthcoming studies may add to it. There are not yet estimates of how much might be technically recoverable. Although the UK's shale resource may be smaller than in the US, it is nevertheless likely to be substantial, especially if thicker shale deposits in the UK produce more gas from a given area.

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88 Q 209.

89 Q 127.

90 US Energy Information Administration (2013) 'Technically recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States', 10 June.

91 *Ibid.*

92 Andrews, I.J. (2013) *The Carboniferous Bowland Shale gas study: geology and resource estimation*, British Geological Survey for Department of Energy and Climate Change, London, UK.

Population density

57. Mr Wright told us that in the US, fracking was accepted even in densely populated areas: "fracturing in densely populated urban areas and remote wilderness areas was not problematic". He recalled "fracturing over a dozen wells in Beverly Hills and nearby Los Angeles."[93] In the narrow confines of the UK, there is more public concern and resistance. Mr Atherton said that in the UK, "It is the local issues that are holding it up and the fear that the companies have."[94] We consider public acceptability of fracking in the UK more fully from paragraph 77 below.

Experience

58. The UK is a major offshore oil and gas producer in the North Sea. Wytch Farm in Dorset is Western Europe's largest onshore oilfield and has produced successfully for decades in an area of outstanding natural beauty without arousing controversy. The US nevertheless has far more experience of onshore oil and gas exploration and production. According to Bloomberg "the vast majority of high-horsepower rigs and pressure pumping systems needed to frack are in North America."[95] Professor Muller said, "The UK and China has this enormous advantage that that you can now build on our … 15 years of horizontal drilling, multi-stage fracking in the US."[96] Mr Andrew Austin, CEO of IGas Energy, did not see any barrier to the successful development of the necessary supply chain, "if we can give them the confidence from early results we will get the supply chain to follow."[97]

Regulation

59. The regulatory framework in the US and the UK is radically different. Professor Muller told us that in the US, "there are no national regulations on fracking. There are state regulations".[98] In the UK, by contrast, there is national regulation by several Government departments and agencies as well as local authority planning controls. We heard evidence that the UK's regulation is more rigorous than that of the US. But, Wytch Farm apart, the UK's system has not been tested by widespread onshore exploration and production. In the UK the EU dimension to regulation could cause more uncertainty and complication. We examine the UK's regulatory framework in Chapter 8 below.

Ownership of petroleum rights and permissions to drill

60. In the US landowners own subsurface mineral rights. Operators therefore have to negotiate permission from the landowner to drill for and extract petroleum. Mr Peter Hughes of Peter Hughes Energy Advisory told us "Individuals and landowners are incentivised not to stand in the way of this because they own mineral rights. A lot of people in the US have made an awful lot of money by virtue of owning land under which there was

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93 Chris Wright.

94 Q 206.

95 Bloomberg.

96 Q 47.

97 Q 89.

98 Q 47.

considerable shale gas."[99] Mr Wright said "it helps enormously that [US] landowners own those royalty rights".[100] None of our witnesses cited recalcitrance on the part of US landowners as an obstacle to exploitation of shale gas and oil. The speed and scale of the industry's development in the US suggests that any opposition by landowners has been limited.

61. In the UK, the owner of the surface of land is also the owner of the strata beneath it, including any minerals present unless common law or statute has vested ownership of these in someone else.[101] Parliament, however, granted ownership of all subterranean petroleum to the Crown in 1934.[102] Operators are therefore required to obtain a licence from the Government to search for and produce gas and oil.[103] The Supreme Court recently held in *Star Energy v Bocardo* that an operator would be committing a trespass unless he had also received permission from the landowner to drill underneath his land.[104] Rt Hon Owen Paterson MP, Secretary of State for the Environment, told us "Coal seams run under land owned by a whole range of landowners … I do not see why we cannot, with a bit of wit and good will, come to a similar arrangement for shale."[105]

62. We would expect that an operator in the UK would normally secure a landowner's permission to drill under his land in return for a payment, as in the US. If a landowner in the UK refuses permission to drill underneath his land, operators can acquire rights compulsorily using a rarely used procedure[106] in the Mines (Working Facilities and Support) Act 1966. This requires the operator to apply to the responsible Minister for a referral to the High Court which will assess the claim and if granted, determine compensation for the landowner. The Supreme Court in *Star Energy v Bocardo* determined that such compensation would be nominal as drilling deep beneath land would not be regarded "as an interference with any actual existing right or as involving any loss of amenity value or at any rate not such an interference as required more than essentially nominal compensation."[107] The landowner in *Star Energy v Bocardo* was awarded £1000.

63. In October 2013, Greenpeace launched a campaign to encourage landowners close to possible drilling sites to state explicitly that they would not allow hydraulic fracturing under their land.[108] They called this a "legal block": without permission, "fracking companies would be acting unlawfully if they were to drill under your home."[109] Operators could, however, use the procedure described above compulsorily to obtain rights (with nominal

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99 Q 204.

100 Q 229.

101 *Star Energy Basin Limited v Bocardo SA* [2010] UKSC 35.

102 Petroleum Act 1934 (since replaced by the Petroleum Act 1998).

103 See paragraph 193 for further detail.

104 *Star Energy Basin Limited v Bocardo SA*, *Op. Cit.*

105 Q 269.

106 Evidence given by Star Energy at the trial in the *Star Energy v Bocardo* case stated that although deviated or directional drilling had been common industry practice for some years, they were not aware that any onshore oil company had applied for ancillary rights to permit deviated drilling on UK onshore operations.

107 *Star Energy Basin Limited v Bocardo SA, Op. Cit.*

108 See http://www.greenpeace.org.uk/blog/climate/don%E2%80%99t-want-your-home-fracked-just-say-no-20131014 for a blog entry on the Greenpeace website that discusses the campaign.

109 See http://www.greenpeace.org.uk/blog/climate/don%E2%80%99t-want-your-home-fracked-just-say-no-20131014 for a blog entry on the Greenpeace website that discusses the campaign.

compensation), though after delay and costs incurred while permissions were sought from the High Court.

64. In April 2014 it was reported that the Government might put forward in the Queen's Speech changes to the law of trespass to allow operators to exploit gas reserves under privately-owned land even if the owners object.[110] **We recommend that the Government should amend relevant legislation to ensure that subsurface drilling for oil and gas can go ahead without undue delay or cost. This change should ensure that the fact that UK landowners do not own petroleum rights makes little difference to the speed of shale gas and oil development; in practice, it may even make subsurface drilling under third party land easier in the UK than it is in the US.**

The UK's shale resource

65. Terms used include:

- resource, or total resource, or gas-in-place (GIP) refer to the volume of gas trapped in shale rock; the British Geological Survey uses this measure;
- technically recoverable resources are the estimated volume of gas that can be extracted; US agencies use this measure;
- reserves are the part of the resource deemed to be commercially (or economically) recoverable; this is the measure of most interest to industry.

66. DECC has commissioned studies by the British Geological Survey (BGS) of shale deposits in "prospective" areas (those thought most likely to contain shale gas and oil resources). Studies by the BGS of the Bowland-Hodder shale, roughly the area between Nottingham and Scarborough in the east and Wrexham and Lancaster in the west, were published in 2010 and in July 2013.[111] The BGS's central estimate is of 1300tcf gas in place. Professor Mike Stephenson told us:

> "there are parts of Britain where there is no point in [carrying out a survey] because there is simply no shale. There are other areas where it is worth a look: the Weald … is being done at the moment … The intention is to look at the central lowlands of Scotland after that … it is sensible to concentrate in the areas that have the most potential."[112]

The Scottish Government last year launched a consultation document on planning policy.[113] It has convened an Independent Expert Scientific Panel on unconventional oil and gas to provide a base for further policy development.[114] Figure 9 shows the principal shale-bearing areas of the UK being assessed by the BGS. As this report went to print, it was expected that BGS and DECC would soon publish a report on the shale gas and oil resource in the Weald basin.

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110 Elliot, F. And Charter, D. (2014) 'Fracking to go ahead under homes even if owners object', *The Times*, 2 April.

111 Andrews, I.J. (2013), *Op. Cit.*

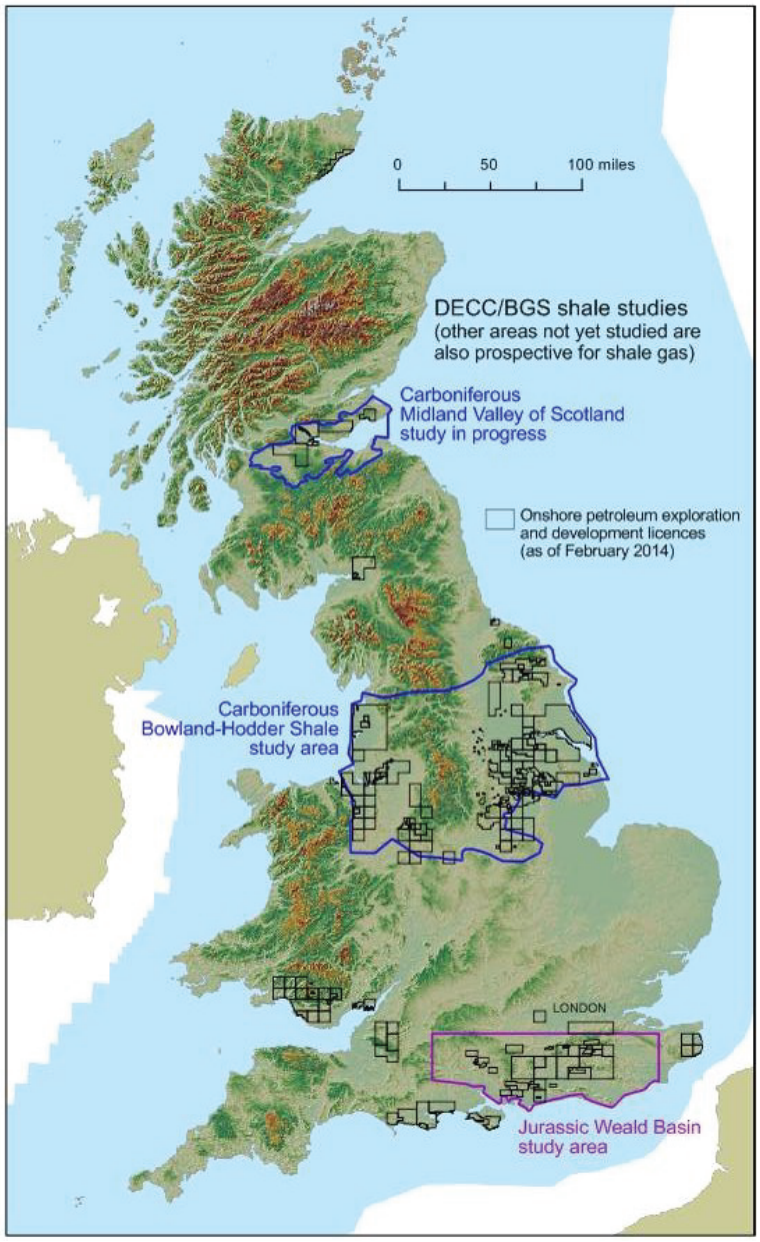
112 Q 24.

113 Scottish Government (2013) *Draft Scottish Planning Policy for Consultation*, 30 April.

114 Scottish Government (2014) *Scottish Planning Policy: Scottish Government Position Statement*, 6 January.

FIGURE 9

The UK's Principal Shale-Bearing Areas



Source: DECC, February 2014

This map shows the three areas where the BGS has undertaken studies on behalf of DECC to estimate the shale gas resource:

- Bowland-Hodder—completed, report published July 2013
- Weald Basin—publication expected shortly
- Midland Valley of Scotland—in progress

67. The UK may also have substantial resources of shale gas offshore. Mr Richard Sarsfield-Hall of Poyry told us that "there is a great potential offshore that has not really been investigated."[115] Mr Figueira said that "the costs of offshore shale development are of an order of magnitude significantly above those onshore. That has generally been the reason why we have not

[115] Q 12.

pursued that as a priority."[116] It was however reported in February 2014 that DECC had awarded licences for exploration in the Irish Sea to Nebula Resources. Dr Chris Cornelius of Nebula was reported as believing that a considerable quantity of gas was in place: "Is any of that exploitable? That's the billion dollar question and we won't know that for many years."[117]

68. There may also be some scope to exploit offshore shale gas by horizontal drilling from the shore. Professor Alan Riley of City University said "we may be able to do inshore drilling from the shore outwards quite significantly."[118]

Resource estimates

69. Professor Riley said "we just do not know the scale of the resource base."[119] Mr John Williams of Poyry said "Until there is more evidence … the jury is out."[120] BGS estimates for the Weald and central Scotland, not yet known, are likely to add to the 1300tcf estimated for Bowland, as might offshore gas resources. The Weald may also have natural gas liquids or shale oil. Ms Toni Harvey (DECC) told us that "The experience from America is that every shale play is different and that it varies dramatically from basin to basin".[121] The Weald was "likely to be mostly [shale oil] liquids."[122] Meanwhile initial studies of UK rocks by geologists at Imperial College have produced encouraging results. According to a report in the *New Scientist*, "A study of 200 samples from shale rock formations throughout England suggest that they contain as much oil and gas per cubic metre as rocks under the North Sea once did."[123] Project leader Alastair Fraser from Imperial College is quoted as saying, "The onshore shales are rich enough in organic material and have the right petrology for hydraulic fracturing."[124]

Economically recoverable reserves

70. With estimates of the UK's shale gas resource still incomplete, and little or no exploratory drilling and appraisal yet undertaken, there are no well-grounded assessments of economically recoverable reserves of shale gas. Most guesses seem to take as their starting point the central BGS resource estimate of 1300tcf in the Bowland basin and extrapolate drawing on experience in the US. A widely held assumption is that about 10%, or 130tcf, or more, of the Bowland resource might be economically recoverable, equivalent to between 40 and 50 years of UK gas consumption. Mr Philip Lambert of Lambert Energy Advisory said "[if] you take 10% recovery, that is 130tcf … so we are talking about something … that could be as big as the North Sea."[125] Mr Wright was more upbeat: "My guess would be 10% to 20%, but it could be much higher."[126] Estimates from the North Sea and

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116 Q 267.

117 Ben King (2014) 'Shale gas pioneer plans world's first offshore wells in Irish sea', *BBC News,* 13 February.

118 Q 12.

119 Q 2.

120 Q 3.

121 Q 26.

122 Q 22.

123 Coghlan, A (2014) 'Massive stores of UK shale gas will tempt frackers', *New Scientist*, 7 March.

124 *Ibid.*

125 Q 196.

126 Q 225.

other oil and gas provinces have typically grown once production is underway. If 130tcf were economically recoverable, there would be a substantial impact on the UK's energy mix.

71. Only exploratory drilling can tell what the recoverable reserves really are. The Minister for Energy said "we know that there is a lot more of it down there than we thought, but we do not know whether it can be extracted to the same volume and at the same cost as it has been extracted in the States. That is why we need to get on and encourage the industry to drill."[127]

72. Once a drilling programme has taken place, operators would need to carry out detailed appraisal to test costs. Mr Atherton said

> "Where we need to get to … is the position where we know it is commercial. If we can bring [shale gas] to market at about $8 per MMBtu, it is a very commercially viable industry. If it is going to take $15 to bring it to market, then it is not viable until the world gas price goes to $20. So let us find out whether we can bring it to market at $8 or $15."[128]

73. **On the available evidence, there may well be potential for economic development of shale gas in the UK. Estimates of the UK's total onshore shale gas resource are however still incomplete and it is impossible to tell how much of the resource can be economically recovered until exploratory wells are drilled and appraised. It is vital that we get on with it.**

Timescale

74. Permits and planning permission must be granted before exploration or production can take place. Mr Atherton said "they have to drill 20 to 30 wells just to know what the producibility of the Bowland and other UK shale formations are. On the current timetable that is likely to take a very long time; we are into 2020/2025."[129] He added: "From an engineering and finance perspective, that can be done within three years very straightforwardly. What is stopping it is due process and political will".[130] Mr Fallon said "the next stage … is the drilling of … some 20 to 40 exploratory wells over the next couple of years … we have been doing everything we can to encourage it."[131] Mr Figueira said the industry "would certainly expect production to start before the end of the decade, but to be at scale in the early 2020s."[132] **The evidence we heard suggests that large-scale production of onshore shale gas in the UK is unlikely before the next decade unless effective and immediate action is taken to bring forward exploration and appraisal.**

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127 Q 257.

128 Q 200.

129 Q 197.

130 Q 200.

131 Q 252.

132 Q 156.

The snail's pace of exploration

75. Ministers are keen for exploration to go ahead. The Chancellor of the Exchequer told us "we want to see exploratory drilling, and my hope is that commercial drilling will follow."[133] The Minister for Energy said "I shall certainly do everything I can to step up the pace of exploration."[134] But the pace is still slow. Mr Francis Egan, CEO of Cuadrilla, said "We do need to start. From 2008 to probably the end of this year, we will have drilled a grand total of three wells in the Bowland shale and partially fractured one. I would not call that an accelerated exploration programme."[135] Dr Tony Grayling of the Environment Agency told us that "since the Government gave permission for hydraulic fracturing in principle to resume [in December 2012], we … have not yet received any permit applications to undertake hydraulic fracturing."[136] The delays seem mainly due to uncertainties over regulatory requirements, which we examine more fully in Chapter 8.

76. **Despite Ministerial encouragement and eagerness on the part of the industry to get on with exploratory drilling, progress on the ground has been at a snail's pace while industry and officials come to grips with a dauntingly complex regulatory regime for onshore shale gas and oil.**

Public acceptability

77. We deal with public concerns about the possible environmental impact of hydraulic fracking in Chapter 7.

78. Onshore shale gas cannot be developed in the UK without public acceptance. At the national level, the available evidence, which is slender, seems to suggest that public attitudes are not clear-cut. The DECC's latest attitudes survey, published in January 2014, found 27% of respondents in favour of shale gas extraction, 21% against and 48% neither supporting nor opposing.[137] A survey by the University of Nottingham, also in January 2014, found 26.7% in favour (39.5% in July 2013).[138] Taken together, they seem to suggest that most people nationally have yet to take a firm view on shale development.

79. Public acceptance at local level is essential if shale is to be exploited. Mr Wright said that "very key to [shale gas] development, is getting communities on your side."[139] But there is some local hostility to onshore drilling in areas affected. Ms Tina Rothery of Residents' Action on Fylde Fracking (RAFF) said "we do not want this in anyone's backyard."[140] Opponents of Cuadrilla's activities in Balcombe are deeply hostile to local drilling.[141] Mr Austin of iGas said "the barriers … right now … are getting

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133 Evidence to Economic Affairs Committee, 4 February, Q 1.

134 Q 266.

135 Q 76.

136 Q 159.

137 DECC (2014) *DECC Public Attitudes Tracker – Wave 8*, 4 February.

138 See http://www.nottingham.ac.uk/news/pressreleases/2014/january/support-for-fracking-continues-to-decline.aspx for a summary of the University of Nottingham survey findings for January 2014.

139 Q 235.

140 Q 186.

141 Frack Free Balcombe Residents' Association.

local acceptance where we are trying to drill … it is the inability to manage that that would rule out any particular area."[142]

80. The industry recognises it has ground to make up and needs to engage local opinion. It announced in June 2013 that each operator would create a "community benefit mechanism" based on a one percent share of revenue from each production well.[143] In January 2014 the UK Onshore Operators' Group (UKOOG) announced a pilot scheme at selected shale gas exploration sites. Once planning consent is granted and exploratory drilling operations begin, each pilot exploration site will have £100,000 made available for the benefit of the local community.[144] The Government supports these industry initiatives. The Minister for Energy wrote in the *Sun on Sunday* that they could "amount to £10 million for an average-sized "pad" development."[145]

81. The Local Government Association (LGA), welcoming the Prime Minister's announcement of a shale-related rates concession to local authorities (paragraph 91 below), called for more detail on how "the community benefits package will be strengthened to fairly remunerate those who will be most affected."[146] It added: "Given the significant tax breaks proposed to drive forward the development of shale gas and the impact drilling will have on local communities, these areas should not be short-changed by fracking schemes. One per cent of gross revenues distributed locally is not good enough".[147] The LGA also called for the community benefits of fracking to "be enshrined in law."[148]

82. Mr Wright told us that if he were a developer (he has no plans) he "would probably offer 2% of gross revenues to the surface owners of the land because they would immediately become my partners".[149] The Secretary of State for the Environment said

> "I think that the potential of 1% of revenues could be an absolutely enormous sum that compares favourably with the regime pertaining in other countries … I admire the [Local Government Association's] bargaining technique … [1%] will potentially be welcomed in quite remote rural areas where there are not many great wealth creation opportunities … once it gets started, it will be very widely welcomed."[150]

83. The Minister for Energy also welcomed the industry's offer of community benefit schemes:

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142 Q 77.

143 See http://www.ukoog.org.uk/about-ukoog/press-releases/58-oil-and-gas-onshore-industry-group-launches-shale-community-engagement-charter for the June 2013 UKOOG press release introducing the community benefit mechanism.

144 See http://www.ukoog.org.uk/about-ukoog/press-releases/68-united-kingdom-onshore-operators-group-announces-next-steps-in-the-formation-of-its-community-benefits-scheme for the January 2014 UKOOG press release announcing the introduction of the pilot schemes.

145 Fallon, M. (2014) 'It's VITAL that we win fight with EU over red tape on fracking', *The Sun on Sunday*, 12 January.

146 See http://www.local.gov.uk/media-releases/-/journal_content/56/10180/5831546/NEWS for the LGA press release containing their response to the Prime Minister's announcement.

147 *Ibid.*

148 *Ibid.*

149 Q 229.

150 QQ 280–281.

> "£100,000 for a fractured well will go some way towards compensating the very immediate local residents from some of the disruption involved over the period of the actual fracturing before the gas starts to flow. One per cent of the revenues per well-site could amount to … between £5 and £10 million … a formidable sum of money which could be used for the benefit not simply of local residents but of the slightly wider community around the well-head."[151]

The Minister was "not so sure that these two parts of the offer should go to any of the councils involved."[152] He hoped

> "local residents … could opt for a reduction in their bills … it may be that they would want the £100,000 devoted to a particular facility. So far as the £10million is concerned … I would rather see it go either to some community or to a local charitable foundation that is working in the area and not see it sucked into the local government finance system."[153]

84. Ministers did not express support for the LGA's proposal to enshrine community benefit schemes in legislation. The Secretary of State for the Environment spoke instead of "a legally binding commercial transaction."[154]

85. Areas where fracking takes place will benefit through investment and the creation of jobs. Those adversely affected by development may be compensated under existing planning legislation and through community benefit schemes but local councils should be reimbursed for the full cost of infrastructure repairs that may prove necessary such as damage to roads.

86. **We welcome the industry's introduction of community benefit schemes for localities where drilling for shale gas is to take place. We also welcome the Government's support for the industry's schemes, which should be given the chance to prove themselves. We consider that the industry, as well as the Government, will also need to present the case for shale development more effectively to local communities, including clarity of plans and meticulous compliance with regulation as well as local economic benefits.**

87. Local incentives, however substantial and well-targeted, will not avail if public concerns about perceived dangers to health and environment from fracking (addressed in Chapter 7) are not assuaged. Witnesses recognised that these concerns need to be taken seriously and that government and industry should make every effort to offer reassurance. Mr Egan said "the protests [at Balcombe] were not against what was actually happening; they were about what people were concerned might happen."[155] Mr Wright said "The public has every right to know what we are doing, why it works and how it works."[156] Mr Hughes said "The issue of course … is reassurance … The biggest challenge we face at the moment as an industry is reassuring the people and winning hearts and minds."[157]

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151 Q 262.

152 *Ibid.*

153 *Ibid.*

154 Q 281.

155 Q 82.

156 Q 236.

157 Q 201.

88. Some opponents are not open to reassurance that well-regulated fracking should pose low environmental risks. Asked if anything could be done to satisfy his concerns, Mr Roberts of Residents Against Fylde Fracking (RAFF) replied, "I do not believe so, no … we are backing the wrong horse here."[158] He thought that "This is entirely the wrong industry to be backing. We need now to be backing the renewable sector."[159] Mr Molho of WWF-UK told us that "Our organisations [WWF, Greenpeace and Friends of the Earth] are opposed to the development of shale gas in the UK, mainly on grounds relating to climate change".[160] Mr Egan said that "decarbonisation … is at the root of a lot of the NGO position."[161] We discuss shale gas and climate change in Chapter 6.

89. Other opponents seem more concerned about local disturbance in the form of increased traffic and visually intrusive installations. We heard evidence that this disturbance would usually be temporary while drilling and related works took place. Mr Wright told us that "There definitely would be a noticeable impact. Drilling rigs are 200 feet tall".[162] But once production is under way, as Sir David King, Special Representative for Climate Change, Foreign and Commonwealth Office, told us, "When the fracking is done, what is left in the ground is something like a metre and a half high … the actual visual impairment arising from these wells is pretty minimal."[163] Mr Wright said that "you do not see wells that are producing."[164]

90. **At the national level, there is little hard evidence of public opinion on shale gas development and what there is shows mixed results. There is some strident local opposition to fracking. There is a chicken-and-egg aspect to public acceptability: the most convincing argument for onshore shale gas development in the UK would be a successful working example.**

Government action

91. The Government are publicly committed to developing shale gas in the UK. The Prime Minister said in January "We're going all out for shale."[165] He also announced that local councils would be able to keep 100% of business rates from shale gas, instead of 50%.[166] The Chancellor of the Exchequer told us "I am a huge supporter of shale gas".[167] In his 2013 Autumn Statement he announced a new fiscal regime for the onshore oil and gas

158 Q 191.

159 Q 186.

160 Q 33.

161 Q 88.

162 Q 226.

163 Q 214.

164 Q 226.

165 See https://www.gov.uk/government/news/local-councils-to-receive-millions-in-business-rates-from-shale-gas-developments for the Prime Minister's statement.

166 *Ibid.*

167 Evidence to Economic Affairs Committee, 4 February, Q 3.

sector.[168] He had earlier said he wanted to make the new tax regime "the most generous for shale in the world".[169]

92. The new tax regime and rates concessions to local authorities will doubtless be welcome to the industry. But it is probably not a key factor since investment decisions are likely to turn on expected costs and volumes. Nor has tax been the main obstacle to development of onshore shale gas in the UK. Viscount (Matt) Ridley said "a tax break is less important than the planning system in holding this back."[170] Other witnesses agreed.

93. Industry witnesses argued that the Government should do more to encourage public acceptance of shale gas exploration. Mr Lambert said "It should not be really left just to the companies. It is almost a national issue, trying to find out what we have got."[171] Mr Atherton said that "Cuadrilla is a small company … They are not equipped to take on the legions of environmental protesters. The state has to step in at some point and say "No, this is definitely in the public interest, and we are going to do it."[172] Mr Tom Crotty of INEOS agreed: "there is an enhanced role for Government in getting the imperative explained in the public domain."[173]

94. The Chancellor of the Exchequer assured us that "there is a determined effort at the top of the Government to sell the benefits of this not just to the nation but to the local communities involved."[174] But the Government are less assertive in countering the perceived environmental risks of fracking which have stalled progress on exploration for shale gas. The Secretary of State for the Environment told us that "opponents … have done a good job in alarming the public. We have to counter that, but it cannot just be done by the Government."[175] The Minister for Energy said "Ministers are not always believed when they go out and say that things are absolutely safe."[176] If, however, Ministers are unwilling to say that the technology is safe, the public will understandably suspect that this is because it is not safe.

95. **We welcome the Prime Minister's and Chancellor's commitment to development of shale gas in the UK. We also welcome Government support for the industry's community benefit schemes and the tax and rates measures the Government have announced to encourage development. But industry's investment decisions will turn mainly on estimated costs and production volumes. These cannot be assessed without exploratory drilling and appraisal, which are being delayed by regulatory constraints and vocal opposition from some groups. The Government must be much more forceful in their public advocacy of the economic benefits of well-regulated shale development. They must also explicitly address the safety issues.**

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168 See https://www.gov.uk/government/topical-events/autumn-statement-2013/about for the 2013 Autumn Statement.

169 Gosden, E. (2013) 'George Osborne pledges most generous tax regime for shale gas', *The Daily Telegraph*, 19 July.

170 Q 145.

171 Q 206.

172 *Ibid.*

173 Q 91.

174 Evidence to Economic Affairs Committee, 4 February, Q 3.

175 Q 282.

176 Q 254.

CHAPTER 5: POTENTIAL ECONOMIC IMPACT OF THE UK'S SHALE GAS

General

96. The UK economy is bound to be affected by the global impact of the US shale gas revolution. This includes US coal already exported to the UK market and forthcoming US exports of LNG. The effects of home-produced shale gas are less certain: the scale of the UK's economically-recoverable reserves is not known, nor when they might be exploited. Even if large, commercial reserves of shale gas are confirmed in the UK, witnesses doubted there would be significant output before the early 2020s.[177]

97. Even then, the impact on the UK's fuel prices and wider economy would not be as dramatic as in the US because production costs would be higher. Mr Hughes said, "Everything points to the fact it is going to cost considerably more than it does in the US."[178] Mr Austin said

> "it is realistic to expect that the cost of execution here would be of the order of 150% to 200% in the first instance of what it would be in the United States, because of having high levels of environmental monitoring and less depth in the supply chain. The biggest determinant is actually down to the flow rates."[179]

98. The UK gas market's substantial imports and its links to continental European markets also limit the scope for home-produced shale gas to bring about price cuts on US lines. Mr Williams told us "we cannot replicate the impact on [US] prices. The [UK] price is made up of a number of sources of gas".[180] Mr Rogers did not think there would be "a discernible effect on prices, linked as the UK is not just to the European continental gas market but to the global LNG supply market as well."[181] Mr Dorner expected "to see a gradual convergence in regional gas prices, but we do not expect to see an actual global gas price from now to 2035."[182]

99. US gas prices are expected to rebound from current lows as the US begins to export LNG. Professor Helm said "the impact of US shale gas prices on world gas prices is, and is likely to remain, very limited … US gas exports will probably … raise the price of gas in the United States."[183]

100. Although it might not match current low US prices, UK shale gas should be cheaper than imported LNG, with its high processing and transport costs. The world price of LNG is also sustained by demand from Asia. Mr Hughes told us: "So if the [US] Henry Hub price today is $4, then probably it could be landed here at around $9, but it will not be because the Asians will pay much more for it."[184]

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177 Q 128.

178 Q 205.

179 Q 83.

180 Q 2.

181 Q 132.

182 Q 98.

183 Q 115.

184 Q 205.

101. UK-produced shale gas would also offer better security of supply than imports. Domestic production, even if some went to Europe, would help insulate the UK from volatile patterns of world demand, the effects of regional instability and any politically-motivated interruptions of supply. The crisis in Ukraine highlights Europe's reliance on Russian gas supplies. (Although not strictly part of our inquiry, similar considerations seem to apply to North Sea gas production: Mr Atherton made a case that taxation misguidedly aligned with that on oil had "crippled the recovery of the [North Sea] gas industry."[185])

102. **Even if its economically recoverable reserves of shale gas prove substantial, the UK is not likely to see gas price cuts on the scale of those in the US. Indigenous production would however be cheaper than imports of liquefied natural gas (LNG), improve the balance of payments and provide better security of supply.**

Energy intensive/ petrochemical industries

103. We heard evidence that low gas prices in the US had led to an investment boom in energy-intensive and petrochemical industries which, in Professor Helm's words, present "a serious long-term competitive threat."[186] He added: "The real question is whether anyone is going to invest in any energy-intensive industries in Europe, to which the answer at the moment is no."[187]

104. INEOS plan to use imported US shale-derived feedstock in their chemical plants at Grangemouth.[188] Indigenous shale gas could provide competitively-priced fuel and feedstock that energy intensive industry in the UK needs in the longer term. Mr Tom Crotty of INEOS said "Energy intensive users … employ almost a quarter of a million people in this country, and I believe that without this sort of development we will no longer be able to do that in 10 or 15 years' time."[189] **Substantial shale gas production in the UK could help retain and develop energy intensive industries and provide feedstock to petrochemical plants. If however there is no prospect that the UK's shale gas resource will be developed within a reasonable timescale, energy intensive industry is likely to move elsewhere.**

Jobs

105. Development of shale gas in the UK could provide substantial job opportunities in areas of exploration and production, for example in Lancashire. As well as industry specialists, there would be openings for local suppliers and service providers. If the UK has first mover advantage among countries on this side of the Atlantic, there might also be the opportunity to create a British or European skills hub, with scope to grow and prosper as shale gas develops in other countries. Mr Austin saw "the opportunity to create a new onshore version of Aberdeen somewhere in the UK."[190]

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185 Q 201.

186 Q 115.

187 Q 123.

188 INEOS.

189 Q 80.

190 Q 89.

106. Estimates of the numbers of new jobs which might be created by shale gas development vary widely. At the top end of the scale, a paper by Mr Corin Taylor for the IoD estimates that it could support at the peak 74, 000 jobs, direct, indirect and induced.[191] A report by AMEC for the Department for Energy and Climate Change estimated that at the peak the latest round of onshore oil and gas licensing would generate 16,000–32,000 full-time equivalent (FTE) positions, including direct, indirect and induced jobs.[192] The TUC noted that job estimates so far rely heavily on US research, including assumptions untested in the UK.[193] The scope for job creation should become clearer when more is known through exploration and appraisal about the commercial potential of shale in the UK.

107. **The UK's shale gas and oil could help create a new, viable and internationally competitive industry attracting investment, creating jobs and skills which would make a strong regional impact in areas such as North- West England, providing secure energy and yielding revenue. This would be a valuable prize, obviously better in the national interest than increased, costly and perhaps unreliable imports which would weigh on the balance of payments. But the benefits cannot be quantified until exploratory drilling and appraisal show what the UK's economically recoverable reserves of shale gas and oil are.**

[191] Taylor, C. Lewis, D. (2013) *Infrastructure for Business: Getting shale gas working*, Institute of Directors.

[192] DECC (2013) 'Strategic Environmental Assessment for Further Onshore Oil and Gas Licensing', AMEC Environment and Infrastructure UK Limited for DECC.

[193] TUC.

CHAPTER 6: SHALE GAS AND CLIMATE CHANGE

108. The UK is committed to achieving a number of climate change objectives. National[194] and local organisations[195] expressed to us concerns that greenhouse gas emissions from extraction and use of the UK's shale gas might not be compatible with these objectives. This chapter examines the issues.

Greenhouse gas emissions of shale gas

Carbon footprint compared to conventional gas and LNG

109. In December 2012 DECC commissioned a study (the 'MacKay' report) into the greenhouse gas emissions associated with shale gas extraction and use. This was published in September 2013.[196] The MacKay report found that the carbon footprint[197] of shale gas extraction and use is comparable to gas extracted from conventional sources and lower than the carbon footprint of liquefied natural gas (LNG).[198] E.ON told us that the "emissions when burning [shale gas or oil] are no different to any other form of gas or oil … transport emissions would be lower when using domestic sources of gas and oil rather than LNG/oil imports."[199]

110. The MacKay report found that shale gas would produce a "significantly lower" carbon footprint when used for electricity generation than coal.[200] Professor Muller wrote that for the "same energy produced, carbon (the main component of coal) produces twice the carbon dioxide that does methane (the main component of natural gas)".[201]

Fugitive methane

111. Methane itself is also greenhouse gas. The UK Energy Research Centre note that "methane … can leak from wellheads during the extraction process and during transportation."[202] Methane escaping in this way is commonly referred to as 'fugitive methane'.

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194 WWF, Greenpeace and Friends of the Earth.

195 Residents Action on Fylde Fracking (RAFF) and Frack Free Balcombe Residents Association (FFBRA).

196 MacKay, D. and Stone, T. (2013) *Potential Greenhouse Gas Emissions Associated with Shale Gas Extraction and Use*, DECC, 9 September.

197 *Ibid*. The carbon footprint includes the carbon dioxide emissions associated with the combustion of shale gas and the methane that can be released into the atmosphere as a result of shale gas extraction (known as 'fugitive methane').

198 *Ibid*. The report found that the carbon footprint of shale gas extraction and use is likely to be in the range 200–253 g CO2e per kWh of chemical energy, which makes shale gas's overall carbon footprint comparable to gas extracted from conventional sources (199–207 g CO2e/kWh(th)), and lower than the carbon footprint of Liquefied Natural Gas (233–270g CO2e/kWh(th)).

199 E.ON.

200 MacKay, D. and Stone, T. (2013), *Op. Cit.* The report found that when shale gas is used for electricity generation, its carbon footprint is likely to be in the range 423–535 g CO2e/kWh(e), compared to 837–1130g CO2e/kWh(e) for coal.

201 Professor Richard Muller.

202 UK Energy Research Centre.

Level of fugitive methane emissions required to negate benefits of shale gas over coal

112. WWF, Greenpeace and Friends of the Earth told us that research from Princeton University suggested that for shale gas to maintain a lower carbon footprint than coal, cumulative fugitive methane emissions should not exceed 3.2 per cent of the gas produced.[203] Professor Muller disagreed and told us that the 3.2 per cent figure was "misinformation … based on a simple calculation you can do that is mistaken … 15 per cent to 18 per cent has to leak before it is as bad as coal."[204] He referred us to his explanatory article in the *New York Times*.[205]

Levels of fugitive methane emissions during shale gas operations

113. Estimates of cumulative fugitive methane emissions from shale gas production range from 0.4 per cent to 9 per cent of the gas produced.[206] WWF, Greenpeace and Friends of the Earth drew attention to studies from the US which suggest that fugitive emissions are "significantly higher" than those reported by the industry,[207] citing research from Cornell University[208] and the US National Oceanic and Atmospheric Administration (NOAA)[209] in support. The Frack Free Balcombe Residents Association (FFBRA) also referred to these studies as "powerful evidence" that "threatened" the argument that shale gas could be used as a transitional fuel to a low carbon future.[210] They added that this US evidence was "completely ignored" by the MacKay report.[211]

114. The MacKay report acknowledges that "the current evidence base originates mainly from the USA"[212] and analysed the Cornell and NOAA studies. It noted that the calculations made in the Cornell study had been "strongly criticised" by other experts, many of whom regard its findings as an outlier.[213] Professor MacKay's report also noted that the authors of the NOAA study had acknowledged the difficulties of attributing their results to an exact source and had pointed out that new regulations were now in place in the area assessed by the study.[214] The MacKay report also referred to a more

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203 WWF, Greenpeace and Friends of the Earth.

204 Q 48.

205 Published in a New York Times blog which is available at: http://dotearth.blogs.nytimes.com/2013/08/01/two-climate-analysts-fault-gas-leaks-but-not-as-a-big-warming-threat/?_php=true&_type=blogs&_r=0. In the New York Times post, Professor Muller refers to an explanatory paper on his own website which can be found here: http://static.berkeleyearth.org/memos/fugitive-methane-and-greenhouse-warming.pdf

206 Q53 for the 0.4% estimate & see http://www.nature.com/news/methane-leaks-erode-green-credentials-of-natural-gas-1.12123#b1 for the 9% estimate.

207 WWF, Greenpeace and Friends of the Earth.

208 Howarth, R., Santoro, R. and Ingraffea, A. (2011) 'Methane and the greenhouse-gas footprint of natural gas from shale formations', *Climactic Change*, Volume 106, Issue 4. This study concluded that between 3.6 per cent and 7.9 per cent of methane from shale gas production escapes to the atmosphere over the lifetime of a well.

209 See http://www.nature.com/news/methane-leaks-erode-green-credentials-of-natural-gas-1.12123#b1. The study found that rates of methane leakage from a field in Utah were 9 per cent.

210 Frack Free Balcombe Residents Association.

211 *Ibid.*

212 MacKay, D. and Stone, T. (2013), *Op. Cit.*

213 *Ibid.*

214 MacKay, D. and Stone, T. (2013), *Op. Cit.*

detailed study being undertaken by the University of Texas (this study was published after the MacKay report was issued). Professor Muller told us this Texas study had measured emissions at 190 wells in the US and the average level of fugitive emissions was found to be low.[215]

115. Professor MacKay told us that large fugitive emissions would be "extremely unlikely to occur in the UK because of the much stronger regulation",[216] for example, unlike in the US, the venting of methane would not be permitted in the UK except in an emergency. Mr Egan said he thought it was recognised in the US that the largest source of methane emissions was flowback water stored in open pits on the sites.[217] He said that this practice would not happen in the UK as flowback water would be held in a closed tank and taken to an offsite treatment plant.[218] Dr Grayling told us that the Environment Agency "would not allow waste fracking fluids to be stored in open pits or lagoons."[219]

116. Professor MacKay told us that his report's estimate of the carbon emissions of shale gas took account of estimates for shale gas emissions based on US studies.[220] His report warns that "actual emissions will vary according to circumstances and that we must be cautious when extrapolating results."[221] Professor Robert Mair, University of Cambridge, told us that "the jury is still out" on the precise quantities of methane emissions during operations and that careful measurements of methane escape needed to be made.[222] Professor MacKay agreed: "We think it is essential that monitoring and baselining should take place before the substantial production of shale gas in any location."[223] The MacKay report recommended a "detailed scientific programme of methane measurement" that should be independent and managed jointly between Government and industry.[224] Sir David King told us that the Environmental Protection Agency in the US is planning an extensive programme of monitoring methane emissions.[225]

117. **We find persuasive Professor MacKay's conclusion that the carbon footprint of shale gas, including fugitive methane emissions, is similar to that of conventional gas production and substantially less than coal. We endorse the recommendation in his report for a monitoring programme, jointly managed by the Government and the industry, to measure the level of fugitive methane when shale gas extraction begins in the UK.**

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215 Q 53. The study reported average leakage of 0.4% of gas produced.

216 Q 209.

217 Q 86.

218 *Ibid.*

219 Q 167.

220 Q 209.

221 MacKay, D. and Stone, T. (2013), *Op. Cit.*

222 Q 71.

223 Q 209.

224 MacKay, D. and Stone, T. (2013), *Op. Cit.*

225 Q 209.

Compatibility with UK climate change objectives

UK's current commitments

118. The Climate Change Act 2008 requires that "the net UK carbon account for the year 2050 is at least 80% lower than the 1990 baseline."[226] To ensure that regular progress is made towards this target, the Act established a system of five-yearly carbon budgets.[227] The Committee on Climate Change was set up by the Act to advise the Government on the carbon budgets. Four budgets have been announced to date, the latest covering the period 2023 to 2027. The Committee on Climate Change has also recommended extensive decarbonisation of power generation by 2030 to ensure the UK is on track to meet the 2050 target.[228] The Government did not include this target in the Energy Act 2013 and Parliament voted against proposed amendments to introduce it. [229]

Compatibility of shale gas development with current commitments

119. Mr Molho of WWF-UK told us that increased reliance on gas infrastructure "risks creating a breach of our carbon budgets."[230] He described a "false choice between either burning lots of shale gas or burning lots of coal, when fundamentally we have another possibility ahead of us … which is to make a rapid move towards an efficient and low-carbon energy system."[231] The UK Energy Research Centre (UKERC) wrote that "significant amounts of unabated gas-fired generation in the UK power generation mix in the 2020s and beyond would make it very difficult to comply with the UK's legally binding carbon targets."[232]

120. Professor Muller told us that environmental protection activists opposed shale gas development because "if we have a cheap alternative then there will be less of an incentive to develop [renewables]."[233] His answer was that, "if we do not develop natural gas then it will be coal that will come in."[234] Mr Cronin said that "the facts are that we will need low-carbon forms of energy for the future, whether that is wind or nuclear. They are quite expensive at the moment, and we need to have a transition. The transition has to be gas".[235] The renewables industry should not fear shale gas as it "will give the opportunity for a transition to enable renewable energy to become cost-competitive."[236]

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226 Climate Change Act 2008, section 1(1).

227 Climate Change Act 2008, section 4.

228 Committee on Climate Change (2013) 'Next Steps on Electricity Market Reform'. The report called for legislation in the current Parliament to set a target to reduce the carbon intensity of power generation to 50 gCO_2 /kWh. The Government said that the Secretary of State would be allowed to consider a 2030 decarbonisation target for in 2016. 50 gCO_2 /kWh would represent a 90% reduction from the carbon intensity of power generation in 1990.

229 HC Deb, 4 June 2013, col 1440; HL Deb, 28 October 2013, col 1368.

230 Q 33.

231 Q 45.

232 UK Energy Research Centre.

233 Q 57.

234 *Ibid.*

235 Q 62.

236 Q 66.

121. The Minister for Energy told us that "new gas is consistent with the decarbonisation of the power sector and it will help us to meet some of these targets."[237] The Government have set aside £1 billion for commercial development of carbon capture and storage.[238] Mr Figueira said that "there will be a continued need for gas in the decarbonisation efforts … it is potentially a destination fuel if we can get [carbon capture and storage] working".[239]

122. Chapter 2 describes the role of gas in the UK energy's mix.[240] The recent report of the Committee on Climate Change that recommended extensive decarbonisation of power generation by 2030 acknowledged a continuing role for gas: "well regulated production of shale gas could have economic benefits to the UK, in a manner consistent with our emissions targets, while reducing our dependence on imported gas."[241]

Problem of "lock-in"

123. The Tyndall Centre for Climate Change feared that a "golden age" of gas might "turn out to be a gilded cage, locking the UK into a high carbon future."[242] Professor Dieter Helm disagreed; "lock-in" was a problem especially associated with coal, "the difference between gas stations, coal stations, nuclear stations … is that gas stations are very cheap to build relative to other technologies and they can be built very quickly. Therefore they can be depreciated very fast, so you get your economic return back pretty early on in the cycle".[243] Mr Rogers said that the "very nature of shale gas militates against [lock-in] … the wells decline very quickly … the degree of lock-in is not really an issue to be too concerned about."[244]

124. **We consider that development of shale gas in the UK is compatible with the UK's commitments to reduce greenhouse gas emissions. There is an acknowledged role for gas in the UK's energy mix as it moves towards fulfilment of its commitments. The carbon footprint of home-produced shale gas would be smaller than that of imported LNG (which needs to be processed and transported). Substitution of home produced shale gas for imported LNG should therefore make a positive contribution to achievement of the UK's commitments on climate change.**

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237 Q 261.

238 Q 266.

239 Q 179.

240 See from paragraph 5 onwards.

241 Committee on Climate Change (2013), *Op. Cit.*

242 Tyndall Centre for Climate Change.

243 Q 124.

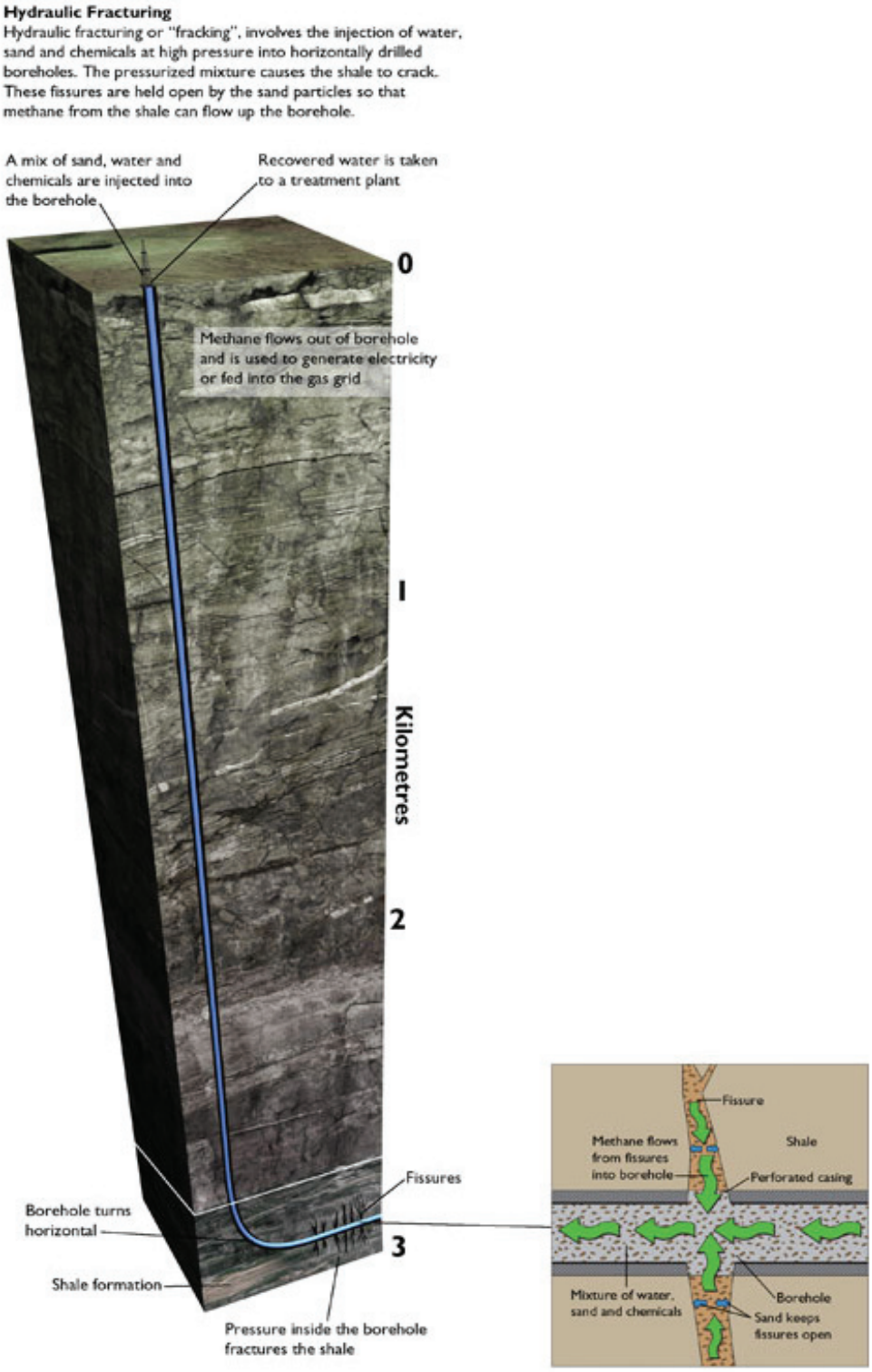
244 Q 133.

CHAPTER 7: ENVIRONMENTAL IMPACT OF DEVELOPMENT OF SHALE GAS IN THE UK

125. Opponents of shale gas development are concerned about environmental and health risks. These concerns must be taken seriously and addressed by Government, regulators and the industry. This chapter will examine each of the main fears and attempt to distinguish between the legitimate concerns and those that have been exaggerated. We address the regulation of shale gas development in the UK in Chapter 8.

FIGURE 10

Shale Gas Extraction



Source: CP14/038 British Geological Survey © NERC. All rights reserved.

Groundwater contamination

126. Groundwater contamination was described by Lord Smith of Finsbury, Chairman of the Environment Agency, as "the biggest environmental

risk".[245] Opponents of fracking told the Committee that contamination could arise from: chemicals present in the fluid used to fracture the rock; fugitive methane; and naturally occurring radioactive materials (NORMs) that return to the surface with wastewater after fracking has taken place.

Chemicals present in hydraulic fracturing fluid – US experience

127. The Frack Free Balcombe Residents Association (FFBRA) wrote that in the US, over 600 chemicals had been used in fracking fluid and some of these were "hazardous air and drinking water pollutants."[246] They were also concerned that many of the chemicals used are "proprietary and 'trade secret chemicals', making assessment of their health impact difficult".[247] They cited a 2011 report from the US House of Representatives' Committee on Energy and Commerce as the source of these claims.

128. This report was the result of a Committee on Energy and Commerce investigation that looked at hydraulic fracturing during the infancy of the US shale revolution. The 14 leading oil and gas service companies were asked to disclose the products used in their fracturing fluids between 2005 and 2009. 750 chemicals and other components were found to have been used over the period. The US report concluded that "more than 650 of these products contained chemicals that are known or possible human carcinogens[248]".[249] Presenting the report, Representative Henry Waxman urged the US regulators to make certain that there were strong protections in place to prevent chemicals from entering drinking water supplies.[250] He did not otherwise propose restrictions on fracking. The findings of the report do not reflect current practice in the US.

129. Since that report was published in 2011, the Shale Gas Subcommittee of the Secretary of Energy Advisory Board in the US has recommended that operators disclose all chemicals used in fracturing fluid.[251] Mr Chris Wright told us that unlike the chemicals involved "in making a couch, a sculpture, a wind turbine, a solar panel or a Starbucks … you can increasingly access all of the chemicals used on each fracturing job from the Frac Focus website."[252] The Royal Society and Royal Academy of Engineering report into shale gas extraction in the UK said that many claims of contaminated water wells due to shale gas have been made in the US and none have shown evidence of chemicals found in hydraulic fluids.[253]

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245 Q 161.

246 Frack Free Balcombe Residents Association.

247 *Ibid.*

248 A carcinogen is a substance that may lead to cancer. Substances labelled as carcinogens will have different levels of cancer-casuing potential; some may cause cancer only after prolonged, high-levels of exposure (American Cancer Society, www.cancer.org).

249 United States House of Representatives, Committee on Energy and Commerce (2011) *Chemicals Used In Hydraulic Fracturing*, 18 April.

250 See http://democrats.energycommerce.house.gov/index.php?q=news/committee-democrats-release-new-report-detailing-hydraulic-fracturing-products for the Committee on Energy and Commerce press release, 16 April 2011.

251 Secretary of Energy Advisory Board (2011) *Shale Gas Production Subcommittee Second Ninety Day Report*, US Department of Energy, 18 November.

252 Chris Wright.

253 Mair, R. et al (2012) *Shale gas extraction in the UK: a review of hydraulic fracturing*, Royal Society and Royal Academy of Engineering.

Chemicals present in hydraulic fracturing fluid – UK practice

130. Unlike in the US, the composition of fracturing fluid in the UK requires regulatory approval from the Environment Agency. Dr Tony Grayling, Head of Climate Change and Communities at the Environment Agency, said they would, "not allow the use of substances in fracking fluid that we consider to be hazardous to groundwater … we have a tighter regulatory regime than is the case in some states in America."[254] Professor David MacKay, Chief Scientist at DECC, told us that the Environment Agency "has the powers to require full disclosure of chemicals used in hydraulic fracturing, so there will not be anything secret."[255]

131. With reference to Cuadrilla's operations in Lancashire, Mr Ian Roberts from the Residents Action on Fylde Fracking (RAFF) group said that the wastewater that returns to the surface following fracking "contains some nasty chemicals".[256] Asked to specify, Mr Roberts replied, "I do not have a scientific background and I cannot detail the chemicals involved."[257] Ms Tina Rothery added that when the companies "go into full production, they have access to up to 600 chemicals in the States at each well … We cannot say which ones they will use because generally they will not say. It is very hard to get this information."[258]

132. The Cuadrilla website has a section entitled "fracturing fluid". It displays the pie chart below which shows that 99.95 per cent of their proposed fracturing fluid is water and sand. The remaining 0.05 per cent is polyacrylamide, a chemical that Professor MacKay said is "commonly used in cosmetics and facial creams."[259] Mr Egan told us that Cuadrilla

> "propose to use one chemical, which is non-toxic, in our fracturing fluid. The Environment Agency will review it and approve it, and if it is declared hazardous to groundwater we will not use it … people say frequently to me: "You don't say what is in your fracturing fluid", and I say, "It's been on our website for the last three years."[260]

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254 Q 167.

255 Q 211.

256 Q 187.

257 Q 188.

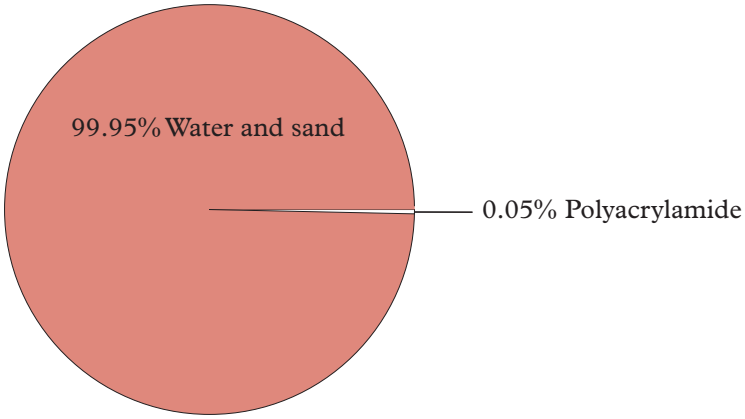
258 *Ibid.*

259 Q 211.

260 Q 82.

FIGURE 11

Composition of hydraulic fracturing fluid proposed by Cuadrilla



Source: www.cuadrillaresources.com

133. Concerns about pollution of groundwater by fracking fluid seem largely based on reports of past practice in the US, where greater transparency is now enforced. The position in the UK is clear: the regulators require full disclosure of chemicals used in fracking fluid, they do not permit use of hazardous chemicals and operators do not use them. Provided that the regulator enforces this prohibition, hydraulic fracturing fluid poses no risk to groundwater in the UK.

Fugitive methane

134. Some witnesses expressed fears that methane might find its way into groundwater. The Committee heard that this could happen by methane migrating up natural faults into groundwater or through leaking from a poorly constructed well.

Fugitive methane – "flaming faucets" and repudiating myths

135. Two American films, *Gasland* and *Gasland 2*, have received great publicity for appearing to demonstrate that hydraulic fracturing has led to tap water in nearby homes becoming flammable.[261] Professor Richard Muller, Professor of Physics at the University of California, Berkeley, told us that it was well documented that the "flaming faucets" shown in the movie are a natural phenomenon that pre-dated fracking, and are known to be the result of generation of biogenic methane by bacteria that gets into well water.[262] Mr Wright told us that the portrayal in the second Gasland film of water from a hosepipe being set on fire had been ruled a fraud by the local courts as the perpetrators simply hooked a garden hose up to a residential gas line.[263] No opponents of fracking cited these two films in support of their arguments.

136. The UK Onshore Operators' Group (UKOOG) said that "repudiating some of [the] myths" around contamination has been more difficult due to the

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261 Chris Wright.

262 Professor Richard Muller.

263 Chris Wright.

"lack of baseline monitoring in the US, making it difficult to prove that the industry has not been at fault".[264] Professor Mair told us that

> "the evidence from the US is rather hard to unravel … not least because of the absence of baseline monitoring … there is no question that there are some areas where the geology is such that methane naturally bubbles up into groundwater. It can be very misleading to imply that it is all down to hydraulic fracturing and shale gas extraction."[265]

Fugitive methane – migration through natural faults up to aquifers

137. As Figure 10 at the beginning of this chapter illustrates, shale gas is found deep underground; it starts to be produced between depths of 1,500 metres and 4,200 metres.[266] Professor Stephenson told us that "the key is to remember that shale will be exploited or fracked pretty deep, so a long way from rocks that contain water … Most geologists find it very hard to imagine contamination could occur in those circumstances."[267] He also said that the BGS were mapping areas where there were big differences and small differences between possible shale layers and layers containing aquifers: "it is not finished yet but that would be a very important way of essentially screening which parts of the country have aquifers close to shales".[268]

138. Professor David Smythe, Emeritus Professor of Geophysics at the University of Glasgow, thought it was likely that in the UK, "fugitive methane … will eventually contaminate aquifers."[269] FFBRA cited Professor Smythe's concerns and quoted him as saying, "a leaky fault is a fast-track back to shallow groundwater and to the surface for methane".[270]

139. The Royal Society and Royal Academy of Engineering's report does not reflect Professor Smythe's fears. It considered propagation of methane through natural fractures very unlikely: sufficiently high upward pressures would be required during the fracturing process and then sustained for a long time afterwards once the fracturing process had ceased and it was difficult to conceive of how this might occur. Even if that did happen, the permeability of the fractures would need to be similar to the overlying aquifer for any significant quantity of liquid to flow and it did not think this would be likely either.[271] Professor Mair told us that the risk was "very low".[272]

140. Professor Richard Davies of the Durham Energy Institute, Durham University said that, although there had been well over a million fracking operations in America, many of which happened in areas where there were natural faults, "There is not yet any hard evidence to show that contamination has occurred in the water supply due to fracking operations."[273] Mr Wright wrote that there was not a single instance of a

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264 UKOOG.

265 Q 70.

266 DECC (2013) *Developing Onshore Shale Gas and Oil – Facts about 'Fracking'.*

267 Q 30.

268 Q 26.

269 Professor David Smythe.

270 Frack Free Balcombe Residents Association.

271 Mair, R. et al (2012), *Op. Cit.*

272 Q 69.

273 Q 130.

hydraulic fracture contaminating groundwater in the more than two million hydraulic fractures that have been performed over the last 65 years.[274]

141. The Environment Agency issued draft technical guidance on onshore oil and gas exploration in August 2013. It provides that if the Environment Agency determines that there is a risk of groundwater contamination, a permit for groundwater activity will be required.[275] An operator applying for a permit would need to provide the Environment Agency with "a conceptual model showing the hydrogeological relationship between the zone of interest and any overlying or adjacent aquifers."[276] Dr Grayling told us that the Environment Agency would object to shale gas development if there were proposals to drill in a location which was important to supplies of drinking water.[277] Ms Harvey said that the industry would monitor how high fractures grow during operations to make sure that the fractures did not get near water supplies.[278]

142. **The weight of scientific opinion is that the risk of methane migrating up natural faults and into aquifers is "difficult to conceive" and "hard to imagine" in the UK. With strict regulatory oversight and monitoring, the risk of methane contamination of aquifers through natural fractures is very low.**

Naturally occurring radioactive materials (NORMs)

143. About 25 per cent to 75 per cent of the injected fracturing fluid flows back to the surface through the well after fracking has taken place.[279] This fluid is mixed with methane and saline water containing minerals from the shale formation below. This 'flowback water' (or 'wastewater') will typically contain naturally occurring radioactive materials (NORMs).[280] Most witnesses who expressed fears about NORMs were concerned with the safe treatment and disposal of the wastewater once it returns to the surface. These concerns are dealt with in a separate section below. Fears were also expressed that well failure could lead to NORMs entering groundwater underneath the surface.[281]

Leaks from poorly constructed or sealed wells

144. A leak from a poorly constructed or sealed well could provide a way for fracturing fluid, methane or NORMs present in wastewater to get into groundwater. Tony Grayling told us that "where there have been problems … in the United States, they have been to do with the poor sealing of the well nearer the surface".[282] Professor Stephenson said that "There are peer-reviewed papers in the United States that have come out recently that show

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274 Chris Wright.

275 Environment Agency (2013) *Onshore oil and gas exploratory operations: Consultation Draft*, August 2013.

276 *Ibid.*

277 Q 160.

278 Q 31.

279 Mair, R. et al (2012), *Op. Cit.*

280 *Ibid.*

281 Q 192.

282 Q 181.

that there is evidence of fracking gas getting into water supplies."[283] Professor Stephenson and Professor Smythe both highlighted one recent study from the US.[284] This paper attributed the presence of methane in aquifers near to shale gas extraction sites in the Marcellus shale to leaking wells.[285] The paper concluded that the two simplest explanations were that methane had leaked from wells due to faulty or inadequate casings and imperfections in the sealing of the wells.[286]

145. The British Geological Survey considers that there is a risk of contamination where the well goes through the underground layer that contains aquifers.[287] Professor Stephenson said that "the important thing is that those wells are completed and engineered properly".[288] Professor Mair agreed: "a much more likely source of potential contamination is poorly constructed wells, so well integrity is paramount."[289] Dr Grayling said that "It is particularly critical from the point of view of environmental protection that the well is properly constructed and sealed … it is our responsibility to ensure, along with the Health and Safety Executive, that those regulations are properly applied."[290]

146. Professor Mair said that "if all the right safeguards are applied … that is an important proviso … then, yes, I believe that shale gas can be produced safely without any significant risk of contamination."[291] Lord Smith of Finsbury, Chairman of the Environment Agency, said that "provided that drilling takes place in the right place and provided that it is properly regulated … there should be no risk to groundwater."[292]

147. **The only significant risk posed to groundwater by hydraulic fracturing is of methane or wastewater entering aquifers as a result of a poorly constructed or sealed well. This is also a risk for conventional onshore gas and oil production. The risk is low as long as independent monitoring ensures that wells are properly constructed and sealed.**

Disposal and treatment of flowback water

148. Flowback water returning to the surface after hydraulic fracturing may contain hazardous materials. The water that returns is heavily salted and often contains heavy metals and naturally occurring radioactive materials (NORMs). Mr Chris Wright described this as the "real hazard" from oil and gas production, a problem he said was as old the industry itself.[293] Opponents of fracking have cited the disposal and treatment of flowback water as an environmental risk.

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283 Q 30.

284 Q 30 and Professor Smythe.

285 Q 30.

286 Jackson et al (2013) 'Increased stray gas abundance in a subset of drinking water wells near Marcellus shale gas extraction', *Proceedings of the National Academy of the Sciences of the United States of America*, Volume 110, No 28.

287 Q 30.

288 Q 26.

289 Q 69.

290 Q 181.

291 Q 71.

292 Q 181.

293 Chris Wright.

US experience

149. Frack Free Balcombe Residents Association (FFBRA) told us that recent reports had revealed elevated levels of radioactivity, salts and metals downstream from US water treatment plants.[294] FFBRA also quoted Avner Vengosh, Professor of Geochemistry and Water Quality at Duke University: "'Years of disposal of oil and gas wastewater with high radioactivity has created potential environmental risks for thousands of years to come'."[295] Professor Vengosh made this statement in October 2013 when releasing a study from Duke University that compared the quality of shale gas flowback water from the Marcellus shale with stream water above and below a disposal site in Pennsylvania.[296]

150. The Duke study was based on water samples taken between August 2010 and November 2012.[297] Mr Wright told of an operator in the Marcellus shale in Pennsylvania who sent flowback water to a water treatment facility that was not equipped to handle the NORMs present.[298] He said, "It should never have happened … It would never happen in Pennsylvania today."[299]

151. FFBRA also said that much of the flowback water in the US was injected into the ground to be disposed of, "where it can cause earthquakes by stressing and lubricating existing faults."[300] Professor Muller told us that earthquakes induced this way "are of concern."[301] He said the larger earthquakes produced in the United States "came from storage of flowback water in specialised sites and pumping far more water down into those than should have been done. That can be avoided by regulating the use of the flowback water".[302]

152. Finally, FFBRA said that flowback water in the US was often held in open lagoons.[303] Sir David King said that "in the United States, still today, the water is pooled. The pools have membranes to prevent the water from going into the ground. I would suggest that membranes are not always trustworthy."[304]

Flowback water in the UK

153. DECC published a Strategic Environmental Assessment in December 2013 (carried out by AMEC) which predicted that under a high activity scenario, there could be annual production of 108 million cubic metres of flowback water that would require treatment.[305] This was approximately three per cent

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294 Frack Free Balcombe Residents Association.

295 Frack Free Balcombe Residents Association.

296 See http://nicholas.duke.edu/news/radioactive-shale-gas-contaminants-found-wastewater-discharge-site for Professor Vengosh's discussion of the study's results.

297 Warner, N., Christie, C., Jackson, B. and Vengosh, A. (2013) 'Impacts of Shale Gas Wastewater Disposal on Water Quality in Western Pennsylvania', *Environmental Science & Technology*, 47 (20).

298 Chris Wright.

299 Q 236.

300 Frack Free Balcombe Residents Association.

301 Professor Richard Muller.

302 Q 49.

303 Frack Free Balcombe Residents Association.

304 Q 210.

305 DECC (2013) *Strategic Environmental Assessment for Further Onshore Oil and Gas Licensing*, AMEC Environment and Infrastructure UK Limited for DECC.

of UK total annual wastewater. Depending on where it was treated it "could place a substantial burden on existing wastewater treatment infrastructure capacity."[306]

154. FFBRA quoted this assessment as indicating that "currently there is no safe way of treating and disposing of this material, and it is deemed to be nasty enough that there is no waste facility in Britain equipped to treat it."[307] Mr Roberts said that Residents' Action on Fylde Fracking (RAFF) understood that Cuadrilla "do not have any plans in place to treat safely and dispose of the waste flow-back water."[308] He said that the flowback water that came out of the Preese Hall site[309] went to a treatment plant at Davyhulme,[310] "but our understanding is that that plant became overwhelmed with the quantity, toxicity and radioactive nature."[311]

155. Mr Lee Petts from Remsol Limited said that the flowback water "can be treated, the contaminants largely removed and it can be returned back into the water environment".[312] He said the flowback water could be treated at about a dozen existing industrial waste water treatment plants around the UK.[313] Cuadrilla had yet to make a decision on future plans as it was exploring options around on-site recycling.[314] It was "incorrect" that the Davyhulme treatment plant had been compromised as described by Mr Roberts: "my enquiries … confirm that treatment of the wastewater was completed successfully and without any identified detriment to the treatment process."[315] The DECC Strategic Environment Assessment said that given the industry is not expected to be at substantial scale before the 2020s, "this will allow time for any necessary new investment in infrastructure such as waste water treatment capacity."[316]

156. Under the UK regulatory regime, flowback water is deemed to be a mining waste and operators require an environmental permit to dispose of it.[317] The disposal method is agreed between the operator, the treatment facility and the environmental regulator as a condition of the permit.[318] All facilities in the UK that can treat flowback water hold the appropriate permits to deal with the waste.[319] As explained in paragraph 115, the Environment Agency would not permit flowback water to be stored in open pits and lagoons in the UK.

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306 *Ibid.*

307 Frack Free Balcombe Residents Association.

308 Q 187.

309 Preese Hall was a well near Blackpool, Lancashire that Cuadrilla hydraulically fractured in 2011. See paragraph 165 for more detail.

310 An area of Trafford in Greater Manchester. A wastewater treatment works, operated by United Utilities, is located there.

311 Q 187.

312 Q 188.

313 Q187.

314 Q 187 & Q 188.

315 Remsol Limited (supplementary written evidence).

316 AMEC for DECC (2013), *Op, Cit.*

317 DECC (2013) *About shale gas and hydraulic fracturing (fracking)*, 19 December.

318 DECC (2013) *About shale gas and hydraulic fracturing (fracking)*, 19 December.

319 *Ibid.*

Technological advances

157. Professor Muller told the Committee that the technology for recycling flowback water has been developed so that it could be substituted for fresh water for future hydraulic fractures.[320] Mr Petts said that a better option than treatment would be "to clean it up at the drill site so that it can be reused by fracturing at another stage in the well."[321] The DECC Strategic Environment Assessment said that "if on-site treatment and recycling could occur, wastewater volumes … could be reduced."[322]

158. **In the US, disposal of flowback water after hydraulic fracturing has in recent years aroused some environmental concerns, now being addressed. In the UK, by contrast, flowback water is subject to the regulations on mining waste and its disposal and treatment is carefully controlled.**

Demands on UK water supply

159. Hydraulic fracturing requires water. WWF, Greenpeace and Friends of the Earth were concerned about possible demands on the UK water supply.[323] Ms Rothery said that "you are using four Olympic-size swimming pools per frack, per well … it is an awful lot of water."[324]

160. DECC's recent Strategic Environment Assessment predicted that under a high activity scenario, annual water use could be up to 9 million cubic metres.[325] This would represent an increase of nearly 18.5 per cent on the current amount of mains water supplied to the energy, water and waste sectors annually but was "substantially less" than 1 per cent of total UK annual non domestic mains water usage.[326] Mr Wright told us that water usage in the US was "quite modest … water consumption for fracturing is 0.13 per cent of Colorado total water usage."[327] Mr Roberts said RAFF would "not want to overstate this problem" as they believed it was the South East of England that was most at risk.[328]

Response from regulators and the water industry

161. The Chartered Institute for Water and Environmental Management (CIWEM) published an independent report in January 2014 which considered the implications of shale gas development for water resources. The report described claims that the shale gas industry represents a threat to the security of public water supplies as "alarmist."[329] It suggested that if a large industry developed, there would be greater pressures on water that

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320 Professor Richard Muller.

321 Q 188.

322 AMEC for DECC (2013), *Op, Cit*.

323 WWF, Greenpeace and Friends of the Earth.

324 Q 190.

325 AMEC for DECC (2013), *Op, Cit*.

326 *Ibid*.

327 Chris Wright.

328 Q 190.

329 Grant, L. and Chisholm, A. (2014*) Shale Gas and Water*, The Chartered Institution of Water and Environmental Management (CIWEM).

could lead to issues with water sourcing, particularly in the South East, although water usage would be comparable with other industrial users. UK Water Industry Research (UKWIR) and Water UK believe that the risks can be mitigated with appropriate regulation.[330]

162. Dr Grayling said that

> "it is very important to understand that if you want to take large amounts of water from the environment, you require a licence from the Environment Agency … we would not license levels of abstraction beyond that which would be environmentally safe."[331]

Professor MacKay told us that

> "there is no potential at all for a shortage … planning permission will be granted and permits will be issued … only when there is a plan that will ensure that the water requirements are sustainable and that there will no impact on the security of supply to existing customers."[332]

Water UK and the UKOOG have a memorandum of understanding which is intended to identify and address any potentially locally significant effects on water resources.[333]

Technological advances

163. Professor Mair told us that technological advances could enable water use to be minimised by replacing it with flowback water.[334] Mr Petts agreed. He also thought there would be a "move to waterless fracturing systems using inert gases instead of water to reduce that water demand."[335] Professor Muller said that some operators in the US have started to use saline water instead of fresh water.[336]

164. **Fears of water shortages arising from shale gas development have been overplayed: demand for water from onshore shale operators, even at high levels of activity, would be comparable to demand by other industrial users; regulators will not permit levels of water consumption that threaten household supplies; and technological advances such as the substitution of saline water and recycling of flowback water are likely to reduce demand for fresh water.**

Seismic activity

Preese Hall

165. On 1 April and 27 May 2011, two earth tremors measuring 2.3 and 1.5 on the Richter Scale were detected in the Blackpool area. A link was suspected to hydraulic fracture injections at a well at Preese Hall, Lancashire, operated

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330 See http://www.water.org.uk/home/policy/positions/shale-gas for Water UK's policy position (27 November 2013) on shale gas extraction.

331 Q 166.

332 Q 212.

333 AMEC for DECC (2013), *Op, Cit*.

334 Q 69.

335 Q 190.

336 Q 47.

by Cuadrilla Resources Limited. This well was hydraulically fractured during exploration of a shale gas reservoir in the Bowland basin.[337] Operations were suspended and Cuadrilla commissioned a number of studies into the relationship between the earth tremors and their operations.[338]

166. As a result of these tremors, earthquakes are perceived in the public consciousness as one of the major environmental risks associated with shale gas development.[339] Ian Roberts from the RAFF group told us they were "a concern".[340] A section labelled "Our Concerns" on the RAFF website says "we have already had two notable earthquakes and numerous small ones … What more is to come?"[341]

Significance of the 2011 tremors

167. Natural seismicity in the UK never exceeds magnitude 5 on the Richter Scale.[342] Coal-mining operations can produce seismic tremors up to magnitude 4.[343] Professor Mair told us that it was "very unlikely" that any tremor produced by shale gas operations would be greater than magnitude 3, an event he described as "no worse than a heavy lorry driving past the house".[344] He said the two tremors at Preese Hall were "very, very small events" and that the Royal Society and Royal Academy of Engineering were "quite clear that there is no material risk from earthquakes."[345]

168. Mr Petts said that "there was one in Wigan in Lancashire last month or the month before that was a magnitude 1.5.[346] We have not heard anything about that in the press; there has been no discussion of that."[347] Mr Wright said the Preese Hall tremors were "far below the magnitude able to be felt at the surface."[348] The Secretary of State for the Environment told us the tremors probably caused "the same drama in someone's house as a bus going past."[349] FFBRA said that in relation to the issue of groundwater contamination, "the question of earthquake triggering is but a sideshow."[350]

Government response to the Preese Hall tremors

169. The Government announced in July 2011 that following discussions between DECC and Cuadrilla, there would be a pause in hydraulic fracturing

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337 Green, C., Styles, P. and Baptie, B. (2012) *Preese Hall Shale Gas Fracturing, Review and Recommendations for Induced Seismic Migration*, commissioned by DECC.

338 Eisner et all (2011); Harper (2011); GMI (2011); de Pater and Pellicer (2011); Baisch and Voros (2011)

339 Q 119; Q148.

340 Q 189.

341 See http://stopfyldefracking.org.uk/our-concerns/

342 Q 70.

343 *Ibid.*

344 *Ibid.*

345 *Ibid.*

346 An earth tremor of magnitude 1.5 was recorded by the British Geological Society on 20 October 2013 in Wigan: http://www.earthquakes.bgs.ac.uk/earthquakes/recent_events/20131020170645.html#page=summary

347 Q 189.

348 Chris Wright.

349 Q 268.

350 Frack Free Balcombe Residents Association.

operations to enable further study of the seismic events.[351] A report by three independent experts was commissioned by DECC.[352] It agreed with the reports commissioned by Cuadrilla that the tremors were caused by the direct injection of fluid in a tremor zone. It made a number of recommendations for the mitigation of seismic risks in the conduct of future hydraulic fracture operations. The report concluded that there was "no reason why Cuadrilla Resources Ltd should not be allowed to proceed with their shale gas exploration activities" and they recommended "cautious continuation of hydraulic fracture operations".[353]

170. On 13 December 2012, DECC announced that exploratory hydraulic fracturing could resume in the UK subject to new controls to mitigate the risks of seismic activity:[354] These controls would require the operator to:

- carry out, prior to the start of activity, an assessment of stress fields and historical seismicity to identify what stress faults might exist in the area;
- submit a hydraulic fracturing plan to DECC showing how the identified seismic risks would be addressed, ensuring no intention to frack near active faults;
- carry out seismic monitoring before, during and after hydraulic fracturing;
- put in place a traffic light system which has a trigger mechanism to stop hydraulic fracturing operations under certain conditions.[355]

171. Ms Harvey said the measures were "probably the most stringent anywhere in the world for induced seismic activity"; Professor Mair agreed.[356] Professor Stephenson thought these measures were "important" for public reassurance.[357] Mr Egan said that Cuadrilla "will put in an exhaustive seismic monitoring array around each well site".[358] In relation to the introduction of monitoring systems, Mr Roberts said that, "I think we have to acknowledge that that might mitigate further problems."[359]

Damage to well integrity

172. Mr Roberts said that the particular concern of RAFF was the damage seismic activity could cause to well integrity.[360] FFBRA also raised this issue.[361] The Royal Society and Royal Academy of Engineering report recommended that attention should be given to any damage to well integrity following seismic activity; well integrity should be reviewed by the independent well

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[351] House of Commons Energy and Climate Change Committee, *Shale Gas: Government Response to the Committee's Fifth Report of Session 2010–12'* (7th Special Report, Session 2010–12, HC Paper 1449).

[352] Green, C., Styles, P. and Baptie, B. (2012), *Op, Cit*.

[353] *Ibid*.

[354] See https://www.gov.uk/government/news/new-controls-announced-for-shale-gas-exploration for the DECC press release announcing that shale gas exploration can resume and introducing the new controls.

[355] *Ibid* & Q 31.

[356] Q 31 & Q 70.

[357] Q 29.

[358] Q 86.

[359] Q 89.

[360] Q 189.

[361] Frack Free Balcombe Residents Association.

examiner.[362] The UK Onshore Shale Gas Guidelines provide that operators should include in their well examination scheme arrangements for the examination of induced seismicity risks in well design.[363]

173. **The Government have introduced stringent planning and monitoring requirements governing the activities of onshore oil and gas operators which might lead to induced seismicity. On the evidence we have heard, there should be no risk that seismic activity caused by hydraulic fracturing would be of sufficient magnitude to constitute any risk to people and property.**

Dangers to public health

174. Opponents of fracking expressed concerns about the dangers of emissions into the atmosphere arising from on-site machinery, HGV movements, drilling, hydraulic fracturing and flaring. They feared that communities living close to shale gas developments would be at a higher risk of health problems as a result of atmospheric pollution. These fears are based on studies from the US that appear to point to health risks for people living close to unconventional gas and oil production sites.

US academic studies

175. The most detailed human-health assessment to date in peer-reviewed literature is a study by McKenzie and others of the Colorado School of Public Health.[364] This research looked at the impact on a local community of a large shale gas development site. It estimated that health risks were greater for those living within half a mile of a well site than those living more than half a mile away.[365] Another study highlighted to us found that the concentration of carcinogenic pollutants (polycyclic aromatic hydrocarbons) near an unconventional gas field in Colorado were over 60 times the legal limit in the UK.[366]

Public Health England report and response of UK regulators

176. Both the US studies were addressed in the draft report by Public Health England (PHE) into the public health impacts relating to shale gas extraction.[367] It noted that the McKenzie paper was preliminary and further research was required; it took the view that the McKenzie study had limitations and uncertainties, that the results were not easily applicable to other areas and that the methodology was not recommended for use in the UK. PHE concluded that "the currently available evidence indicates that the potential risks to public health from exposure to the emissions associated

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362 Mair, R. et al (2012), *Op. Cit.*

363 UKOOG (2013) *UK Onshore Shale Gas Well Guidelines*, Issue 1, February 2013.

364 Kibble, A. et al (2013) *Review of the Potential Public Health Impacts of Exposures to Chemical and Radioactive Pollutants as a Result of Shale Gas Extraction: Draft for Comment*, Public Health England, 31 October.

365 McKenzie LM, et al (2012) 'Human health risk assessment of air emissions from development of unconventional natural gas resources', *Science of the Total Environment*, 10 February.

366 Colborn T, et al (2011) 'Natural Gas Operations from a Public Health Perspective', *Human and Ecological Risk Assessment: An International Journal*, 20 September.

367 Kibble, A. et al (2013), Public Health England *Op, Cit.*

with shale gas extraction are low if the operations are properly run and regulated."[368]

177. Dr Grayling emphasised that "there are practices permitted in the United States … that we would not permit in [the UK]".[369] Mr Figueira said that under licence conditions venting of methane would only be allowed in case of a safety requirement and flaring of methane would be kept to the technical and economic minimum.[370]

178. Dr Grayling suspected that part of the air quality issue identified in Colorado arose at production stage with a higher density of operations.[371] The UK would "certainly need to be mindful of the cumulative risk that you might get when operations scale up, and we will adapt our regulatory approach accordingly to ensure that you do not get unacceptable levels of pollutants going into the atmosphere."[372] The DECC Strategic Environment Assessment considered that regulatory controls through the planning system and environmental permitting would reduce the risk of impacts on air quality.[373]

Occupational health

179. The Trades Union Congress expressed fears over the impact of air emissions on the health of workers.[374] It cited a study of 2012 by the National Institute for Occupational Safety and Health (NIOSH) in the US which found that workers may be exposed to dust with high levels of "respirable crystalline silica", a cancer-causing substance, during hydraulic fracturing.[375] The reports of the Royal Society and Royal Academy of Engineering and of Public Health England do not refer to this study. The Health and Safety Executive told us that the occupational health and safety risks to workers from shale gas pilot activities are "considerably lower than for other mineral extraction industries (e.g. coal mining and offshore oil and gas)."[376]

180. **Public Health England (PHE) has recently reviewed all the available evidence on the risks to public health arising from air emissions from shale gas activities, including US studies brought to our attention by opponents of shale gas development. We find persuasive the conclusion of PHE's preliminary report that the risks to public health from shale gas exploration and production are low with proper regulation.**

Radon

181. Dr David Lowry told us that shale gas "would have to be stored for at least a month before being distributed to people's homes to allow for this radioactive decay of radon."[377] He cited a US report that "some shale gas deposits contain as much as 30 times the radiation that is found in normal

368 *Ibid.*

369 Q 167.

370 Q 164.

371 Q 167.

372 *Ibid.*

373 AMEC for DECC (2013), *Op, Cit.*

374 TUC.

375 *Ibid.*

376 Health and Safety Executive.

377 Dr David Lowry.

background."[378] Professor Stephenson did not regard the presence of radon in gas as "a serious risk."[379] He told us that shales are "weakly radioactive … much less than you get in somewhere like Aberdeen or Cornwall … This is quite a well known phenomenon".[380] Public Health England's interim report took account of the US study and "considered very unlikely that shale gas activities would have any significant effect on radon levels in homes."[381] **We find persuasive the view of Public Health England that shale gas development would be very unlikely to have a significant effect on radon levels in homes.**

Traffic and noise pollution

Traffic

182. Opponents of fracking expressed concerns about the impact of increased traffic resulting from shale gas development, particularly in rural areas. The RAFF website warns that "the Fylde will be turned into an industrial zone and will have a negative knock-on effect on our main industries—tourism and agriculture."[382] FFBRA said villagers at Balcombe were "plagued by heavy traffic" as a result of activity by Cuadrilla.[383] Mr Grealy told us that "the number one concern" from Balcombe residents was traffic.[384] Citing a recent report from the Institute of Directors, EDF wrote that a typical 10 well shale gas pad would require 8,000 truck movements over the course of its life.[385]

183. The DECC Strategic Environment Assessment estimated the expected traffic levels at a well pad site during three different stages of shale gas development:[386]

TABLE 1

Estimated Vehicle Movements

Development phase	Vehicle movements/day	Duration of vehicle movements
Exploratory drilling	14–36	12–13 weeks
Production development	16–51	32–145 weeks[387]
Production and operation	10–45[388]	Dependent on well productivity

Source: DECC (2013)

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[378] *Ibid.* The report by Marvin Resnikoff from the Radioactive Waste Management Associates is available here: http://energyindepth.org/wp-content/uploads/marcellus/2012/04/Resnikoff.pdf

[379] Q 32.

[380] *Ibid.*

[381] Kibble, A. et al (2013), Public Health England *Op, Cit.*

[382] See http://stopfyldefracking.org.uk/our-concerns/

[383] Frack Free Balcombe Residents Association.

[384] Q 1 42.

[385] EDF.

[386] AMEC for DECC (2013), *Op, Cit.*

[387] 32 to 73 weeks under a low activity scenario, 32 to 145 weeks under a high activity scenario

[388] Dependent on the assumed duration of fracturing per site and management of flowback water

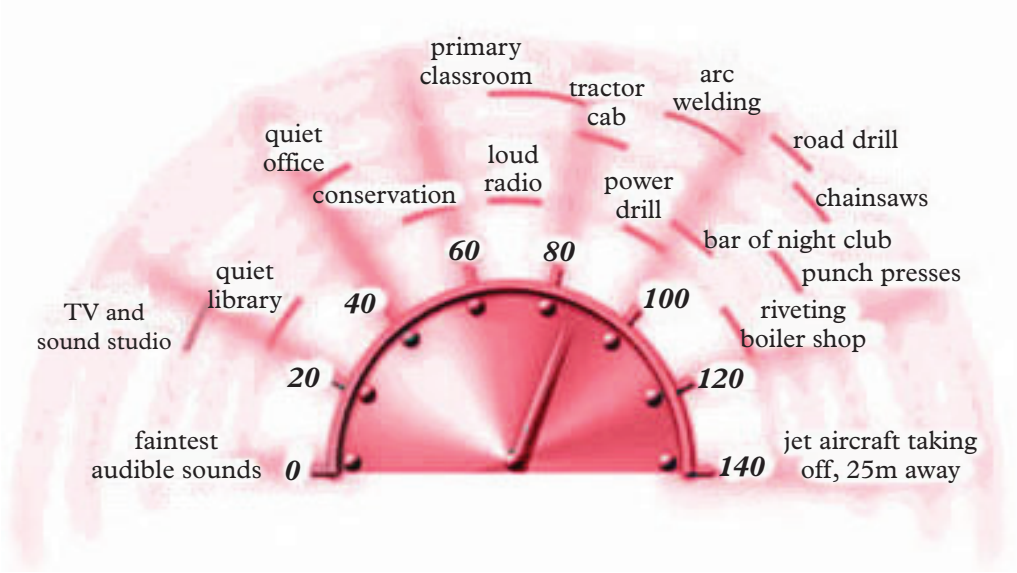
184. The Strategic Environment Assessment concluded that any adverse effects of traffic on local communities could be mitigated by planning controls.[389] The Department for Communities and Local Government also told us that consideration of applications for planning permission would take account of expected traffic movements.[390] Planning controls could cover the development of a transport plan, the scheduling, timing and frequency of movements, speed restrictions and the use of alternative routes to and from the site.[391] INEOS welcomed the industry's proposed community benefit scheme because of the inconvenience that could be caused to local communities by increased traffic.[392]

185. **The Committee recognises that development of shale, like any other industrial activity, would cause an increase in traffic and disruption in some places, especially during periods when wells were being drilled. Although planning controls may mitigate disturbance, there should be a role for the industry's community benefits scheme to compensate those affected individually.**

Noise from shale gas operations at Balcombe

FIGURE 12

The Decibel Scale



Source: Reproduced by permission of HSE

186. Noise requirements around operating sites are put in place as part of the planning approval from the local authority and of the environmental permit issued by the environmental regulator.[393] Lord Smith told us that the Environment Agency had received complaints from residents about the noise from Cuadrilla's site at Balcombe.[394] Mr Egan said that Cuadrilla had

[389] AMEC for DECC (2013), *Op, Cit*.

[390] Department for Communities and Local Government.

[391] AMEC for DECC (2013), *Op, Cit*.

[392] INEOS.

[393] Q 168.

[394] *Ibid*.

received a complaint which they investigated[395] and measured 52 decibels, whereas the night time limit was 48 decibels,[396] a difference he described as "less than a whisper."[397]

187. Balcombe residents made representations that the breach was more significant than a whisper. On the basis of analysis from acousticians at Salford University, the Parliamentary Office of Science & Technology understands that it was probably misleading of Mr Egan to assert that the difference between 48 and 52 decibels was less than a whisper, but the increase could be considered modest. Figure 13 above shows where some common sounds would register on the decibel scale.

188. Spectrum Acoustic Consultants were monitoring noise levels at Balcombe over the 10 week period these events took place. They found that there were some occasions when noise levels increased slightly above the night time limit, "occasional short term 'spikes'… to above 50 decibels".[398] They noted that sound levels prior to drilling were shown to be above the noise limits and that the minor excesses would not be significant. They concluded that "the noise limits during well site operations are being met."[399]

189. **On the evidence available to us, Cuadrilla's operations at Balcombe appear usually to have observed prescribed noise limits, with occasional minor lapses.**

Cuadrilla and the Advertising Standards Authority

190. Ms Rothery told us that the Advertising Standards Authority (ASA) had upheld complaints about a number of claims that Cuadrilla had made in an advertising brochure, published in summer 2012.[400] We received representations from Balcombe residents that also drew attention to the ASA ruling on the brochure. The ASA examined 18 complaints against advertising by Cuadrilla.[401] It rejected 12 of these. The remaining 6 complaints that were upheld by the ASA were matters of nuance and modest misstatement rather than blatant attempts to mislead. The ASA ruled that the brochure must not appear in the same form again.[402]

191. **It is widely believed, by opponents and others, that exploration and production of shale gas in the UK would pose dangers to the environment and to public health. Government, regulators and the industry need to take these fears, legitimate and exaggerated,**

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395 Q 81.

396 The night time limit was actually 42 decibels.

397 Q 81. Mr Egan asked to make a correction to the transcript following the evidence session: the night-time limit was 42 decibels, the day-time limit was 55 decibels and the noise level measured, following a report, was "varying between 45 and 48 decibels with occasional short duration peaks to 51 decibels". He added: "Cuadrilla accepts that a 50Db noise level is louder than a whisper and noise at a level of 50 Db has been compared to a "quiet suburb" or a "conversation at home"."

398 See http://balcombeparishcouncil.files.wordpress.com/2013/09/noise-report-balcombe-sep-13.pdf for the report by Spectrum Acoustic Consultants entitled 'Noise monitoring during operations: Lower Stumble Well Site, Balcombe, West Sussex'.

399 *Ibid.*

400 Q 186.

401 See http://www.asa.org.uk/Rulings/Adjudications/2013/4/Cuadrilla-Resources-Ltd/SHP_ADJ_203806.aspx for the April 2013 adjudication of the Advertising Standards Authority.

402 *Ibid.*

seriously and tackle them. We heard an impressive amount of scientific evidence that with a robust regulatory regime the risks to the environment and public health are low. With such a regime in place, we consider the environmental risks to be small, whereas the benefits if shale gas development takes place are substantial.

CHAPTER 8: THE UK'S REGULATORY SYSTEM

192. The Better Regulation Task Force defined five principles of good regulation in 1997.[403] The principles, endorsed by the present Government,[404] state that any regulation should be "transparent, accountable, proportionate, consistent and targeted". This chapter will consider the effectiveness of the regulatory regime for shale gas in the UK.

The UK regulatory regime: shale gas exploration and appraisal phases

193. In December 2013, DECC published a "Regulatory Roadmap" to help operators understand the regulatory process for onshore oil and gas exploration and appraisal in the UK.[405] A diagram from the Roadmap that explains the process in detail is at Appendix 4. The main regulatory bodies involved are DECC, local Mineral Planning Authorities, the Environment Agency and the Health and Safety Executive. The responsibilities of each are outlined below.[406]

DECC

Issue of petroleum exploration and development licences (PEDLs)

194. The Crown has the exclusive right for searching and boring for and getting petroleum in Great Britain.[407] DECC issues production licences (known as 'petroleum exploration and development licences' (PEDLs)) to operators through licensing rounds. These licences grant exclusivity to an operator within a certain area. As part of the licensing process, DECC assesses operator competency, safety management systems, well examination schemes and financial capability.[408] The licence does not grant any right to drill a well but exploratory work through seismic investigations may begin.[409]

Environmental risk assessment

195. Where hydraulic fracturing is planned, DECC requires an environmental risk assessment (ERA) to be carried out. This is an overview that assesses environmental risks over the full cycle of the proposed operations with the participation of stakeholders, including local communities. DECC

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403 Better Regulation Task Force (2003) *Principles of Good Regulation*.

404 See https://www.gov.uk/government/policy-teams/better-regulation-unit

405 DECC (2013) *Onshore oil and gas exploration in the UK: regulation and best practice*, 17 December. The roadmap does not cover the production phase.

406 This chapter outlines the regulatory regime for England since this is where exploration is expected to take place first. DECC have produced separate roadmaps for the regulatory regimes in Scotland, Wales and Northern Ireland. The Roadmap for each regime is available here: https://www.gov.uk/government/publications/regulatory-roadmap-onshore-oil-and-gas-exploration-in-the-uk-regulation-and-best-practice

407 Petroleum Act 1998, section 2(1) and 2(2). In Northern Ireland, ownership of petroleum is vested in the Ministry of Commerce under the Petroleum (Production) Act (Northern Ireland) 1964, section 1(1).

408 DECC (2013) *Onshore oil and gas exploration in the UK, Op, Cit.*

409 Most local authorities do not consider that seismic investigations require planning permission. Operators must notify landowners, planning authorities and DECC if they plan to conduct seismic surveys in the licence area.

recommends it as a starting point for early engagement by operators with local authorities and other regulators as it can subsequently inform other required assessments.[410]

Approval and consent

196. Under the terms of the PED licence, operators are required to submit to DECC for approval a hydraulic fracturing plan that demonstrates a full understanding of the risks involved. Operators also need to evaluate the historical and background seismicity, describe faults in the proposed area and identify the risk of activating any fault through hydraulic fracturing activity. Traffic light monitoring systems are required to enable operators to mitigate induced seismicity.[411]

197. Operators are required to seek consent from DECC to drill and consent to fracture once all permissions and permits from other bodies discussed below have been granted. Operators can make the requests for drilling and fracturing consent together.[412]

Local authorities / Mineral Planning Authorities

Planning permission

198. Operators require planning permission from the relevant Minerals Planning Authority (MPA) to conduct both exploratory and appraisal work.[413] County councils or unitary authorities usually exercise MPA duties. The MPA will determine applications in accordance with planning law. Permission is granted for the location of any wells and wellpads and conditions may be imposed to ensure that the impact on the use of the land is acceptable.[414] If an MPA refuses permission for the proposed development, operators can appeal to the Secretary of State for Communities and Local Government.[415]

199. The focus of the planning system is on whether the development is environmentally acceptable. Key issues may include site location, traffic volumes, noise, groundwater, induced seismicity and waste.[416] Guidance from DCLG states that Mineral Planning Authorities should "use appropriate planning conditions, having regard to the issues for which they have responsibility, to mitigate … any adverse environmental impact."[417] The guidance recognises that a number of issues are covered by other regulatory regimes and MPAs

> "should assume that these regimes will operate effectively … as they can rely on the assessment of other regulatory bodies. However, before

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410 DECC (2013) *Onshore oil and gas exploration in the UK, Op, Cit.*

411 *Ibid.*

412 *Ibid.*

413 Separate applications are required for each stage. Applications for both stages can be made within one application.

414 Department for Communities and Local Government (2014) *Planning Practice Guidance: Minerals*, 6 March. See http://planningguidance.planningportal.gov.uk/blog/guidance/minerals/

415 Town and Country Planning Act 1990, section 78

416 DECC (2013) *Onshore oil and gas exploration in the UK, Op, Cit.*

417 Department for Communities and Local Government (2014) *Planning Practice Guidance, Op, Cit.*

granting planning permission they will need to be satisfied that these issues can or will be adequately addressed by taking the advice from the relevant regulatory body."[418]

Environmental Impact Assessment (EIA)

200. The MPA considers whether a proposal requires an Environmental Impact Assessment (EIA). If the project is likely to have significant environmental effects, the operator is required to complete an EIA.[419] Operators can request a decision from the MPA as to whether an EIA is needed in advance of any planning application. The EIA assesses the likely significant environmental effects of the proposed development. Operators are expected to draw upon the content of the environmental risk assessment required by DECC. Once the EIA is complete, the results are presented in an environmental statement submitted with the planning application. Professor Mair considered that the EIA played a "crucial role" and "should be mandatory for all shale gas operations … if [it] is done properly … the whole path will be much smoother."[420]

201. Mr Figueira told us that once the planning application is made together with the environment statement, the MPA will "place and advertise and consult for usually around 21 days, and then the planning permission would normally take 16 weeks if it involved an environmental impact assessment, and, if it did not, around 13 weeks."[421] The Environment Agency is a statutory consultee to the planning process.

Agree plan for site restoration

202. Operators are required to present plans for restoration of the planned development site to the MPA. The MPA is responsible for ensuring proper restoration and aftercare of the site when operations terminate.[422]

Environment Agency

Notice of intention to drill

203. Operators are required to serve notice on the Environment Agency (EA) before drilling a borehole. A detailed statement needs to be submitted with information on well drilling, well casing, storage of substances including fuel and chemicals and a proposed plan for dealing with waste.[423]

Environmental permits

204. Operators may require environmental permits for:[424]

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418 Department for Communities and Local Government (2014) *Planning Practice Guidance, Op, Cit.*

419 *Ibid.*

420 QQ 72–73.

421 Q 159.

422 Department for Communities and Local Government (2014) *Planning Practice Guidance, Op, Cit.*

423 Environment Agency (2013) *Onshore oil and gas exploratory operations: technical guidance, Consultation Draft* August 2013.

424 DECC (2013) *Onshore oil and gas exploration in the UK, Op, Cit.*

- Groundwater activity[425]
- Mining waste activity[426]
- Industrial emissions activity[427]
- Radioactive substances activity[428]
- Water discharge activity[429]
- Groundwater investigation consent[430]
- Water abstraction licence[431]
- Flood risk consent[432]

Dr Grayling told us that "the number of permits and consents that are required … will depend on the site in question, its geology and what activities are actually proposed."[433] As some of the technical documentation supporting operators' planning and environmental permit applications may need to be submitted to the EA and to the MPA, the EA "strongly recommend 'parallel tracking' of environmental permits and planning applications."[434]

205. Lord Smith said that the EA aims to issue permits within a 13-week period but "that, however, has to include a period for public consultation. If it is a matter of high public interest, the consultation period might have to be a slightly extended one, which might push the timetable a bit beyond the 13-week period."[435] Draft technical guidance from the EA says that "given the current level of public interest in unconventional gas and oil exploration, it's likely that we treat such sites as being of high public interest … For a bespoke permit application where there is a lot of public interest, determining a permit may take four to six months from where the application is duly made."[436]

206. The Secretary of State for the Environment, Food and Rural Affairs told us that the Government planned "to reduce the timescales … with the intention of there being a standard permit."[437] Dr Grayling thought that the EA would be able to issue these "within two to three weeks" and they would be available in early 2015.[438] **We heard from the Secretary of State for the Environment and from the Environment Agency of plans for standard**

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425 Unless the EA is satisfied that there is no risk of inputs to groundwater.

426 Likely to apply in all circumstances.

427 When the operator intends to flare more than 10 tonnes of gas per day.

428 Likely to apply in all circumstances.

429 If surface water runoff becomes polluted.

430 To cover drilling and test pumping where there is the potential to abstract more than 20m³/day in the production process.

431 If the operator plans to abstract more than 20m³/day for own use rather than purchasing water from a public water supply utility company.

432 If the proposed site is near a watercourse or main river.

433 Q 272.

434 Environment Agency (2013) *Onshore oil and gas exploratory operations*, *Op, Cit*.

435 Q 155.

436 Environment Agency (2013) *Onshore oil and gas exploratory operation*', *Op, Cit*.

437 Q 272.

438 Q 273.

permits to be issued on reduced timescales. We consider that changes on these lines would be highly desirable but doubt if they will happen without the changes we recommend to simplify the regulatory framework.

Health and Safety Executive

Well design and integrity

207. The Health and Safety Executive (HSE) monitors onshore oil and gas operations for well integrity and site safety. Prior to the start of drilling, the operator must notify the HSE of the well design and operation plans.[439] The design of wells is regulated by the Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996 (DCR). These regulations include specific requirements for all wells, whether onshore or offshore, and include well integrity provisions which apply throughout the life of wells.[440]

208. The regulations also require a well operator to provide HSE with regular reports of any activities on the well and to appoint an independent well examiner to undertake regular assessments of well integrity. In addition to the well examiner scheme, Mr Peter Baker, Director, Hazardous Installations Directorate at the HSE, told us that wells will get "independent inspection by HSE well specialists."[441] HSE and the Environment Agency have agreed jointly to inspect future hydraulic fracturing operations.[442] HSE wrote that "for new and first time shale gas operators, HSE and the Environment Agency will meet and advise them of their duties under the relevant legislation; and conduct a joint inspection of the key operations, such as cementing."[443] The two regulators have a memorandum of understanding which sets out a framework for how they work together and planning interventions.[444] Dr Grayling told us that it was "particularly critical from the point of view of environmental protection that the well is properly constructed and sealed".[445]

Regulatory regime for shale gas production phase

209. The regulatory roadmap produced by DECC covers only the exploration and appraisal phases of shale gas development. The same permissions and permits described above will have to be applied for again if operators wish to move into production.

Effectiveness of the UK regulatory regime

210. Mr Figueira told us that in the UK "we certainly have the capability and the regulatory structure in place to enable the exploratory phase to proceed in line with industry expectations."[446] Mr Smith of Shell said that the UK has

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439 Borehole Sites and Operations Regulations 1995, section 6.

440 Health and Safety Executive.

441 Q 162.

442 Health and Safety Executive.

443 *Ibid.*

444 Q 154.

445 Q 181.

446 Q 156.

"a world class set of regulations".[447] Mr Dorner from the International Energy Agency (IEA) said that "internationally, the UK regime as it stands is very highly regarded".[448] The IEA published a report in 2012 that set out seven principles for the development of shale gas that "can allow policymakers, regulators, operators and others to address these environmental and social impacts."[449] Mr Dorner said he "suspected" that the UK regime already incorporates those principles. Professor MacKay and Mr Lambert pointed out that drilling for and production of onshore oil had successfully occurred in the UK at Wytch Farm for many years.[450]

211. Some witnesses made comparisons between the UK and US regulatory regimes. The UK Onshore Operators' Group wrote that the UK regime is "different and significantly more stringent" than the US regime.[451] Policy Exchange stated that "much of the regulation of shale gas in the US occurs at the state level, meaning there can be significant variations in environmental compliance."[452] Professor Stevens said that many shale gas operations in the US have been done with "little environmental impact assessments."[453] However, Cuadrilla disagreed that regulation was weaker in the US: "contrary to the popular view, American regulation in this sector is extremely experienced, intensive and confident."[454]

Slow progress of exploration to date

212. Mr Egan told us that "physically, we could drill tomorrow … the thing that takes the longest time, is the planning and permitting process."[455] Mr Austin told us that "the level of consultation and engagement, and the time spent considering applications, has been considerably longer than what would otherwise have been looked at as industry best practice."[456] Dr Grayling told us that since the Government moratorium on hydraulic fracturing ended in December 2012,[457] "the Environment Agency have not yet received any permit applications to undertake hydraulic fracturing."

213. The Committee Clerk wrote to Mr Egan to ask why Cuadrilla had not submitted any applications for permits since December 2012. Mr Egan replied that permit applications for hydraulic fracture and flow test exploration wells (the appraisal phase) were made in August 2012. These applications were delayed as Cuadrilla undertook an Environmental Impact Assessment (EIA) as part of the planning process.[458] Dr Grayling said there was "no disagreement" with Cuadrilla on this matter, "an Environmental Impact Assessment … may reveal issues material to our permitting decisions

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447 Q 110.

448 Q 107.

449 International Energy Agency (2012) *Golden Rules for a Golden Age of Gas*.

450 Q 204 & Q 212.

451 UKOOG.

452 Policy Exchange.

453 Professor Paul Stevens.

454 Cuadrilla Resources Limited.

455 Q 76.

456 Q 77.

457 Q 159 and see paragraph 75.

458 Cuadrilla – Supplementary correspondence with Committee Clerk.

… permitting need not delay operations if operators make sure that they align their permit applications and submit new ones."[459]

214. Cuadrilla withdrew the original permit applications and is expected to submit new ones, alongside planning applications, for several sites in north-west England later this year.[460] In Mr Egan's view it was "perhaps not wholly unsurprising" that "the timescale involved in delivering these very first permits of their kind in the UK has been very lengthy."[461] Dr Grayling told us that the Environment Agency is "going through a learning exercise as an agency, while the industry was also going through a learning exercise on how to apply for the appropriate permits."[462]

215. There is no indication as to how long the whole regulatory process would take. DECC's regulatory roadmap explicitly states that "the roadmap does not define timescales for the planning and permitting process or individual steps within it."[463] It advises operators to contact the relevant regulatory authorities to establish indicative timelines. The table below summarises the timescales that we have been made aware of for each stage:

TABLE 2

Indicative Timescales

Stage	Length of time
DECC	
Issue of PED licence	Granted through licensing rounds
Environmental risk assessment	No indication given
Approval of hydraulic fracturing plan	No indication given
Consent to drill	No indication given
Local authorities	
Planning permission[464]	21 day consultation[465] 16 weeks if EIA required, 13 weeks if not[466]
Environmental Impact Assessment (EIA)	
Agree plan for site restoration	

459 Environment Agency – Supplementary correspondence with Committee Clerk.

460 Q 273.

461 Cuadrilla – Supplementary correspondence with Committee Clerk.

462 Q 273.

463 DECC (2013) *Onshore oil and gas exploration in the UK, Op, Cit.*

464 Operators are encouraged to make parallel applications for planning permissions and environmental permits.

465 See paragraph 201.

466 *Ibid.*

Stage	Length of time
Environment Agency	
Notice of intention to drill	Served 1 month prior to drilling[467]
Environmental permits[468]	13 weeks to 26 weeks[469]
Health and Safety Executive	
Notice of intention to drill	Served 21 days prior to drilling[470]

216. Table 2 above lists the stages in the regulatory process that are described above and provides indicative timescales where available. As no operator has been through the whole process since the publication of the regulatory roadmap, it is not clear how long the various stages, or the whole process, would take in practice. There could also be delays if planning and permitting decisions where subject to legal challenge.

217. Figure 13 below shows how the regulatory process looks to industry. It outlines Cuadrilla's view of the expected timescales for certain stages, including the requirements of Environmental Impact Assessments.

[467] Environment Agency (2013) *Onshore oil and gas exploratory operations*, *Op, Cit*. The EA recommends that drilling should not begin until one month after notice is served. If the EA does not consider the information received with the notice to drill sufficient, it can serve a notice on the operator requesting more information.

[468] *Ibid*.

[469] See paragraph 205.

[470] DECC (2013) *Onshore oil and gas exploration in the UK*, *Op, Cit*. The HSE must be satisfied by the proposed design of the well.

FIGURE 13

Cuadrilla's view of key steps and associated timelines

Key Steps and Timeline in Securing Approvals to Drill, Hydraulically Fracture and test the flow rate from a Shale Gas Exploration Well

The high level timeline tabulated below is for securing a Planning Consent only and assumes that an exploration site has already been identified.

In parallel with applying to the County Council for a Planning Consent the applicant will also apply to the Environment Agency for up to 8 or 9 separate Environmental Permits required for the drilling, hydraulic fracturing and testing the flow of gas from an exploratory shale well. It is assumed that from a timing perspective this is carried out within the minimum 16 month period outlined below required to secure a Planning Consent.

Activity	Duration	Commentary
1) Complete all surveys required for an Environmental Impact Assessment (EIA), e.g. Newts, Wintering Birds, Bats, Traffic, Noise etc.	Approx. 6 months	Certain surveys can only be carried out at particular times of year (e.g. Wintering Birds)
2) Complete EIA and associated Planning Application (including getting an EIA Scoping Opinion from the County Council and carrying out pre-application consultation with local communities and stakeholders)	6 months (some overlap possible with step 1 above, incremental time assumed to be 3 months)	EIA Scoping opinion from Council typically 5 to 6 weeks. Pre application consultation process typically 3 to 4 months
3) Submit Planning Application and associated EIA to County Council. Council consults with statutory consultees and decides.	Minimum of 4 months for an EIA planning application.	Council should respond in 16 weeks from application but can take longer.
4) Fulfil any associated planning conditions (if application approved)	Typically 1 month	Conditions could include widening road access or other such provisions
5) Prepare Exploration site (foundation, drainage, security etc.) and mobilise drilling equipment	2 months	
Start Drilling	16 months later	

Note: it is possible that a successful Planning consent and/or Environmental Permit application could be subjected to a Judicial Review (JR) challenge. The JR process could add approx. 12 months to above timeline, post the completion of step 3.

Source: Cuadrilla Resources Limited

Is the UK regulatory regime effective?

218. Asked whether he would invest in the UK at the moment, Mr Wright said that "if you had rigorous but crisp and clear environmental regulations, and you had a way to align the community and move quickly, I would do it in a heartbeat, but that is not there today … If the business climate was here, it would happen."[471] He said that "certainty to move quickly" was required.[472] Mr Egan said that if the UK was to move into a production phase, the regulatory regime "will require a step change in the pace and scale of operation."[473]

219. Mr Hughes said "objectively the regulation regime … is probably okay"; but local residents did not have confidence because "the industry has done a lousy job of providing the reassurance that is necessary … the industry is not gaining the benefit of the doubt … the regulatory machine probably has to go beyond what is objectively required in order to win that confidence back."[474] He told us that there is "probably a need for a step up in the regulatory regime, and one that is communicated in such a way that it will reassure them."[475]

220. **The UK's regulatory framework for onshore exploration and production applies to conventional as well as shale gas and oil. There is no special regime for shale gas and oil, except that extra rules govern hydraulic fracturing. Applicable regulations in the UK are rigorous and thorough and address the environmental and health risks. We heard that they are well respected internationally. We were also told of measures to improve coordination in the system so as to deal more effectively with development of shale gas and oil.**

221. **The regulatory framework is however unnecessarily complicated, with responsibilities shared between various Departments and agencies. Wytch Farm apart, it has no track record of dealing with large scale onshore operations. Bureaucratic complexity and diffusion of authority are not the best basis for clear and effective regulation of a new and fast-evolving industry. It is not clear how long the whole regulatory process, or its various stages, would take. We set out recommendations below to reduce the complexity and increase the transparency of the regulatory regime.**

Reducing the complexity and increasing the transparency of the regulatory regime

Reducing the complexity of the regulatory regime

222. The Royal Society and Royal Academy of Engineering report into shale gas recommended that a single body should take the lead for regulatory responsibilities relating to shale gas.[476] Professor Mair told us that at present,

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471 Q 231.

472 Q 233.

473 Q 202.

474 Q 202.

475 Q 201.

476 Mair, R. et al (2012) *Shale gas extraction in the UK: a review of hydraulic fracturing*, Royal Society and Royal Academy of Engineering.

"there is DECC, there is HSE, there is the Environment Agency. We said that there should be one organisation that oversees the whole process."[477] Duarte Figueira said that DECC set up the Office of Unconventional Gas and Oil in March 2013 to "provide exactly the sort of coordinated approach that was recommended in the Royal Society report, so there was clarity on the roles and responsibilities of different regulators".[478] The Minister for Energy told us that following the publication of the regulatory roadmap in December 2013, "the system is now crisp and clear."[479] Regrettably, however, that is not the case.

223. Despite the introduction of the Office of Unconventional Gas and Oil and the regulatory roadmap, responsibilities are still fragmented. For example, DECC must approve operators' plans to mitigate the risk of induced seismicity;[480] the Environment Agency approve operators' plans for air emissions to mitigate the risk to public health;[481] and the Health and Safety Executive monitor well integrity that mitigates the risk of groundwater contamination.[482] Although the Environment Agency and Health and Safety Executive intend to carry out joint well inspections; the EA will be assessing the risk to the environment, the HSE the risk to health and safety.[483]

224. There are also significant levels of duplication. For example, operators must discuss plans to mitigate the risk of groundwater contamination in four different contexts:

- the environmental risk assessment required by DECC;[484]
- the Environmental Risk Assessment required by the Minerals Planning Authority;[485]
- an application to the Environment Agency for a groundwater permit;[486]
- and the Health and Safety Executive will ultimately review the design of wells to ensure that nothing can escape into aquifers.[487]

225. Some witnesses questioned whether the individual regulators had sufficient resources to manage when activity increases. Mr Parr said his question was "whether they have the capacity to manage the sort of expansion that is being proposed and to develop whole new areas of understanding and expertise".[488] The Environment Agency was of particular concern. Mr Bennett told us that "there are already very significant concerns about a lack of capacity within regulators like the Environment Agency to even deliver on their current

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477 Q 73.

478 Q 154.

479 Q 256.

480 See paragraph 196.

481 See paragraph 204.

482 See paragraph 207.

483 See http://www.hse.gov.uk/aboutus/howwework/framework/aa/hse-ea-oil-gas-nov12.pdf for the November 2012 memorandum of understanding between the Environment Agency and the Health and Safety Executive.

484 See paragraph 195.

485 See paragraph 200.

486 See paragraph 204.

487 See paragraph 207.

488 Q 36.

expectations".[489] Professor Smythe wrote that "the weakest point of the regulatory process concerns the Environment Agency" and said they appear to have "insufficient in-house expertise".[490] It was reported earlier this year that the total number of staff at the Environment Agency was to be reduced from 11,250 to around 9,700 by October 2014.[491]

226. The Minister for Energy said that "we are always looking to see, in the regulatory process, where there is the possibility to reduce intervals and to streamline and avoid overduplication."[492] However, he did not believe that setting up a new body would make regulation easier.[493] His concern was "not just the time that it would take to set it up, but that people might feel that it was completely pro any kind of development."[494]

Increasing the transparency of the regulation regime

227. As discussed in Chapter 7, groundwater contamination through a failure of well integrity is a significant risk for all onshore oil and gas drilling. That risk is low as long as wells are properly constructed and sealed and the regulations on well design and integrity are rigorously enforced.[495] Mr Cronin said that "we have a very strict regime for well integrity in this country. It is sufficiently more stringent than the US's."[496] Discussing well integrity, Mr Austin told us that "the UK has gold standards throughout the North Sea, which … are the same standards that are applied onshore … So this is not us policing ourselves but a well established regulatory system that is being applied to an established industry".[497]

228. However, Ms Rothery told us that "there are no actual onshore regulations … [the regulations that apply] are based on offshore regulations."[498] Mr Michael Hill wrote that "there is a clear need of specific onshore industry specific regulations. At present there are none."[499] Mr Petts disagreed, "I think it is wrong to say that there are no onshore regulations … It is covered through lots of our existing legislation."[500] Describing the Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996, he said "it is a mistake in the way the regulations were titled … there is a lot of regulation out there … it is just a bit clunky and disjointed, or appears that way to people who are not familiar with it."[501] Wytch Farm, for example, is an outstandingly successful large onshore oilfield regulated under the existing system.

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489 Q 37.

490 Professor David Smythe.

491 BBC News (2014) 'UK flooding: Environment Agency to cut hundreds of jobs', 3 January.

492 Q 258.

493 Q 259.

494 *Ibid.*

495 See paragraphs 144 to 147.

496 Q 62.

497 Q 82.

498 Q 193.

499 Michael Hill.

500 Q 193.

501 *Ibid.*

229. Mr Hill told us that the Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996 were "aimed at offshore development" and the Borehole Sites and Operations Regulations 1995 were introduced prior to high volume hydraulic fracturing.[502] Professor Riley said that

> "the entire approach to oil and gas has been focused on offshore. Recalibrating for onshore will be a major task … The problem is not the focus on fracking but the traditional oil and gas problems: security of the wellhead and ensuring that flow-back waters cannot seep into the ground. All this is known to the regulators, but we have never had to deal with it on any scale onshore."[503]

230. The Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996 only require the well operator and well examiner to take account of the risk to "the health and safety of persons" when designing and examining a well.[504] They are not required to take account of the risk to the environment which is likely due to the original focus of the Regulations on offshore development. The Royal Society and Royal Academy of Engineering report recommended that the scheme "should be widened so that well integrity is also considered from an environmental perspective. Wider expertise within or outside the oil and gas sector may need to be drawn upon."[505]

231. **We agree with the Royal Society and the Royal Academy of Engineering that a single body to regulate onshore development of shale gas and oil would be desirable in principle. We fear, however, that the necessary reorganisation would cause delays. We therefore recommend a more coordinated and responsive regulatory approach within the existing framework, with a lead regulator identified by the Government, following the five principles of good regulation advocated by the Better Regulation Task Force and adopted by the present Government:**

Transparent

"Regulators should be open and keep regulations simple and user-friendly"[506]

We recommend that the Government should consolidate the applicable provisions in the confusingly titled and potentially misleading Offshore Installations and Wells Regulations and Borehole Sites and Operations Regulations into one clearly labelled set of regulations for onshore oil and gas operations.

As recommended by the Royal Society and Royal Academy of Engineering, the consolidated regulations should specify that well integrity is to be considered from an environmental perspective as well as a health perspective. The Environment Agency and Health and Safety Executive should make it much clearer to the industry and the public exactly how and when they would inspect well sites.

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502 Michael Hill.

503 Q 7.

504 Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996, section 13(1)(b).

505 Mair, R. et al (2012), *Op, Cit.*

506 Better Regulation Task Force (2003), *Op, Cit.*

Accountable

"Regulators must be able to justify decisions, and be subject to public scrutiny…There should be well-publicised, accessible, fair and effective complaints and appeals procedures"[507]

The Government should provide a single, clear appeals process for operators in the event that an application for planning permission is refused by a local authority.

Proportionate

"Regulators should only intervene when necessary. Remedies should be appropriate to the risk posed, and costs identified and minimised…Policy solutions must be proportionate to the perceived problem or risk and justify the compliance costs imposed"[508]

Operators are often required to submit the same information to different regulators. The Office of Unconventional Gas and Oil should provide a single point for data input to remove duplication and reduce costs for operators.

Consistent

"Government rules and standards must be joined up and implemented fairly"[509]

The Government should ensure that operators are able to make all the required planning and permit applications in parallel, in order to speed the process. There is room for much greater coordination, particularly in relation to information sharing between local authorities and the Environment Agency.

Targeted

"Regulation should be focused on the problem, and minimise side effects"[510]

A targeted approach by the regulators should include a clear timetable for decision-making, agreed beforehand with the operators.

Independent well examiners

232. The Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996 require the design and construction of onshore wells to be examined by an "independent and competent person".[511] This well examiner is commissioned and paid for by the operator. The Regulations do not prohibit the well examiner being an employee of the well operator's organisation."[512]

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[507] Better Regulation Task Force (2003), *Op, Cit.*

[508] *Ibid.*

[509] *Ibid.*

[510] Better Regulation Task Force (2003), *Op, Cit.*

[511] Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996, section 18(2).

[512] *Ibid*, section 18(7). The examiner must only be "sufficiently independent" of a management system which bears or has borne any responsibility for any aspect of the operations subject to examination.

233. The Royal Society and Royal Academy of Engineering report recommended that the guidelines should be clarified to ensure that the well examiner is independent of the operator.[513] Professor Mair told us they "expressed strong views" on this in the report: "In some cases, under existing practice, that well examiner can be an employee of the operator's organisation. We felt that that was undesirable and that the well examiner should be truly independent."[514] Ms Rothery said of the well examiner scheme that "to us that is not regulation; that is self-regulation."[515]

234. Mr Baker said "it is right that operators have the option of using someone they directly employ … it does not necessarily follow that having your own people do third-party verification is a bad thing."[516] The Secretary of State for the Environment, Food and Rural Affairs thought that the existing regime had already proved itself, "we should not devalue what we have achieved."[517]

235. **We recommend that regulations should make explicit that the well examiner for onshore oil and gas operations should be independent of the well operator.**

Abandoned wells

236. Following abandonment of a well, mineral planning authorities are responsible for ensuring proper restoration and aftercare of a site through imposition of suitable planning conditions.[518] Operators are required to notify the Health and Safety Executive of the abandonment. The HSE would receive weekly reports of the abandonment process and it would be reviewed by the well examiner. Unless there is unusual or adverse development during the abandonment process, no subsequent monitoring is required. The operator remains liable for the well and is expected to remedy any subsequent problems.[519]

237. The main risk from an abandoned well arises from a subsequent sealing failure that allows methane or other contaminants to enter groundwater. Dr Grayling said that operators have to develop a "closure and rehabilitation plan and they have to implement it before they can surrender their environmental permits to us."[520] The Secretary of State for the Environment, Food and Rural Affairs said that "Permits will not be issued if there is an unsatisfactory programme at the end of the life of the well … there is absolutely no question of cutting corners at the end of a well's life".[521] He confirmed that he thought concerns over abandoned wells were "groundless."[522]

238. Professor Davies said that the UK had around 2,100 wells onshore already, drilled from 1902 to the present day: "we have gone looking for the wells,

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513 Mair, R. et al (2012), *Op, Cit.*

514 Q 72.

515 Q 193.

516 Q 162.

517 Q 274.

518 Department for Communities and Local Government (2014) *Planning Practice Guidance*, *Op, Cit.*

519 Q 165.

520 Q 276.

521 *Ibid.*

522 *Ibid.*

and you cannot physically put your hands on about 65 per cent of them. That means they would be difficult to monitor."[523] Operators today are required to submit plans for well abandonment and DECC has a database that documents the location of wells.[524] However, once a well has been abandoned there are currently no requirements for continuous monitoring arrangements. The Royal Society and Royal Academy of Engineering report said that

> "monitoring arrangements should be developed to detect possible well failure post abandonment … continuous ground gas monitoring and aquifer sampling could be similar to that carried out before and during fracturing operations … Monitoring would be at a reduced frequency, perhaps every few years."[525]

239. Sir David King said that the "major problem" was the "orphaned wells for which no company is responsible any longer."[526] The Royal Society and Royal Academy of Engineering recommended that "consideration should be given to establishing mechanisms, such as a common liability fund, to ensure funds are available to respond to well failure post-abandonment in the case that the operator can no longer be identified."[527] Dr Grayling said that there were "live discussions between the Office of Unconventional Gas and Oil and the industry to develop appropriate arrangements."[528]

240. **We recommend that, as proposed by the Royal Society and Royal Academy of Engineering, rules should be introduced to monitor wells abandoned in future, and a common liability fund established by the industry in case of default by an operator.**

European developments

European Commission unconventional hydrocarbons initiative

241. The European Commission recently reviewed the European legislative framework for unconventional hydrocarbon extraction which includes shale gas. This legislative framework comprises a number of environmental Directives which are already applicable in the UK. Mr Alan Seatter, Deputy Director General, Environment, European Commission, told us that the Commission's objective

> "is to enable the safe production of shale gas by addressing two factors. The first is the degree of public acceptance … the second … does the framework provide a clear and predictable framework for investors in this industry … Those are the objectives that we have put forward … consistent … with our overall climate change objectives."[529]

He said that there was "a public perception … of a certain number of risks … our legislation already covers those … we have to be very clear to the public

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523 Q 129.

524 Mair, R. et al (2012), *Op, Cit.*

525 *Ibid.*

526 Q 211.

527 Mair, R. et al (2012), *Op, Cit.*

528 Q 277.

529 Q 240

about whether those risks can be managed adequately by this legislation so that people feel reassured that it is possible to have safe extraction of shale gas."[530]

242. The Commission adopted a Recommendation[531] in January 2014 which sets out a number of minimum principles that Member States are "invited to give effect to."[532] On the whole, the UK regulatory regime appears to incorporate the minimum principles. A possible exception is Recommendation 9.2(e) which says Member States should ensure that operators,

> "ensure well integrity through well design, construction and integrity tests. The results of integrity tests should be reviewed by an independent and qualified third party to ensure the well's operational performance, and its environmental and health safety at all stages of project development and after well closure."[533]

As discussed above, well examiners in the UK do not have to be independent of the operator and the current regulations only take account of the risk to health and not the environment.[534] That is why we recommended at paragraph 235 above that regulations should make explicit that the well examiner for onshore oil and gas operations should be independent of the well operator.

243. The Secretary of State for the Environment, Food and Rural Affairs told us that he thought in respect of the minimum principles, the UK is "well covered."[535] In an explanatory memorandum setting out DECC's position on the Recommendation, the Minister for Energy said that "we already in the UK practice or require much of what is recommended."[536]

244. Before publication of the Recommendation, there were fears from Government and the industry that the Commission would propose new legislation. The Minister for Energy said that "We have been arguing very strongly that there is no need for further European legislation in this area".[537] Mr Figueira told us that "we must ensure that EU action is proportionate and does not result in new regulation in the industry that is not required … we want to get the exploration phase away as soon as possible".[538] Mr Cronin said that the UK industry "does not really want any further regulation … additional regulation will not improve public perception but the enforcement of the current regulation will."[539]

245. Mr Seatter told us that "we have never had in mind coming out with some beautifully comprehensive thing that is going to take a very long time to

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530 *Ibid.*

531 Recommendations of the European Commission are non-binding on Member States

532 2014/70/EU: Commission Recommendation of 22 January 2014 on minimum principles for the exploration and production of hydrocarbons (such as shale gas) using high-volume hydraulic fracturing.

533 *Ibid.*

534 See paragraphs 232 to 235.

535 Q 274.

536 DECC Explanatory Memorandum on Commission recommendation of 22.1.2014 on minimum principles for the exploration and production of hydrocarbons (such as shale gas) using high volume hydraulic fracturing, February 2014.

537 Q 260.

538 Q 173.

539 Q 61.

discuss and decide … we are talking about principles and standards, not detailed provisions".[540] However, the Recommendation said that the Commission will review its effectiveness in 18 months and as part of that review, "will decide whether it is necessary to put forward legislative proposals with legally-binding provisions on the exploration and production of hydrocarbons using high-volume hydraulic fracturing."[541] DECC thought that the 18 month timetable was "likely to be insufficient to enable the Commission to undertake an evidence-based assessment."[542]

Environmental Impact Assessment Directive

246. The Environmental Impact Assessment Directive requires environmental impact assessments to be carried out for projects that are likely to have significant effects on the environment. The Commission proposed a revision to the Directive in 2012.[543] The main objectives of the revision were to simplify the assessment process and enable the process to reflect emerging challenges like climate change. The European Parliament used the opportunity of the revision to propose an amendment that would add shale gas operations to the list of projects requiring a mandatory assessment.[544] A blocking minority of Member States in the Council of the EU (including the UK) would not agree to the Parliament's amendment and were successful in December 2013 in preventing the amendment.[545]

247. **We agree with the Government that there is no need for new European legislation on shale gas.**

248. **The regulatory framework governing development of shale gas in the UK is dauntingly complex and largely untested. Industry, public and even regulators seem uncertain how it would apply in practice. No single body has clear lead responsibility. We do not believe there is any trade off between speed and rigour in the regulatory process; complexity does not increase the quality of regulation. Unless the Government act to streamline the system so that regulation is effective as well as rigorous, the UK will be unable to take full advantage of the economic opportunity offered by shale gas.**

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[540] Q245 and Q249.

[541] 2014/70/EU: Commission Recommendation of 22 January 2014, *Op, Cit.* 16.4.

[542] DECC Explanatory Memorandum on Commission recommendation of 22.1.2014, *Op, Cit.*

[543] See http://ec.europa.eu/environment/eia/review.htm for details of the review of the Environmental Impact Assessment Directive.

[544] Q 238.

[545] Q 248 and see http://www.europarl.europa.eu/news/en/news-room/content/20131220IPR31634/html/Environmental-impact-assessment-directive-agreement-reached-with-EU-ministers

CHAPTER 9: PROMOTING SHALE GAS DEVELOPMENT IN THE UK

249. Although the potential for shale gas development in the UK appears strong, with the prospect of significant economic benefits, progress is disappointingly slow. Despite the optimism of the Prime Minister and other Ministers about the prospects for shale gas, at the current pace of development large-scale production is unlikely until well after 2020. We heard that a main cause of delay is the complexity of the regulatory process.

250. This complexity is in sharp contrast to the simplicity of the regulatory regime under which North Sea oil and gas was developed in the UK in the 1970s and 1980s. Mr Austin told us that "a level of scrutiny and consideration has probably been given by the Environment Agency in particular, and by DECC and the planning authorities to a lesser extent, which is over and above what we have seen for conventional oil and gas exploration."[546] Mr Egan said "some of the questions that come out [of the planning and permitting process] are not strictly related to drilling 10 wells but 4,000 wells."[547]

251. Other witnesses feared that regulatory delays would mean that the UK might miss the bus as potential investors in shale gas, who have other options, looked elsewhere: Professor Riley told us "The traditional view has always been that capital chases resources. My worry is that resources now chase capital … if the UK delays and ponders, it will not find anybody willing to invest on the scale necessary and we will only be importing [gas]."[548]

252. Effective regulation is essential to win and retain public confidence in the face of concerns, legitimate and exaggerated, about perceived dangers of fracking to public health and the environment. As Mr Dorner put it, "unconventional gas can be produced safely but … it is of the utmost importance for the industry and for Government to take steps to ensure that the social licence to operate is in place and that they have social support".[549]

253. **A clearer, more coherent and less complex approach to regulation is needed to facilitate speedy development of the industry while providing reassurance to the public that development can go ahead safely. Only the Government can provide the leadership and reassurance needed. The Chancellor of the Exchequer's assurance to us that the Government are doing all they can to give the UK's shale industry a good start in life is welcome, but there is at present a striking contrast with the slow pace of progress on the ground and the frustration felt by the industry over regulatory complexity. The Government have failed to translate their ambitions for development of the UK's shale gas into action at the speed needed.**

254. **The Government must take decisive measures to quicken the pace of exploration and development of the UK's shale gas resource, including to:**

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[546] Q 77.

[547] Q 90.

[548] Q 15.

[549] Q 106.

- **simplify the current unwieldy and slow regulatory structure and accelerate the decision-making timescales;**
- **take the lead in reassuring local communities that with clear and rigorous regulation in place, shale gas can be developed with low risk to health and the environment;**
- **set out more clearly the potential economic benefits for local communities and for the country as a whole if significant volumes of shale gas can be developed commercially.**

255. A distinct but related concern is that policy direction within Government on shale development is fragmented. At least four Government Departments are involved in decision-making, as set out in Chapter 8, including the Treasury, the Department of Energy and Climate Change, the Department of the Environment, Food and Rural Affairs and the Department of Communities and Local Government. With so many players, clear, well-coordinated and timely policy-making may be difficult.

256. **We recommend that, since several Departments share responsibility for policy on shale gas, the Government should take measures to improve coordination, clarity and speed of policy making and its implementation. We recommend in particular that the Prime Minister should establish a Cabinet Committee or Sub-Committee, chaired by the Chancellor of the Exchequer, to direct and coordinate policy on development of shale gas, with a mandate to promote well-regulated exploration and development of the UK's shale gas resource.**

257. **The UK is exceptionally fortunate to have substantial shale gas and oil resources. Much work needs to be done but it is clear that successful development would bring jobs and relatively low cost supplies of fuel. It would also be of direct benefit to the balance of payments and could at least partly reduce the UK's dependence on international markets at risk of disruption from political instability. Public concerns about shale gas need to be confronted if the development of this strategic national asset is to go ahead. Although some of the concerns are ill founded, others have to be addressed through a clear and simplified regulatory regime which can build trust and promote efficient development without more delay.**

258. **Exploration and appraisal of the UK's shale resource base have been too slow. Shale gas and oil are a potential economic prize which the UK should grasp without further delay. Exploration, appraisal and then development of the United Kingdom's substantial shale gas and oil resources is an urgent national priority.**

CHAPTER 10: SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

Chapter 2: The UK's energy market

259. There is a growing risk of power cuts in the UK as the margin of electricity generating capacity over peak demand shrinks. It reflects a lack of clarity and consistency in energy policy over many years. UK-produced shale gas could not, of course, contribute to a short term solution. Its development is a separate issue. Indigenous shale gas could, however, provide in the medium term an additional source of supply which, combined with policy changes to encourage investment in generating capacity, could help ensure that competitively priced electricity supplies are maintained at an adequate level for many years to come. (Paragraph 18)

260. Development of shale gas in the UK on a significant scale could provide substantial benefits:

- enhancement of energy security through a decreased reliance on imports;
- an affordable bridge fuel towards renewables-based electricity generation;
- enable decommissioning of high-emission coal fired generating capacity;
- reduce the risk of gas price increases or even lead to falls in prices;
- reduced costs for energy intensive businesses and the petrochemicals sector that also use gas as a feedstock. (Paragraph 28)

Chapter 3: The US shale gas revolution and its global economic impact

261. Shale development has transformed energy supply in the US. It is now forecast that North America (including Canada and Mexico) will be more than self sufficient in energy within a decade. (Paragraph 35)

262. The US shale gas revolution has already had far-reaching effects but the full impact on world energy markets has yet to be seen:

- low US gas prices have displaced US coal to other markets and as a result coal consumption in both Germany and the UK has risen in the last two years;
- reduced import requirements have diverted gas from the US and have limited price increases in the international market;
- US exports of natural gas are likely to have a greater effect on the patterns of global trade; so too, in the longer term, would the development of large volumes of shale gas in other countries;
- if developed at scale internationally, shale gas and shale oil could alter the balance of the international energy market as a whole and undermine the dominant role of energy exporters in the Middle East and Russia, as the pattern of production and trade in oil and gas is redrawn. (Paragraph 51)

Chapter 4: Shale gas in the UK

263. We recommend that the Government should amend relevant legislation to ensure that subsurface drilling for oil and gas can go ahead without undue

delay or cost. This change should ensure that the fact that UK landowners do not own petroleum rights makes little difference to the speed of shale gas and oil development; in practice, it may even make subsurface drilling under third party land easier in the UK than it is in the US. (Paragraph 64)

264. On the available evidence, there may well be potential for economic development of shale gas in the UK. Estimates of the UK's total onshore shale gas resource are however still incomplete and it is impossible to tell how much of the resource can be economically recovered until exploratory wells are drilled and appraised. It is vital that we get on with it. (Paragraph 73)

265. The evidence we heard suggests that large-scale production of onshore shale gas in the UK is unlikely before the next decade unless effective and immediate action is taken to bring forward exploration and appraisal. (Paragraph 74)

266. Despite Ministerial encouragement and eagerness on the part of the industry to get on with exploratory drilling, progress on the ground has been at a snail's pace while industry and officials come to grips with a dauntingly complex regulatory regime for onshore shale gas and oil. (Paragraph 76)

267. We welcome the industry's introduction of community benefit schemes for localities where drilling for shale gas is to take place. We also welcome the Government's support for the industry's schemes, which should be given the chance to prove themselves. We consider that the industry, as well as the Government, will also need to present the case for shale development more effectively to local communities, including clarity of plans and meticulous compliance with regulation as well as local economic benefits. (Paragraph 86)

268. At the national level, there is little hard evidence of public opinion on shale gas development and what there is shows mixed results. There is some strident local opposition to fracking. There is a chicken-and-egg aspect to public acceptability: the most convincing argument for onshore shale gas development in the UK would be a successful working example. (Paragraph 90)

269. We welcome the Prime Minister's and Chancellor's commitment to development of shale gas in the UK. We also welcome Government support for the industry's community benefit schemes and the tax and rates measures the Government have announced to encourage development. But industry's investment decisions will turn mainly on estimated costs and production volumes. These cannot be assessed without exploratory drilling and appraisal, which are being delayed by regulatory constraints and vocal opposition from some groups. The Government must be much more forceful in their public advocacy of the economic benefits of well-regulated shale development. They must also explicitly address the safety issues. (Paragraph 95)

Chapter 5: Potential economic impact of the UK's shale gas

270. Even if its economically recoverable reserves of shale gas prove substantial, the UK is not likely to see gas price cuts on the scale of those in the US. Indigenous production would however be cheaper than imports of liquefied natural gas (LNG), improve the balance of payments and provide better security of supply. (Paragraph 102)

271. Substantial shale gas production in the UK could help retain and develop energy intensive industries and provide feedstock to petrochemical plants. If however there is no prospect that the UK's shale gas resource will be developed within a reasonable timescale, energy intensive industry is likely to move elsewhere. (Paragraph 104)

272. The UK's shale gas and oil could help create a new, viable and internationally competitive industry attracting investment, creating jobs and skills which would make a strong regional impact in areas such as North-West England, providing secure energy and yielding revenue. This would be a valuable prize, obviously better in the national interest than increased, costly and perhaps unreliable imports which would weigh on the balance of payments. But the benefits cannot be quantified until exploratory drilling and appraisal show what the UK's economically recoverable reserves of shale gas and oil are. (Paragraph 107)

Chapter 6: Shale gas and climate change

273. We find persuasive Professor MacKay's conclusion that the carbon footprint of shale gas, including fugitive methane emissions, is similar to that of conventional gas production and substantially less than coal. We endorse the recommendation in his report for a monitoring programme, jointly managed by the Government and the industry, to measure the level of fugitive methane when shale gas extraction begins in the UK. (Paragraph 117)

274. We consider that development of shale gas in the UK is compatible with the UK's commitments to reduce greenhouse gas emissions. There is an acknowledged role for gas in the UK's energy mix as it moves towards fulfilment of its commitments. The carbon footprint of home-produced shale gas would be smaller than that of imported LNG (which needs to be processed and transported). Substitution of home produced shale gas for imported LNG should therefore make a positive contribution to achievement of the UK's commitments on climate change. (Paragraph 124)

Chapter 7: Environmental impact of development of shale gas in the UK

275. Concerns about pollution of groundwater by fracking fluid seem largely based on reports of past practice in the US, where greater transparency is now enforced. The position in the UK is clear: the regulators require full disclosure of chemicals used in fracking fluid, they do not permit use of hazardous chemicals and operators do not use them. Provided that the regulator enforces this prohibition, hydraulic fracturing fluid poses no risk to groundwater in the UK. (Paragraph 133)

276. The weight of scientific opinion is that the risk of methane migrating up natural faults and into aquifers is "difficult to conceive" and "hard to imagine" in the UK. With strict regulatory oversight and monitoring, the risk of methane contamination of aquifers through natural fractures is very low. (Paragraph 142)

277. The only significant risk posed to groundwater by hydraulic fracturing is of methane or wastewater entering aquifers as a result of a poorly constructed or sealed well. This is also a risk for conventional onshore gas and oil production. The risk is low as long as independent monitoring ensures that wells are properly constructed and sealed. (Paragraph 147)

278. In the US, disposal of flowback water after hydraulic fracturing has in recent years aroused some environmental concerns, now being addressed. In the UK, by contrast, flowback water is subject to the regulations on mining waste and its disposal and treatment is carefully controlled. (Paragraph 158)

279. Fears of water shortages arising from shale gas development have been overplayed: demand for water from onshore shale operators, even at high levels of activity, would be comparable to demand by other industrial users; regulators will not permit levels of water consumption that threaten household supplies; and technological advances such as the substitution of saline water and recycling of flowback water are likely to reduce demand for fresh water. (Paragraph 164)

280. The Government have introduced stringent planning and monitoring requirements governing the activities of onshore oil and gas operators which might lead to induced seismicity. On the evidence we have heard, there should be no risk that seismic activity caused by hydraulic fracturing would be of sufficient magnitude to constitute any risk to people and property. (Paragraph 173)

281. Public Health England (PHE) has recently reviewed all the available evidence on the risks to public health arising from air emissions from shale gas activities, including US studies brought to our attention by opponents of shale gas development. We find persuasive the conclusion of PHE's preliminary report that the risks to public health from shale gas exploration and production are low with proper regulation. (Paragraph 180)

282. We find persuasive the view of Public Health England that shale gas development would be very unlikely to have a significant effect on radon levels in homes. (Paragraph 181)

283. The Committee recognises that development of shale, like any other industrial activity, would cause an increase in traffic and disruption in some places, especially during periods when wells were being drilled. Although planning controls may mitigate disturbance, there should be a role for the industry's community benefits scheme to compensate those affected individually. (Paragraph 185)

284. On the evidence available to us, Cuadrilla's operations at Balcombe appear usually to have observed prescribed noise limits, with occasional minor lapses. (Paragraph 189)

285. It is widely believed, by opponents and others, that exploration and production of shale gas in the UK would pose dangers to the environment and to public health. Government, regulators and the industry need to take these fears, legitimate and exaggerated, seriously and tackle them. We heard an impressive amount of scientific evidence that with a robust regulatory regime the risks to the environment and public health are low. With such a regime in place, we consider the environmental risks to be small, whereas the benefits if shale gas development takes place are substantial. (Paragraph 191)

Chapter 8: The UK's regulatory system

286. We heard from the Secretary of State for the Environment and from the Environment Agency of plans for standard permits to be issued on reduced timescales. We consider that changes on these lines would be highly desirable

but doubt if they will happen without the changes we recommend to simplify the regulatory framework. (Paragraph 206)

287. The UK's regulatory framework for onshore exploration and production applies to conventional as well as shale gas and oil. There is no special regime for shale gas and oil, except that extra rules govern hydraulic fracturing. Applicable regulations in the UK are rigorous and thorough and address the environmental and health risks. We heard that they are well respected internationally. We were also told of measures to improve coordination in the system so as to deal more effectively with development of shale gas and oil. (Paragraph 220)

288. The regulatory framework is however unnecessarily complicated, with responsibilities shared between various Departments and agencies. Wytch Farm apart, it has no track record of dealing with large scale onshore operations. Bureaucratic complexity and diffusion of authority are not the best basis for clear and effective regulation of a new and fast-evolving industry. It is not clear how long the whole regulatory process, or its various stages, would take. We set out recommendations below to reduce the complexity and increase the transparency of the regulatory regime. (Paragraph 221)

289. We agree with the Royal Society and the Royal Academy of Engineering that a single body to regulate onshore development of shale gas and oil would be desirable in principle. We fear, however, that the necessary reorganisation would cause delays. We therefore recommend a more coordinated and responsive regulatory approach within the existing framework, with a lead regulator identified by the Government, following the five principles of good regulation advocated by the Better Regulation Task Force and adopted by the present Government:

Transparent

We recommend that the Government should consolidate the applicable provisions in the confusingly titled and potentially misleading *Offshore Installations and Wells Regulations* and *Borehole Sites and Operations Regulations* into one clearly labelled set of regulations for onshore oil and gas operations.

As recommended by the Royal Society and Royal Academy of Engineering, the consolidated regulations should specify that well integrity is to be considered from an environmental perspective as well as a health perspective. The Environment Agency and Health and Safety Executive should make it much clearer to the industry and the public exactly how and when they would inspect well sites.

Accountable

The Government should provide a single, clear appeals process for operators in the event that an application for planning permission is refused by a local authority.

Proportionate

Operators are often required to submit the same information to different regulators. The Office of Unconventional Gas and Oil should provide a

single point for data input to remove duplication and reduce costs for operators.

Consistent

The Government should ensure that operators are able to make all the required planning and permit applications in parallel, in order to speed the process. There is room for much greater coordination, particularly in relation to information sharing between local authorities and the Environment Agency.

Targeted

A targeted approach by the regulators should include a clear timetable for decision-making, agreed beforehand with the operators. (Paragraph 231)

290. We recommend that regulations should make explicit that the well examiner for onshore oil and gas operations should be independent of the well operator. (Paragraph 235)

291. We recommend that, as proposed by the Royal Society and Royal Academy of Engineering, rules should be introduced to monitor wells abandoned in future, and a common liability fund established by the industry in case of default by an operator. (Paragraph 240)

292. We agree with the Government that there is no need for new European legislation on shale gas. (Paragraph 247)

293. The regulatory framework governing development of shale gas in the UK is dauntingly complex and largely untested. Industry, public and even regulators seem uncertain how it would apply in practice. No single body has clear lead responsibility. We do not believe there is any trade off between speed and rigour in the regulatory process; complexity does not increase the quality of regulation. Unless the Government act to streamline the system so that regulation is effective as well as rigorous, the UK will be unable to take full advantage of the economic opportunity offered by shale gas. (Paragraph 248)

Chapter 9: Promoting Shale Gas Development in the UK

294. A clearer, more coherent and less complex approach to regulation is needed to facilitate speedy development of the industry while providing reassurance to the public that development can go ahead safely. Only the Government can provide the leadership and reassurance needed. The Chancellor of the Exchequer's assurance to us that the Government are doing all they can to give the UK's shale industry a good start in life is welcome, but there is at present a striking contrast with the slow pace of progress on the ground and the frustration felt by the industry over regulatory complexity. The Government have failed to translate their ambitions for development of the UK's shale gas into action at the speed needed. (Paragraph 253)

295. The Government must take decisive measures to quicken the pace of exploration and development of the UK's shale gas resource, including to:

- simplify the current unwieldy and slow regulatory structure and accelerate the decision-making timescales;

- take the lead in reassuring local communities that with clear and rigorous regulation in place, shale gas can be developed with low risk to health and the environment;
- set out more clearly the potential economic benefits for local communities and for the country as a whole if significant volumes of shale gas can be developed commercially. (Paragraph 254)

296. We recommend that, since several Departments share responsibility for policy on shale gas, the Government should take measures to improve coordination, clarity and speed of policy making and its implementation. We recommend in particular that the Prime Minister should establish a Cabinet Committee or Sub-Committee, chaired by the Chancellor of the Exchequer, to direct and coordinate policy on development of shale gas, with a mandate to promote well-regulated exploration and development of the UK's shale gas resource. (Paragraph 256)

297. The UK is exceptionally fortunate to have substantial shale gas and oil resources. Much work needs to be done but it is clear that successful development would bring jobs and relatively low cost supplies of fuel. It would also be of direct benefit to the balance of payments and could at least partly reduce the UK's dependence on international markets at risk of disruption from political instability. Public concerns about shale gas need to be confronted if the development of this strategic national asset is to go ahead. Although some of the concerns are ill founded, others have to be addressed through a clear and simplified regulatory regime which can build trust and promote efficient development without more delay. (Paragraph 257)

298. Exploration and appraisal of the UK's shale resource base have been too slow. Shale gas and oil are a potential economic prize which the UK should grasp without further delay. Exploration, appraisal and then development of the United Kingdom's substantial shale gas and oil resources is an urgent national priority. (Paragraph 258)

APPENDIX 1: LIST OF MEMBERS AND DECLARATIONS OF INTEREST

Members

The Members of the Committee who conducted this inquiry were:

Baroness Blackstone
Lord Griffiths of Fforestfach
Lord Hollick
Lord Lawson of Blaby
Lord Lipsey
Lord McFall of Alcluith
Lord MacGregor of Pulham Market (Chairman)
Lord May of Oxford
Baroness Noakes
Lord Rowe-Beddoe
Lord Shipley
Lord Skidelsky
Lord Smith of Clifton

Declarations of Interest

Members of the Economic Affairs Committee declared the following interests as relevant to the inquiry:

Baroness Blackstone
None

Lord Griffiths of Fforestfach
Board Member of Goldman Sachs International, a wholly owned subsidiary of the Goldman Sachs Group which advises companies in the field of oil and gas exploration.

Lord Hollick
None

Lord Lawson of Blaby
Chairman of the Global Warming Policy Foundation

Lord Lipsey
None

Lord McFall of Alcluith
None

Lord MacGregor of Pulham Market
Chairman, British Energy Pension Fund Trustees
Chairman, Eggborough Power Ltd Pension Fund Trustees

Lord May of Oxford
Member of the Committee on Climate Change

Baroness Noakes
Shareholdings in a wide range of listed companies, as listed in the register of members' interests, including shareholdings in energy companies (including BG Group plc; BP plc; Centrica plc; and Royal Dutch Shell plc).

Lord Rowe-Beddoe
None

Lord Shipley
None

Lord Skidelsky
None

Lord Smith of Clifton
None

A full list of Members' interests can be found in the Register of Lords' Interests:

http://www.parliament.uk/mps-lords-and-offices/standards-and-interests/register-of-lords-interests/

Specialist Adviser

Professor Nick Butler, Visiting Professor at Kings College London, acted as Specialist adviser for this enquiry. Professor Butler is also an energy consultant to companies working internationally in natural gas and renewables. None of those companies have any interests in relation to the development of shale gas and oil in the UK.

APPENDIX 2: LIST OF WITNESSES

Evidence is published online at www.parliament.uk/hleconomicaffairs and available for inspection at the Parliamentary Archives (020 7219 5314).

Evidence received by the Committee is listed below in chronological order of oral evidence session and in alphabetical order. Those witnesses marked with * gave both oral evidence and written evidence. Those marked with ** gave oral evidence and did not submit any written evidence. All other witnesses submitted written evidence only.

Oral evidence in chronological order

**	(QQ 1–16)	Professor Alan Riley
**		Poyry International Consulting Engineers
**	(QQ 17–32)	British Geological Survey
*		Department of Energy and Climate Change
*	(QQ 33–46)	Friends of the Earth
*		Greenpeace UK
*		WWF-UK
*	(QQ 47–57)	Professor Richard Muller
**	(QQ 58–68)	Future Energy Strategies
*		United Kingdom Onshore Operators Group
**	(QQ 69–75)	Professor Robert Mair CBE
*	(QQ 76–95)	Cuadrilla
*		IGas Energy
*		INEOS
**	(QQ 96–114)	International Energy Agency
**		Shell
*		Société Générale
**	(QQ 115–126)	Professor Dieter Helm
*	(QQ 127–133)	Durham Energy Institute
**		Oxford Institute for Energy Studies
*	(QQ 134–152)	Nick Grealy
**		Phelim McAleer
*		Viscount Ridley
*	(QQ 153–184)	Department of Energy and Climate Change
*		Environment Agency
*		Health and Safety Executive
*	(QQ 185–195)	Institute of Directors
*		Remsol Ltd

**		Residents' Action on Fylde Fracking (RAFF)
**	(QQ 196–206)	Liberium Capital
**		Lambert Energy Advisory
**		Peter Hughes Energy Advisory
**	(QQ 207–222)	Sir David King
**		Professor David MacKay
*	(QQ 223–237)	Chris Wright
**	(QQ 238–250)	EU Commission
*	(QQ 251–267)	Rt Hon Michael Fallon MP and Duarte Figueira
*	(QQ 268–287)	Rt Hon Owen Paterson MP and Dr Tony Grayling

Alphabetical list of all witnesses

A.R Day
Bloomberg
** British Geological Survey
Centre for Climate Change Economics and Policy (CCCEP)
Centrica
Chemical Industries Association
* Cuadrilla
Department for Communities and Local Government
* Department of Energy and Climate Change
* Durham Energy Institute, Durham University
Électricité de France (EDF) Energy
* Environment Agency
E.ON
** EU Commission
* Rt Hon Michael Fallon MP
* Duarte Figueira
Frack Free Balcombe Residents Association
* Friends of the Earth England, Wales and Northern Ireland
** Future Energy Strategies
The Geological Society of London
The Government
* Dr Tony Grayling
Grantham Research Institute on Climate Change and the Environment
* Nick Grealy
* Greenpeace UK

* Health and Safety Executive
** Professor Dieter Helm
Michael Hill C.Eng MIET
* IGas Energy
* INEOS
* Institute of Directors
** International Energy Agency
** Sir David King
** Lambert Energy Advisory
** Liberium Capital
Dr David Lowry
** Professor David MacKay
** Professor Robert Mair CBE
** Phelim McAleer
* Professor Richard Muller
National Grid
** Oxford Institute for Energy Studies
* Rt Hon Owen Paterson MP
** Peter Hughes Energy Advisory
The Petroleum Exploration Society of Great Britain
Policy Exchange
** Poyry International Consulting Engineers
* Remsol Ltd
** Residents' Action on Fylde Fracking
* Viscount (Matt) Ridley
** Professor Alan Riley
** Shell
David K. Smythe BSc, PhD
* Société Générale
Professor Paul Stevens
TUC
Tyndall Manchester Climate Change Research
UK Energy Research Centre
* United Kingdom Onshore Operators Group
The Weir Group PLC
* WWF-UK
* Chris Wright

APPENDIX 3: CALL FOR EVIDENCE

The Economic Affairs Committee has chosen for its next inquiry the economic impact of shale gas and oil on UK Energy Policy. The focus of this inquiry is not climate change and we take as given the Government's commitment to reduce carbon emissions.

The British Geological Survey results published in June 2013 have confirmed that the UK has substantial onshore shale gas resources in the Bowland area of the North and the Midlands. Further reports covering other regions have yet to be published. The precise scale and commercial feasibility of these resources is not yet known.

Despite this uncertainty, recent experience in the United States suggests that shale gas can be developed using existing technology and make a material economic impact both in the local areas where production is possible, and to the national energy economy.

The Committee would welcome written evidence on any or all of the issues set out below, or on any other relevant aspects, by **30 September.**

The inquiry will seek to answer questions such as:

(1) How much scope is there for shale gas and oil—from domestic and overseas sources—to be used in the UK? Over what timeframe?

(2) How will the costs, including those on the environment, of accessing the UK's shale gas and oil deposits compare to those of other sources of energy?

(3) What is the potential impact of shale gas and oil on the local economies in areas where development is possible?

(4) What will be the impact of shale gas on the cost of electricity generated at gas-fired power plants and how will it compare to other forms of generation including coal, nuclear and renewable?

(5) Will the UK electricity market be easily able to incorporate shale gas in future or will generators be locked into long-term contracts with other energy sources? Are there any other potential barriers to the use of shale gas in electricity generation?

(6) Which forms of electricity generation is shale gas likely to displace and by how much?

(7) What impact will shale gas and oil have on household energy bills?

(8) What effect will the use of shale gas and oil have on carbon emissions compared to other combinations of energy sources?

(9) Will shale gas and oil increase UK energy security?

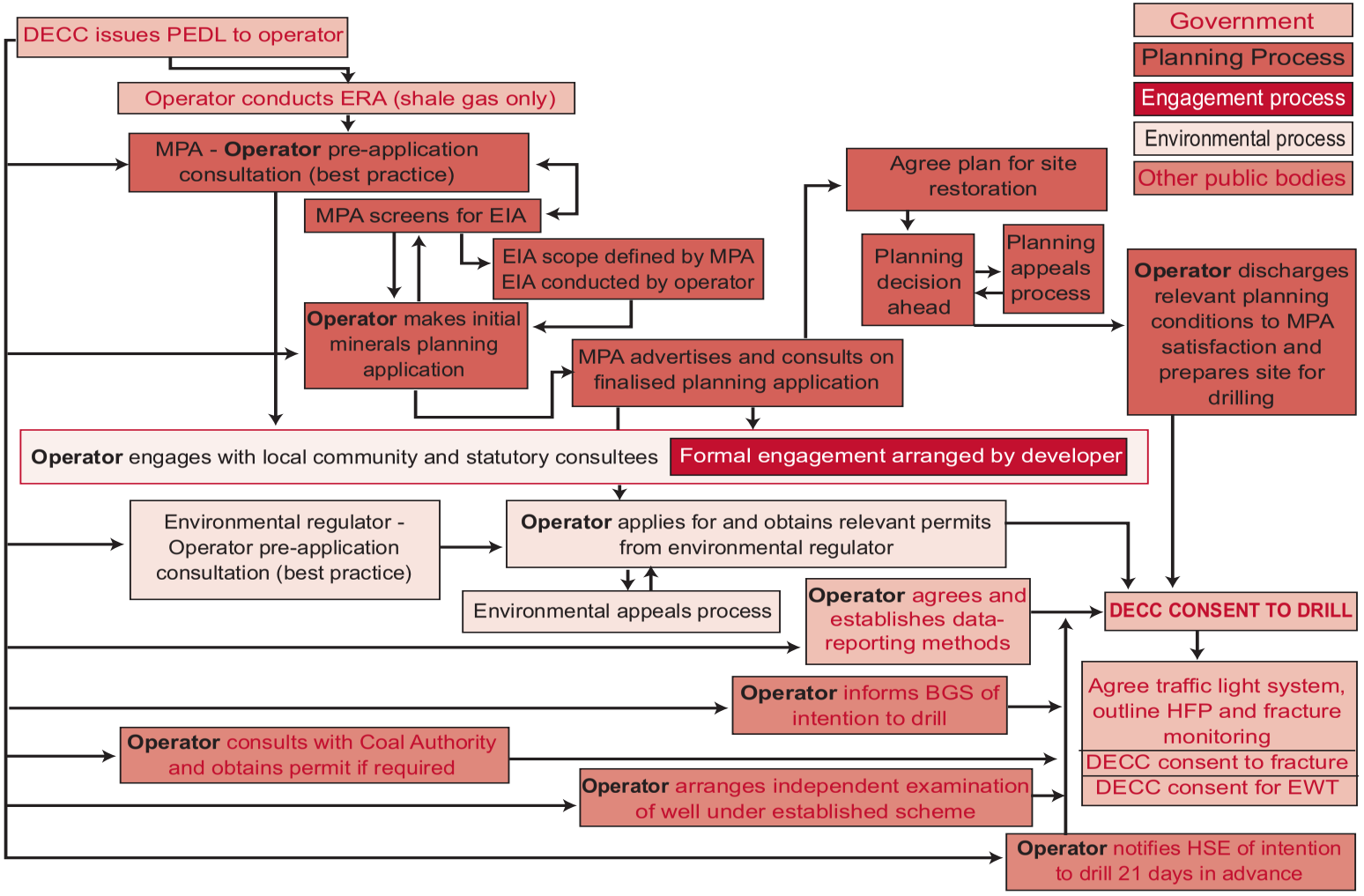
(10) What infrastructure investment will be necessary to cope with the development of shale gas and oil? How far will it help to ensure sufficient UK energy supplies? How will this investment be financed?

(11) What changes to public policies are necessary to maximise the potential of any shale gas development?

(12) Will shale gas and oil lead the UK to be less dependent on energy from less reliable regions of the world such as the Middle East and Russia?

(13) What lessons can be learnt from the US experience of shale gas and oil?

APPENDIX 4: ROADMAP



Source: DECC (2013)

APPENDIX 5: GLOSSARY

ASA	Advertising Standards Authority
Bcf	Billion cubic feet
Bcm	Billion cubic metres
BGS	British Geological Survey
Boepd	Barrels of oil equivalent per day
BSOR	Borehole Site and Operations Regulations 1995.
BTU	British thermal unit
CCS	Carbon capture & storage
DCR	Offshore Installations and Wells (Design and Construction, etc) Regulations 1996
EA	Environment Agency
EIA	US Energy Information Administration
EIA	Environmental Impact Assessment
ERA	Environmental risk assessment
EMR	Electricity Market Reform
EPA	US Environmental Protection Agency
ETS	EU Emissions Trading System
GIP	Gas in place
IEA	International Energy Agency
LNG	Liquefied Natural Gas
HSE	Health & Safety Executive
MMBtu	One million British Thermal Units
MPA	Minerals Planning Authority
Mtoe	Million tons of oil equivalent
MTPA	Million metric tonnes per annum
NGLs	Natural gas liquids
NORMs	Naturally occurring radioactive materials
NTS	National gas transmission system
OUGO	Office of Unconventional Gas and Oil
PEDL	Petroleum exploration and development licence
RES	Renewable Energy Strategy
Tcf	Trillion cubic feet
Tcm	Trillion cubic metres
Therm	A unit of heat equivalent to 100,000 British thermal units
USGS	United States Geological Survey