North Yorkshire Joint Minerals and Waste Plan

Submission of Councillor Paul Andrews

Comments on the MWS of May 17th 2018

Definitions:

MWS I means the Minister's Written Statement of 16th September 2015
MWS II means the Minister's Written Statement of 17th May 2018.
JWMP means the draft North Yorkshire Joint Waste and Minerals Plan
MPA means North Yorkshire County Council, York City Council and the Yorkshire Moors National Park as mineral planning authorities
"The Industry" means the Oil and Gas extraction industry.

The inspector's Questions

The Inspector has requested answers to the two following questions:

Does MWS II affect the JWMP, and if so how;

Should the JWMP be modified and if so how to reflect MWS II?

The answer to both questions is "No" for the following reasons:

Context, Background and Contents of MWS II

MWS II does two things: (i) it purports to give advice and guidance to planning authorities which is intended to have immediate effect; and (ii)it gives notice of the government's intention to introduce and consult upon a number of measures concerning fracking. The matter relevant to this response is the advice which is intended to take immediate effect. The rest of MWS II is of limited relevance to the inspector's above questions, except in so far as it makes clear the government's intention to pre-empt any planned consultation. **The following comments concern (i) above unless (ii) is specifically referred to.**

MWS I was largely unsupported by evidence. The advice in MWS II which is intended to have immediate effect refers to MWS I and repeats many of the opinions of MWS I without referring to any evidence at all.

In so far as MWS II repeats the same views, assumptions and guidance as are contained in MWS I, I repeat all previous arguments made in regard to them. These arguments and the arguments of the other participants in the EIP were fully debated before the inspector and, following the debate, the inspector found that the JWMP was sound and in accordance with national policy.

One impoprtant difference between MWS I and MWS II are the following sentences which come under the sub-heading "Planning Policy and Guidance":

"Plans should not set restrictions or thresholds across their plan area that limit shale exploration without proper justification. We expect Mineral Planning Authorities to recognize the fact that Parliament has set out in statute the relevant definitions of hydrocarbon, natural gas and associated hydraulic fracturing. In addition these matters are described in Planning Guidance which plans have due regard to. Consistent with this Planning Practice Guidance, policies should avoid undue sterilization of mineral resources (including shale gas)."

The matters in this paragraph would seem to be designed to address certain findings by the inspector at the EIP which displeased the industry. The short time gap between the end of the last session of the EIP and the publication of MWS II suggests MWS II was produced by the Secretary of State at the behest of industry lobbying. It was also published at a time when a select parliamentary committee was specifically considering planning guidance on fracking. In the circumstances it suggests a cynical political manipulation of the democratic process of plan preparation and shows complete contempt for the members of the select committee and the participants of the EIP who have taken hours of their time and spent thousands of pounds on preparing the draft plan, comments on it and representation at the EIP.

This also raises issues of profound constitutional importance. The unwritten UK constitution is based on a delicate balance between the executive arms of government and Parliament and the judiciary. It is this balance which preserves our liberties and democracy and prevents us from being overwhelmed by dictatorial or authoritarian rule. If weight is given to controversial ministerial statements which have not gone through due process (ie. embodied in draft circulars and then consulted upon), it opens the door to an over-mighty executive and to ministers becoming susceptible to persuasion by lobbyists from any industry (perhaps with the prospect of contributions towards party funds), without full public scrutiny of any policy pronouncements which might emerge from this. This could lead to wrecking balls being driven through the planning system and the result could be to make the planning system look rotten to the core. It is clearly in the public interest that all ministerial policy decisions which affect property or rights of residents should go through an appropriate form of due process before they can be acted upon and not be issued just at the whim of the moment. Government policy on matters which affect property or rights (such as planning policy does) should not only be properly made, but also seen to be properly made and fully transparent.

Is the JWMP, as debated at the EIP (together with amendments agreed with the inspector) compliant with MWS II?

However, I would submit that the plan as agreed by the inspector at the last EIP session is consistent with the purported guidance of the above italicised passage from MWS II.

Firstly, MWS II does accept restrictions on the extraction of shale gas if there is "proper justification." The justification for the restrictions in the JWMP were fully debated before the inspector and found to be sound and justified.

Further the debate at the EIP did recognise and have full regard to the relevant definitions of "hydrocarbon, natural gas, and associated hydraulic fracturing" contained in statute and ministerial circulars. This issue was fully debated and the definitions in the JWMP, although wider than the statutory definition, were found to be sound in the context of the Plan. There is nothing in statute or ministerial circulars which prevents MPA from using such a wider definition in a mineral plan.

Further, MWS II cannot override legislation and circulars designed to protect National Parks or AONB's or areas identified as having local landscape significance in adopted local plans etc. So, for example, if MWS II is interpreted as requiring MPA to substitute the Infrastructure Act definitions for those in the JWMP, so as to allow hydraulic fracturing in the AONB and National Parks and industrialise them, this will be contrary both to National Policy and the primary legislation which established National Parks and AONB's

Finally, there is the requirement to avoid *"undue sterilisation of mineral resources (including shale gas)"*. This clearly refers to statements by the industry at the end of the EIP which alleged that the 500m residential buffer would "sterilise" the exploitation of the shale gas resource. However, it is submitted that the JWMP does avoid "undue" sterilisation of mineral resources. The word "undue" suggests a balancing exercise between the interests of neighbouring residents and the shale gas drilling pads. The 500 m buffer zone achieves that balance and was held to be sound and justified by the inspector.

Another point arises out of the fact that, in order to maximise the exploitation of shale gas, it is necessary to have a grid of drill pads between each one and a half or two miles apart in every direction. Sirius Minerals and Mr. North on behalf of Mineral Products Association have both given evidence on the ways in which fracking could sterilise the mining of potash deposits. It is suggested that the same arguments apply to the extraction of any kind of mineral deposits, whether by mining, quarrying or some other means. The grid of fracking wells will effectively prevent or inhibit the exploration of other minerals so as to sterilise them. Taken literally, this would be contrary to MWS II.

Further and in the alternative, MWS II should be given little weight

I would also argue that MWS II (along with MWS I) should be given little or no weight because (a) it does not fall within "material considerations as referred to in Section 54A and Section 70(2) Town and Country Planning Sct 1990 or any statutory re-enaactment or modification thereof; (b) it is irrational as being unsupported by sound up to date evidence, (c) it does not accord with good practice, (d) it takes no account of up to date evidence, (e) it has not gone through any process of public consultation, and (f) it is unlawful.

MWS II is not a material consideration for the purposes of Section 54A and Section 70(2) Town and Country Planning Act 1990 or statutory modification or re-enactment thereof.

Please find attached a copy of a statement by Turley on behalf of INEOS Upstream Ltd, dated March 2018. **(Exhibit 1)**Para 30 acknowledges that the NPPF and Minerals PPG are *"the **only** shale specific guidance that clearly falls within material considerations as referred to in Section 54A and 70(2) of the 1990 Planning Act"*.

The statement goes on to say (para.31): *"It would assist ……..if the guidance relating to unconventional hydrocarbon development, as set out in the NPPF (updated to address the points set out above) and the Minerals PPG was incorporated into one policy document ……."*

Para 32 then requests specifically that MWS I and another MWS dated 25th January 2018 should be incorporated into the NPPF.

I take this as an open admission that MWS I should not be regarded as a material planning consideration, and if this is correct, it must follow that neither should MWS II. It follows therefore that the inspector should give neither very little (if any) weight.

MWS II is irrational

MWS II makes a number of statements which are either plainly wrong, unsupported by evidence or unproved. These include statements regarding employment and other matters which do not accord with the evidence gathered by Frackfree Ryedale and reproduced as **(Exhibits 2-11).** The links can be accessed from the Frackfree Ryedale website.

Further, I attach a **copy** of MWS I duly annotated with comments. **(Exhibit 12)**The same comments apply to MWS II.

Further, MWS II suggests that shale gas is necessary to give the UK gas security of supply. This does not recognise the most recent evidence.

In October 2017 the Department of Business, Energy and Industrial Strategy published the report with the title "Gas Security of Supply" **Exhibit 13** . **L**ooking ahead over the next twenty years, it says (Page 14)*: "Whilst the government is optimistic about the potential for shale gas in the UK in an exploratory stage, it is not yet known how much of the UK shale gas resource will ultimately be recoverable. In order to provide a conservative estimate of supply, supply forecasts used in CEPA (2017), assume no shale contributions in the forecast "* The document goes on to say that there will be security of gas supply without shale gas during the forecast period – ie up until 2035.

Further MWS II states: the UK has gone from being a net exporter of gas in 2003 to importing overhalf (53%) of gas supplies in 2017 and estimates suggest we could be importing 72% of our gas by 2030."

This statement takes no account of the 30% of gas produced by UK which is exported. It is also misleading because it fails to state the quantities of the required gas imports.

In her MWS I Amber Rudd MP says: "Last year 45% of UK gas supply was made up of net imports. Our projections suggest that domestic production will continue to decline and, without any contribution from shale, gas net imports could increase to 75% of the gas we consume by 2030."

The Gas Security of Supply document (page 11 para. 6) gives a different picture. This states:

"Current GB gas demand is around 923 TWh per annum, having fallen from around 1,000TWh a decade ago and a peak of around 1,100TWh in 2010. National Grid (2017) forecast gas demand of between 604 TWh and 891 TWh in 2035."

As I understand, the government's policy aim for climate change is to meet its part of climate change targets so that, together with other countries, the "two degree scenario" can be achieved. The 604TWh figure relates to the 2 degrees scenario, and as this is government policy, this is the figure which is relevant to forward planning of infrastructure – not the 891 TWh figure. Indeed, the second para of MWS II repeats the government's commitment to its climate change targets, and so the appropriate figure to use for future projection is the one which meets UK climate change targets – namely 604TWh. It follows that if the 891 TWh figure is relied on, the second para. of MWSII is wrong and MWS II is discredited.

Taking then the 923TWh figure, 53% of this is 489.19 TWh, which is the quantity of gas imported in October 2017.

Taking the 604TWh figure, 72% of this is 434.88 TWh which is the quantity of imported gas which National Grid estimates will be required in 2035 – a **decrease** of 54.31TWh. **So the UK will actually need less gas in 2035 than is being used now.**

This completely discredits MWS II.

MWS II works contrary to good pactice

It is usual to require applicants for planning permission for major projects to provide evidence relating to the impact of their proposals on the environment, residential amenity, and the social and economic impact. MWS II clearly disregards the need for any of this and sacrifices all these considerations for the benefit of the petrochemical industry.

MWS II fails to take into account up to date evidence

Further, MWS II fails to take into account recent evidence, such as a Preliminary Opinion delivered by the international "Permanent People's Tribunal", a Report by Professor Peter Styles on "Fracking and Coal Mining: their relationship and should they coincide?" dated May 2nd 2018, a Briefing Note by ReFINE, a consortium of academics from Keele, Durham and Newcastle Universities and an American court

judgement (Gorsline & Batkowski v Board of Governors of Fairfield Township v Inflection Energy LCC in the Supreme Court of Pennsylvania 2017)

Copies of all the above documents are attached **(Exhibits 14 -17).**

It should be noted that Professor Styles is the man who recommended the "Traffic Light" system in regard to seismicity. His recommendations were accepted by government. So his opinion should carry some weight. It will be seen that his latest report refines his previous views and questions the ability of Fracking Companies to properly investigate faulting.

The outcome of the ReFINE and Prof Styles paper can be summarised below:

– *Fracking companies and regulators have failed to use all available geological data, as they are required to do, for planning application purposes.*

– *Professor Styles' report shows that historic coal mining data has been overlooked or ignored.*

– *The historic mining data shows accurate locations of fault lines capable of triggering earthquakes over a 0.5 magnitude that would shut down fracking operations under current regulations. Further, a fracking operation registering a seismic shock of 0.5 magnitude could trigeer a seismic event of 1.5 magnitude or greater.*

– *The seismic surveying equipment used by the fracking industry is not capable of detecting these faults. They need equipment with 5X greater magnification capabilities.*

– *Professor Styles' report includes a small sample of the available historic data converted to digital format that can be overlaid onto British Geological Survey maps, which only show major fault lines.*

– *The data shows that former coal mining areas are riddled with potentially dangerous faults capable of producing seismic activity greater than a 0.5 magnitude which is the level at which fracking operations must be shut down under the current traffic light system.*

– *Considerable further work and investigation is required on the historic mining data to reveal the full picture. However, it is highly likely to show a similar picture across all previously mined areas. This would render the majority of the current PEDL licences for fracking over the North of England useless and demonstrate that Government and industry estimates for recoverable fracked gas should be halved..*

Neither MWS I nor MWS II have gone through due process

I set out below Section 19 of the Planning and Compulsory Purchase Act 2004:

(1)Local development documents must be prepared in accordance with the local development scheme.

(2)In preparing a local development document the local planning authority must have regard to—

(a)national policies and advice contained in guidance issued by the Secretary of State;

(b)the RSS for the region in which the area of the authority is situated, if the area is outside Greater London;

(c)the spatial development strategy if the authority are a London borough or if any part of the authority's area adjoins Greater London;

(d)the RSS for any region which adjoins the area of the authority;

(e)the Wales Spatial Plan if any part of the authority's area adjoins Wales;

(f)the [F14sustainable community strategy] prepared by the authority;

(g)the [F15sustainable community strategy] for any other authority whose area comprises any part of the area of the local planning authority;

(h)any other local development document which has been adopted by the authority;

(i)the resources likely to be available for implementing the proposals in the document;

(j)such other matters as the Secretary of State prescribes.

As will be seen, subsection 2 (a-j) lists the matters to which an authority must have regard in the preparation of local development documents. At the top of the list (a) are national advice contained in guidance issue by the Secretary of State. At the bottom (j) is the "wash-up" clause: "such other matters as the Secretary of State prescribes" Planning Guidance such as that issued in 2014 comes within category (a), whereas MWS I and MWS II both come within para (j)(if they can be considered material considerations at all – see above)

My understanding of due process is that ministerial statements are followed by the issue of draft circulars which are consulted on and then by the circular itself. This is a process which has not been followed. **An MWS is the beginning of a process and not the end of it.**

In dealing with any planning matter, authorities are required to determine the weight which should be given to policies, particularly where there is a conflict between different policies and one has to be preferred to another. The usual practice is to give greater weight to policies which have been carefully considered, are up to date and have undergone a process of public consultation – the more thorough the consultation, the greater the weight to attach to the policy. So the weight to be attached to MWS I and MWS II should be considered by MPA in this context.

On this basis, both MWS I and MWS II should be given little or no weight, as they have not gone through any process of public consultation and are irrational. Further MWS II should not be allowed to over-ride the views the inspector and the MPA came to after consideration of all the evidence submitted and the appropriate and extant planning policies.

MWS II has been issued contrary to Law.

The unwritten UK constitution is based on a system of legally enforceable checks and balances, mainly set by legal case-law, which limit the powers of the executive arm of government, and this has become the bedrock of our liberties and democracy.

The powers of the Executive (ie ministers and the cabinet) are limited to those exercisable under "The Royal Prerogative" (eg the right to declare war or peace etc.), and those specifically granted to ministers by statute.

This outcome of the Case against Proclamations (1610) was reaffirmed in the judgement of the Supreme Court in Miller v Secretary of State for Exiting the EU (January 2017)(The Brexit Case). This particularly applies to matters which relate to property or the rights of the queen's subjects, as all planning law and policies do.

Further, para. 51 of the Brexit Case establishes that *"ministers cannot frustrate the purpose of a statutory provision, for example by emptying it of content or preventing its effectual operation".*

So, for example, if MWS II is interpreted as requiring MPA to substitute the Infrastructure Act definitions for those in the JWMP, so as to allow hydraulic fracturing in the AONB and National Parks and industrialise them, this will be contrary both to National Policy and the primary legislation which established National Parks and AONB's, and will therefore be ultra vires.

Another aspect of this is the status of adopted local plans. The Ryedale Plan has been adopted under the Planning and Compulsory Purchase Act 2004, and as such enjoys the protection of that statute as if it was itself part of the statute. So again, if the effect of MWS II is to compel MPA to frustrate the purpose of the adopted Ryedale Plan, for example by emptying it of content or preventing its effectual operation through in effect requiring the industrialisation of the areas specified in the Ryedlae Plan as being of significant local landscape value (eg the Vale of Pickering and the Yorkshire Wolds), then again MWS II is ultra vires.

Formal Request

I would ask the inspector to reconvene the verbal hearing of the EIP if MPA decide to change the substance of any of the policies decided and agreed in regard to hydrocarbon development at the last hearing.

COUNCILLOR PAUL ANDREWS Ryedale District Council
Mayor of Malton
Chair Habton PC June 2018

Written evidence submitted by Turley on behalf of INEOS Upstream Ltd [PGF 163]

Executive Summary

1. INEOS is the largest holder of Petroleum Exploration and Development Licences (PEDLs) in the UK.
2. INEOS considers that there is a need to update and improve the available planning guidance. The National Planning Policy Framework (NPPF) has limited policy guidance and whilst the "Minerals Planning Practice Guidance (PPG)" is useful, it does not contain the full extent of guidance available in current Written Ministerial Statements and other non-planning guidance documents.
3. INEOS concludes that a comprehensive policy document, aimed at users of the planning system would be a useful addition and would help to clarify and collate the wealth of available guidance with unclear planning status.
4. INEOS also concludes that the guidance available should be expanded and updated to assist Mineral Planning Authorities (MPAs) in managing the issues created by organised objection groups which use various tactics to slow and / or frustrate the progress of shale related developments at every step of the process.
5. INEOS considers that the use of the 2008 Planning Act system would not be suitable for individual well applications. The exploration and appraisal wells are small in scale and have very limited land use implications owing to their temporary nature.
6. INEOS may welcome the opportunity to utilise this system for a larger scale production application, and recognises some of the advantages of the process. However, it can foresee issues where multiple elements of a wider production scheme are not well enough progressed to include everything in a single Nationally Significant Infrastructure Project (NSIP) application. This could delay overall progress in fulfilling the obligations of the PEDL. INEOS therefore considers that any use of the 2008 Planning Act route should be undertaken on an "opt in" basis, in a similar manner to the current approach to large scale commercial development.
7. INEOS is also open to considering an alternative form of national planning regime, although has no firm views on the nature or governance of such a system.
8. Our recommendations to the Select Committee are in **bold** type face.

Introduction to INEOS Upstream Ltd

1. INEOS Group is one of the largest chemicals companies in the world and employs over 4,000 people in the UK. It is a leading manufacturer in the petrochemical sector and has an unrivalled safety record, having successfully and safely operated numerous hazardous installations across the UK for decades.

2. INEOS has set up its own shale gas business, INEOS Upstream Ltd, also known as INEOS Shale, to ensure that it can directly source low cost energy in the UK, to the benefit of manufacturers like INEOS and domestic consumers alike. It is now the largest holder of onshore acreage prospective for shale gas in the UK and is actively exploring opportunities across North and South Yorkshire, the East Midlands and Cheshire.

Why is INEOS exploring for Shale Gas in the UK?

3. INEOS considers that it is necessary for the UK to make the most of its domestic shale gas resources. There are a number of reasons for this.

4. INEOS recognises that tackling climate change is of fundamental importance. This means reducing our reliance on coal and transitioning to a mix of energy sources which have lower emissions. The UK will need to rely on gas during this transition process.

5. Estimates of how long this transition will take vary and some parties argue that gas will not be needed to assist with this transition at all. However, the alternative to gas during this transition is unclear and it is likely that it will be several decades before the UK is able to de-carbonise sufficiently to reduce its reliance on fossil fuels for a reasonable proportion of its energy mix. Gas is an important fuel for domestic heating, cooking and manufacturing, and is likely to remain so for decades to come. The UK faces a significant challenge to replace gas with a reliable, low-cost alternative fuel source.

6. In addition, INEOS uses gas as a feedstock for chemical manufacturing. Gas is an essential component in manufacturing products as diverse as the chlorine that cleans our drinking water, building insulation, clothing, pharmaceuticals and indeed components for manufacturing renewable technologies such as wind turbines and solar panels. These are all services and products that our society is likely to need beyond the transition to a lower carbon energy system and as such gas is therefore likely to be needed in the longer term as well.

7. It is possible that the UK could import increasing volumes of gas to help meet the country's energy needs during this transition period. However, this simply devolves the responsibility of extraction to other countries which, in turn, raises other issues including potential risks to the UK's security of supply and the robustness of environmental controls and standards in these countries. To import gas as liquid natural gas (LNG) it needs to be compressed to a liquid form and transported. These processes both carry additional environmental costs compared to a domestic supply.

8. A domestic onshore gas supply would deliver tax revenues, jobs and critical investment in manufacturing in the North of England. It is clear that there is great potential in this industry, particularly as the revenue from North Sea oil and gas declines, and skilled oil and gas workers in the UK become available for employment.

9. Whilst there is a strong argument for making use of our domestic supply, it is unlikely that the UK can eliminate the need for importing gas. We currently import 54% of our gas supply and this is forecast by the Oil and Gas Authority (OGA) to increase to around 90% by the 2030. UK shale gas can make an important contribution to reducing these imports.

10. The production of shale gas and the availability of low cost fuel would have important benefits for the UK's manufacturing industry, which now accounts for less than 10% of the UK's gross domestic product.

Progress so far

11. INEOS has been actively gathering geological information at various locations in England, through 2D and 3D imaging technology. It has also submitted three planning applications for exploratory vertical core wells, one in Derbyshire and two in Rotherham. Two of these applications have recently been appealed, following non-determination by the relevant MPAs.

12. To date, INEOS' experience of promoting shale gas projects has been very frustrating. There is a lack of understanding of the operations involved, both within MPAs and among the general public. MPAs are under-resourced and overworked, leading to unacceptable delays in pre-application consultation and during the determination of planning applications. Statutory time limits for the issuing of screening opinions, the acceptance (and processing) of large numbers of representations and the determination of applications are frequently extended and/or missed, without any clear reasons being articulated.

13. INEOS has three current development schemes which are actively in the planning system. Two of these were presented to Committee in between 34 to 39 weeks, an outcome prompted by the lodging of non-determination appeals. The third is programmed to be determined around 19 weeks from submission, which is closer to, but still in excess of the statutory deadline. Each of these applications is for a simple, small scale vertical borehole, and each presents such limited environmental effects that they have all received "standard rules" permits from Environment Agency.

14. In addition, INEOS is aware that certain MPAs are currently in the process of promoting policies, as part of their Development Plan reviews, that positively discriminate against unconventional hydrocarbon development. This is created by such an approach to forward planning, if allowed to diverge meaningfully from national policy, would have a material adverse impact on the promotion of shale gas projects.

Is there the need to update and improve the guidance available?

15. The short answer to this is yes.

16. The NPPF only makes one reference (in paragraph 147) to development involving unconventional hydrocarbons and this is in the context of distinguishing between the various phases of development.

17. INEOS believes that **the NPPF should be updated to emphasise the significant benefits that the production of gas from unconventional sources can play in:**

- **tackling climate change**

- **addressing risks associated with the UK's security of energy supply**

- **delivering tax revenue, jobs and much needed investment in manufacturing in the UK**

18. In particular, INEOS recommends that **the NPPF should confirm that the significant economic benefits associated with the development of unconventional hydrocarbon projects is a material consideration that MPAs are required to have regard to when determining applications. Importantly, this should include landowner and community funds that will be established during the production stage of such projects.**

19. The NPPF should also be updated to:

- **Place MPAs under an obligation to promote unconventional hydrocarbons in their Mineral Local Plans**

- **Recognise that there is an urgent and pressing need to establish, through the granting of planning permission of exploratory and appraisal wells, the presence of economically viable quantities of unconventional hydrocarbons**

- **Emphasise that when considering planning applications for exploratory and appraisal wells, MPAs should not have regard to issues relating to future activities such as production, which are not part of the current application**

- **Confirm that MPAs should not concern themselves with issues that are dealt with by other regulatory bodies such as the Environment Agency, the Oil and Gas Authority and the Health and Safety Executive**

- **Require MPAs to process and determine applications for unconventional hydrocarbon development in a timely manner**

- **Require MPAs to enforce statutory time limits for submission of representations during the planning application determination period**

20. INEOS accepts that the planning practice guidance contained in "Guidance on the planning for mineral extraction in plan making and the application process" ("the Minerals PPG") addresses a number of the matters noted above. However, the Minerals PPG does not go far enough in highlighting the clear benefits of the production of gas from unconventional sources and emphasising the need for the prompt determination of applications.

21. It is acknowledged that planning applications for unconventional hydrocarbons are likely to attract considerable interest and generate a large number of comments. It is only right that the Government and INEOS is committed to ensuring that local communities are fully involved in planning decisions that affect them. Nevertheless, the Written Ministerial Statement dated 16 September 2015, makes clear that applicants can expect local planning authorities to ensure that decisions on planning applications are made within the statutory timeframe of 16 weeks where an application is subject to Environmental Impact Assessment (EIA).

22. Furthermore, it is our experience that decision-makers within MPAs are not giving sufficient weight to the Minerals PPG when determining applications. If the matters referred to above were instead incorporated into an amended NPPF, it is more likely that decision-makers would find it harder to ignore the policy support for unconventional gas development.

23. **Further guidance on what factors are considered to be relevant to an application, and on how MPAs should manage applications, would also be welcome**.

24. The key practical areas where INEOS has experienced delay, and where guidance could either be provided or clarified, are:

- High volume mass objection, which delays administration and officer review of the issues being raised by objectors. This results in undue cost to MPAs. **Guidance should be clearer that applications for this sort of development are considered based on the material issues raised, rather**

than the volume of objection. MPAs may be encouraged not to log duplicate / template objections. Consideration should also be given to how MPAs should manage high volume customised objections, which is a tactic seemingly being employed to make organised objection appear to be more individual, thus increasing the reported number of objectors.

- Set periods for public objection. Whilst statutory consultation dates are set out, the reality is that MPAs are forced to accept and consider any objections lodged during the determination period. **MPAs should be encouraged to disregard late objections, unless they raise new material considerations which are relevant to the determination of the scheme**.
- Challenges to screening opinions. **Guidance should be provided on when third parties can and should seek a screening direction from the Secretary of State.** There is current potential for objectors to seek to challenge the lack of EIA for a shale development, either just as the applicant is preparing to submit a non-EIA application, or just before an application is ready to be reported to planning committee. Such requests can be tactically timed to maximise delay to the submission or determination of an application. **This potential should be removed, whilst seeking a balance to allow people the right to challenge decision makers appropriately**.
- Re-consultation on revised or additional information submitted after the application is validated. The need to re-consult on new information is clear and should be retained. **However, MPAs should be reminded that new information does not need to be consulted upon extensively.** The statutory minimum may well be adequate, depending on the circumstances. **There should be defined and limited periods for consultations of this nature**. Further, whilst this is difficult to define categorically, **some guidance on when re-consultation should be undertaken would be useful.** This could draw on examples to illustrate a rule.

25. In addition, there is scope for confusion on the roles and responsibilities of the different regulators involved. **Guidance should further clarify which body is responsible for which aspect of regulation, and be clear on which matters can be considered when determining a planning application**.

26. As the industry matures, there is also likely to be a need for some guidance on planning conditions. **Guidance should be reiterated that for shale related schemes, conditions and obligations should only be imposed where absolutely required**.

27. Finally, whilst it has not yet been an issue for INEOS, the potential for Minerals Local Plans and/or Supplementary Planning Documents (SPD) to introduce unduly stringent local policy tests should be limited. **Guidance on what is appropriate content for these documents would be welcomed, and this should include guidance on when and how to restrict matters such as noise limits, off set distances to dwellings or other sensitive receptors and any other locally set limits or restrictions which may unduly hamper the development of this important industry, in direct contravention of national policy**.

28. INEOS generally welcomes the changes proposed to the NPPF in the current consultation, and will review and comment on those changes through the appropriate consultation exercise.

Is there the need for a comprehensive document incorporating existing and updated guidance?

29. Again, the short answer is yes.

30. The NPPF and the Minerals PPG are the only shale gas specific planning guidance that clearly falls within "material considerations" as referred to in Section 54A and Section 70(2) of the Town and Country Planning Act 1990 (although see further comment on this point below).

31. **It would assist both applicants and decision-makers if the guidance relating to unconventional hydrocarbon development, as set out in the NPPF (updated to address the points set out above) and the Minerals PPG, was incorporated into one policy document that related specifically to this sector of development**. This document should clearly have equivalent "material consideration" status. Given the importance attached to economic benefits of all forms of mineral extraction and the need to ensure security of supply of reliable, low-cost shale gas to the UK, such a step is warranted.

32. A further planning related document that should also be incorporated with the updated NPPF is the Written Ministerial Statement from the Secretary of State for Communities and Local Government dated 16 September 2015 ("the Ministerial Statement"[1]). This set out a number of measures to enable planning applications and appeals to be dealt with "*as quickly as possible*". Furthermore, the guidance in "Guidance

on fracking: developing shale gas in the UK" updated in January 2017 and the relevant parts of the recent Written Ministerial Statement from Greg Clark of 25 January 2018[2] also contain relevant guidance which could usefully be incorporated into a comprehensive planning policy document. **These Written Ministerial Statements should be incorporated into the guidance.**

33. Unfortunately, given INEOS' experience to date, it would appear that MPAs are not having due regard to the respective Written Ministerial Statements. Inclusion of the measures into a single comprehensive document would emphasise these measures as set out in the Written Ministerial Statements, which in turn should speed up the determination process of applications.

34. Indeed, it is clear that not all MPAs are following existing guidance in the NPPF, in that decision making is not always taken in a positive manner, where the MPA is actively looking for solutions, and approving sustainable development wherever possible as they should.

What is the status – in planning terms – of the extant Government guidance?

35. As has already been stated, only the NPPF and Minerals PPG provide formal planning guidance for MPAs to take into account when promoting their Development Plans and when handling planning applications for unconventional hydrocarbons. The Written Ministerial Statements do not specifically provide planning guidance but represent material considerations that MPAs should have regard to when determining applications.

36. There are many other documents that have been produced by or on behalf of Government that provide guidance to applicants, MPAs, stakeholders, householders and landowners on the development of unconventional hydrocarbons. These include the following (in chronological order, most recent first):

- Shale Wealth Fund dated 11 November 2017
- Committee on Climate Change report and government response on the compatibility of UK onshore petroleum with meeting the UK's carbon budgets dated 7 July 2016
- Regulatory Roadmap: Onshore oil and gas exploration in the UK regulation and best practice dated 17 December 2015
- Amendment to permitted development rights for petroleum exploration dated 13 August 2015
- Bowland Shale Gas Study dated 5 March 2015
- BGS Weald Basin Jurassic Shale reports dated 5 March 2015
- BGS Midland Valley of Scotland Shale reports dated 5 March 2015
- Business rates retention and shale oil and gas: technical consultation dated 23 January 2015
- Public engagement with shale gas and oil dated 3 December 2014
- Shale gas exploratory operations: environmental risk assessment dated 30 July 2013
- Map of Onshore Licences, SEA Areas and Prospective Areas dated 28 July 2014
- Shale gas extraction: review of the potential public health impacts of exposures to chemical and radioactive pollutants dated 25 June 2014
- The Government's response to the MacKay-Stone report: Potential greenhouse gas emissions associated with shale gas extraction and use dated 24 April 2014
- Harnessing the potential of the UK's natural resources: a fiscal regime for shale gas dated 10 December 2013
- Potential greenhouse gas emissions associated with shale gas production and use dated 19 September 2013
- Review of assessment procedures for shale gas well casing installation dated 15 October 2012
- Shale gas extraction in the UK: review of fracking dated 29 June 2012
- Monitoring and control of fugitive methane from unconventional gas operations dated 8 June 2012
- Research and analysis Induced seismicity in the UK and its relevance to hydraulic stimulation for exploration for shale gas: background note dated 17 April 2012
- Policy paper Preese Hall shale gas fracturing review and recommendations for induced seismic mitigation dated 17 April 2012
- Independent report The 'Shale Gas Revolution': hype and reality, a Chatham House report dated 1 September 2010

37. These documents are listed in the "Collection of Information on exploration, hydraulic fracturing and approach to the development of shale gas in the UK" on the GOV.UK website

https://www.gov.uk/government/collections/shale-oil-gas-and-fracking. It is therefore assumed that Government regard all these documents as still of relevance to the shale gas sector.

38. In order to ascertain the status of these documents in planning terms, it is necessary to consider case law on the definition of "material considerations" as neither Section 54A nor Section 70 of the Town and Country Planning Act 1990, nor Section 38(6) of the Planning and Compulsory Purchase Act 2004 define material considerations from a planning point of view. Nor is there a definition in the NPPF or the wider Planning Policy Guidance.

39. Case law has made it clear that whether or not a particular consideration is material is a matter for the court: *(Tesco Stores Ltd v Secretary of State for the Environment [1995 1 W.L.R. 759*]. Case law has also established a broad interpretation of material considerations, as per Cooke J. in *Stringer v Minister of Housing and Local Government [1971] 1 All E.R. 65:*

"In principle, it seems to me that any consideration which relates to the use and development of land is capable of being a planning consideration. Whether a particular consideration falling within that broad class is material in any given case will depend on the circumstances."

40. In light of this, it is not possible to state that every part of the guidance set out in the documents listed above is automatically a material consideration in relation to the determination of unconventional hydrocarbon planning applications. However, much of the guidance will be relevant, given that the guidance does relate to the use and development of land for shale gas exploration and production.

41. Accordingly, **it is important that MPAs recognise the existence of these documents and have due and proper regard to them, and the information included in them, when determining applications for unconventional hydrocarbon development. It would assist all parties involved with such applications if the relevance of these documents was highlighted in the amended NPPF or an amended version of the Minerals PPG**.

Should applications for fracking be dealt with as national infrastructure under the 2008 Planning Act?

42. The short answer to this question is no.

43. The Planning Inspectorate's Advice Note 8: Overview of the nationally significant infrastructure planning process for members of the public and others dated February 2017 states:

"1. What is an NSIP?

1.1 An NSIP is a Nationally Significant Infrastructure Project. They are projects of certain types, over a certain size, which are considered by the Government to be so big and nationally important that permission to build them needs to be given at a national level, by the responsible Government minister (the 'Secretary of State')."

44. Although the benefits of a shale gas industry that have already been described are significant, both locally and nationally, the form of development involved is minor in scale. The footprint of the exploration and production sites is small when compared to many other forms of development. Furthermore, although some regard the form of development as controversial, the actual impact in land use terms is very limited.

45. In light of this, **INEOS believes that planning applications for the exploration and appraisal of unconventional hydrocarbons should remain within the remit of the Town and Country Planning Act 1990.** Given the small scale nature of each well pad, even production applications may not warrant use of the NSIP regime. Indeed, it may not be possible to bring forward all elements of a production "scheme" for a PEDL area at the same time, due to land ownership considerations.

46. However, there may be cases where, due to the inclusion of longer connecting pipelines, and/or multiple well pads in multiple authority areas, it may be both appropriate and convenient to consider the collective development under a single consenting regime. **INEOS would welcome the flexibility to employ this option, should this be the most expedient and convenient way to bring forward a larger scale development across a PEDL area. This could function as an "opt in" mechanism, in a similar manner to the approach that has been adopted to large scale commercial schemes, and as previously consulted upon by Government in 2012. However, should this option be considered to be appropriate, INEOS would expect a National Policy**

Statement (NPS) to be put in place, to ensure that issues, including the fundamental need for shale gas extraction, are not disputed during the examination phase of the process. If this option is pursued, INEOS would request to be involved in determining the content of the NPS.

47. **INEOS also recommends that the Secretary of State should actively consider calling in planning applications for his or her own determination where MPAs have failed to determine applications within the statutory time limits and/or where MPAs are failing to have due regard to relevant guidance**.

48. INEOS considers that a flexible solution should be found that offers the industry room to utilise a national system where beneficial to securing the necessary approvals expeditiously and with due regard to the process. INEOS is therefore open to considering alternative forms of a national consenting process, although would wish to be fully involved in determining the scope, nature and obligations around any such system. INEOS' primary concern is delivering against the undertakings it gave to the OGA with regard to its portfolio of PEDLs and would seek to ensure that satisfying these obligations is not impeded by uncertainty around the consenting process.

March 2018

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[1] HCWS201
[2] HCWS428

MYTH #1: “Fracking will provide energy security for the UK.”

FACT: The UK is part of an integrated European energy market, which means all the gas produced in the UK is traded on the open market and sold to the highest bidder. The Government cannot therefore ‘reserve gas for the UK’, or control the price.

In fact, the UK currently *exports* nearly 30% of the gas it produces. If the government was really worried about energy security, why would they let this happen? The simple reason is that they can’t stop private companies selling gas to whoever they want – that’s how the free market works. If they can earn more money by selling gas abroad, they will. So, even if we did start producing large quantities of fracked gas, there is no guarantee that it would be used in the UK and may just as easily be sold abroad anyway.

Also, despite what politicians would have you believe, we do not rely on Russia for our gas supply. (How often have you heard politicians say things like “If we don’t start fracking, Putin will turn off the gas supply and the lights will go out.”?). According to the 2014 Government DUKES report – the latest figures available at the time of writing – 97% of our imported gas comes from Norway (57.4%), Qatar (24.4%) and Holland (15.1%) – but very little comes from Russia. And Russia is so reliant on its petrochemical industry that if they stopped exporting gas and oil, their economy would collapse very rapidly.

Please see **p114** of the 2015 DUKES report for the exact figures for imports and exports. This report also contains lots of interesting information about gas production in general, if you’re into that sort of thing. Here are a couple of interesting sections from the headlines on p93:

- Imports fell by 11 per cent in 2014 versus 2013; exports increased by 17 per cent.
- Net imports were 18 per cent lower in 2014 compared to 2013 (Table 4.1).
- These decreases were primarily due to a reduction in demand for natural gas within the UK during 2014.

You can also check these figures on the fracking industry’s trade association UK Onshore Oil and Gas (UKOOG) website, which is a much easier read than the DUKES report!

But hasn’t fracking reduced gas prices in the USA?

Yes, it has. However, this is because until very recently, the USA had a closed energy market and gas exports was severely restricted under US law. In December 2015, the US voted to allow oil and gas exports again, as they now have so much gas that they don’t know what to do with it. It’s also worth noting that to produce this reduction in price, over 1.1 million fracking wells have been sunk in the USA (more about this in Myth 2).

Another reason why fracking cannot help the UK improve its energy security in the short or medium term is because of the time scale involved. Even if the industry moved ahead as fast as it wanted to, we wouldn’t see significant production until the mid-2020s, by which time we need to be moving rapidly towards a decarbonised energy system based on renewables to meet our climate change commitments.

Also very much related to Myth 1 is its twin, Myth 2:

MYTH #2: “Fracking will lower energy prices.”

FACT: Although this claim has been made by many politicians and supporters of fracking, most economists and gas industry executives do not believe this is the case because of the nature of the EU energy market (see above) and the amount of gas available, which is relatively small in relation to the whole European market. This claim is made partly because the price of gas has fallen in the USA (see above) because of fracking and therefore some people think that the same would happen here – thus showing a lack of understanding of basic economics and the difference between a closed market and an open market. David Kennedy, head of the Committee on Climate Change – the government’s official adviser – said that “*fundamental economics*” showed bills were unlikely to fall. “*It is highly unlikely to happen here. There isn’t enough shale gas in the UK and in Europe to change the European market price*.”
Here are some more quotes from economists, politicians and fracking industry executives who don’t think that fracking will lower gas prices:

Lord Stern of the London School of Economics: “*I do think it’s a bit odd to say you know that it will bring the price of gas down. That doesn’t look like sound economics to me. It’s baseless economics*.”
Lord Browne, ex-Chairman of fracking company Cuadrilla, said: “We’re part of a well-connected European gas market and unless it is a gigantic amount of gas, it is not going to have material impact on price.”
Professor Jim Watson, Director, UK Energy Research Centre: Researchers from the UK Energy Research Centre (UKERC): “It is very frustrating to keep hearing that shale gas is going to solve our energy problems – there’s no evidence for that whatsoever… it’s hype. It’s extraordinary that ministers keep making these statements. They clearly want to create a narrative. But we are researchers – we deal in facts, not narratives. And at the moment there is no evidence on how shale gas will develop in the UK. Shale gas has been completely oversold. Where ministers got this rhetoric from I have absolutely no idea. It’s very misleading for the public.”
Ed Davey, Secretary of State for Energy, Department of Energy and Climate Change (DECC) said during the last government: “North Sea gas didn’t significantly move UK prices – so we can’t expect UK shale production alone to have any effect.”
We could go on, but you get the point. Also, next time you hear a politician claim that fracking will result in lower prices, listen carefully to the words used. Since this myth has been so roundly debunked by economists, politicians and industry insiders alike, what they now say is things like ‘Fracking *could* lower prices’ or ‘Fracking *has the potential to* lower prices’, or Fracking *may* result in lower bills for hard-working families’ – thus perpetuating the myth without actually saying it.
We’re also told that we shouldn’t be worried about fracking, because of Myth 3:

MYTH #3 “Fracking has been going on for decades.”

FACT: The technique causing such controversy, and the one that everyone is concerned about, is known as **High Volume Hydraulic Fracturing** (HVHF), or ‘fracking’ for short. Fracking requires millions of gallons of fresh water, sand and chemicals, is done at very high pressure in vertical and horizontal wells, and is designed to fracture solid shale rock deep underground. HVHF Fracking – which is considered to be a method of *unconventional* oil and gas extraction – has only been done commercially since about 2007, mainly in the USA, where over a million wells have sinced been fracked.

This is a very different process from the long-used technique of pumping water at low pressure into conventional wells to increase the amount of oil and gas recovered. This technique has been used for decades to stimulate *conventional* gas wells near the end of their life in order to extend their production, and uses low pressure, very small quantities of water and no dangerous chemicals. It is estimated that about 200 wells in the UK have been subject to this ‘well stimulation’ technique since the 1980s, and is a very different – and much less environmentally damaging – technique to HVHF fracking, which Cuadrilla admitted was the cause of two small earthquakes at Preese Hall in 2011.

This has been confirmed by a letter from the Department of Energy and Climate Change (DECC), which said: “*Cuadrilla is so far the only operator in the UK to use High Volume hydraulic fracturing – this technique was used on the Preese Hall well in Lancashire in 2011*.” (Letter Ref: TO2013/15618/RL, 20/08/13)

Click on the link below for the letter itself:

DECC letter confirming only one frack in the UK

Interestingly, this was confirmed in a letter to Peter Lilley MP after an altercation with a Balcombe Resident in 2014 after a Channel 4 interview. You can read details of this, and the letter to Mr Lilley from DECC on the Drill or Drop site.

A related extraction technique is Coal Bed Methane production, which is very similar to fracking, but uses large volumes of high-pressure frack fluid made up of water, sand and chemicals to extract hydrocarbons from coal seams, not shale rock.

Much of this myth hangs on which definition of ‘fracking’ you mean. The global protests about fracking all relate to HVHF fracking, not old-fashioned well stimulation. Yet the shale gas industry and various politicians try to muddy the waters by using ‘fracking’ to describe both techniques, thus implying that the controversial technique of *HVHF fracking* has been used for decades, which is not the case.

A good example of the industry spin around the word ‘fracking’ is Wytch Farm, in Poole, Dorset, which is the centre of Europe’s biggest oil field. Many supporters of HVHF fracking have cited Wytch farm as a model of responsible fracking, including an article in the Telegraph. However, there are very clear differences between Wytch Farm and the HVHF fracking that is causing such environmental problems elsewhere.

Firstly, Wytch Farm is a conventional oil and gas field, from which the hydrocarbons flow freely, and does not produce oil or gas by blasting high-pressure frack fluid into tight shale rock or coal seams. Of the 199 wells drilled at Wytch Farm not a single one is classified as either Coal Bed Methane or Shale Gas. Also the oil field is actually out at sea, and is accessed via a series of horizontal wells drilled from the 18-hectare well-site in Poole Harbour.

Finally, what well-stimulation that has occurred there to extend the life of the wells has been with sea water injected at low pressure, with no added chemicals. This is *very* different to HVHF fracking, which has never been done at Wytch Farm.

So, when you hear someone say that ‘fracking has been done in the UK for decades’, ask them what they mean by ‘fracking’!

Which brings us on to one of the most popular myths of all …

MYTH #4: “Fracking poses no risk to public health.”

Dead fish in a creek due to leak of fracking fluid at Halliburton’s site in Monroe County in Monroe County, Ohio.

FACT: Recent research studies in Pennsylvania have found that drilling and fracking activities have been associated with a 27% increase in cardiology hospitalisations for people living near fracking wells.

A Yale University study also found that people living near fracking wells had increased numbers of skin conditions and upper respiratory conditions. The study included 180 randomly selected households and 492 people in Washington County, Pennsylvania, and is “the largest study to date of general health status of people living near gas wells,” said Rabinowitz, first author of the study and an associate professor in the University of Washington’s School of Public Health. “The major symptoms seem to be upper-respiratory symptoms,” including “coughing … itchy eyes, nosebleeds” as well as skin problems such as rashes, itching and burning, Rabinowitz said.

Further studies have linked fracking to high-risk pregnancy, pre-term birth, and low birth weight in infants.

A report highlighting the increase in still-born babies in Vernal, Utah, has also received a lot of publicity, and this report from the Los Angeles Times also highlighted how much the industry is trying to shut down the debate about health and fracking.

The standard industry response to any stories about health and fracking is that there is no 100% proof of cause and affect, ie that the pathways for the myriad of health complaints that appear to be occurring to people living near well-sites is not proven. However, New York State banned fracking on grounds of serious risk to public health following a rigorous six-year study, as reported in the New York Times and Huffington Post. You can read the full NY study here, which we highly recommend.

Dr. Howard A. Zucker, NY State Health Commissioner, said on the publication of the report: “***Would I let my family live in a community with fracking? The answer is no. The potential risks of fracking are too great. In fact, they are not even fully known***.”

This view is backed by rigorous study of peer-reviewed papers by Concerned Health Professionals of New York, who have produced an extensive compendium of health and fracking related research. They state in a letter to President Obama from October 2015 that “*More than 100 new peer-reviewed studies on the impacts of drilling and fracking have been published since New York’s high volume fracking ban was announced in December 2014.* ***Overwhelmingly, these studies find significant risks and adverse impacts, as do the more than 400 studies that we had reviewed in the previous edition of the Compendium.***“

Another source of information about the health risks of fracking is PSE (Physicians, Scientists and Engineers) Healthy Energy, which says “The scientific community is only beginning to understand the impacts of shale gas development on human health and the environment. Many data gaps remain, but numerous gaps and risks have been identified.” They also point out that there are now over 550 peer-reviewed papers on the health effects of fracking, and that over 80% of these have been published since 2012 (the year in which the UK government commissioned their own health report, which we’ll come to in a minute).

The PSE report also stated that:

- 84% of studies on health indicated potential public health risk or actual adverse health outcomes’.
- 69% of studies on water quality “indicated potential, positive association, or actual incidence of water contamination.”

- 88% of studies on air quality "indicated elevated air pollutant emissions and/or atmospheric concentrations."

For more information and a very useful and informative downloadable graphic, go to the PSE Science of Shale Gas Health Development page. and for those with a desire to read the source material, here is their full report.

Here in the UK, a report by Medact concluded that hydraulic fracturing for shale gas poses significant risks to public health and called for an immediate moratorium to allow time for a full and comprehensive health and environmental impact assessment to be completed. Please read their letter to the BMJ (British Medical Journal), or read their report – entitled Health and Fracking – The Impacts the Opportunity Costs.

Unsurprisingly, this damning report was criticised by UKOOG, the representative body for the fracking industry, and you can read their comments here. Medact issued a strong rebuttal, which addressed UKOOG's points, which you can read here. In another letter to the BMJ, they stated: "*All substantive criticisms were looked at in detail, but none gave reason to change the conclusions and recommendations of the Medact report. We also note that a number of criticisms were bogus and spurious which suggest a failure to carefully read the Medact report; a wish to incorrectly suggest that the Medact report is full of errors; or an intention to muddy the waters and create (even more) misunderstanding about fracking amongst the public and policy-making community*."

Just to underline that this report was written by serious health professionals, not a bunch of anti-fracking campaigners, here is a list of the people who put their names to the original Medact report:

Dr Robin Stott, Co-Chair, Climate and Health Council
Professor Sue Atkinson CBE, Co-Chair, Climate and Health Counci
Professor Hugh Montgomery, UCL
Professor Maya Rao OBE
Professor Martin McKee, LSHTM
Dr Clare Gerada, GP and former Chair of RGCP
Dr Christopher Birt, University of Liverpool and Christie Hospital, Manchester
Professor John Yudkin, Emeritus Professor of Medicine, UCL
Dr Sheila Adam, former Deputy Chief Medical Officer
Professor Klim McPherson, Chair of the UK Health Forum
Dr John Middleton, Vice President UKFPH
Professor Alan Maryon-Davis, KCL
Helen Gordon, Board Member, Climate and Health Council
Dr Frank Boulton, Medact and Southampton University
Dr Sarah Walpole, Academic Clinical Fellow
Professor Allyson Pollock, QMUL
Dr Julie Hotchkiss, Acting Director of Public Health at City of York Council
Professor Jennie Popay, Lancaster University

Their conclusion is as follows: "**The arguments against fracking on public health and ecological grounds are overwhelming. There are clear grounds for adopting the precautionary principle and prohibiting fracking**."

Another report that again concludes there are significant health risks in fracking is by the CHEM Trust, whose Executive Director Dr Michael Warhurst said: *"Widespread fracking will threaten many of our valuable wildlife sites, as this technology has a high potential to pollute sensitive aquatic ecosystems;* ***it can also harm human health****."* You can read their full report here. Again, this was criticised by UKOOG, which the CHEM Trust responded to here.

There are numerous other health reports that are worth reading, including this one from the Chartered Institute of Environmental Health.

On a more personal level, people in Pennsylvania have compiled a chilling List of the Harmed, written by people whose health and livelihoods have been adversely affected by fracking.

Many other parts of the world, including France, Holland, Bulgaria, Tasmania and Victoria (in Australia) have all banned fracking due to public health and environmental concerns. The debate about whether fracking is banned in Germany, or just severely restricted, is ongoing. Currently Scotland and Wales also have moratoria (temporary bans) on fracking while health assessments are carried out (although in both cases some observers feel that these are under pressure and have been criticised for allowing exploration drilling and potentially coal bed methane production). Northern Ireland have issued planning guidelines to say no to fracking until "there is sufficient and robust evidence of its safety on all environmental impacts".

So where does this leave us here in England, the only part of the UK where the government's 'dash for gas' is continuing, apparently unhindered by the weight of public and scientific concern about the effects of fracking? We believe that, at the very least, the increasing weight of evidence that fracking has a detrimental affect on human health should lead to a moratorium so that this can all be examined thoroughly. Many people across the world feel that with hundreds peer-reviewed reports already saying that fracking can cause serious health problems, there is already more than enough evidence to ban the practice forever.

What does the British government say?

Whenever the government is challenged on the health impacts of fracking, their response is always the same. They point to a Public Health England report published in October 2013 which concluded, *"Public Health England anticipates a low risk to public health from direct releases of chemicals and radioactive material if shale gas extraction is properly operated and regulated."*

However, this report only drew on selected research that had been published by December 2012 – and as the PSE Energy have stated, **over 80% of the peer reviewed papers** on the health and environmental impacts of fracking have been published since that date.

The Public Health England report was updated and published in its final form in June 2014, with a note saying, "The report has been updated in the light of new significant scientific evidence in peer reviewed or published reports, **up to January 2014**."

The report also stated that "There have been no significant changes to the findings in the draft report, PHE-CRCE-002, which was published for comment in October 2013."

However, as the graphic from PSE Energy shows, there have been over 300 new peer-reviewed health studies since January 2014, and the overwhelming number of these show a range of health problems related to fracking. Indeed, new research appears so regularly that it is hard to keep up. However, the government have not updated their report.

For more on the issues of health and fracking, please visit www.isfrackingsafe.com for the views of a concerned Yorkshire GP on this issue, and also see this article in the Ecologist for a view about the original report.

We leave you with the conclusion of the final Natural Health England report, which appears to fly in the face of the vast majority of peer-reviewed research on the topic. It states: "*In conclusion, the currently available evidence indicates that the potential risks to public health from exposure to the emissions associated with shale gas extraction will be low* ***if the operations are properly run and regulated***. ***In order to ensure this, regulation needs to be strongly and robustly applied***."

All of which is very relevant to the next myth, perhaps even the king of fracking myths

MYTH #5: "The UK has gold standard fracking regulations."

Dead hare in a ditch at West Newton

FACT: This myth underpins the government's argument for their 'dash for gas', and their belief that whatever problems there have been in every other country that has allowed fracking, and whatever the risks to public health, air and water quality, the environment and pretty much anything else, it can all be avoided because in the UK we have '"gold standard fracking regulations."

However, the regulations that would govern fracking were created for the *conventional* oil and gas industry, not fracking, despite the very different – and in the UK, untried – technology that would be used. An important paper called 'Fracking – *Minding the Gaps'* by Joanne Hawkins in the Environmental Law Review has examined the current legislation in detail, and concludes: "*These controls were designed pre-fracking and their application leaves a number of gaps, which may risk harm to human health and/or damage to the environment. Under the current regulatory system, the uncertainty and risk associated with fracking is not justifiable*." We strongly recommend that you read the whole paper, which is well-written for non-technical readers and is only 14 pages long, but if you don't have the time, this interview with Joanne Hawkins is also very illuminating.

So, we have a regulatory system that has been designed for conventional gas production, not the new technology of High Volume Hydraulic Fracturing, or 'fracking' for short. But how well does this regulatory system work for the conventional gas industry? Back in 2012, the Guardian reported that "*companies operating in the North Sea have been fined for oil spills on just seven occasions since 2000, even though 4,123 separate spills were recorded over the same period, the Department of Energy and Climate Change (DECC) has confirmed*". That doesn't sound like 'gold-standard regulations' to us.

Whenever the government is challenged on fracking regulations, the government uses the same tactic as it does when questioned on health, by always referring back to one particular report they commissioned back in 2012. This report, by the Royal Society and the Royal Institute of Engineering, is called Shale gas extraction in the UK: a review of hydraulic fracturing. This report, which is now over four years old, suggests that shale gas extraction can be managed safely only if 10 recommendations – shown on pages 6 and 7 of this report – are implemented in full. However, it is very questionable whether these recommendations have been implemented, a view supported by Joanne Hawkins in her paper in the Environmental Law Review referenced earlier. A paper by Michael Hill, B.Sc. C.Eng. MIET, which was presented at a conference of the Engineering Institute of Technology, concludes that only one of the ten recommendations has been implemented in full. You can read the paper by clicking on the link below.

Mike Hill Paper on RS Report and Current Status – Final4

Also, many people believe that however strong the regulations, they cannot prevent the harm that fracking may cause. This view is also held by Louis Allstadt, Retired Executive vice-president of Mobil, who said in April 2014, "**Making fracking safe is simply not possible**."

However, for the purposes of this discussion, let's assume that the regulations could make fracking safe. In fact, this is a requirement of the Natural Health England report referred to in Myth #5, which states: "*In conclusion, the currently available evidence indicates that the potential risks to public health from exposure to the emissions*

associated with shale gas extraction will be low ***if the operations are properly run and regulated. In order to ensure this, regulation needs to be strongly and robustly applied***."

The **Environment Agency** (EA) is the main body responsible for policing the fracking industry – the same EA that has failed to maintain flood protection across the UK for the last few years. How can they be trusted to monitor this new and potentially dangerous new industry if they can't maintain our flood defences adequately? Also the EA have been on the government's hit list for cuts over the last few years. In 2013 the EA cut 1,700 jobs when they lost 15% of their budget, and DEFRA, which funds the EA, is suffering budget cuts of up to 30% over the next four years. How could they possibly cope if there were thousands of new fracking wells to monitor?

Fracking and gold-standard regulations – the story so far …

The onshore gas industry is still very much in its infancy in the UK, but the regulatory system already seems woefully adequate, as these examples show.

- At **Preese Hall** in Lancashire, at the only well that has so far been fracked, there were **two mini-earthquakes**. One earthquake, perhaps, you could forgive – but why wasn't the site shut down before they caused another one? Where were the regulators? Interestingly, at that time there were no regulations covering fracking and seismic activity, although a new traffic light system has been brought in since.
- The **West Newton** exploratory well-site in East Yorkshire made national headlines last September when neighbours complained about a foul smell coming from the site. However, this was just one of a series of problems facing West Newton over the summer and early autumn of 2014. During that period the site and its operator, Rathlin Energy breached environmental permit conditions **eight times in three months**. To find out the details, please read this Drill or Drop investigation. Why was this allowed to happen? Where were the regulators? And amazingly, despite these multiple infractions, Rathlin were still given permits to continue the operation at West Newton for another three years.
- It was revealed in 2015 that a Coal Bed Methane site at Doe Green, between Warrington and Widnes, has been operating without **any Environmental Permits at all**. The site, which is operated by IGas, has been producing coal bed methane since 2009 and now generates electricity from the gas. You can read more about this lack of regulation here.
- At the **Barton Moss** exploratory well-site, near Manchester, an environmental expert found **'dangerously high levels of contaminated mud'** near the site, as reported in the Manchester Evening News. Why was that not prevented by our 'gold standard regulations'?
- Another big concern about fracking is **fugitive methane leaks**, both during production and also after the well has been decomissioned and abandoned (see Myth #8). One would think that conventional gas wells that had already been abandoned would be monitored regularly by the Environment Agency, wouldn't you? Well, you'd be wrong. A survey by Durham University's industry-funded fracking research group, ReFINE, shows that 30**% of abandoned wells are quietly leaking methane into the atmosphere, with no EA oversight**. You can read more about this on Drill or Drop, which includes a link to the original survey. Imagine the scenario in, say, 50 years' time, if tens of thousands of wells have been drilled, fracked and abandoned, and 30% are quietly leaking methane. And that's all before fracking has even got started. **The truth is that once a company has got the necessary permits, the industry is effectively self-regulating and there is very little inspection by the regulatory bodies**. Companies are only required to send in data from the well-site every few months, and there are hardly any on-site inspections – and no random unannounced inspections. That is clearly not the case now, and is less like to be true once there are thousands of fracking wells all over the country.

So the government's argument that fracking can only be safe if regulations are "strongly and robustly applied" does not stand up to scrutiny, as no matter how strong the regulations are on paper, if they are not applied, then they are worthless. As Kevin Hollinrake said to FFR supporters ast the Malton Show last year, "industry doesn't do what's **expected**, it does what's *in*spected."

This may be one of the reasons why supporters of fracking are so keen to push the next myth, as they know that this is the one that will worry a lot of people, whatever their views on the safety or otherwise of fracking.

MYTH #6: “Fracking will not affect house prices.”

FACT: The government’s draft Shale Gas Rural Economy Impacts Paper (released July 2015) says: *“House prices in close proximity to the drilling operations are likely to fall.* ***There could be a 7% reduction in property values within one mile of an extraction site***.”

The same report (the history of which you can read here) also said the following:

“Those residents owning property close to the drilling site my suffer from lower ***resale prices*** *due to the negative perception being located near the facility and potential risks.”*

“A study in Texas concluded that house prices valued at more than $250,000 and ***within 1,000 ft of a well site*** *saw their values* ***decrease by 3-14****%.”*

The conclusions of the DEFRA draft report might have underestimated the impact of fracking. In this article in the Daily Telegraph (01/05/15), entitled Fracking could wipe tens of thousands of pounds off house prices, A survey of UK estate agents in potential fracking areas showed that **67% thought that house prices would suffer**. The majority of estate agents thought the loss of value would be between 10-15%, while some estimated a fall of up to 70%.

A report in the Daily Express says that fracking “could see millions of people living in and around drilling sites lose **up to 30 per cent off the value of their homes**.”

Research in the USA, published in the American Economic Review in December 2015, concluded that the value of homes in Pennsylvania within **1 km of fracking wells fell by 12.9%**.

Perhaps the most famous example of falling house prices is this story from the Daily Mail of a woman in Lancashire saying the value of her home has been cut by £535,000, or over 70%. The reason? It was close to Cuadrilla’s proposed fracking sites on the Fylde Peninsula.

What about house insurance?

Again, it’s not good news if you live near a fracking well-site. The DEFRA draft report said: “*Properties located within a 1-5 mile radius of the fracking operation may also incur an additional cost of insurance to cover losses in case of explosion on the site*.”

It’s even worse if you live on a flood plain. According to an investigation by the Independent on Sunday (09/01/16), companies representing two thirds of the UK insurance market will not insure against damage caused as a result of fracking, or else have exemptions covering pollution of water from the controversial technique. The UK’s biggest domestic insurer, Direct Line, said although “subsidence and earthquake caused by fracking are covered as they are insured risks”, there is “no cover for contamination caused by fracking as contamination is a general exclusion of our policy”. And with 20% of the new PEDL fracking licence areas on flood plains, this could be a major concern for a very large number of people.

We will leave the final word to Ray Boulger, from the independent mortgage broker, John Charcol, who said in an interview with Talk Fracking: “**The prospect of fracking in your area is a bit like putting a motorway or railway, like HS2, through your front garden – it’s going to have an impact on the valuation of your property**.”

Still, at least you’ll be able to drink the water – or will you? Take a look at Myth #7…

MYTH #7: “Fracking has never contaminated drinking water.”

FACT: There are hundreds of cases of people having their private drinking water supplies contaminated by the fracking industry, particularly those who have their own boreholes. This can be caused by leaking wells, chemical spills, blowouts, flood damage, waste water disposal and underground migration of methane and other toxic chemicals.

A 30-month investigation by investigative news reporters at Public Herald found that the Department of Environmental Protection (DEP) in Pennsylvania has been routinely covering up hundreds of complaints about contamination of drinking water, by cooking the complaints and shredding documents.

Another Public Herald investigation shows that two public drinking water systems have been impacted and at least seven private drinking water supplies contaminated due to ongoing pollution being caused by a natural gas fracking operation of JKLM Energy in Potter County, Pennsylvania.

An open letter from the Physicians for Social Responsibility to Governor Wolf of Pennsylvania in October 2015 states: “Fracking threatens drinking water. Cases **of drinking water contaminated by drilling activities, as well as waste disposal, are now proven**. These include research studies conducted in Pennsylvania addressing the pathways of contamination and hundreds of documented drinking water contamination cases.” You can also read the full PSR report, which is an excellent compendium of the increasing amount of research into the health and environmental effects of fracking (and we challenge anyone to read this report in its entirety and conclude that there’s nothing to be concerned about in this country). This letter to President Obama is an excellent summary if you’re not keen on long reports.

So how come supporters of shale gas can keep claiming that there have been no incidents of fracking contaminating water supplies? Well, this defence often relies on a very narrow definition of fracking – in this case, the part of the whole unconventional gas extraction process that involves pumping the frack fluid down the well and fracturing the rock deep underground. If the water contamination is caused by a leaking frack well, or spills of frack fluid or chemicals, or flood damage, or any other part of the process that doesn’t involve breaking rock thousands of feet below the surface, they can claim that, ‘Well, that’s not fracking.” However, if you have lost your water supply and have to rely on the gas company providing you with tankers of water for the rest of your days (and were asked to sign a gagging order preventing you from talking to the media about what had happened), it probably doesn’t matter much which part of the gas extraction process has put you in such an invidious position.

There are, however, other reasons why environmentalists are urged to embrace fracking, such as Myth #8 …

MYTH #8: “Fracking is a bridge fuel to a low-carbon economy.”

Rathlin Energy’s West Newton exploratory drill site

FACT: It is true that burning gas in power stations does produce less CO2 compared to burning coal. However, by focusing only on CO2 emissions, supporters of fracking are not telling the whole story.

A far more dangerous greenhouse gas is **methane** – the main gas produced by fracking – which is **86 times more potent than CO2 over a 20-year time frame**, according to the Intergovermental Panel on Climate Change (IPCC). This was widely reported in the press when the IPCC report was released – see this reports in Scientific American and EDF or Clean Technica – or if have time and want to get the information from the horse’s mouth, you can read the original IPCC report.

However, policymakers – encouraged by the oil and gas industry – typically ignore methane’s warming potential over 20 years (GWP20) when releasing countries’ figures about fracking. Instead, they describe methane’s warming impacts over a century, which makes the gas appear more benign than it is, experts said. The 100-year warming potential (GWP100) of methane is 34, according to the IPCC. And 34, while huge compared to CO2, is nowhere near as big a number as 86. And – crucially – the arguments relating to ‘fracking as a bridge fuel to a low-carbon economy’ are entirely about the next twenty years.

According to Scientific American, there is no scientific reason to prefer a 100-year time horizon over a 20-year time horizon; the choice of GWP100 is simply a matter of convention – one that strongly favours the fracking industry in downplaying the effect of fugitive methane on their claims that gas is a ‘green fuel’. And, as anyone following the climate debate knows, it’s the next 20 years that are crucial if we are to stop global temperatures rising above 2 degrees, and causing irreversible climate change. **And – crucially – the arguments relating to the ‘fracking as a bridge fuel to a low-carbon economy’ are entirely about reducing greenhouse gases in the next twenty years.**

How much methane is leaking into the atmosphere from fracking?

Studies vary in their methods and measurement of fugitive (i.e. leaking) methane, but there is a growing consensus that up to 10% may be lost to the atmosphere during exploration and production, and that even more is lost from leaking abandoned wells. This would make fracked gas even more damaging for the climate than coal.

According to the Texas Tribune, well pads, compressor stations, processing plants and other equipment used in gas production across the 25-county region leak 50% more of the greenhouse gas than the federal Environmental Protection Agency (EPA) has estimated**,** according to the 11 peer-reviewed papers published in the journal *Environmental Science and Technology.*

In fact, some methane leaks are so big that they can be seen from space. This report from NASA shows how much methane is leaking from fracking well-sites across the USA. This report on leaks from New Mexico shows that if anything, the problem has been underestimated.

Also, in Pennsylvania – the state where MP Kevin Hollinrake visited for a few days and declared that he was ‘reassured’ about fracking – showed that hundreds of abandoned wells there were leaking methane. Abandoned wells are not currently included in methane leak estimates by the EPA, meaning the amount of methane going into the atmosphere could be significantly higher.

But that couldn’t happen in the UK, could it? I mean, we have gold-standard regulations that would prevent this?

A recent study by Durham University’s gas industry funded research group, ReFINE, looked at 102 abandoned conventional gas wells across the UK, and found that **30% were quietly leaking methane**.

While the amount of methane from each well was relatively small, what is interesting is that these wells are not being monitored by any of the regulatory bodies in charge of the onshore oil and gas industry. Fast-forward 50 years and imagine what would happen if tens of thousands of fracking wells are drilled, and then abandoned. Currently a fracking company only has responsibility to monitor these wells for five years after abandonment. The responsibility then falls to the landowner.

The bottom line is this. Natural gas as an energy source for electricity production is less of a contributor to global warming than coal only if less than 3.2 percent of methane escapes during production. Recent measurements (as reported here in the Washington Post) estimate that between 2.3 percent and 17.3 percent of gas escapes.

"***You can be in favour of fixing the climate. Or you can be in favour of exploiting shale gas. But you can't be in favour of both at the same time***." John Ashton, former Special Representative on Climate Change to the Foreign Secretary, 2006-2012.

Then we come on to a relatively new myth, which seems to have appeared because the industry knows how worried everyone is about proliferation of wells and the industrialisation of the countryside.

MYTH #9: “A fracked well can produce gas for over 20 years.”

FACT: A conventional gas well can produce gas for about 20 years or more, whereas most fracked wells will only produce commercial quantities of gas for 1-3 years. According to Lord Oxburgh, former Chairman of Shell, “*The flow rates of the majority of fracked shale gas wells halved in the first twelve months. 84% of fracking wells became uneconomic within just three years*.” This is why companies have to keep drilling more and more wells just to stay in business.

This might even be an over-estimate. According to this Bloomberg report, production from wells bored into [shale gas formations] declines **by 60% to 70% in the first year alone**, says Allen Gilmer, chairman and chief executive officer of Drillinginfo, which tracks the performance of U.S. wells.

Why is this so important? The shale gas industry in the UK is doing everything it can to claim that fracking is almost the same as producing gas from conventional wells. Third Energy, for example, have applied for nine years’ production from their proposed test-frack well-site at Kirby Misperton, even though there is little evidence that any well, particularly a vertical well, will produce for this long.

How many fracking wells do we need in the UK?

This is the main reason for this myth. The reality is that if fracking takes place in the UK, we will need tens of thousands of wells to make any meaningful contribution to the amount of gas produced. In the words of Andy Aplin, Professor of Unconventional Petroleum at Durham University, “**To recover 15% of shale gas in Lancashire would need 33,000 wells on 5,500 pads. To be independent of gas imports, we need to continue drilling 1,000 wells every year**.”

In the USA there are already 1.1 million fracking wells. In Pennsylvania, there are over 10,000 wells, and this is estimated to be only 10%-25% of the number of wells that the industry estimates the state will need.

And of course if the UK became home to tens of thousands of wells, new compressor stations, gas processing plants, pipelines, new roads, it would result in the industrialisation of the countryside. And the fracking industry know that when people realise the sheer scale of the industry, and how it will change the face of the areas where fracking takes place, the opposition from local businesses, councils, residents and everyone else will be much, much stronger.

Then we come on to one of the most dangerous myths, but one that you hear time and time again

MYTH #10: “Fracking will create 64,000 jobs.”

A fracking site in Pennsylvania

FACT: This “64,000 new jobs from fracking” figure is quoted time and time again by supporters of fracking, including Thirsk and Malton MP Kevin Hollinrake. It is now appearing on the promotional material for INEOS at their public meetings across the country.

This headline figure comes from a report commissioned by fracking industry trade body UKOOG in April 2014, as reported here in the Guardian. This draws upon a report commissioned by the Institute of Directors (IoD), and partly funded by fracking company Cuadrilla, from the previous year, which had a higher estimate for job creation of 74,000 jobs. You can read an eight-page summary or the full report here.

However, what the politicians don’t tell you is how this headline figure is arrived at. The report’s estimate of **64,500** jobs relates to a best-case scenario of **4,000 fracking wells in 2024-26** (requiring a total spend of **£33 billion**). However, only about **6,100** of these would be direct jobs in the gas industry. The extra **58,400** jobs are described as indirect or induced jobs, with little explanation how this figure is arrived at.

Compare this to a similar report commissioned by DECC, which was compiled by AMEC Foster Wheeler (an engineering consultancy firm that has previously provided environmental reports for Cuadrilla). AMEC Foster Wheeler estimated that only **15,900 to 24,300 full-time jobs** – direct *and* indirect – would be created at **peak construction** by the shale gas industry. You can read about AMEC Foster Wheeler’s estimate in the Financial Times, You can read a summary of this report here, which includes the slightly higher estimated figure of 16,000 – 32,000 full-time jobs created. Here is the complete report if you have a lot of time on your hands.

According the DECC Summary, this figure would be the result of a ‘high **activity scenario’** in the Strategic EA assumes that a substantial amount of shale gas is produced during the 2020s, (4.32–8.64 trillion cubic feet), which is up **to three times current gas demand in the UK**.

This is to be compared to the 27,000 jobs already lost or under threat because of the government’s cuts in support to the solar industry alone.

The aforementioned AMEC Foster Wheeler report, which was compiled for DECC, also points out that “**the jobs would typically be short term, at between four and nine years**.” and that at the only well to be fracked in the UK, Preese Hall, Lancashire, “**only 17 per cent of jobs had gone to local people.”**

So, fracking is not going to produce many jobs, and even if it did, they would be short term and very few would go to local people.

You can download a FRACKING MYTHS AND FACTS leaflet by clicking on the link below, which gives summaries of the top ten fracking myths. Please feel free to print it out and give to people next time they tell you one of these myths!

Whole policy:

- Insular and disregards other options e.g. renewables, North Sea gas etc.
- Disregards public views on fracking – no social licence
- Does not take into account negative impacts of SGE on current economy
- Designed to overrule local democracy and force through shale development – against stated intent of PM May - Where is 'fairness, working for everyone', ' being a force for good', 'everyone plays by same rules' (Tax and planning). 'Government at Service of ordinary people'. 'New laws we will not listen to powerful but listen to you', 'supporting vital public services'
- Does not review 'potential' against 'proven' – this is key – where is the contingency planning?

Made by: **Amber Rudd** (Secretary of State for Energy and Climate Change)
HCWS202

SHALE GAS AND OIL POLICY

My Rt Hon Friend Greg Clark (Secretary of State for Communities and Local Government) and I wish to set out the Government's view that there is a national need to explore and develop our shale gas and oil resources in a safe, and sustainable and timely way, and the steps it is taking to support this. In laying this statement before Parliament, it **formally replaces** the Shale Gas and Oil Policy Statement issued by DECC and DCLG on 13 August 2015. This statement to Parliament **should be taken into account in planning decisions and plan-making.**

The national need to explore our shale gas and oil resources

Exploring and developing our shale gas and oil resources could **potentially** bring substantial benefits and help meet our objectives for secure energy supplies*(renewables are proven not 'potential'*, **economic growth**, *(longer term and overall cost to economy, impact on existing economy e.g. tourism and agriculture jobs, uncosted impacts to public purse , better alternatives-proven- e.g. North sea Gas, and renewables is a sustainable industry whereas SGE is short term so we will still have the same problem if we don't invest heavily now in renewables i.e. balance of trade if purchasing renewables tech from abroad etc.)* and **lower carbon emissions** – *(Now under question – see research).*

Having access to clean, safe and secure supplies of natural gas for years to come is a key requirement *(North Sea Oil & Gas not an unproven SGE strategy)* if the UK is to successfully transition in the longer term to a low-carbon economy. The Government remains fully committed to the **development and deployment of renewable technologies** (tax regimes, removal of subsidies – how is this evidenced?)for heat and electricity generation and to driving up energy efficiency, but we need **gas** *(why not North Sea or from US, other alternatives, cheaper from current suppliers***)**- the cleanest of all fossil fuels – **to support our climate change target by providing flexibility** *- (de-bunk new research re not the cleanest, time to deliver renewables faster and sustainable industry for economy of UK, and also health implications of SGE)* while we do that and help us to reduce the use of high-carbon coal.

Natural gas is absolutely vital to the economy. It provides around one third of our energy supply.

· About one third of gas supply is used for industry and services, not just for power or heating but also as feedstock, e.g. for chemicals; 33%

(Shale from US cheaper than UK Production and proven supply, also plastics trying to move away from – why subsidise? Do a deal with current suppliers if want guaranteed supply? UK SGE not Guaranteed)

· one quarter is used for electricity generation; and *25%*

· the remainder is used in domestic households for heating and cooking[1]. *42%*

Show % of renewables in other countries in timescale and % SGE expected to deliver in same timescale – again unproven supply against proven and sustainable supply

Since 2004, the UK has been a net importer of gas due to the rapid decline of production from the UK Continental Shelf.

(Uplift 10% 2015 investment will uplift further with investment or a tax regime similar to SGE – would also deliver significantly more UK and sustainable jobs)

· Last year around 45% of UK gas supply was made up of net imports[2]**. Our projections** *(see issue re Europe evaluation against actual use + wrong because UK domestic use has increased)* suggest that **domestic production will continue to decline** and, without any contribution from **shale** *(– rework or increase North Sea also review with Bloomberg info on decline of gas and oil and increase in renewables)* gas, net imports could increase to 75% of the gas we consume by 2030[3].

· Domestic oil production has also declined since reaching a peak in 1999. Currently net imports comprise around 40% of the oil we use and DECC projections suggest net imports could increase to 73% by 2030[4].

(again investment via tax regime N.S. + renewables – Bloomberg now saying in decline by 2027 latest, also where is the onshore shale oil?)

Meanwhile events around the world show us how dangerous it can be to assume that we will always be able to rely on existing sources of supply. Developing home-grown shale resources could reduce our (and wider European) dependency on imports and improve our energy resilience.

(US and Norway? Why danger? Also energy resilience is better funded by renewables as sustainable?)

There are also potential economic benefits in building a new industry for the country and for **communities. –** *Untrue see overall cost by roads,public costs etc. impact on current economies in the targeted areas – tourism and agriculture, not a sustainable industry building a similar industry to coal i.e. will end when gas becomes uneconomic in 2025 latest so how help country if have to recover from another decline of fossil fuels industry – just delays a decline and impacts growth in the areas as highlighted by the LEP and Local Plans – particularly when our Tourism offering is growing above national trend and is internationally gaining traction?, we at least need research onn that impact before these statements can be made and Govt canned only research – also 64% of people wont buy a house so why would they holiday? doesn't embed wealth in local communities, impact on economies of SGE areas in comparison i.e. underlying economy has dropped in comparison to other areas with no SGE when SGE pull out.*

· Nationally, we will benefit from development of a new industrial sector, building on the experience and skills developed here in 50 years of on- and offshore oil and gas development.

Business case taking into account all costs, migrant nature of work, and predominance of lift and shift and Migrant workers.negatives re new industry – unconventional and implications of issues, against proven industry e.g. off shore and renewables

· Developing shale resources would deliver investment in key domestic energy infrastructure (*So would production of renewables & 120k UK jobs in NorthSea gas.)* boosting the UK's capital stock and leading to increased productivity and growth.

- *Short term left with industry no longer viable in overall global context of energy development and use - business case?*

· Reducing imports would improve the balance of trade.

- *Export renewable technology does same- and is a sustainable industry. Also is this a target or an outcome?*

· Consultants EY *(EY also say no to shale in latest research*) estimated in **2014[5]** that a thriving shale industry could mean cumulative investment of £33 billion and support 64,500 jobs in the gas, oil, construction, engineering and chemical sectors at peak. Locally that **might mean** (*research doesn't now support this view and offshore could give 120k jobs)* new facilities and jobs for local companies no migrant workers.

We do not yet know the full scale of the UK's shale resources nor how much can be extracted technically or economically – could be none – *(massive investment on a guess like Poland – Tax cost, capital costs, opportunity costs re other proven industries – should shale be a contingency approach not a lead?)*

· The British Geological Survey estimates the shale gas resource in the Bowland-Hodder basin *(what is their lowest value)* under Northern England could be 1300 trillion cubic feet (tcf)[6], compared to current UK annual gas consumption of around 2.5 tcf[7]. The industry need to test how much of this gas in place can be extracted technically and economically. Why the industry and allowing 1 test should not have a presumption this policy is 'all out for shale' not a test scenario which should then go back to parliament and the impacted communities for debate

· National Grid's Future Energy Scenarios (2015) report[8] presents a wide range for potential shale gas production in the UK up to a peak of 32 bcm/year in 2030 *(Demand shift also key will actually displace our long-term security as not sustainable and takes investment away from what is – invest in renewables, do a long term deal and we achieve the same result with no risk of massive investment in unproven resources)*. This would be around 40% of all the gas we are projected to consume and result in our import dependency falling to 34%, compared to current projections that net imports could reach 75% in 2030.

Shale gas can **create a bridge** *(new research challenges as bridge fuel – speed with which other countries have achived this?)* while we develop renewable energy, improve energy efficiency and build new nuclear generating capacity. Studies have shown that the carbon footprint of electricity from UK shale gas would be likely to be significantly less than unabated coal and also lower than imported Liquefied Natural Gas[9].

The Government therefore considers that there is a clear need to seize the opportunity now to explore and test our shale potential. *(Why not North Sea and renewables? Also may be a need to explore and test but further debate re production – also why the industry and not the Government as in Germany?)*

Safety and environmental protection will be ensured through responsible development and robust regulation – Not in place
(What does this mean? 3 new reports show this is not possible in current position)

This must and can be done whilst maintaining the very highest safety and environmental standards, which we have established with a world-leading framework for extracting oil and gas for over 50 years. *– (Very different, destroys geology and longer term contamination degrading wells, impact in 10,20,50 years ? Leaking wells)*

Reports by the Royal Society and Royal Academy of Engineering, Public Health England and others have considered a wide range of evidence on hydraulic fracturing in the UK context, and concluded that risks can be managed effectively if the industry follows best practice, enforced through regulation[10],[11].

- *Over what term did they review? 30 – 50 years timeframe of degrading wells?Also challenge on whether this can be done at all – some is just unable to be regulated, self-regulation not gold standard – compare to Austra?*

The Government is confident *(but research isn't and neither is the populations affected so need for further review)* we have the right protections in place now to explore shale safely (see Annex). Planning authorities can also have confidence that the regulators will enforce safety, environmental and seismic regulation effectively. But we are not complacent. We will continuously look to strengthen and improve regulation where necessary as the industry develops.

Transparency and information for the public

It is also important that the public has objective information about shale and that communities where shale development is proposed are effectively engaged, with the opportunity to hear from the expert regulators at the Health and Safety Executive and the Environment Agency.

The Government allocated £5m for 2015-16 in the last Autumn Statement for this purpose (see Annex).

- *Not happening and communities being overruled – no social licence and no information – being stopped – where is the message 'no reduction to bills?'*

Planning

The Government is committed to ensuring that local communities are fully involved in planning decisions that affect them. We are also making the planning system faster and fairer for all those affected by new

development. No one benefits from the uncertainty caused by delay. This is why we expect every planning application or appeal, large or small, to be dealt with as quickly as possible.

- *Hypocritical*

There is a clear expectation that local planning authorities should ensure that decisions on planning applications are made within statutory timeframes: 16 weeks where an application is subject to Environmental Impact Assessment. This should be supported through an upfront timeline agreed with the applicant including the anticipated decision date.

To avoid unnecessary work causing delay, when determining planning applications**, local planning authorities should carefully consider which issues can be left to other regulatory regimes,** taking full account of the Government's planning guidance on this issue.

- *How do these engage local communities ensure transparency etc., - clear attempt to disenfranchise an 'prefer oil and gas lobby'*

We also expect local planning authorities to make full use of the funding available for 2015/16 through the £1.2m shale support programme. This will ensure there are adequate resources locally to enable the timely determination locally of planning applications for shale gas. Local planning authorities should also agree to Planning Performance Agreements where this is appropriate.

But we cannot be complacent. Therefore:

· Appeals against any refusals of planning permission for exploring and developing shale gas, or against non-determination, will be treated as a priority for urgent resolution. The Secretary of State for Communities and Local Government may also want to give particular scrutiny to these appeals. To this end he will **revise the recovery criteria and will consider for recovery appeals for exploring and developing shale gas.**

- *Presumption of approval – how when there can be no presumption at local level?- legal challenge?*

This new criterion will be added to the recovery policy issued on 30 June 2008 and will be applied for a period of two years after which it will be reviewed.

· The Secretary of State will also actively consider calling in shale applications. Each case will be considered on its individual merits in line with his policy. Priority will be given to any called-in planning applications.

- *Presumption of approval – how when there can be no presumption at local level?*

· The Government commits to identifying underperforming local planning authorities that repeatedly fail to determine oil and gas applications within statutory timeframes. When such applications are made to underperforming local planning authorities, the Secretary of State will consider whether he should determine the application instead.

- *Presumption of approval – how when there can be no presumption at local level?*
- *Legal appeal?*
- *Removal of local democracy how does this now fit with PM May vision – appeal?*

· The Government has published its response to consultation and will take forward **amending permitted development rights** to allow the drilling of boreholes for groundwater monitoring. The Government is also inviting views on proposals for further rights to enable, as **permitted development**, the drilling of boreholes for seismic investigation and to locate and appraise shallow mine workings. These proposals will speed up the delivery of essential monitoring information for safety and environmental protection and free local resources for where the express attention of the local planning authority is required.

- *Removing totally democratic rights and views of local communities*

My Rt Hon Friend Greg Clark (Secretary of State for Communities and Local Government) will be laying before Parliament a written ministerial statement setting out more detail.

Sharing shale income with communities

We also strongly believe that communities **hosting** *- (why use hosting when the word is 'over-ruling')* shale gas developments should share in the financial returns they generate. The Government welcomes the shale gas companies' **commitment** to make set payments to these communities,

- *Costs to communities much higher and not a requirement*

which could be worth **£5-10m** for a typical 10-well site, and we want to go further. As announced by the Chancellor in the 2014 Autumn Statement, and set out in our manifesto, we are determined to ensure that local communities share more of the proceeds and feel more of the benefits, using a proportion of the **tax revenues** – *tax revenues unlikely at all – initially just sleight of hand* - that are recouped from shale gas production. We will present our proposals later this year for how we intend to design the **sovereign wealth fund.**

ANNEX

This Annex contains supporting material for the main statement.

Safety and environmental protection

· Our regulatory **system is robust** – *unproven for shale and reports show lacking, even UN see the difference and recommend not in areas of population density or agriculture – how is this reflected?-* and we are proven world leaders, with a 50 year track record, in well-regulated, safe and environmentally sound oil and gas developments. We have strict requirements through environmental permitting and DECC licencing for on-site safety, to prevent water contamination, air pollution and mitigate seismic activity.

· The Health and Safety Executive and the environmental regulators (the Environment Agency in England) are independent and highly specialised regulators. They will enable the development of shale gas in a safe and environmentally sound manner.

· The Environment Agency assesses the potential use of chemicals used in hydraulic fracturing fluids on a case-by-case basis. The use of hazardous chemicals will not be permitted **where there is a risk** – *always a risk with fracking so how ensure?* that they may enter groundwater and cause pollution.

- *Too few and no shale gas experience also new research shows this can't be done and time frame to new horizon*

· The Health and Safety Executive scrutinise well design and require week by week written updates on drilling progress.

- *What about after decommissioning? Also look at what happened at Pease Hall and allowing gas industry to 'self-regulate'.*

· DECC has implemented a thorough system of rigorous checks before any drilling or fracking and a live traffic light system during the actual operations, to ensure earth tremors will not occur – *Unproven*

To reinforce the existing regulatory regime further, the Infrastructure Act 2015 brought forward a range of additional requirements and safeguards if an operator is to carry out hydraulic fracturing.

· These include taking account of the environmental impact of development, baseline monitoring of methane in groundwater in the 12 months preceding hydraulic fracturing operations, disclosure of all chemicals, community benefits and the **exclusion of protected areas. –** *Under is not exclusion, and what about SSI etc.,*

· Draft regulations, laid on 16 July, defining the protected areas in which fracking will be prohibited as specified areas of groundwater, National Parks, Areas of Outstanding Natural Beauty, the Broads and World Heritage Sites. **Fracking can only take place at depths below 1200 metres in these areas. – *STILL AT RISK***

- ***What about Amenity zones?***

· Ministers also set out their clear commitment to ensure that hydraulic fracturing cannot be conducted from wells that are drilled at the surface of National Parks and other protected areas. This is not intended to impact on conventional drilling operations.

Transparency and information for the public

Following the Autumn Statement announcement of £5m for 2015-16 to **"provide independent evidence directly to the public about the robustness of the existing [shale gas] regulatory regime",**

- *What about ensuring public hear clear messages re health, environmental, cost impacts of shale – Government controlling the message.*

DECC received £1.7m to establish independent environmental monitoring and is working with a research consortium led by the British Geological Survey to expand an existing Lancashire-based programme for gathering baseline environmental data to North Yorkshire, where a planning application for a shale gas project is being submitted. The data produced would be made available to the public *– where is this?*

In addition, DCLG announced in March a £1.2m fund to support Mineral Planning Authorities dealing with shale planning applications. The Health & Safety Executive has received £0.5m to increase the availability of inspectors for onshore oil and gas operations and to double its local engagement capacity. The Environment Agency received £1.5m to undertake pro-active local engagement by deploying dedicated local officers. The Government is also publishing factual material on shale, including web documents and videos.

- you are funding shale but taking subsidies from renewables – short-term thinking

[1] DECC, Digest Of UK Energy Statistics, July 2015

[2] DECC, Digest of UK Energy Statistics, July 2015

[3] DECC, UK Oil and Gas Production Projections, March 2015 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/414172/Production_prjections.pdf

[4]Ibid

[5] EY, Getting Ready for UK Shale Gas, April 2014 http://www.ey.com/Publication/vwLUAssets/Getting_ready_for_UK_shale_gas/$FILE/EY-Getting-ready-for-UK-shale-gas-April-2014.pdf

[6] BGS/DECC, Bowland Shale Gas Study, June 2013 https://www.gov.uk/government/publications/bowland-shale-gas-study

[7] Based on DECC, Digest of UK Energy Statistics, July 2015

[8] National Grid, Future Energy Scenarios, 2015 - CHASE

[9] Mackay-Stone report (requested by DECC), Potential Greenhouse Gas Emissions Associated with Shale Gas Extraction and Use, Sept 2013 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/237330/MacKay_Stone_shale_study_report_09092013.pdf - REVIEW

[10] The Royal Society and The Royal Academy of Engineers, Shale gas extraction in the UK: a review of hydraulic fracturing, 2012 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/256359/Publication_RoyalSociety_2012-06-28-Shale-gas.pdf - REVIEW

[11] Public Health England, Review of the Potential Public Health Impacts of Exposures to Chemical and Radioactive Pollutants as a Result of the Shale Gas Extraction Process https://www.gov.uk/government/publications/shale-gas-extraction-review-of-the-potential-public-health-impacts-of-exposures-to-chemical-and-radioactive-pollutants - **REVIEW**

Exhibit 13

Department for Business, Energy & Industrial Strategy

GAS SECURITY OF SUPPLY

A strategic assessment of Great Britain's gas security of supply

October 2017

Contents

Executive summary

Energy security is a priority for government. Affordable and secure energy supplies are essential for our economic success.

Natural gas provides the main source for heating homes and businesses in Great Britain (GB). It is also a major primary energy source for industry and an essential fuel source for electricity generation as well as being a feedstock for some industrial applications. In 2016 natural gas accounted for nearly 39% of all the UK's primary fuel consumption[1].

This report provides a detailed evaluation of the long term security of one of our critical energy sources. It brings together conclusions from a number of recent assessments from government, the regulator, system operator and private sector to examine the security of gas supply over the next 20 years. In particular it is supported by a detailed analysis from external consultants, Cambridge Economic Policy Analysts (CEPA), of gas security in the face of unlikely but significant geopolitical 'black swan' (i.e, rare and unpredictable) shocks that could disrupt supply.

GB benefits from a strong, liquid market which has delivered a system built on supply diversity. This, coupled with spare capacity, means we have never suffered a gas deficit emergency and GB is resilient to multiple infrastructure failures.

The gas system in GB has evolved with changing patterns of demand and supply, and will continue to change. GB is a net importer of gas, with the proportion growing since 2004[2]. This is set to continue primarily due to the long-term decline in gas coming from the UK Continental Shelf (UKCS) and increase in worldwide availability of Liquefied Natural Gas (LNG). Demand is likely to be impacted by energy efficiency measures, heat decarbonisation and electricity generation.

Our analysis finds that the market will adapt to these changes in supply and demand. This means that GB will have enough import capacity to deliver even in high demand scenarios, and will have the resilience to cope with severe shocks to the system. Even under the most severe, very low probability shocks, our analysis suggests that our system is robust.

We find that the diversity of supply and the available capacity underpin the strength of the GB system. This system must be supported by a market that continues to be price responsive, allowing the GB market to attract sources of gas when they are needed. In the longer term, a strong market incentivises investment in the infrastructure to maintain the capacity and diversity which underpins our security.

We are secure now, and the GB gas system is well placed to continue to be secure and robust in a range of supply and demand outcomes over the next two decades.

[1] See table 1E in BEIS (2017) *Digest of United Kingdom Energy Statistics (DUKES)*. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/637823/DUKES_2017.pdf
[2] Oil and Gas Authority (October 2016) *UKCS Oil and Gas Production Projections*. Available at: www.ogauthority.co.uk/data-centre/data-downloads-and-publications/production-projections/

Rough closure

Whilst the CEPA (2017) report was concluded before the announcement[3] in June 2017 of the planned closure of the Rough gas storage site, the scenarios considered within the report examine the impact of Rough closing.

As such, the announcement of Rough's planned closure is not considered to have impacted the findings of the CEPA (2017) report, or of this assessment. As this assessment outlines, current and forecast levels of GB supply and storage infrastructure are sufficient to meet all customer demand in all but the most extreme cases.

[3] www.centrica.com/news/cessation-storage-operations-rough

Current GB gas system

The GB gas system is made up of a diverse range of supply sources with sufficient capacity to meet the demands of users: be they electricity generation, industrial, residential or other sectors.

Gas supply and demand needs to balance on a daily basis, requiring a flexible system that can respond to demand peaks. Gas shippers are incentivised to keep the system in balance through a regime that penalises them for over or under supplying. This encourages not only balancing of market positions on a daily basis, but use of other mechanisms (such as storage and supply contracts) to guarantee that they will be able to balance their positions into the future. The gas market therefore incentives both sufficient gas to meet peak demand and sufficiently diverse and robust capacity to deliver it.

The supply side is made up of three main sources: gas pipelines direct from production fields, primarily the UKCS and Norway; Liquefied Natural Gas (LNG) imported by ship from a range of global locations and interconnectors transferring gas from the continental European gas network. Gas storage, while not strictly a supply source, can act as a supply source at times of high demand.

In assessing gas security we therefore need to consider if there is sufficient gas available, capacity to deliver it, sufficient system flexibility to respond to peaks in demand, and a market which responds effectively to price signals.

Assessing current levels of gas security

The GB gas system is subject to regular assessments of security of supply (through National Grid's twice-yearly 'Outlook' publications, the biennial European gas risk assessment and ad-hoc assessments such as Ofgem's 2012[4] gas security report). These assessments demonstrate that GB's gas system is able to respond effectively to unexpected changes in supply and demand. It is secure in the face of all but the most extreme and unlikely shocks, with diversity of supply being identified as a primary contributor to this robustness. Together these assessments show that the GB system has high levels of security:

- **the range of supply diversity available to the UK markets (including storage) can deliver 130million cubic metres per day above the maximum daily demand** we expect to see once in every 20 years of 472 million cubic metres per day[5];
- **even for a higher daily demand (expected once in 50 years) combined with an infrastructure loss, the market could adequately deal with this shock** with an effective demand side response[6] from large users

[4] Ofgem (2012)
[5] National Grid (2016b) based on a 1 in 20 peak day. The highest ever gas demand was 465mcm/d in January 2010.
[6] Demand Side Response is a demand management technique where users volunteer to reduce their gas usage in exchange for a payment. It is focused on large gas users only, not domestic consumers.

- **if the UK were to lose its single largest piece of gas infrastructure, the wide range of supply sources available mean that it would still have 27% more capacity than it needs** to deliver maximum daily demand seen once in 20 years[7].
- **between 60% and 70% of supply capacity would have to be lost before supplies to domestic consumers would be interrupted**[8]. A 60% loss in supply capacity would represent losing all LNG supply, all imports from Belgium and Netherlands, and a loss of fifty per cent of current UK production.
- **at average demand levels, there is sufficient capability for the GB gas system to meet all required demand**, both domestic and expected exports to continental Europe and Ireland, for all disruption scenarios relating to the Russia-Ukraine dispute.[9]

Case studies: flexibility and resilience in practice

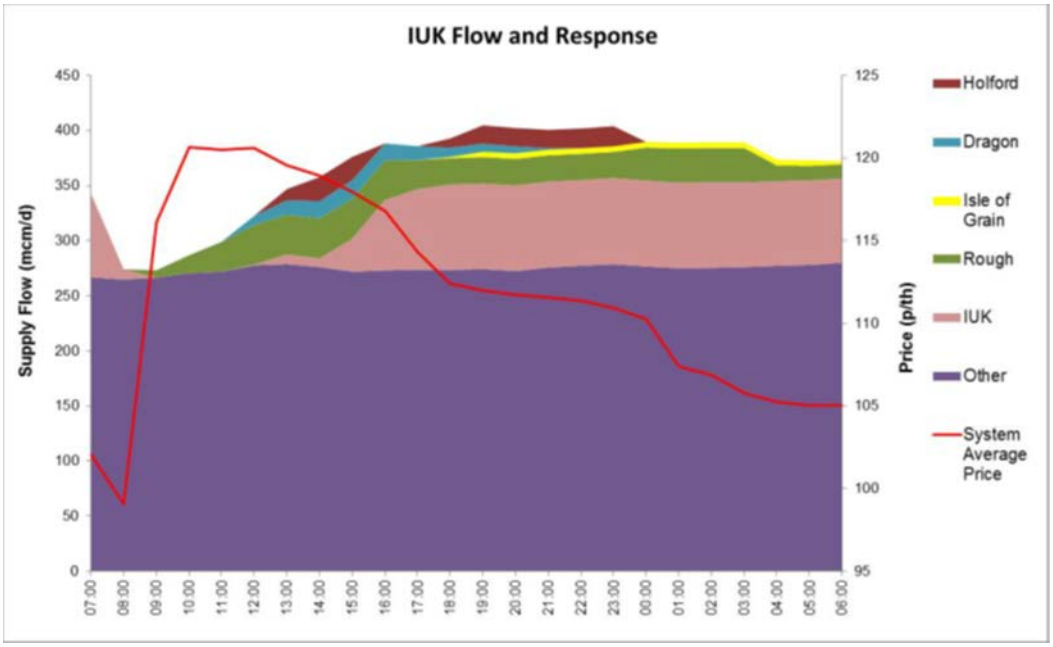
There has never been a gas deficit emergency[10] in GB or UK (where supplies to consumers have been interrupted), signalling the high levels of gas security we have experienced to date.

GB has shown itself to be resilient and responsive to actual restrictions to gas supply infrastructure. National Grid has identified case studies where there have been potentially significant disruptions to supply[11], which demonstrate the ability of the GB gas market to respond and absorb the impacts of these disruptions without consumer detriment.

A failure of the IUK interconnector in 2013 provides such an example of a market reaction to a short-term supply disruption (within-day). On 22 March 2013, the coldest March since 1962, IUK experienced an outage early in the day. The price rose rapidly, bringing on supplies from storage and LNG, with prices falling back as the supply situation eased and IUK came back online before the end of the gas day (Figure 1).

[7] BEIS (2016)
[8] Ofgem (2012)
[9] BEIS and National Grid assessments supported by Ofgem contributing to European Commission (October 2014) *Communication from the Commission to the European Parliament and the Council on the short term resilience of the European gas system: Preparedness for a possible disruption of supplies from the East during the fall and winter of 2014/2015*. Available at: https://ec.europa.eu/energy/sites/ener/files/documents/2014_stresstests_com_en.pdf
[10] A Gas Deficit Emergency is a type of Gas Supply Emergency arising as a result of insufficient deliveries of gas being available to meet required demand on the gas system; or as a result of a potential or actual breach of a safety monitor.
[11] Further detail and analysis is available in BEIS (2016).

Figure 1 - Price and flow response following IUK outage, March 2013



Source: National Grid

An outage at the Rough storage facility in early 2006 demonstrates market response to a longer-lasting disruption. In February 2006, a fire at the Rough storage facility halted withdrawals between February and June. Rough had been a major supply source in the first half of the winter but the market responded to the price increases, in particular through short and medium range storage and interconnectors.

In both these cases, the market responded to the supply failure, reacting appropriately to price signals, bringing on additional supply and ensuring that there were no supply interruptions.

Conclusion

GB has always experienced, and continues to experience, high levels of security of gas supplies. The strength of the GB gas system is built on supply diversity and capacity.

As UKCS has declined, this diversity has grown and now includes additional pipelines from Norway and Europe; LNG import terminals; and new storage facilities. Furthermore, as the system has developed, it has provided spare capacity on the system as shown in the most recent National Grid Winter Outlook[12] analysis. This means that we are resilient to multiple infrastructure failures. As Ofgem reported in 2012[13], we would have to lose between 60% and 70% of supply infrastructure before supplies to domestic customers would be interrupted.

The diversity provides alternative routes for the gas in the event that one fails and the available capacity means that those alternative routes can cope with the additional flow. This has meant that, to date, there has never been a period when the supply of available gas is not sufficient to meet GB demand (a “gas deficit emergency”). Even where there have been infrastructure incidents, such as major infrastructure outages, they have been limited, and the market has reacted effectively to bring forward supplies.

[12] National Grid (2017b)
[13] Ofgem (2012) p6

Summary of current GB gas security

- There has never been a gas deficit emergency.
- The strength of the GB gas system is built on supply diversity.
- There is currently spare capacity on the gas system.
- We are resilient to multiple infrastructure failures.

Future transition of the energy system

The gas system in GB has evolved in response to the changing demand and supply context. GB is now a net importer of gas, with the proportion growing since 2004[14]. GB benefits from a strong, liquid market which has delivered a system built on supply diversity. This, coupled with spare capacity, means we have never suffered a gas deficit emergency (where there is insufficient supply to meet demand) and GB is resilient to multiple infrastructure failures.

The supply and demand balance in GB will continue to change. Change in supply will be driven primarily by long-term decline in UKCS output and increase in LNG availability. Demand will mostly be impacted by energy efficiency measures, heat decarbonisation and electricity generation demand.

In order to estimate the level of security in the future we need to understand the demand trends and model their cumulative impact on gas demand. We then need to consider how supply sources will develop and whether they have will have the capacity to meet this demand.

Demand and supply scenarios

This report draws on National Grid's Future Energy Scenarios 2017[15] to frame the bounds of supply and demand.

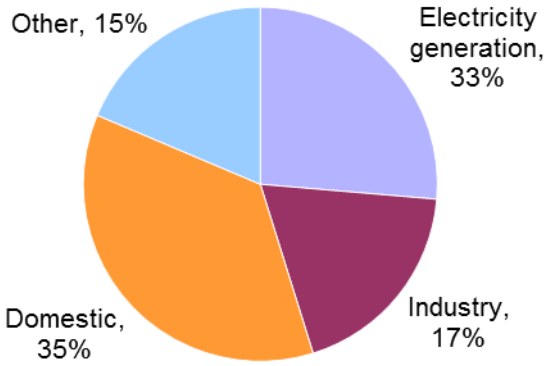
- The "Steady State" scenario has the highest gas demand (excluding exports) towards 2035, with some energy efficiency gains, but with continued use of gas for both heating and power generation.
- The "Two Degrees"" scenario has the lowest gas demand, where gas use is reduced to meet emissions reduction targets.

Changing demand

An understanding of future levels of gas demand, and the drivers of demand, are important to making an assessment of gas security going forward. There are three key demand sectors: domestic, industrial, and electricity generation. Each has its own drivers and consequences for the future. These are discussed below.

[14] Oil and Gas Authority (October 2016) UKCS Oil and Gas Production Projections. Available at: www.ogauthority.co.uk/data-centre/data-downloads-and-publications/production-projections/
[15] National Grid (2017a)

Figure 2 - UK annual gas consumption by sector in 2016



Source: Digest of UK Energy Statistics (BEIS, 2017)

Domestic heating

Domestic use is the largest demand segment. Around 98% of gas in UK homes is used for heating[16], making it the single largest use of gas[17]. Domestic heat, therefore, is an important factor in gas demand overall.

Widespread installation of energy efficiency measures has meant that median gas usage in all property types has fallen over the past decade.[18] National Grid expects to see continued efficiency gains over the next two decades under all scenarios. Under the high demand scenarios these efficiency gains offset new connections, meaning a net zero increase in gas demand. Under the lowest domestic gas demand scenario (Two Degrees) these efficiency gains would be greater and would be expected to lead to a net fall in domestic gas consumption.

In their Future Energy Scenarios, National Grid forecast domestic gas consumption of around 185TWh (in the Two Degrees scenario) and 322TWh (in the Steady State scenario) in the mid-2030s. This compares with 333TWh in 2016.

Electricity

Electricity generation currently accounts for just over a quarter of gas demand. In all scenarios gas generation is expected to play a role, particularly as a flexible generation alongside renewables; and as coal is phased-out. In the high gas demand scenario we expect to see an increase in gas demand from more gas generation online. Under the low demand scenario, higher deployment of low carbon technologies is likely to lead to a lower demand for gas generation.

[16] Space heating and water heating
[17] See Data Table 1.04 in BEIS (July 2017) Energy Consumption in the UK (ECUK) 2017. Available at: www.gov.uk/government/statistics/energy-consumption-in-the-uk
[18] BEIS (June 2016) National Energy Efficiency Data-Framework (NEED): summary of analysis 2016. 0.Available at: www.gov.uk/government/statistics/national-energy-efficiency-data-framework-need-report-summary-of-analysis-2016

National Grid's Future Energy Scenarios forecast that electricity generation demand will change from 249TWh in 2016 to around 46TWh (in the Two Degrees scenario) and 225TWh (in the Steady State scenario) by the mid-2030s.

Industry

Industrial demand is currently around 17%, so any changes here, particularly efficiencies, will have a smaller effect than in the domestic sector. Under all scenarios, National Grid forecasts that industrial gas demand will continue to decline. This is largely due to the electrification of low-grade heat and due to a general reduction in GB industry over time.

National Grid forecasts industrial gas demand declining from around 187TWh in 2016 to around 175TWh (in the Two Degrees scenario) and 170TWh (in the Steady State scenario) by the mid-2030s.

Changing demand – summary

The extent and speed of decarbonisation of both electricity and heat is significant amongst the wide range of drivers that together will impact on GB gas consumption.

Under most projections, gas demand is not expected to rise; however, it is still expected to be an important part of the energy mix in the next two decades, remaining at least two thirds of current demand.

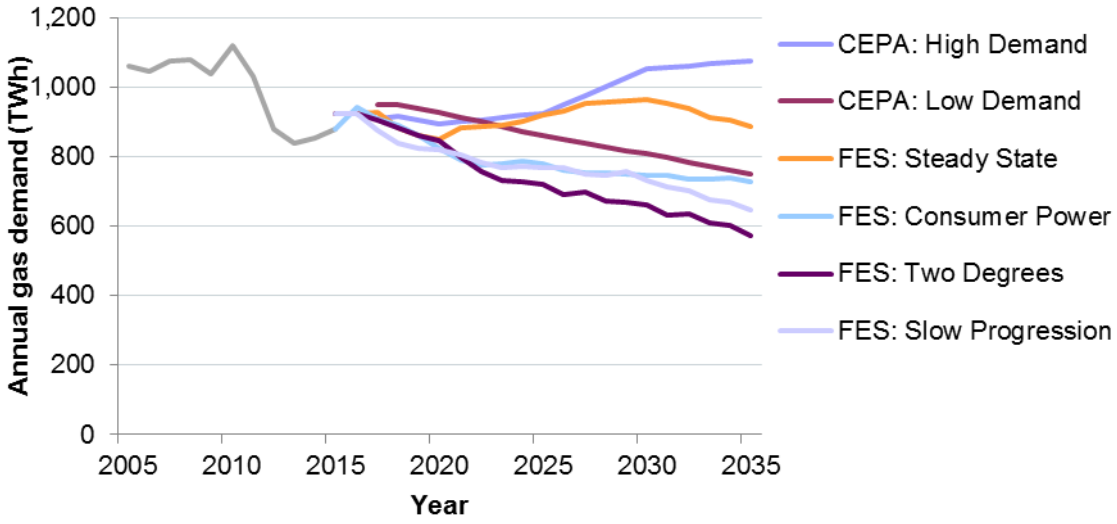
Current GB gas demand is around 923TWh per annum[19], having fallen from around 1,000TWh a decade ago and a peak of around 1,100TWh in 2010[20]. National Grid (2017) forecast gas demand of between 604TWh and 891TWh in 2035.

Modelling demand

As part of this exercise to review GB gas security, we asked CEPA to undertake some analysis to inform our thinking. Their report is published alongside this report. CEPA have modelled two demand scenarios. The High Demand scenario is higher than that of the National Grid Future Energy Scenarios and allows for higher domestic gas consumption and demand for electricity generation. When assessing security of supply this is a cautious approach – a markedly higher demand than would otherwise be expected. Figure 3 compares the demand numbers across the different models.

[19] In 2016: from National Grid Future Energy Scenarios 2017
[20] See table 4.1 in BEIS (2016) *Digest of United Kingdom Energy Statistics (DUKES)*. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/577712/DUKES_2016_FINAL.pdf

Figure 3 - GB annual demand 2005 to 2035 (TWh)

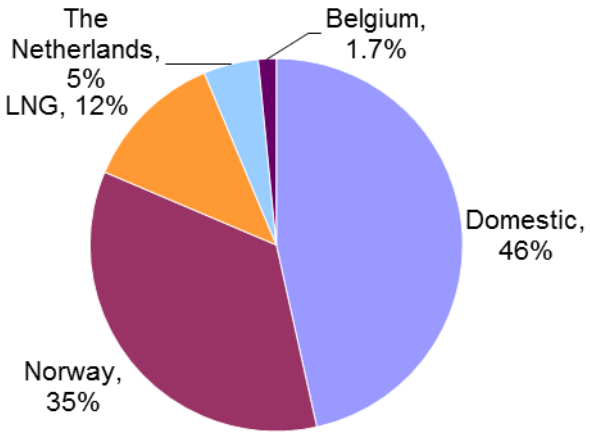


Sources: Future Energy Scenarios (National Grid, 2017a); A Review of Gas Security of Supply within Great Britain's Gas Market – from the Present to 2035 (CEPA, 2017)

Changing supply

GB's sources of natural gas have changed over time. While we cannot, and do not need to, predict the future supply mix, making an assessment of future security of supply requires an understanding of all of our available supply sources, how they may change over time, and what their potential is to supply the GB market (including any risks and benefits). These factors are discussed below. Figure 4 shows the breakdown of gas by source for 2016.

Figure 4 - UK gas supply in 2016 by source



Source: Digest of UK Energy Statistics (BEIS, 2017)

UKCS production

The single most fundamental change in the GB gas market is the decline in UKCS output. From 2004 GB became a net importer of gas. The Oil and Gas Authority projects that gas from the UKCS will supply approximately 24% of demand in 2035, down from 48% in 2016 . This means that there will continue be a significant shift in the supply balance over the next 20 years as UKCS output continues to decline. As a result of this shift, GB has already increased

imports, and demand has declined. As discussed above and below, we expect both trends to continue. Furthermore, exploiting new domestic resources would provide another source of gas as UKCS output declines.

Pipeline and interconnectors

GB has received pipeline imports since before we were a net importer of gas. However, the volume of pipeline imports has been rising steadily, from 1.5 bcm imported in 2000 to 38.3 bcm in 2016[21].

Pipeline imports are an important part of the system and will continue to be over the next 20 years. Depending on the source, they provide either strong reliable baseload supplies or responsive flexible supplies, responding to price signals.

In considering the future potential, there is some scope for the expansion of pipeline supplies. However, this is subject to the economics of the wider European gas market.

Norwegian imports currently run close to full capacity during the winter months. While there may be scope for expansion of capacity over existing infrastructure, significant expansion is likely to require high levels of investment, and therefore a sustained high gas price in GB, to be economic.

Sustained high price differences, beyond current levels, between GB and the continent are a likely prerequisite of any further expansion of interconnector capacity.

Liquefied Natural Gas (LNG)

LNG is growing in importance both in GB and globally. Since 2005, LNG supply has grown and provided around 12% of UK demand in 2016[22] (although this varies year on year depending on a number of factors).

There is good evidence to suggest that LNG as a supply source has sufficient flexibility over the long term to fill the gap left by declining UKCS production (although other sources may compete with LNG for this role as described in the rest of this section). GB currently has a lot more LNG regasification capacity than it uses annually[23]. CEPA (2017) estimate that the market will continue to develop LNG as the key supply source and has the potential and capability to contribute up to 60% of GB demand by 2035.

As LNG is traded on a global market, the global context over the next 20 years has a bearing on the security and reliability we can expect from LNG as a supply source. A significant increase in Australian and US LNG capacity is expected; and the global LNG market is expected to be well supplied through the early 2020s, with supply driving demand[21]. GB is likely to benefit from the increased LNG from these suppliers.

There is sufficient gas globally, but supply of LNG will be reliant on sufficient levels of LNG projects coming online to meet demand, and new and sustained demand to drive investment in such projects. A section of this new demand is likely to be price sensitive, with markets that will

[21] Oil and Gas Authority (October 2016) UKCS Oil and Gas Production Projections. Available at: www.ogauthority.co.uk/data-centre/data-downloads-and-publications/production-projections/
[22] BEIS (2017) www.gov.uk/government/statistics/gas-section-4-energy-trends
[23] National Grid (2017a)

fuel switch as gas prices rise, allowing the supplies of LNG to move to higher-priced markets when there is a constraint elsewhere in the market.

Gas storage

Gas storage is not strictly speaking a ‘source’ of gas but is an important source of system flexibility.

Storage takes in gas when it is low priced (usually at times of over-supply such as in the summer) and returns it to the system when prices are high (usually during peak demand). Some storage operates over short timescales (days/weeks) while other facilities exploit longer term seasonal differences. GB storage does not operate as a ‘strategic reserve’ of gas – providing a large volume of gas to be used in case of an emergency but otherwise not utilised. Instead, the value of storage lies in its ability to operate flexibly in response to relatively short term price signals and ultimately reduce price volatility.

Storage relies on the variations in gas price over time (the spreads). For long range storage, this is summer-winter (seasonal) spreads and for short range storage it is a combination of seasonal and shorter term spreads. Volatility in the gas market has declined, which can be explained by the diversity of sources and capacity of infrastructure. In particular, seasonal spreads have declined significantly. While short range volatility may improve in the medium term, bringing on new short-range gas storage, the increased diversity of gas sources throughout the year makes it unlikely that high seasonal volatility will return. Nonetheless, we will continue to monitor the value of long-term storage as the dynamics of the gas market continue to evolve.

Other domestic supply

Developing new sources of domestic supply may provide new sources of gas while reducing the reliance on imports.

The government believes that shale gas has the potential to play a crucial role in the GB energy system. It could also help to rebalance the economy and reduce carbon emissions as it is a cleaner source of energy than coal. The development of shale gas could provide a valuable new source of gas for the GB market at a time when gas supplies from the UKCS are forecast to decline. Whilst the government is optimistic about the potential for shale gas in the UK, given the industry is currently in an exploratory stage, it is not yet known how much of the UK shale gas resource will ultimately be recoverable. In order to provide a conservative estimate of supply, supply forecasts used in CEPA (2017), assume no shale contributions in the forecast period. We will update these forecasts moving forward and any shale projects that do come forward will be in addition to supply already forecast.

Biomethane is another potential source, manufacturing gas from waste or energy crops. National Grid (2017) assumes that by 2050 around 13% of GB gas demand will be met by biomethane under the Two Degrees scenario.

Hydrogen could play a role in replacing or blending natural gas. Further work is required to understand the impact on energy security from increasing hydrogen production and use.

Modelling future supply trends

CEPA (2017) modelled demand and supply driven by factors within the model. These therefore represent possible future supply balances, rather than a forecast. The actual supply balance will depend on a range of factors as discussed above.

Conclusion

The liberalised gas market has responded effectively to changing supply and conditions in the past, most recently the decline in UKCS output. Since 2005 (after GB became a net importer), the GB market has delivered significantly, including three additional pipelines with Norway; an upgrade to the Belgian interconnector; commission of an interconnector with the Netherlands; and investment in 4 Liquefied Natural Gas (LNG) regasification facilities.

The gas market is continually evolving. Driven by the continuing decline in UKCS output, from 53% of GB demand in 2016 to forecasts of around 21% by 2035, the GB supply balance will continue to change over the next 20 years. While gas demand is unlikely to rise significantly over the next 20 years there will still be significant demand out to 2035. National Grid forecasts put gas demand between 604TWh and 891TWh by 2035 (compared to 923TWh in 2016).

In this supply and demand context, analysis shows that there will be capacity for supply to meet demand, although this could evolve in different ways. LNG has the capacity to increase to make-up the decline in UKCS, CEPA modelling shows that LNG has the capacity to meet up to 60% of GB demand by 2035; although a portion could be displaced by other sources depending on the economics.

Pipelines will remain an important source of supply flexibility over the next 20 years, in the absence of significant changes in gas prices or spreads between GB and European gas markets; significant new pipeline capacity is unlikely to be economic.

Shale gas has the potential to play an important role in the energy system in the future by increasing supply diversity.

Future transition - summary

- The liberalised gas market has responded effectively to changing supply and conditions in the past, most recently the decline in UKCS output.
- Gas demand is unlikely to rise significantly over the next 20 years but there will still be significant demand out to 2035.
- GB supply balance will continue to change over the next 20 years.
- LNG has the capacity to increase to make-up the decline in UKCS.
- Pipelines will remain an important source of supply flexibility over the next 20 years.
- Shale has the potential to increase supply diversity in the future.

Future levels of GB gas security

Future security of supply needs to be considered in two dimensions: a base case to assess whether the gas system has the capacity to balance supply and demand under 'normal' conditions, and stress testing, looking at the impact of supply or demand shocks (or a combination) on the gas system.

The base case provides information on the gas system under normal circumstances and the ability to cope with a range of demand and supply variance within each scenario (such as cold winters).

Stress testing the system involves modelling increasingly severe shock scenarios on the system, such as unexpected rises in demand (due to a severe cold snap for example) or sudden changes in supply (for example a major infrastructure outage).

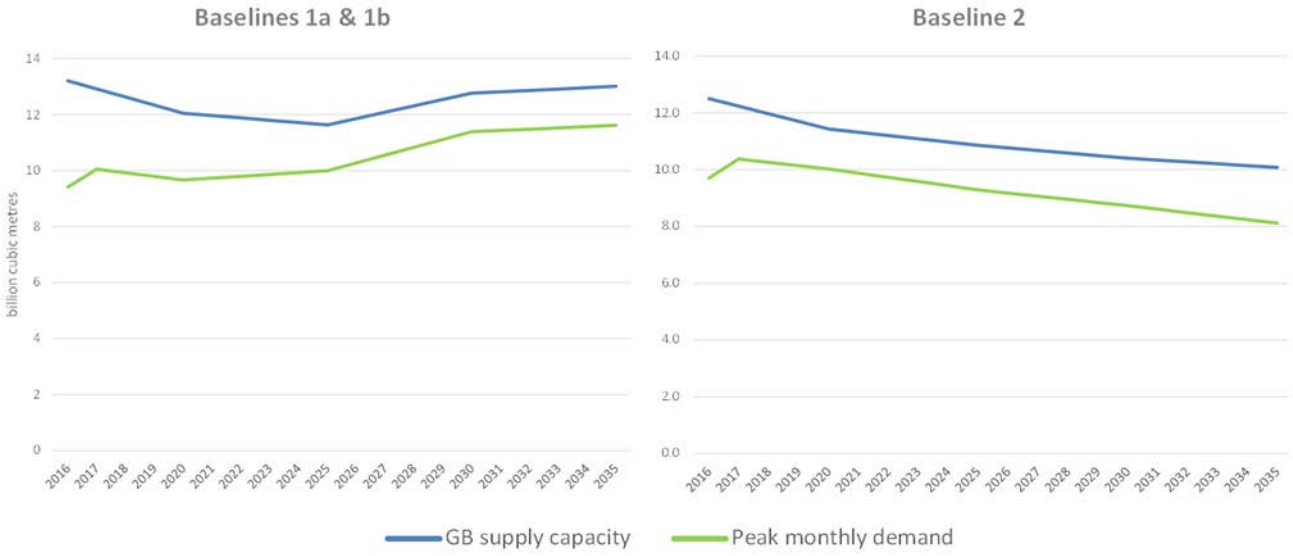
A relatively simple stress test is the 'N-1' scenario, which considers what happens to the system if the largest single piece of infrastructure fails. In the latest assessment the UK achieved an N-1 score of 127% meaning that GB has 27% more infrastructure than is required to meet demand we would expect to see once in 20 years even if the single largest piece of infrastructure fails.

To test the limits of the system, we need to use highly unlikely 'black swan' scenarios (single events or combinations of events) to detect potential failure points. Once these scenarios have been modelled we can consider both the likelihood and impact of them occurring to make an assessment of security. The more unlikely the shock required to reach this breaking point the more secure the system. This is the approach taken in the stress tests below.

Baseline security in the future

GB is secure in baseline scenarios under both high and low demand conditions. Consistent with other studies (such as Pöyry (2014)), the baselines show that under normal conditions (i.e. no major infrastructure failures) there is a good amount of additional supply relative to demand (margin) despite some rationalisation of capacity in both scenarios.

Figures 5 and 6 - GB capacity margins Baseline 1a/1b[24] (high demand) and Baseline 2[25] (low demand)



Source: CEPA (2017)

Stress testing the gas system

Looking forward, we need to understand how robust our supply and demand scenarios are. We wanted to test the system against highly unlikely 'black swan' events to identify potential failure points to highlight residual risks or areas for further action.

Ofgem modelled stress tests on the system in 2012 as part of the Gas security of supply report and in 2014 (undertaken by Pöyry) as part of a cost benefit analysis into a demand side response mechanism. The Ofgem security of supply report modelled a number of stress tests with most extreme tests modelling infrastructure shocks up to a simultaneous loss of 50% of non-storage supply infrastructure. The Pöyry (2014) study modelled a number of stress scenarios.

In generating the shock events the reports showed that:

- reasonable assumptions for probabilities of infrastructure and supply outage made the chance of interruptions extremely small[26];
- it requires an unlikely combination of multiple infrastructure failures and an usually cold winter in order to generate unmet demand[27]; and
- the size of non-storage supply infrastructure failure required was significant (and of very low probability) before non-domestic or domestic customers might be affected[28].

[24] **Baseline Scenario 1a**—based on the IEA's "Current Policies Scenario" ("CPS"). This scenario projects increasing global and GB gas demand out to 2035, and also assumes that the Rough gas storage facility is operational until 2035; **Baseline Scenario 1b**—based on the same IEA CPS set of assumptions as in Scenario 1a, but assumes that the Rough storage facility is closed from 2016.
[25] **Baseline Scenario 2**—based on the IEA's "450 Scenario" ("450"). This projects decreasing European and GB gas demand and stagnant global demand from 2025 onwards. The Rough storage facility is closed in this scenario.
[26] Ofgem (2012)
[27] Pöyry (2014)

These reports concluded that:

- current and forecast levels of GB supply and storage infrastructure are sufficient to meet all customer demand in all but the most extreme cases[29];
- in all scenarios, even with high demand, there are no interruptions before 2020. The low demand scenario does not generate any unserved demand between now and 2030[30]; and
- effective market operation (responding to price signals) in times of system stress, was shown to be important to delivering this security[31].

Security of gas supply – CEPA (2017)

The CEPA (2017) study published alongside this report specifically looks at, low-likelihood shocks. Bearing in mind the decline in UKCS output and the expectation in increasing imports, this study focussed specifically on long-duration geopolitical shocks, lasting twelve months in order to cover an entire gas year.

The report concluded that the GB gas market is highly resilient, with demand likely to be met in all but the most extreme combination of events. The following sections summarise key elements of the report.

Development of the modelled scenarios

The modelling was run under high and low demand baselines. Under the low demand baselines, there was no unmet demand, so the discussion that follows applies only to the high demand baseline.

We conducted workshops with stakeholders where we discussed risks to gas supply and demand over the next 20 years to find the “best to test” shocks to model. Modelled shocks were chosen not because they were thought likely (or more likely than other shocks). Rather, they were chosen as proxies for a range of shocks of a particular type that could be large enough to represent the impact of ‘black swan’ events. The scenarios are all highly unlikely and should be considered theoretical rather than representative of a potential reality.

The three scenarios chosen were:

- a large and sustained global LNG disruption scenario;
- a large and sustained global supply shock scenario, affecting the whole of Europe; and
- a large and sustained global supply shock coupled with a major and sustained GB infrastructure outage

[28] Ofgem (2012)
[29] Ofgem (2012)
[30] Pöyry (2014)
[31] Ofgem (2012)

Likelihood of shocks occurring

All of the shocks modelled are proxies for 'black swan' type events. These shocks are highly unlikely to occur, and the scale and duration is even more unlikely. Furthermore, the supply shock combined with an infrastructure outage is a combination of two highly unlikely events.

In all three shocks, we have modelled an event which is likely to have much bigger economic, geopolitical, and even national security impacts than simply disruption to gas supplies. It is therefore likely, that the main mitigations to these risks would reach further than the gas system. In addition:

- Russia is heavily dependent on gas exports for budgetary revenues, and kept up sales, remaining a reliable supplier throughout the Cold War. Furthermore, Russia's pipeline network serving Europe has considerable over-capacity, so a major catastrophe affecting one pipeline can be mitigated largely by resupply via an alternate route.
- There is no operational connection between Qatar and North Africa and weak political connections. Closure of the Straits of Hormuz is quite unlikely because of their critical importance for both gas and oil for the whole region; in effect a state of war would have to exist and then it's unlikely the Straits would stay closed for long.
- Since 2000, there has been a gas infrastructure outage roughly every 1-2 years, although these have not always been full outages, and no occurrences of simultaneous failures have been experienced. Pöyry (2014) puts the probability of a failure at Bacton or Milford Haven at 2%. Given that CEPA (2017) models these two highly unlikely shocks occurring together, this simultaneity significantly reduces the likelihood of this scenario occurring.

Outcome of stress tests

The shocks were modelled against high and low demand baselines[32] in 2025 – this is close enough to the present day to provide confidence that the future will look similar to the modelled baselines and is far enough into the future to enable any resulting policy decisions to take effect.

Global LNG disruption scenario

The results showed that GB could maintain supplies of gas under this scenario with no involuntary interruption to any sector of demand (power, industrial or domestic), although we would expect to see some degree of price response, especially in the industrial sector as this sector tends to be the most exposed to short-term changes in wholesale prices. There is sufficient flexibility in the growing LNG market to adjust LNG flows to balance demand and Europe would also be able to increase pipeline imports.

Global supply shock scenario, affecting the whole of Europe

Where pipeline imports to Europe are impacted, the results show that there is no unmet demand for any consumer sector within GB, such that even a voluntary response is not necessary. As the European gas system is also in stress in this scenario due to the cessation

[32] The high demand baseline is taken from the IEA "Current Policies Scenario" which considers only those policies for which implementing measures were formally adopted by mid-2015. The low-demand baseline is based on the IEA 450 scenario and assumes policies with a trajectory of emissions reduction to meet the global limit of a 2 degree rise in global temperatures.

of pipeline supplies, GB must raise its prices to a sufficient level to attract gas from other markets[33].

In order to cope with the supply shortfall from Europe, GB LNG imports rise significantly, reaching maximum capacity to bridge the supply gap. There is a similar response from the European gas markets, but as described above, there is sufficient flexibility in the growing LNG market to adjust flows.

Global supply shock coupled with major GB infrastructure outage

This shock is the coincidence of two unlikely shocks occurring at the same time – a major European supply disruption and a major outage at key import infrastructure at the highest demand point of the year. This unlikely combination of events leads to small amounts of unmet demand for all consumer groups as the modelled constraint at Isle of Grain LNG terminal restricts the amount of LNG that can be imported.

That said, unmet non-daily metered demand (which includes all domestic demand) is minimal (a total of 0.01bcm); and given that the model does not take into account demand side response and other possible actions, it is likely that steps could be taken to mitigate such a small loss.

It is likely that the loss of economic output as a result of any of the economic shocks modelled in this report will significantly reduce gas demand that year and will make it far less likely that gas supply is constrained. In these circumstances, the challenge would be addressing the political and economic effects of the shock, not the consequential tightening of gas supply margins.

Key findings for future security

Markets must function and give strong price signals

Markets must be able to respond effectively to price signals to be able to secure supplies in the short term and ensure the infrastructure is available to secure supplies over the longer term.

Both Ofgem (2012) and CEPA (2017) indicated the importance of the market operating efficiently to minimise any impacts of a severe shock, in particular the ability for prices to rise sufficiently to bring in more marginal sources of gas.

Over the longer term, allowing prices to respond effectively will support the infrastructure that provides capacity and flexibility that reduces the chance of interruption of supplies thereby supporting security of gas supplies.

Responsiveness and flexibility

We also find that over the next twenty years, the gas system will require effective sources of price responsive flexibility to respond to changing demand patterns throughout the year and to be able to respond to changes in supply, from small interruptions through to major shocks. We have a flexible gas system that responds well now, and as the supply and demand context develops over the next twenty years, flexible sources of gas will need to continue to develop.

[33] A few pence per them above the European price to account from the commodity entry charge

Pipeline gas (from Norway) and interconnectors (with Belgium and the Netherlands) in particular are a useful source of flexibility within the system.

Once the LNG market has adjusted to a shock, it should be able to provide a steady stream of cargos in response to the shock. However, the response can be limited by the speed with which the market can respond to a shock. Pipelines and interconnectors have the benefit of being able to respond quickly. However, where there is regional stress, pipeline imports may be limited.

Improving the diversion times for LNG (such as making contract renegotiations more efficient) will reduce the time lag for acquiring additional supplies.

Storage also has the capability to provide a source of flexible capacity in the intervening period.

Timing of shocks

Even with the large supply and infrastructure shocks, unmet demand is concentrated in the high demand periods of the year (i.e. winter), with the summer period being largely unaffected.

Storage

As the gas system changes, the role of storage on the system is also changing in response to the gas system and the gas market. On a day to day basis, storage provides value to the system by providing a source of flexibility and responding to short-run changes in supply and demand on the system.

However, gas storage is not a strategic reserve for use in the case of a gas emergency. The ability of storage to respond to a shock is limited by the total storage stocks available (a function of its capacity and how full it is at the time the shock occurs); the speed of depletion of stocks; whether it can refill during a shock; and the aggregate daily deliverability of those storage stocks. Keeping a strategic supply of gas out of the market only for emergency use is poor value for money due to the cost of maintaining the asset and holding that gas out of the market[34].

Conclusion

As UKCS production declines, import capacity becomes an important consideration. GB's good levels of capacity, particularly import capacity over the next 20 years mean that in both the high and low demand scenarios, we maintain a healthy capacity margin out to 2035. This is despite some closures in response to prevailing market conditions, but overall security of supply remains unaffected: in the high demand scenario, there is a slight tightening of capacity as demand rises in the mid-2020s, accompanied by new investment; and in the low-demand some capacity closes as demand falls.

Where there are shocks to the system, modelling results show that GB is highly resilient. Under low demand scenarios, modelling shows no un-met demand. In high demand scenarios, GB has enough import capacity and diverse import capacity to meet demand even under stressed conditions. CEPA (2017) showed that even under the unlikely scenarios of global

[34] Redpoint Energy (2013) for DECC

pipeline disruptions or global LNG disruptions, there is sufficient import flexibility to meet demand.

When testing the limits of the system, modelling demonstrates the high degree of resilience of the system. Even under high demand scenarios the system is highly resilient with interruptions only occurring under highly unlikely, severe conditions. In the CEPA study, only one of three of the unlikely shocks – where the shock is compounded by an unlikely coincident infrastructure failure – generated unserved demand. In the Ofgem 2012 security of supply report, interruptions only occur after the equivalent of 50% of non-storage supplies are interrupted; and the Pöyry study (2014) finds a "1 in 50" winter, compounded by an infrastructure failure (of 1% to 2% probability of occurring), would cause supply interruption.

Future levels of gas security – conclusions

- In both the high and low demand scenarios, we maintain a healthy capacity margin out to 2035.
- In both the high and low demand scenarios, there is some closing of capacity as the market adjusts to the changing market conditions, but this does not affect security of supply.
- Under low-demand scenarios, the GB system is highly resilient into the future.
- GB has enough import capacity and diverse import capacity to meet demand even under stressed conditions.
- Even under high demand scenarios the system is highly resilient with interruptions only occurring under highly unlikely, severe conditions.

Headline conclusions

How secure are we?

It is clear that we are secure in the short term, and that the gas system is well placed to respond to a wide range of demand and supply scenarios well into the future. While there are possibilities of exploiting new domestic resources, the reality is that an increasing proportion of gas consumption will need to be met through imports. Modelling shows that while we need to be vigilant to the world market, the GB gas market is able to withstand all but the most extreme shocks and still maintain supplies to protected (non-daily metered) customers.

We will be able to meet demand from available supply under all but the most extreme circumstances

Looking to the future, increasing energy efficiency and improvements in technology mean that gas demand is not expected to rise significantly in the next 20 years. Even in the highest demand scenarios (such as that modelled in CEPA (2017)), gas demand rises only modestly from levels seen today.

There will be sufficient global production to meet global demand for gas and there will be sufficient import infrastructure in GB to meet peak demand.

The gas system has evolved and will continue to do so

The GB gas system is undergoing a transition as domestic supplies decline. This has altered the dynamics of the market requiring new approaches to managing and exploiting demand especially around peaks.

Diversity rather than domestic supply has become the basis of our security of supply. This diversity is apparent not only in the different sources but the use of innovative and adaptable business models within those.

Government's role is to monitor the assumptions underlying this report to ensure they hold true in the evolving market, and take action if they do not, and to ensure that innovation is supported with barriers removed.

The gas system is resilient to all but the most extreme, unlikely shocks

While the modelled shocks in CEPA (2017) are high impact, the likelihood of them occurring is extremely low. This is consistent with previous studies which concluded that the risk of a gas deficit emergency is very small.

However, this does not mean that we should be complacent. The studies undertaken so far on security of gas supplies provide insights into what becomes most important in a shock situation:

- Price is a strong driver of security, the market needs to operate effectively and we must avoid unnecessary constraints;
- This encourages flexibility in the market and allows flexible assets to respond appropriately and effectively;

- This can also be supported by effective demand response, especially through an effective demand side response mechanism; and
- LNG delivers a truly global gas market in which GB is well positioned; we should seek to further consolidate this position.

Key components of security

What does the new system look like?

As UKCS declines, current modelling suggests that pipeline supplies will remain stable and LNG supply can increase to ensure demand is met, providing a diverse range of supply sources. However, short term flexibility will be vital to maintain secure supplies, and this will require diverse sources of flexibility from storage, interconnectors and LNG.

New domestic sources are beneficial for gas security

Additional domestic sources (such as shale) would be beneficial to GB. They could reduce reliance on imports, have the potential to bring economic benefits by rebalancing the economy, and would increase the diversity of supply available to the GB market.

LNG has flexibility to balance supply and demand over the long term

By 2035 LNG has sufficient flexibility (in the long term, taking into account the expansion in global liquefaction capacity) to become the principle supply source. Norwegian supply will still be an important source of gas; and continental imports will provide a key source of seasonal flexibility, particularly in scenarios where there is no longer any long-range storage available in the market.

LNG is flexible, and we must ensure its flexibility develops

The widespread availability of liquefaction capacity and the expectation that this will increase in the future mean that there will be a liquid market that is ready to respond in a shock.

In other words, in the first few days, there may be some scope for re-diversion of cargoes that are near to a market in distress, although if there is regional distress this may be limited. However, in a long-run shock, the LNG market will adjust and provide a steady stream of cargos to the distressed market as long as is necessary.

The key limitation therefore is that “there will be a time delay before additional un-programmed LNG cargoes arrive at UK terminals following the onset of a stress situation”[35]. A key mitigating factor is diversity of supply, including existing LNG stocks in the distressed country which may be able to cover a gap.

System diversity and flexibility continues to be important

The gas system requires flexibility to respond to changing supply and demand patterns. There is a role for a range of sources of flexibility, exploiting different aspects of the gas market. Pipeline gas from Norway and Interconnectors from Europe will remain important sources of gas and gas storage will continue to have an important role.

[35] Poten & Partners (2017)

The role of price and markets

A market that functions effectively and provides strong price signals ensures security in the short-term by attracting sources of gas when they are needed, and in the longer term by supporting gas infrastructure.

Next steps

Summary

The conclusions lead to a number of next steps. It reinforces some work that is currently underway (such as the widening of the gas quality (WOBBE) standards), provides an indicator of further work that should be done in the near term, and of some areas that should be kept under review in the future.

Ensure a robust, well-functioning market

We need to ensure that the market has the right incentives to deliver the right infrastructure, keep that infrastructure operational and replace it where necessary. This requires strong incentives to secure supplies and allow redundant infrastructure to be replaced with more appropriate infrastructure. We must also ensure that our gas trading relationships across the world are maintained.

Market functioning

Markets must be well developed and liquid enough to deliver gas when required during times of high demand. Trading platforms need to be robust and supported to perform during times of stress with a strong legal and regulatory underpinning. We must be confident that our regulatory framework ensures that physical gas is delivered even under times of stress.

Ofgem's Significant Code Review (SCR), and in particular allowing the cashout price to rise to the value of lost load, helps to ensure that the market is incentivised to provide security of supply.

A continued close gas trading relationship with Europe

Efficient market trading of gas with Europe can assure good security of supply and efficient allocation of gas resources during times of system stress.

Ensure the development of the LNG market and further development of GB as a mature gas hub

As LNG becomes a larger proportion of our supply, the flexibility of LNG as a supply source will become more crucial. This improves our gas security and provides an opportunity to develop GB's position as an import and trading hub for the entry of LNG to Europe.

Development of LNG markets

The evidence to date suggests this market is developing in the GB's interests and we will be engaging closely with industry stakeholders to understand the role government can take to ensure it continues on this track. We should ensure the right incentives on shippers, support LNG flexibility, promote GB as an LNG hub for our own use and as an entry point to Europe (which will in turn support the interconnectors), and to remove barriers and reduce costs.

Reducing costs and increasing attractiveness of GB market

Making it cheaper to land LNG will make GB a more attractive destination and reduce consumer bills. Current gas standards, set narrowly for the characteristics of North Sea gas, are being reviewed by the Health and Safety Executive (HSE) and could result in wider gas standards which would allow 90% (up from 10%) of LNG into GB[36] without processing. It is suggested the value could exceed £300m pa by 2020[37].

Monitoring of LNG markets

LNG is secure globally with significant amounts available from a range of exporting countries. However, the delay in reaching GB shores reduces its impact during the first few days of a shock. Government could support the development of the LNG market to reduce future turnaround times through international fora. However, it is important that we monitor developments in the LNG market and act on the risks it presents.

Exploit opportunities to reduce reliance on imported gas

Although it is likely that imports will become an increasing proportion of supply, it is beneficial to seek economic opportunities to reduce the need to import gas through exploiting indigenous resources or reducing demand.

Continue to explore indigenous resources

While our security of supply does not depend on new indigenous supplies, if they can be exploited economically, shale gas and biomethane would provide valuable additional supplies, reducing our reliance on imports and contributing to economic growth.

Further action on energy efficiency

Energy security does not depend on further improvements in energy efficiency. However, as well as delivering their primary objective, improvements in this space would reduce exposure to shocks through lower demand.

[36] SGN (October 2016) Opening Up The Gas Market. Available at: www.sgn.co.uk/uploadedFiles/Marketing/Pages/Publications/Docs-Innovation-Oban/SGN_Gas_Market_Report_Full-report-2016-170116.pdf

[37] SGN (October 2016) Opening Up The Gas Market. Available at: www.sgn.co.uk/uploadedFiles/Marketing/Pages/Publications/Docs-Innovation-Oban/SGN_Gas_Market_Report_Full-report-2016-170116.pdf

Bibliography

Cambridge Economic Policy Associates Ltd (CEPA), (2017), *A Review of Gas Security of Supply within Great Britain's Gas Market – from the Present to 2035*.

Department for Business, Energy & Industrial Strategy (BEIS), (2016), *UK Risk Assessment on Security of Gas Supply: Report completed for EU Regulation 994/2010*. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/560125/UK_Risk_Assessment_Gas_BEIS_template_Final__4_.pdf

Department for Business, Energy & Industrial Strategy (BEIS), (2017), *Energy Trends*. Available at: www.gov.uk/government/statistics/gas-section-4-energy-trends

Ofgem, (2012), *Gas Security of Supply Report*. Available at: https://www.ofgem.gov.uk/ofgem-publications/40204/gas-sos-report-pdf

Ofgem, (2014), *Gas Significant Code Review Impact Assessment for Final Policy Decision*. Available at: www.ofgem.gov.uk/ofgem-publications/85999/1402gasscria-pdf

National Grid, (2016a), *Future Energy Scenarios*. Available at: www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/FES/Documents-archive/

National Grid, (2016b), *Winter Outlook Report 2016/17*. Available at: www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/FES/Winter-Outlook/

National Grid, (2017a), *Future Energy Scenarios*. Available at: http://fes.nationalgrid.com/fes-document/

National Grid (2017b), *Winter Review and Consultation, 2017*. Available at: www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/FES/Winter-Outlook/

Poten & Partners, (2017), *LNG Market Outlook Responsiveness of LNG*.

Pöyry, (2014), *Gas SCR – Cost-Benefit Analysis for a Demand-Side Response Mechanism*. Available at: www.ofgem.gov.uk/ofgem-publications/85990/poyrygasscrdsrcbafinalreportv20-pdf

Redpoint Energy, (2011), *Gas security of supply Significant Code Review: Economic modelling*. Available at: www.ofgem.gov.uk/ofgem-publications/40959/redpoint-energygas-security-supply-significant-code-review-economic-modelling.pdf

Redpoint Energy, (2013), *The impact of gas market interventions on energy security*. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/236757/DECC_FI_Final_report_09072013.pdf

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PERMANENT PEOPLES' TRIBUNAL

Session on Human Rights, Fracking and Climate change (14-18 May 2018)

PRELIMINARY STATEMENT

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The PPT is an international, fully independent organization established in 1979 as an opinion Tribunal having as its primary statute the Universal Declaration of Peoples' Rights (Algiers, 1976). The main aim of the PPT is to contribute to the struggle of peoples for their self-determination and the prevention, assessment, judgment and reparation of their fundamental rights, whenever international institutions do not fulfil their responsibilities to ensure the full respect of obligatory duties of justice by public or private actors.

Over five days, from 14 to 18 May, 2018, the PPT heard testimony and received other evidence relating to fracking and its impact on climate change, human rights and the rights of nature. Included were very substantial reports from four pre-PPT Citizens' Tribunals that had gathered scientific, technical, social, cultural and experiential testimony from many community organizations, experts and individual citizens. The PPT also received other such evidence from individuals, experts and NGOs on the negative impact of fracking on the environment, people's lives and on their communities.

Given the overwhelming volume and comprehensiveness of the evidence received and the need to consider all of this carefully, the panel of ten jurors will necessarily take several months to formulate a precise and comprehensive Opinion, including recommendations.

Because the matters considered by the PPT are of great significance and public concern around the globe, especially to those affected negatively by the fracking industry, and generally speaking by the expansion of the fossil fuel extractive frontier, with all its consequences on the climate crisis, on the environment and on peoples' rights, by industry role players themselves, and governments across the world insofar as they have responsibilities to abide by laws and to protect the public, human rights and the environment, this Preliminary Statement is issued now for public discussion and action to abate the negative effects of fracking.

The dramatic impacts of the Unconventional Gas and Oil Extraction technologies on people, the environment and the climate were elaborately documented to the PPT, including a comprehensive exposition of facts and related oral, visual, juridical and cultural evidence which clearly established beyond any reasonable doubt the reality of violations of the rights of humans and of nature, and a significant contribution to climate change. Such findings require the urgent ascertainment and attribution of responsibilities as well as of the measures which must be undertaken to avoid an irreversible worsening of the situation; and to bring about changes in practices, policies of reparation for injuries suffered, and rehabilitation of environmental destruction including the contribution of fracking to climate change.

What has become clear is that fracking is, with important but limited exceptions, an ongoing and expanding reality that affects both the rights of nature as well as the rights of individuals and communities in all the countries which were considered by the PPT, with specifically dramatic consequences on indigenous peoples. This is just a sample of impacts and consequences suffered elsewhere where fossil fuel exploration and extraction (including of non conventional fuels such as tar sands as well as shale gas and shale oil) continues unabated. The many practices of resistance, research and of resilience by people and their communities that have been presented to the PPT

underline that the violations of rights are generally planned and implemented intentionally, as well as being hidden when possible and denied when exposed. Also, the frequent absence of appropriate juridical-normative terms of reference is not recognised by governments as a vacuum to be urgently corrected, thus providing corporations an excuse to operate within a regime of impunity.

The scenario of rights violations and impunity, often resulting from regulatory capture, that fracking presents appears as an exemplary model of the broader geopolicies and strategies of states and powerful corporations that have imposed a tragic hierarchy of values across the world, which has resulted in the rights of people and the rights of nature being subjugated to the financial interests of states and corporations. A sort of systemic crime architecture.

The Advisory Opinion of the PPT will be oriented to provide proposals that are not merely descriptive by answering the four main questions which have guided the preparation and implementation of this Session. The Opinion will also explore, evaluate and make findings on the responsibilities for the multiple abuses of rights violations and the roles that many actors play in this respect. The Tribunal will, in addition, focus on:

- the possible ways of strengthening the role of local communities and indigenous peoples which must be further recognized as the main subjects of inviolable rights including that of self-determination;

- the necessary evolution of existing international, national, and local juridical institutions, concepts and laws which could ensure an innovative role of the guarantors of the rights of affected and threatened human communities and of nature;

- the promotion of broader and more effective networks of community and political actors capable of transforming the many but fragmented and dispersed experiences of resistance and resilience into a true transversal "people", fighting for the combined respect and promotion of the fundamental Universal Declaration of Human Rights and the more recent Universal Declaration of the Rights of Mother Earth.

It is then the Interim Opinion of the PPT that:

The evidence we have considered is consistent internally, almost without exception. It is also consistent with the external evidence to which the Tribunal was referred, i.e. the results reached, discussed and analysed in hundreds of independent reports and refereed research publications.

The evidence clearly demonstrates that the processes of fracking contribute substantially to anthropogenic harm, including climate change and global warming, and involve massive violations of a range of substantive and procedural human rights and the rights of nature. Thus the industry has failed to fulfil its legal and moral obligations.

The evidence also shows that governments have, in general, failed in their responsibility to regulate the industry so as to protect people, communities and nature. In addition, they have failed to act promptly and effectively to the dangers of climate change that fracking represents.

Finally, this particular Session of the PPT has been an experiment of collaboration and communication. It has sought to overcome the economic constraint of limited resources which impede what should be a permanent, timely exercise of assessing, monitoring, preventing and transforming the universe of violations which occur in the present global scenarios, where the decisions on policies which go against the fundamental rights of nature and of human communities are taken, imposed and directed centrally by those who have unlimited resources.

The experiment has been a resounding success, with the inevitable but instructive limitations, thanks to the commitment of an organising group which deserves the recognition and gratitude not only of the PPT, but of all those who can now transform this experiment into a flexible and powerful tool which could allow the struggles of the communities of the world to become more globally and more timely known, shared and effective.

Panel or the judges:

Alberto Acosta Espinosa
Lilia América Albert Palacios
Andrés Barreda
Upendra Baxi
Gill H. Boehringer
Maria Fernanda Campa
Louis Kotzé
Larry Lohmann
Francesco Martone
Antoni Pigrau Solé

PPT General Secretariat:

Simona Fraudatario
Gianni Tognoni

Fracking and Historic Coal Mining: Their relationship and should they coincide?

Professor Emeritus Peter Styles

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Hydrocarbon-based energy (Fossil Fuels)

The challenges associated with conventional oil and gas are legion. We have exploited the easiest resources and while exploitable reserves may seem to be growing, exploration and production are moving into areas which are geographically challenging (Arctic, South Atlantic, etc.), politically sensitive (Arctic once again, Falklands, Pakistan, etc.) and economically borderline. This has renewed interest in what are known as unconventional hydrocarbons, which include, Coal Bed Methane (CBM) or in Australia Coal Seam Gas (CSG), Underground Coal Gasification (UCG), Methane Hydrates and probably of most significance, **Shale Gas and Oil.**

Apart from coal-generated gas and solid fuels, the source rocks for most hydrocarbons are shales which are globally widespread as **Figure** 1 shows with very large estimates of potential reserves and rather poorer estimates of potentially exploitable resource.

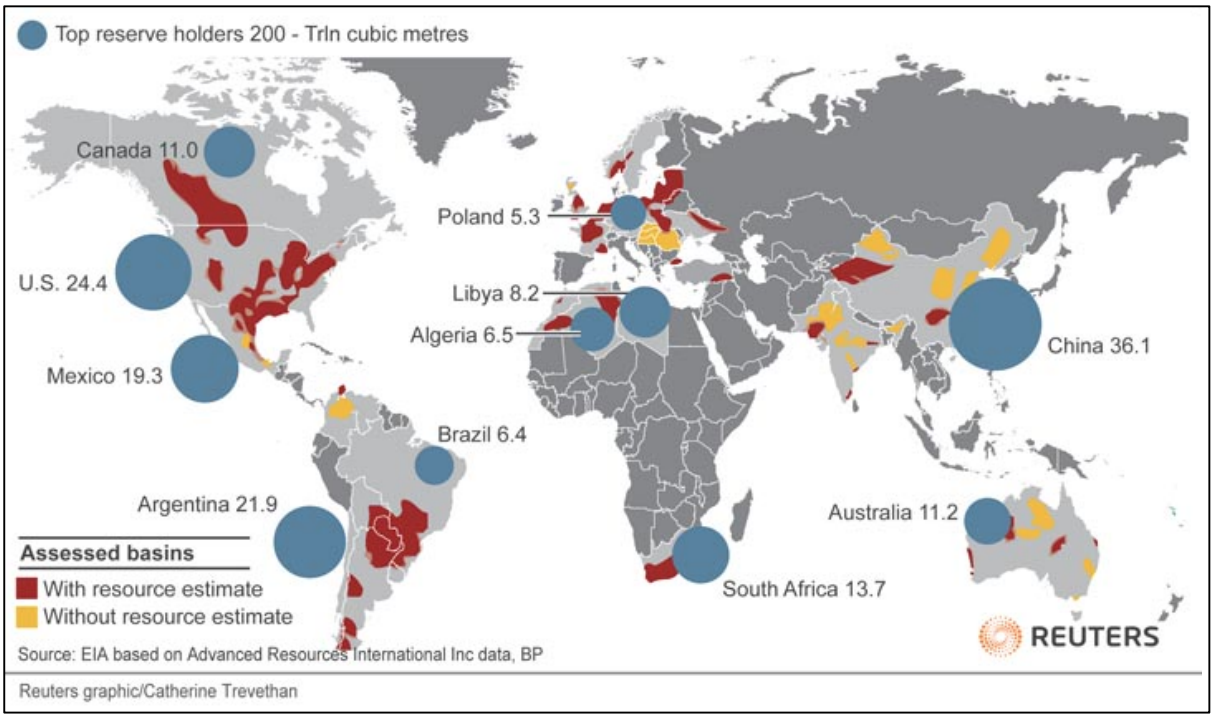


Figure 1. Global distribution of significant shale gas resources (IEA and Reuters). Estimates are rising even from these very large numbers as detailed appraisal is carried out. However, gas in the ground is not the same as gas in the pipeline and extraction of 10% is seen as very good in most cases

But what is Shale?

Shales are fine-grained sedimentary rocks, i.e. laid down in deep still water where oxygen is very limited (anoxic conditions such as currently exist in the Black Sea) and are probably the most extensive rock type we see at the earth's surface.

This far offshore, only very light or very fine particles are transported, as everything else has already been deposited much closer to the shore or even on land. They contain clay particles from the breakdown of igneous rocks such as granite, together with very fine-grained sand particles of a size we call silt or smaller and often a much larger component of calcium carbonate than generally realised and it is these clastic (sand) and carbonate (limestone) components which affect the mechanical properties and hence seismic behaviour in the context of shale gas (Figure 2)

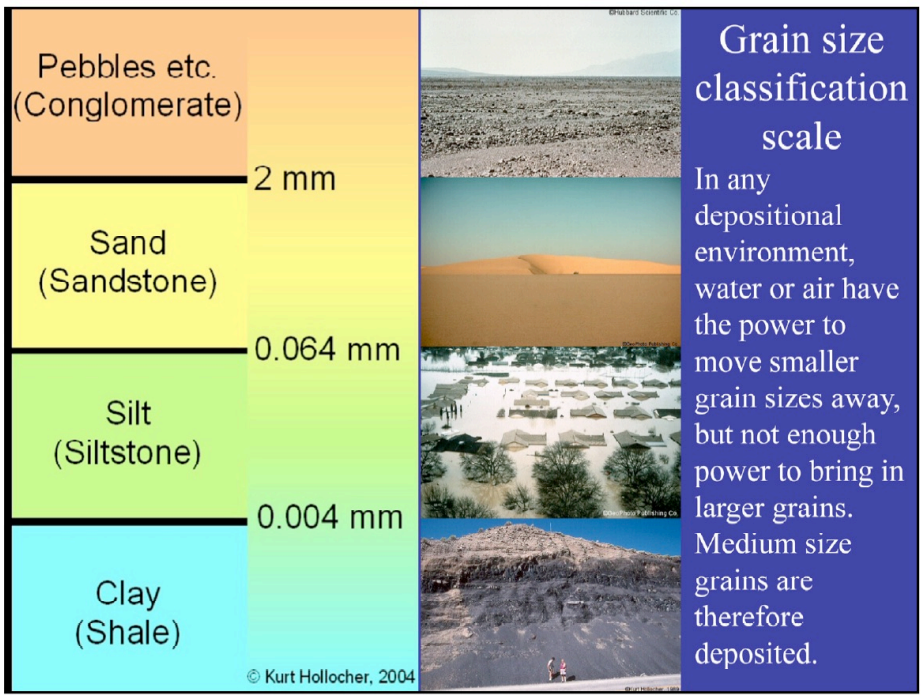


Figure 2 A simplified grain size chart for clastic sediment (e.g., sand, silt), and their respective sedimentary rocks (e.g. Sandstone, Siltstone). The pictures represent some of the places where one can find sediment of the grain sizes to the left.

Top: Desert pavement. Mudflows and flash floods transport materials of all grain sizes and wind then blows the fine-grained materials away, leaving pebbles and larger grains behind.

Second: Sand dunes. The sand was blown from elsewhere and deposited here. Coarser-particles, remained in the supply area, and silt and clay-size particles were blown away.

Third: A flood of the Mississippi River. The slow flow of the river only permits silt to transported and deposited.

Bottom: Shale deposited on the seafloor. The weak currents permitted fine-grained clay to slowly settle and accumulate and consolidate over many millions of years.

(http://minerva.union.edu/hollochk/pedagogy/files/grain_size_clastic_sed.pdf)

Apart from these mineral components, the most important fraction in terms of shale gas is the organic component from organisms which lived in the ocean and fell to the bottom on death and were incorporated into the rock. In these anoxic conditions and under the pressure and temperature of burial these organic remains can be (but are not always) converted by thermogenic process into hydrocarbons, gas/oil/tar depending on temperature and pressure. I call this the ***'Shale Goldilocks Effect'***. Too hot porridge and hydrocarbons turn to tars; too cold porridge and no hydrocarbons are formed, and when it is just right, like baby bear's porridge, we get oil and gas in differing amounts depending on the exact conditions. The very fine-grained nature of the shales and the lack of permeability (the capacity for flow through the rock) mean that much of these hydrocarbons remain *in-situ* for hundreds of millions of years!

Shale Gas

We have up to now in the history of oil and gas exploration , mostly been exploiting the small fraction of hydrocarbon which was generated by biological and geological processes in the shale rocks of the world, and which migrated out of the shale, was trapped by happy accident in a structural or stratigraphic trap and was then found at great cost and with some difficulty, using geophysics and drilling, for the last 100 years or so; or for thousands of years

if we count the use of tars and bitumen which are found in surface seeps in many parts of the world.

Figure 3 shows the different rock types, which are important in sandstone (inorganic) reservoirs and these range from:

i. Permeable sandstones which have high porosities and can contain significant volumes of free gas and high permeabilities which expedites the removal (or storage) of oil, gas and water in them,

ii. Tight gas sands which have reasonable porosities but low permeabilities and while they can store free gas are reluctant to release it,

iii. Coals which have variable permeabilities but can store enormous quantities of gas (typically 7 to 10 times as much as an equivalent sandstone volume in a 'condensed' liquid–like layer held by the Lennard-Jones potential a form of Van der Waals's force.

iv. And last but by no means least, **shales** which have low porosities and extremely low permeabilities and are extremely reluctant to release their gas

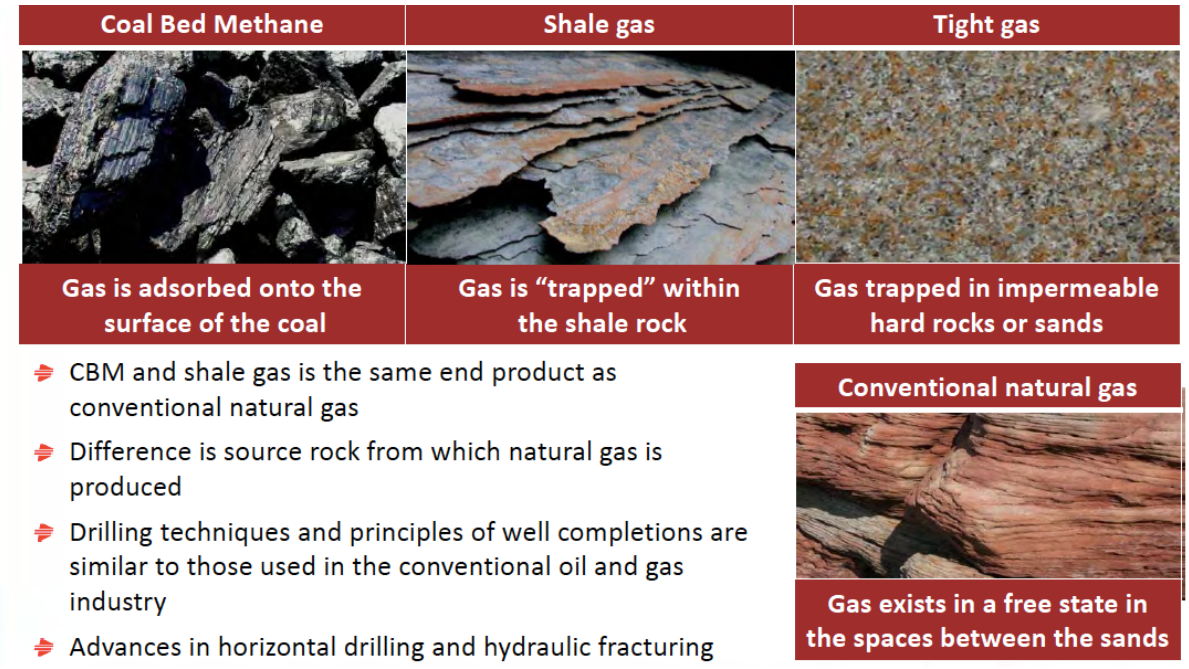


Figure 3 The various types of clastic reservoir, which can contain oil and gas (British Geological Survey)

So: shales contain vast quantities of liquid and gaseous hydrocarbons but are remarkably reluctant to give them up, which of course is why they are still there after many hundreds of millions of years. Therefore, they must be persuaded quite forcibly to participate in this process and this is what we must understand in order to appreciate all the manifold dimensions of shale gas extraction and its consequences.

Advances in drilling technology, initially deployed in coal, such as long-reach horizontal drilling together with **hydraulic stimulation**, more commonly and pejoratively known as **'fracking'** have, however, expedited the extraction of methane and other minor component gases such as Ethane, Propane, Butane, Hexane and various liquid hydrocarbons directly from the shale source rocks

This has not come without some controversy and significant opposition, most notably from NGO's and pressure groups, who had seen, probably optimistically, the decline of hydrocarbon production as signalling a rapid and major switch to renewable technologies and low-carbon power generation.

So, Shale Gas, and all that entails, is inevitably part of the future energy picture. Oil and Gas extraction and the environmental impacts, both sub-surface and surface. associated with it has generally been tacitly accepted as a necessary evil but the rise in 'unconventional' gas has drawn opprobrium for its environmental and climate implications, perhaps because much of the US exploitation has been onshore and in some areas which have not customarily been seen to be 'oily'.

Wells and the Fracking Process

Fracking is simply a method of producing pathways in rock through which fluids can flow. These fluids aren't just oil and gas. It is not widely appreciated, and even less commented on. that this is an essential part of the extraction of deep geothermal energy, where we drill into granites to exploit the high temperatures which are associated with the radioactive decay in these igneous rocks. Granites have little or not any natural permeability either, and in order to be able to inject water to become heated and then to be able to capture it in a separate and distant well for pumping to the surface, where the heat is extracted and used

and then the water recirculated, requires a hydraulic connection and this is created by FRACKING!

Very recently (Grigoli et al 2018) report an earthquake in Pohang, South Korea of magnitude 5.5ML which has been suggested to be linked to the nearby hydraulic stimulation of a geothermal region.

Figure 4 shows a cartoon of a typical hydraulic stimulation operation. This starts out as a conventional well at the surface with the customary set of concentric liners ranging from about half a metre down through to about 25 cm., which are installed to protect the near-surface, and the deeper potable aquifers from drilling fluids and hydrocarbons.

Conductor Casing (c 500 mm. diameter): This outermost casing, usually installed to about 25 metres depth, supports the overburden, isolates shallow groundwater, and prevents corrosion of the inner casings, and may be used to structurally support some of the wellhead load. The casing is secured and isolated from surrounding unconsolidated deposits by a cement caisson, which extends to the ground surface.

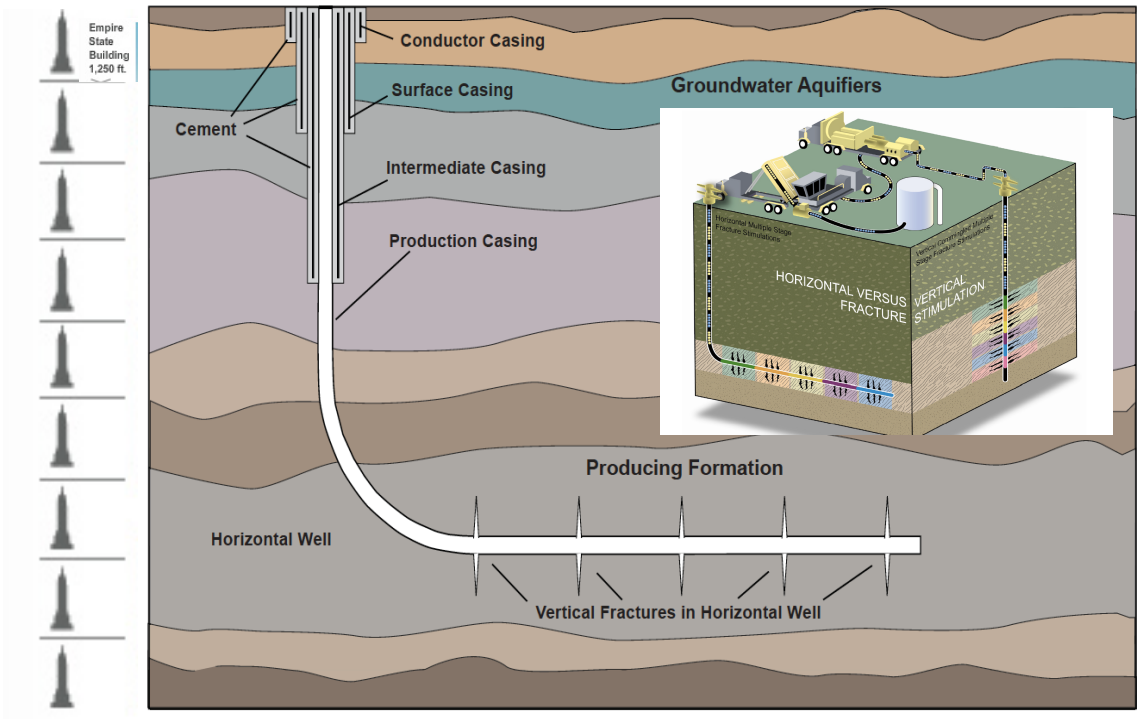


Figure 4 The Casing structure and the geometry of a hydraulic stimulation (fracking) process. Note that this is NOT to scale and that fracking typically occurs at c 3 km (10,000 feet) as shown by the multiple Empire State Buildings shown on the left. (Sundry sources)

Surface Casing c 350 mm.diameter: After the conductor casing has been drilled and cemented, the surface casing is installed to an appropriate depth below the deepest potable aquifer to protect groundwater. Pressure integrity tests are conducted at this stage:

- Casing pressure test: to test whether the casing integrity is adequate
- Formation pressure integrity test (FIT): is performed to ensure the cement job has provided a complete seal and provide an assessment of the strength of the rock formation in that zone.
- A cement bond log (CBL) is also conducted using a sonic tool to confirm the presence and the quality of the cement bond between the casing and the formation along the entire cemented section of the well bore.

N.B. CBLs can also be undertaken during the life of the well to confirm integrity.

Intermediate Casing – c 250 mm. diameter: The purpose of the intermediate casing is "to isolate subsurface formations that may cause borehole instability and to provide protection from abnormally pressured subsurface formations" (API, 2009). It is cemented either to the ground surface or to above any drinking water aquifer or hydrocarbon bearing zone. Casing pressure and formation pressure integrity tests ensure the casing and seal integrity.

Production Casing – c 180 mm. diameter: The production casing extends from the surface all the way into the natural gas producing zone, isolating it from all other subsurface formations and allows pumping the HF fluids into the target zone without affecting other hydrogeological units and then provides the conduit for natural gas and flowback fluid recovery once fracturing is completed. The production casing is pressure tested to ensure well integrity, prior to perforating the casing within the hydrocarbon bearing zone and performing the HF stage.

Petroleum wells therefore consist of a series of concentric steel casings and cement layers. This practice ensures that robust cement integrity exists across casing shoes providing complete zonal isolation in the wellbore. **Casings are similarly tested and**

can also be repaired during the life of the well and a minor defect, which may be a reportable incident and then appear in statistical estimates as 'well failure' should not be seen as a catastrophic or irrecoverable failure.

Prior to Hydrofracturing, the well is plugged using standard cement plugs to isolate the wellbore below the target zone. Production zones are accessed by perforating the production casing and surrounding cement of the well with small holes c 3 mm. in diameter, typically along four sides facing the target formation, using a perforating gun designed to make tiny holes through the casing, cementing, and any other barrier between the formation and the well. Within each zone there are up to 6-7 clusters of small holes with 6-7 perforations in each cluster. The perforations allow injection of the HF treatment into the rock reservoir and the subsequent flow-back of spent HF fluid, produced water from the formation and hydrocarbons into the well and up to surface.

Many issues associated with shale gas have been postulated and are shown in Figure 5

Does the fracking process:

1. Cause contamination of hydrogeological sources, i.e. aquifers, with fracking fluid from deep hydraulic fractures
2. Cause contamination of surface potable water with fracking fluid and especially methane from poorly constructed wells and surface spills
3. Cause overwhelming visual and infrastructural impacts
4. **Pose a serious risk of damaging seismicity**
5. Pose health threats either short-term or long-term
6. Pose a threat to water resources in term of usage
7. Threaten our ability to manage carbon budgets in order to stabilise climate change

The answers to these questions are often: 'it rather depends on what you mean……' and research suggest that answers to many of these questions are likely to be NO if the process is done right, in the right geological conditions, but this is not the main substance of this report and the arguments will be confined to addressing Item 4 concerning seismicity.

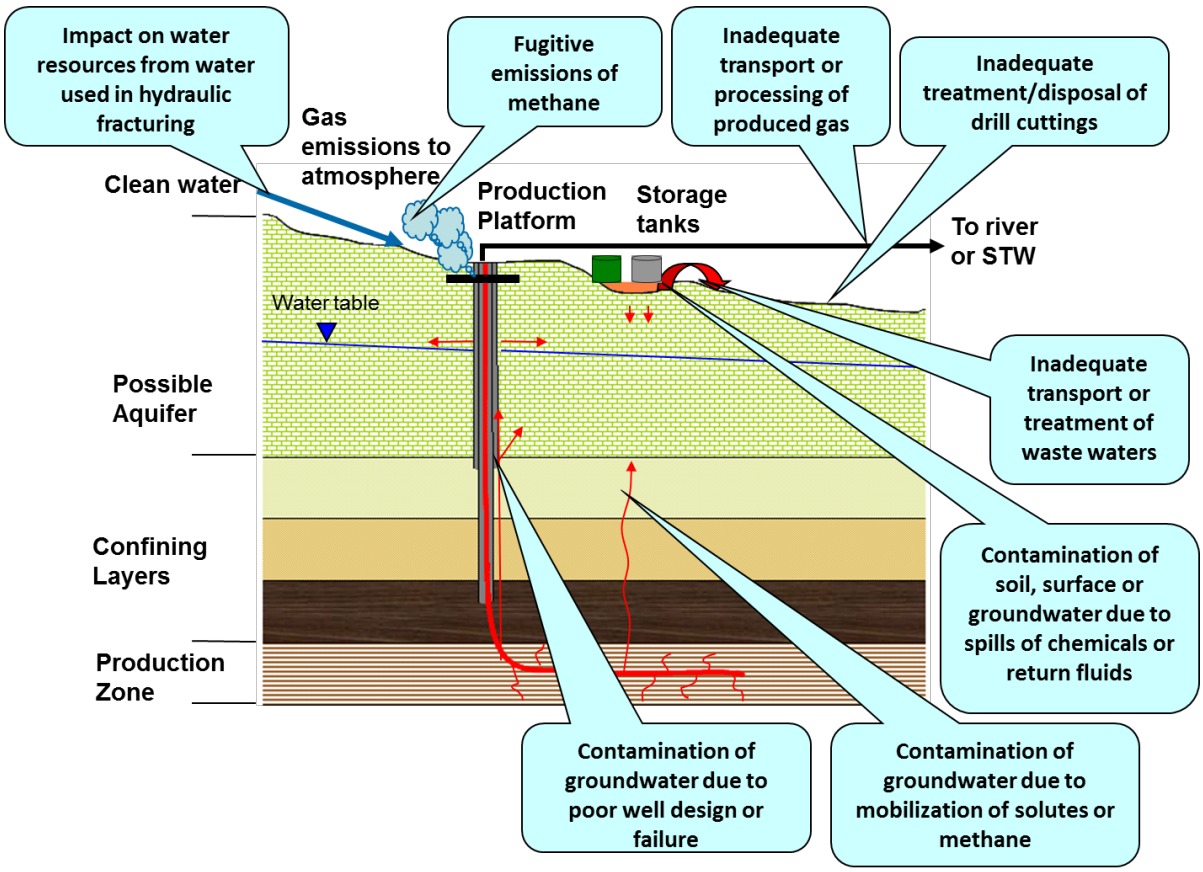


Figure 5. Postulated Routes to Environmental impact from the Shale Gas Hydraulic Fracturing operations. (UK Environment Agency)

N.B. Just because a route is illustrated here does NOT necessarily mean that it IS an environmental threat.

In some cases, a "mini-frac" treatment, a Dynamic Fracture Impedance Test or DFIT, utilizing a small volume of HF fluid, is initially conducted to collect diagnostic data about rock strength. stress magnitudes and orientations, which are then used to refine the computer modelling results and to optimise the HF execution plan.

The HF process is designed and conducted in a series of sequenced pumping stages, at pressures of up to c 10,000psi (c 700 bars) typically over a period of 2-5 hours in order to produce a series of usually vertical fractures which enhance the permeability and achieve stimulation of the formation to form conduits which can release and permit the transport of gas and other hydrocarbons into the well. Volumes are typically of the order of 500,000 US Gallons of fracking fluid which consists principally of water and sand but with minor

amounts of other chemicals. If the pressure is released the fractures will close and so either silica sand, or proprietary ceramic equivalents are emplaced into the fractures to prop them open and ensure a permeable transport path.

The fracking will usually begin at the furthest distance from the well and will progressively move closer, in a sequence of stages to produce a wide zone of stimulated rock. It may seem as if this is a process, which is carried out at such a distance below ground that it will be difficult, if not impossible, to know where, and how big the fractured zone is but in fact this isn't the case. Each tiny fracture, which propagates and eventually coalesces to give the stimulated network, emits a burst of seismic energy, a microseismic event, which carries with it knowledge of where the fracture is, what its orientation is and how large a fracture has developed.

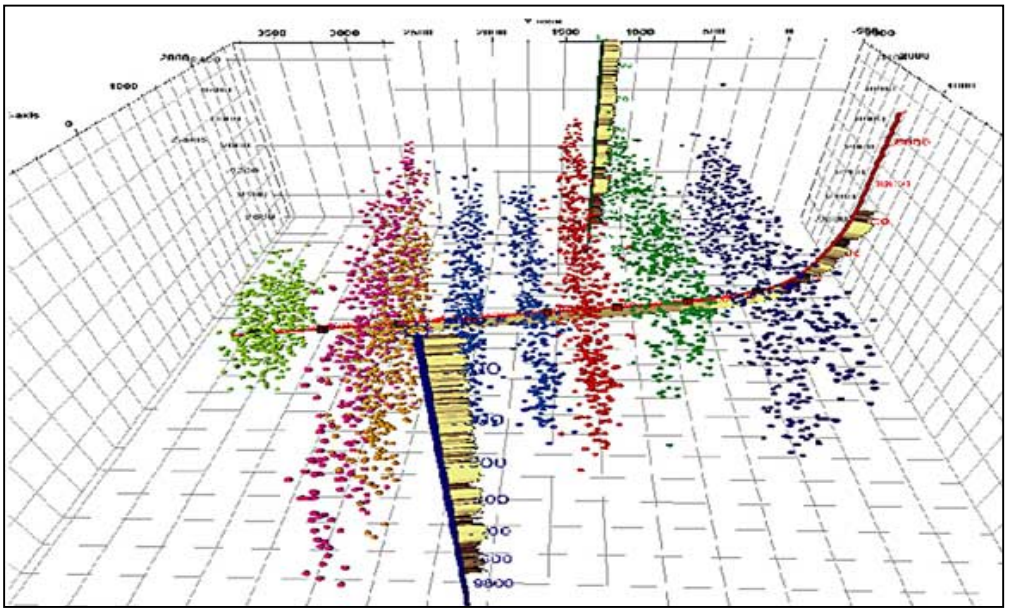


Figure 6 Microseismic clouds for a sequence of stimulations, which start at the furthest extent of the casing (left) and progressively work inwards. The horizontal and vertical extents of the fractures are clearly delineated by this micro seismicity. (Schlumberger 2007)

Figure 6, shows the microseismic event clouds from a series of seven hydraulic fracturing stages showing how they extend away from the well laterally and both upwards and

downwards to varying distances which we will see are determined by local stresses and rock strengths. When fracking is complete it is then possible to flowback the injected fluid which must be either (and preferably) treated and re-used or disposed of in a controlled and regulated manner (of which more later) and the operator can start to extract gas and /or other shale generated hydrocarbons.

There are essentially two families of fracking, '**slickwater fracking'** which as the name implies uses relatively low-viscosity slippery fluids which can penetrate easily into rock for significant distances and **'gel fracking'** which uses more viscous gels which are often formed with other liquids such as propane or as gas foams with Carbon Dioxide and Nitrogen. It may sound environmentally foolish to use a hydrocarbon to frack but as we are trying to recover hydrocarbons it is just part of the product and can be recovered. These gases, including Carbon Dioxide, of which we have too much dispersed in the atmosphere are actually expensive to obtain in pure form for these purposes and the jury is still out as whether these are more efficient/economic/environmentally preferable. These are shown in Figure 7:

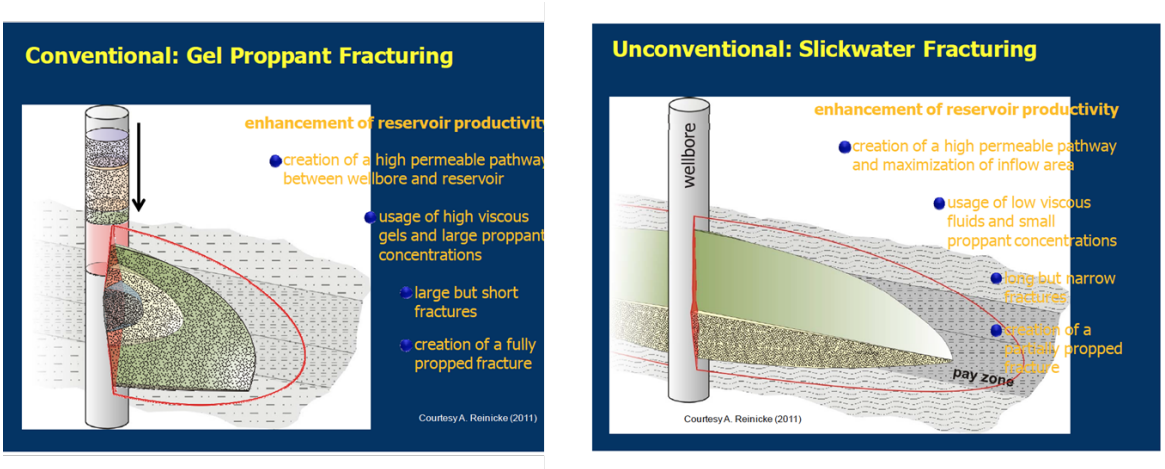


Figure 7 Gel and slickwater fracking

So, we have injected water at sufficiently high pressure to overcome the weight of the rock above which is typically equivalent to about 10,000 psi. A network of anatomising fractures has been produced extending away from the wellbore.

If we now reduce the pressure in a process called flowback and do nothing else, these fractures will immediately close under the huge lithostatic (rock weight) pressure! Therefore, something must be done to keep these fractures open while still permitting gas

to flow through them and this where proppant comes in. This is often just well-rounded particles of silica sand which pack and still leave pathways for gas flow but can also be specially created coated ceramic spheres which are more expensive but are more resistant to crushing by the high pressure in the fracture. 99.5% fracking fluid is composed of water and proppant; It is important to appreciate that the presence of faults or fractures does not necessarily imply that they are conduits for transport of water/gas/oil or dissolved materials. In most case these fractures are of low hydraulic conductivity due to their irregular surfaces, their significant normal confining stresses and the presence of clay minerals created during the faulting process (gouge) or precipitation of minerals of various kinds including calcite and quartz which seal the fault. If it were not so the hydrocarbons which we would like to access would long ago have escaped to the surface and disappeared and in fact this may be true of a fair proportion of the resource which was once there as we see seeps of hydrocarbons at the surface in many part of the world.

In fact, we have a pretty good handle on the height to which fractures can go from the microseismic monitoring which we discussed previously and Figure 8 shows this in two ways. The main Figure shows the depth of aquifers in the Barnett area of Texas which are extensive and extend to more than 1000 feet (300+ metres) but also the extent of the fractures both above and below the well. The inset shows that they rarely rise more than 300 metres and rarely extend below 200 metres from the well and Davies et al (2012) have shown that there is a negligible chance of a hydraulic fracture extending more than 600 metres and, in the UK, this has become the de-factor standard for the respect distance between fracking and overlying aquifers, i.e. c 2000 feet). This is discussed in some detail later.

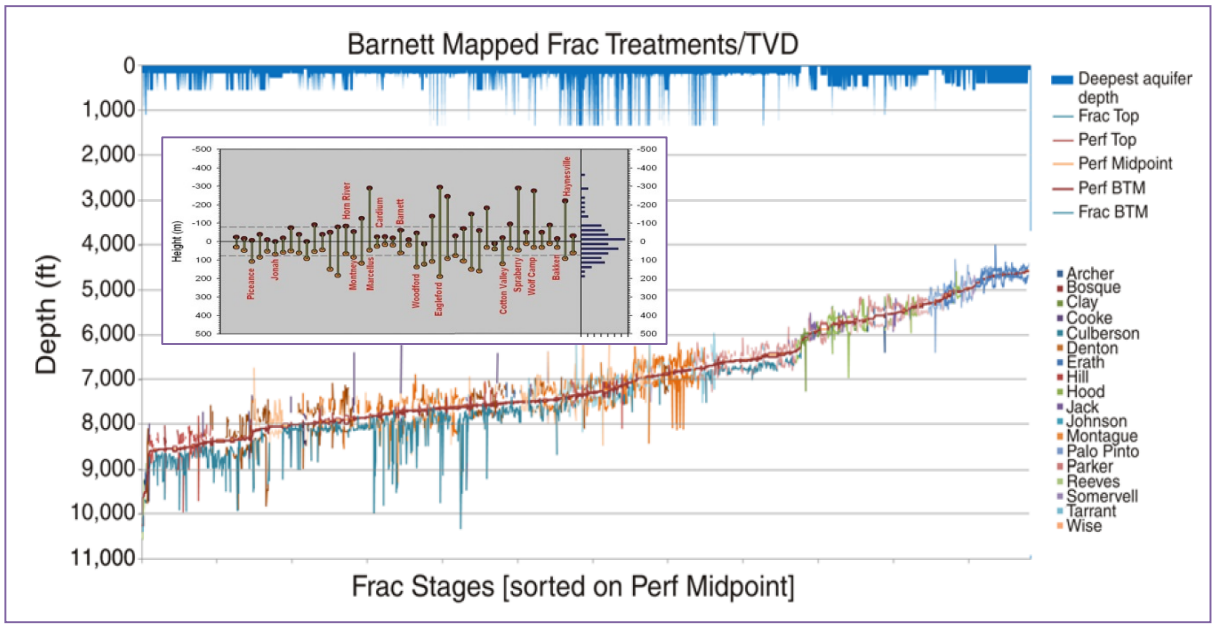


Figure 8. Vertical extent of hydraulically stimulated fractures with respect to aquifers and to the casing position (inset). After Warpinski et al (2012) and Maxwell (pers. comm).

Microseismicity and Induced seismicity; Coal Mining and Hydraulic Fracturing

We have already seen how Hydraulic Stimulation, now much better known as 'Fracking' produces enhanced permeability in shale rocks by generating small fractures through the application of high-pressure water combined with the injection of proppant (sand) and other chemicals to support the fractures during the extraction process (Figure 9)

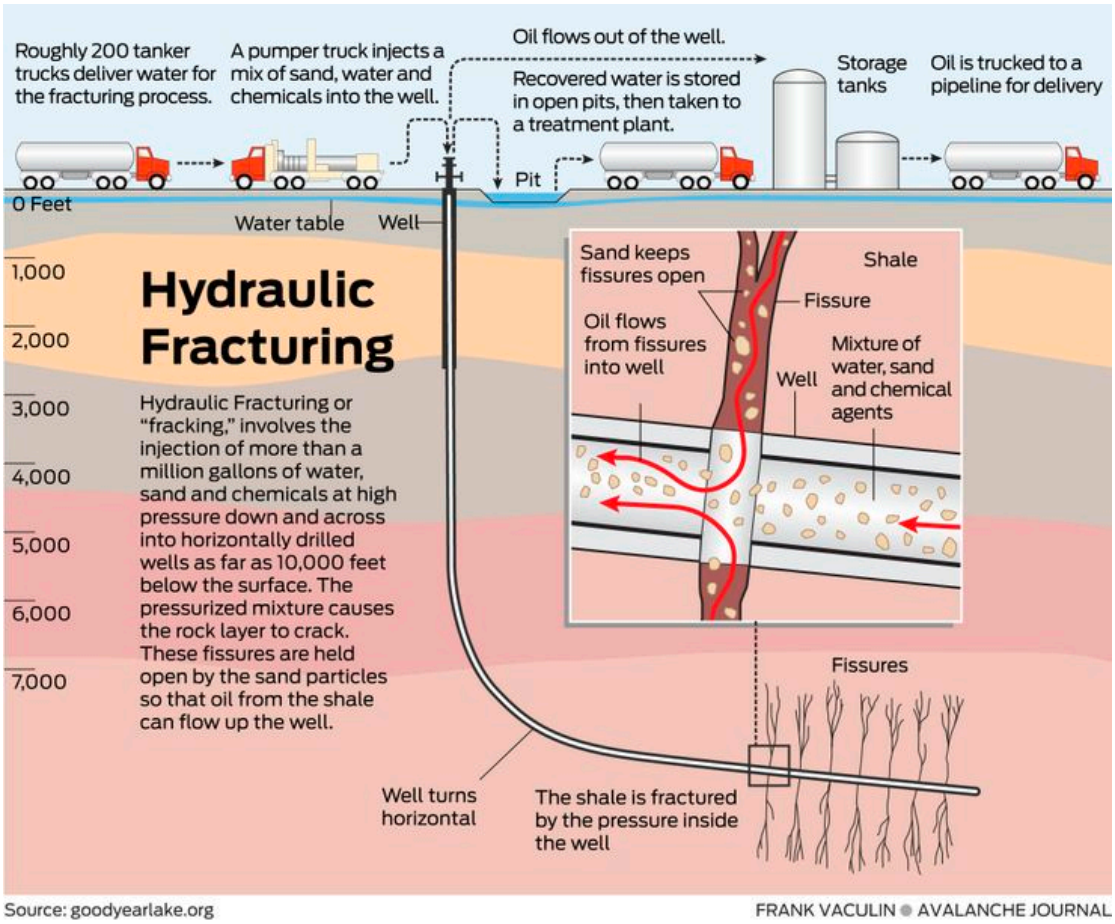


Figure 9 Schematic of the Hydraulic Stimulation ('Fracking') process

The generation of the individual fractures is manifest as very tiny earthquakes, microseismic activity, with magnitudes generally below 0.0 ML. In fact, it is the capability to detect, locate and map these microearthquakes (Figure 10) which has facilitated the mapping of zones which are stimulated by this process and which then have enhanced permeability from which shale gas and oil can be drawn successfully

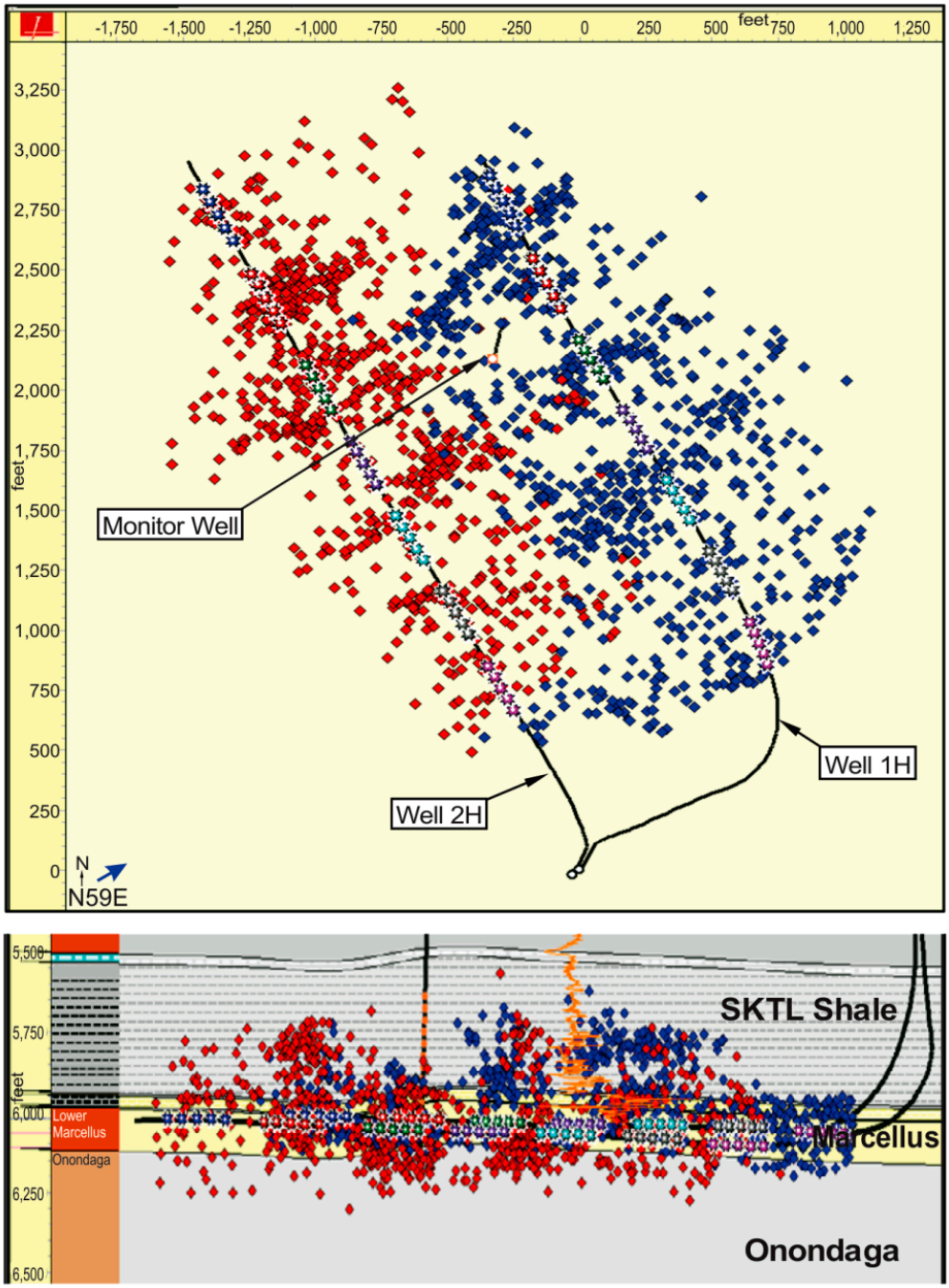


Figure 10 Microseismicity associated with the fracture process from two adjacent horizontal wells (from Warpinski 2012)

These microearthquakes are usually much too small (less than magnitude 0 ML often) to be perceived by the population, even very close to the activity. However, sometimes, the stress changes and /or the changes in groundwater pressure and circulation can facilitate movements on pre-existing, often very old, faults with the generation of larger seismic events, which may be experienced by the population over much wider geographic areas and this is known as 'INDUCED SEISMICITY", which is not, in itself, unknown from a variety of causes, most notably in the UK associated with either current or historic coal mining. Shale-gas related seismicity came to prominence in the UK in 2011 when on April 1st, 2011 a number of felt seismic events occurred during the very first fracking test at Preesall, Lancashire (known now as the Blackpool earthquakes for various reasons) by Cuadrilla Resources with the largest event at 2.3 ML, but with other subsequent events of 1.5 ML and lower. Keele University Applied and Environmental Geophysics Group, together with BGS installed seismometers and monitored the activity over the relatively short period of operation and showed the relationship between frack stages and seismic activity and a report was written advising HMG together with a number of subsequent papers (Green, Styles, Baptie 2012). Shale gas activities were severely curtailed following this and there has been considerable opposition from environmental organisations and local public groups about the concept and its implementation. Rather surprisingly, reports from the USA of shale gas induced events, were initially rather limited and despite induced seismicity, purportedly related to fracking happening in the Horn River Basin in British Columbia in 2009 this was not reported until 2012 after the Blackpool sequence happened (British Columbia Oil and Gas Commission (2012)). The Blackpool seismicity was reported generally by Styles and Baptie (2012), in detail by Clarke et al (2014), Styles (2014) and reviewed by a Royal Society Committee (2012).

Issues associated with the reactivation of faults are very relevant to the Environment Agency who state:

"Reactivation of faults during hydraulic fracturing could cause loss of fluids outside of the permitted zone or formation. As well as being contrary to the permit conditions this could lead to fluid migration to formations that contain groundwater that requires protection. In some cases, there could be damage to the borehole structure that in some circumstances

could conceivably allow loss of fluids that could impact on groundwater and, in the case of gases, could impact on air quality"

Mining-Induced Seismicity

Because of the very limited amount of monitored fracking which has taken place to date in the UK, we must look elsewhere for information about how the rocks of Britain behave when subject to applied stresses. We are fortunate (or unfortunate depending on perspective) to have been able to detect, monitor and analyze many thousands of tiny, small and medium earthquakes and microseismicity from coal mining and I have been carrying out work in this area for some 40 years now. A review of Anthropogenic Seismicity in the UK can be found in Wilson et al (2017).

Mining-Induced Seismicity, i.e. small (usually) earthquakes generated by the extraction of coal have been reported globally and, of more relevance in the UK, since the 1900s, soon after long-wall coal mining replaced pillar and stall mining as the preferred mode of extraction.

I have written extensively about this in many publications (e.g. Styles et al 1997) and the microseismicity patterns are not very different (although occurring at much shallower depths) from those associated with fracking, with a relatively narrow zone of deformation some few hundred metres wide, concentrated around a coal-face (fracking location). While minin- induced earthquakes have raised public apprehension as they can reach magnitudes of c 3ML they have generally been accepted, together with subsidence, as a part of the price of obtaining one of the main UK energy resources over previous centuries and if damage was done then compensation was available (NCB and then Coal Authority) to mitigate the loss. Similar subsidence, if not seismicity, is associated with brine extraction especially in Cheshire and North Yorkshire and was also compensated by the Brine Compensation Board

While at Swansea, Liverpool and latterly at Keele University I, with my research groups and graduate students, have had the opportunity through many research grants both from the UK and Europe (ECSC) to monitor several coal fields in considerable detail and to be able to generate images of the microseismicity from Thoresby, Edwinstowe, Coventry and most recently, albeit some ten years ago of Asfordby Colliery and of course around Keele University in the Potteries.

Some images from that monitoring are shown in Figures 11 a, b, c, d .

In the Potteries areas of Stoke, Newcastle-under-Lyme and surrounding areas of North Staffordshire, coal has been worked extensively from a number of seams to some considerable depths (c 1100m) and one of the consequences, together with considerable surface subsidence and the reactivation of faults (more on this later), has been very extensive felt seismicity which is shown in Figure 11a with an event of 2.4 ML , larger than the Blackpool seismic events but which did not generate a great deal of local concern!!

However, in a '**well-behaved'** coal mine the microseismic activity remains relatively closely defined and can be shown to be much as predicted by numerical models of the stress changes around the excavated zone and extending into the roof and also the floor of the mine. The event size is again, very, very tiny usually with magnitudes below zero and in some case down to -3 and -4 ML. This is shown in Figure 11b from in-seam monitoring of Coventry Colliery. The similarity between this and the patterns of 'well-behaved fracking as shown in Figure 10 are clear.

However, it is not always possible to obtain what is known as 'roof control' and this appears to be often related to the presence of pre-existing geological discontinuities, most notably faults, when stress changes precipitate movement some considerable distance away from where it might be expected and often with seismic events which are much larger and sometimes felt by populations.

In the early 1990s, significant felt seismicity was reported from the Thoresby region of the North Nottinghamshire coalfield and we monitored this with a large network of surface seismometers and published a paper on it (Bishop, Styles and Allen, 1993) and this will be discussed at some length later, but the distribution of the seismicity is shown in Figure 11c

Asfordby Colliery (Figure 11d) is one of those locations where mining was associated with seismicity which occurred on faulting high above the zone of mining and which eventually led to the premature closure of what was a very expensive mine to open and which had been expected to be a major contributor to UK coal extraction. Monitoring at that time, while technically of a high order, and with very refined detection capabilities was generally done in retrospect, with later analysis of the data and its interpretation in terms of mining operations'.

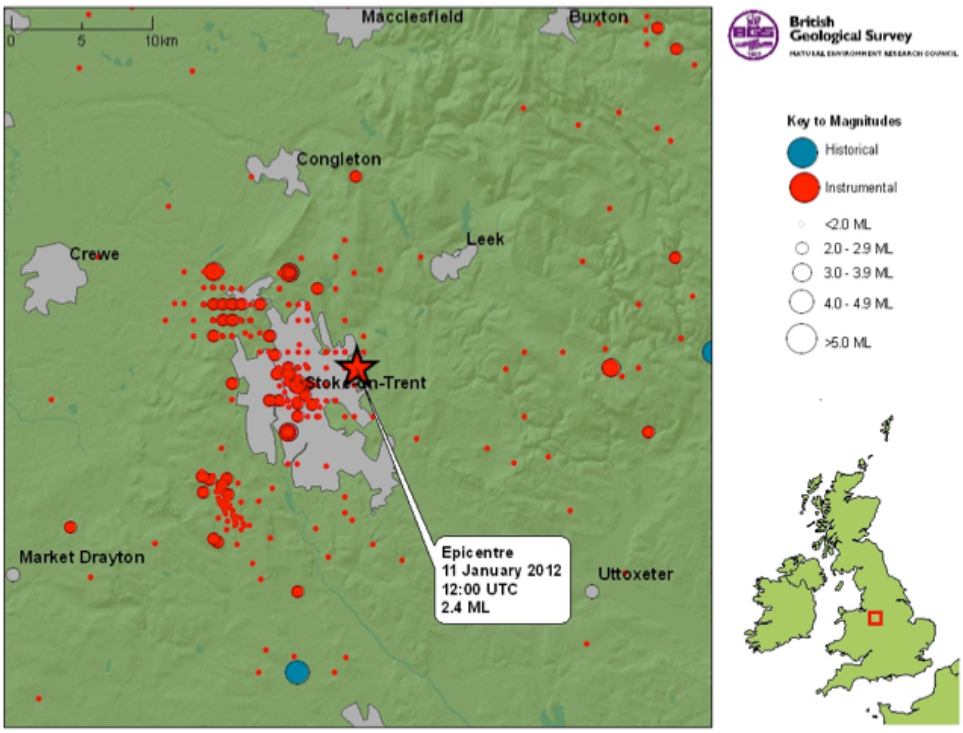


Figure 11a Seismicity recorded in the Potteries associated with coal mining including a magnitude 2.4 ML event (larger than the largest Blackpool Earthquake!)

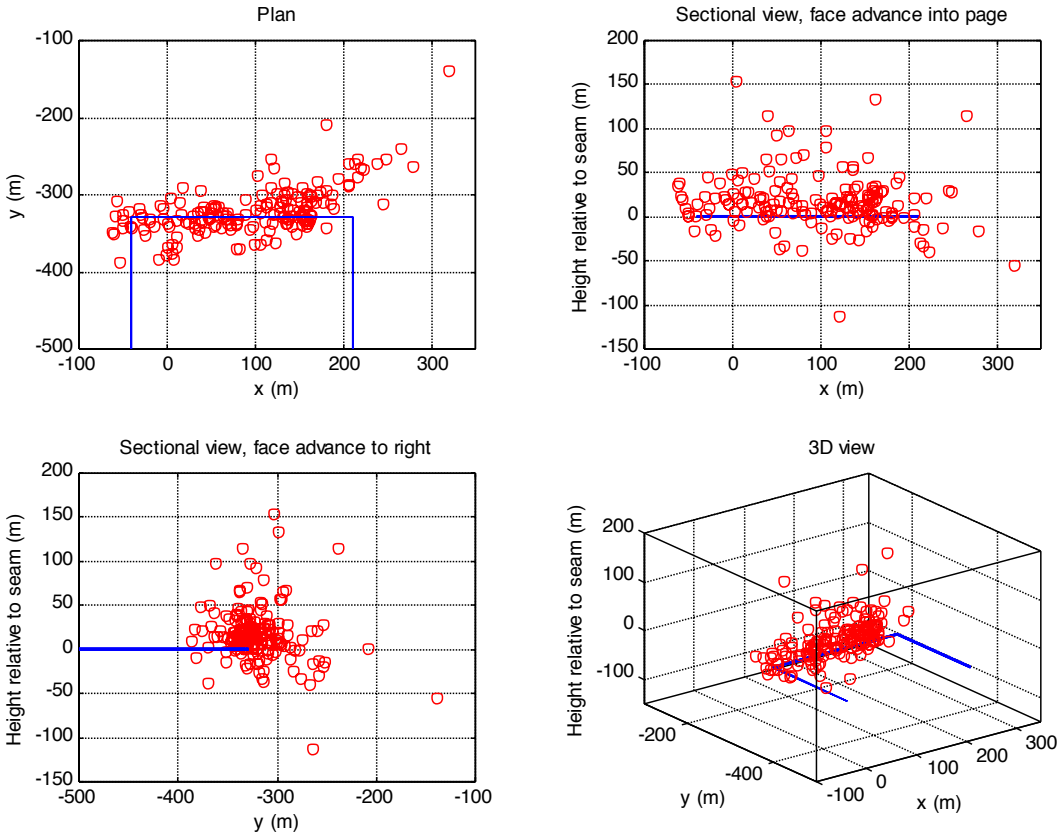


Figure 11b Microseismicity recorded using in-seam techniques from Coventry Colliery (Styles et al 1997)

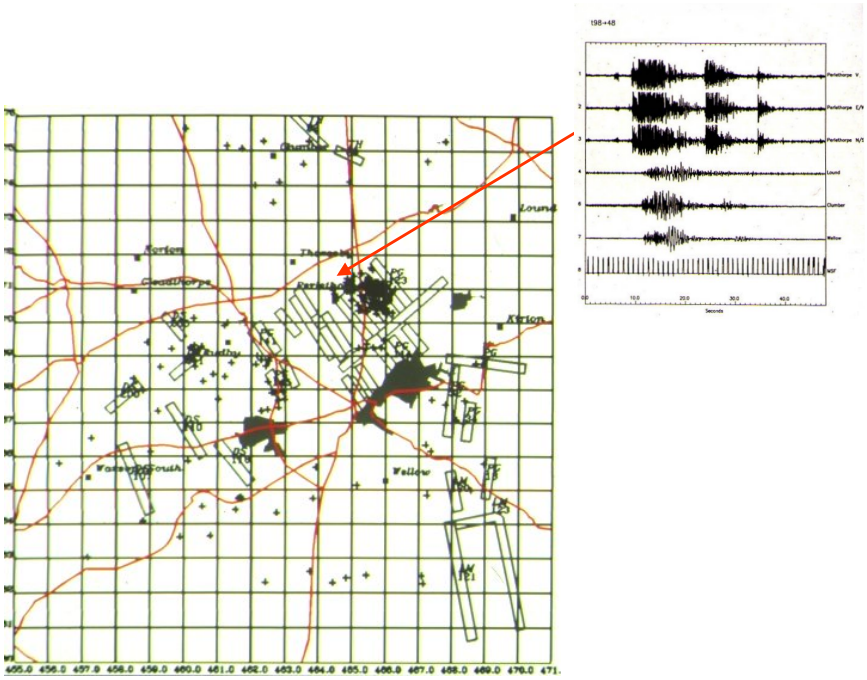


Figure 11c Seismic activity recorded in the North Nottinghamshire Area associated with mining from Thoresby Colliery. (Bishop, Styles and Allen, 1993)

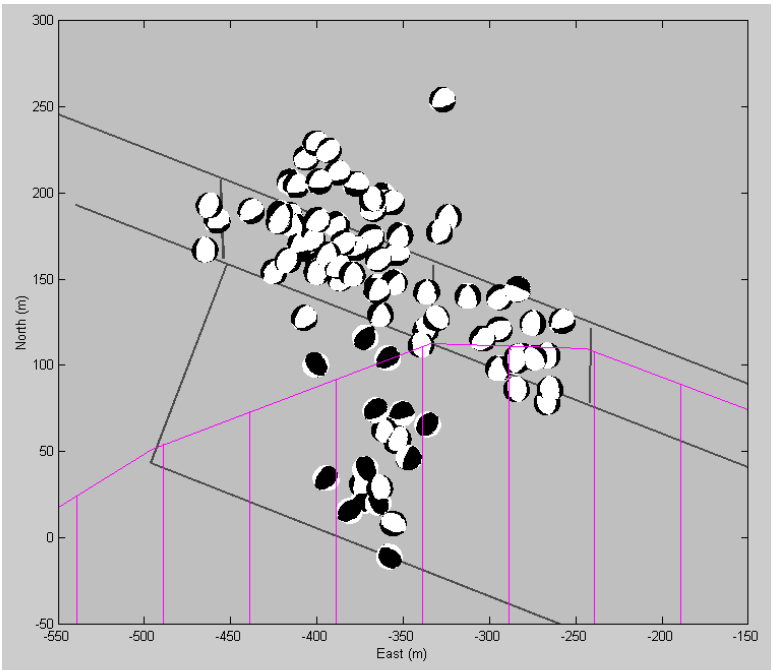


Figure 11 d Location of microseismic events and their source mechanisms during extraction at Asfordby Colliery, Note the normal faulting sources (white rugby balls), in the vicinity of the workings but thrust mechanisms (black rugby balls), lying above and south of the workings, considered to be associated with stimulation of activity on a pre-existing fault.

We can see that the onset of stimulation of activity on pre-existing faults, as opposed to new fractures, is generally associated with an increase in magnitude often of several orders and this has been noted for fracking operations in the USA (Figure 12) albeit still at extremely low magnitudes of less than 0.5ML.

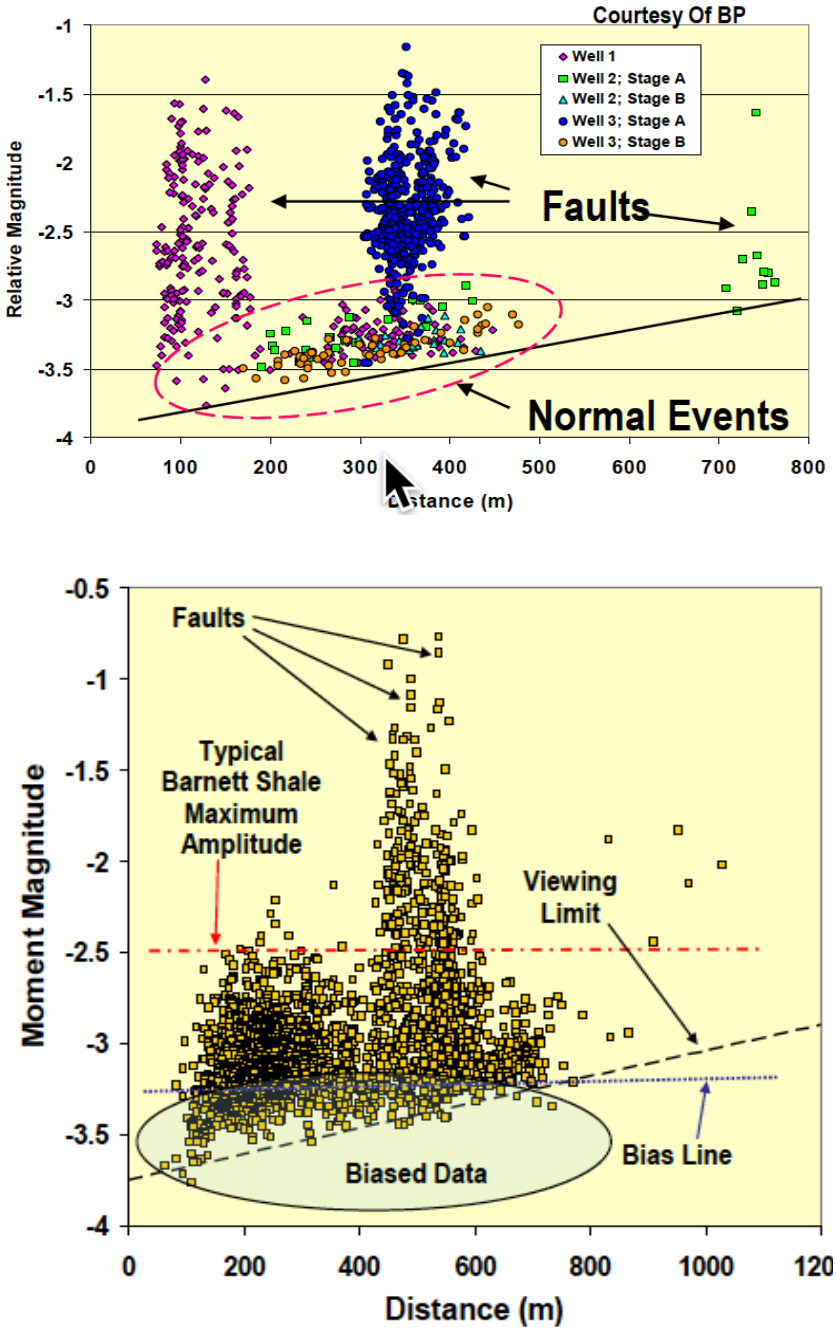


Figure 12 Microseismicity and its increase in magnitude as pre-existing faults are stimulated. Examples from the Barnett Shale.

Figure 13 shows the relationship between the Bowland Shale and the Coal Measures. It lies beneath the Westphalian coals and shales of the Coal Measures in the rocks of Namurian (Millstone Grit) and Dinantian ages both of which overly the Carboniferous Limestone (Frazer and Gawthorpe 1990). In many areas, the Bowland Shale is found within a few hundred metres of worked coal seams.

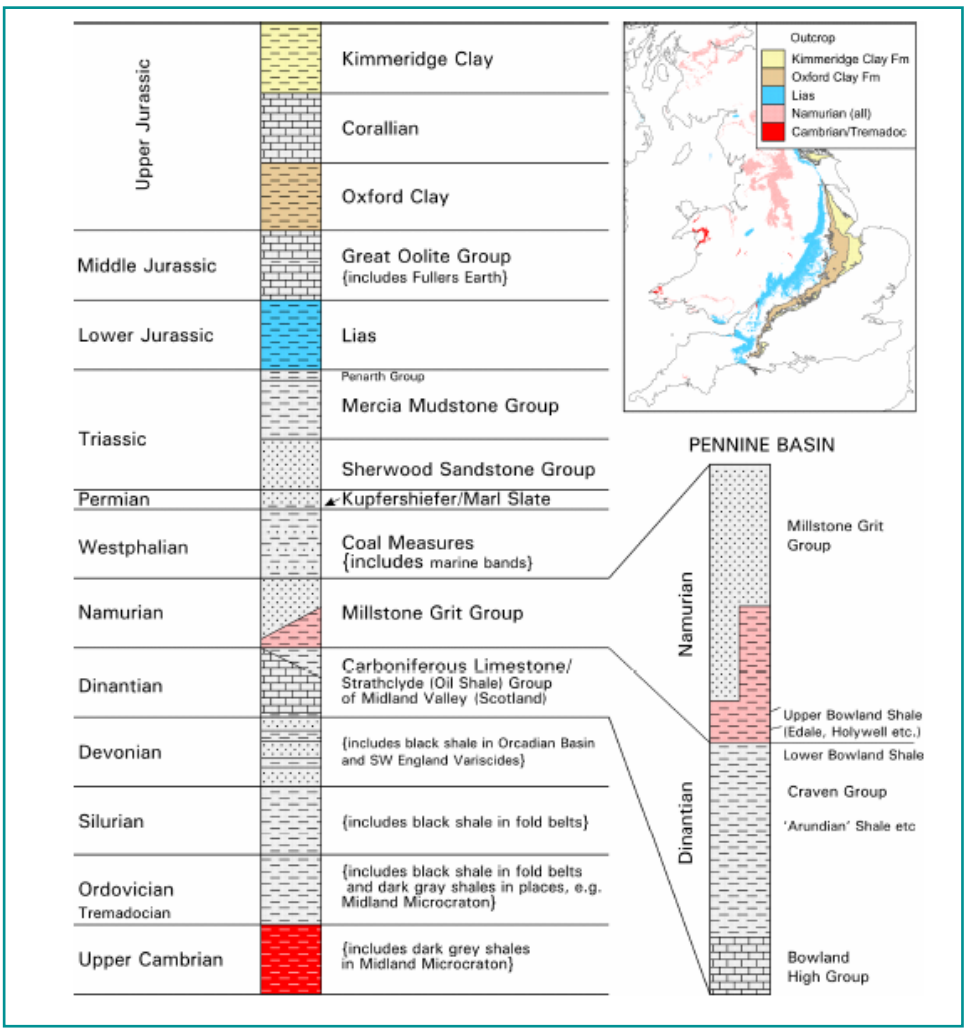


Figure 13 Stratigraphical position of the Bowland Shale with respect to the Coal Measures (BGS)

Figure 14 show the first fracked well for shale gas in the United Kingdom which commenced in March 2011 and Table 1 shows the fracking stages which took place.

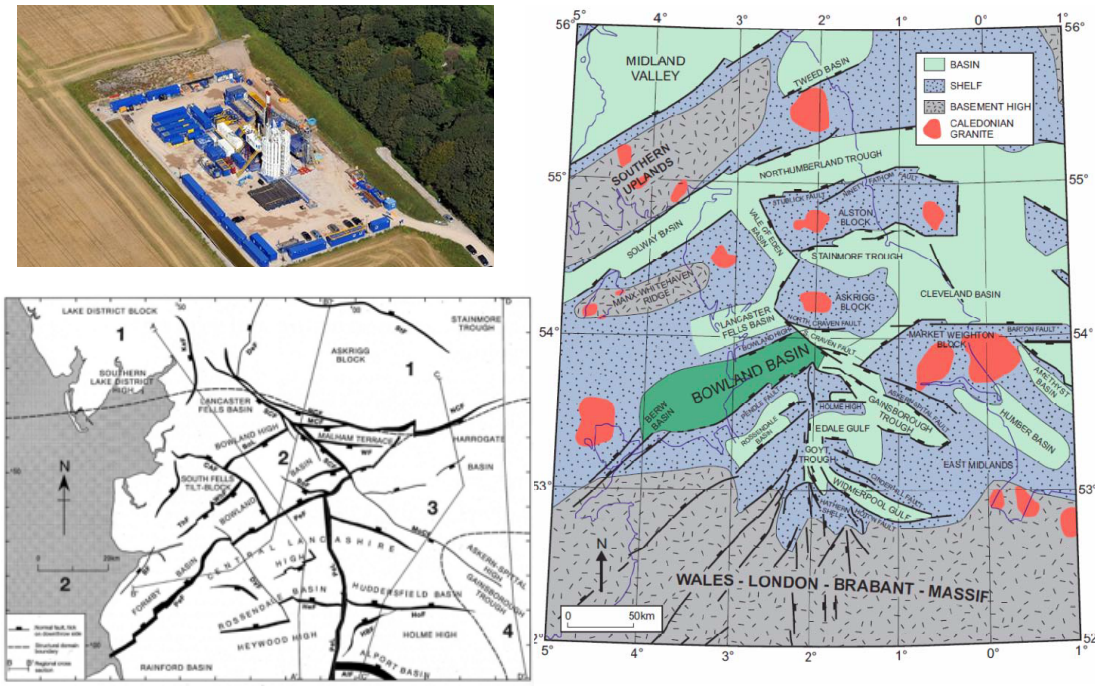


Figure 14. Cuadrilla Preese Hall 1 Borehole and its location in the Bowland Basin which clearly also extends offshore into the Irish Sea.

Stage	Description	Date	Perforations					Slickwater Volume			Proppant	
			Depth			Length	Number					
			Top	Bottom								
			ft MD RKB	ft MD RKB	ft TVD SS	ft		Gallons US	m^3	bbls US	lbm	mton
1	DFIT	26 March 2011	8,841	8,850		9	27	34,314	130	817		
	Job	28 March 2011	8,841	8,949	8,730	36	108	485,856	1,839	11,568	226,240	101
2	DFIT	30 March 2011	8,700	8,759	8,583	27	81	24,780	94	590		
	Job	31 March 2011						593,040	2,245	14,120	262,080	117
		01 April 2011	Magnitude 2.3 seismic event									
		04 April 2011	Deformed casing confirmed with caliper 8480-8640ft MD (just below zone 3)									
3	DFIT	08 April 2011	8,420	8,489	8,340	27	81	10,668	40	254		
	Job	09 April 2011						200,634	759	4,777	116,480	52
4	DFIT	25 May 2011	8,020	8,259	8,052	27	81	21,084	80	502		
	Job	26 May 2011						423,696	1,604	10,088	183,680	82
		27 May 2011	Magnitude 1.5 seismic event									
5	DFIT	27 May 2011	7,970	7,819	7,823	27	81	11,760	45	280		
	Job	27 May 2011						402,780	1,525	9,590	248,640	111
6	DFIT	31 May 2011	7,670	7,789	7,666	27	81	10,290	39	245		
TOTALS							513	2,218,902	8,399	52,831	1,037,120	463

Table 1 Fracking Stages carried out in Preese Hall 1

Although the first frack stage was completed without incident, a sequence of 52 seismic events occurred after the second frack stage and the first earthquake to be noticed was a 2.3 ML event on 1st April 2011. Later analysis of regional seismometers showed that there had been very small (c 0.2 ML) precursory events before this which might have been detected and used as a precautionary warning but as there was no local seismic monitoring (despite my advice that this would be prudent) these were not detected until subsequent analysis of regional seismic records took place. Keele University (i.e. my research group) and BGS then deployed four seismometers between us and recorded a further sequence of earthquakes with a magnitude 1.5 ML event on the 27th May. DECC permitted Cuadrilla to carry out 5 full frack jobs with one additional dynamic Impedance Test (DFIT) which gave a reasonable data set and 5 of the events with magnitudes from 0.4 to 1.5 ML have been scaled to have a common maximum amplitude and are superimposed in Figure 15 showing the remarkable similarity between the waveforms suggesting that they all originated at a common point of the sub-surface and travelled along a very similar propagation path.

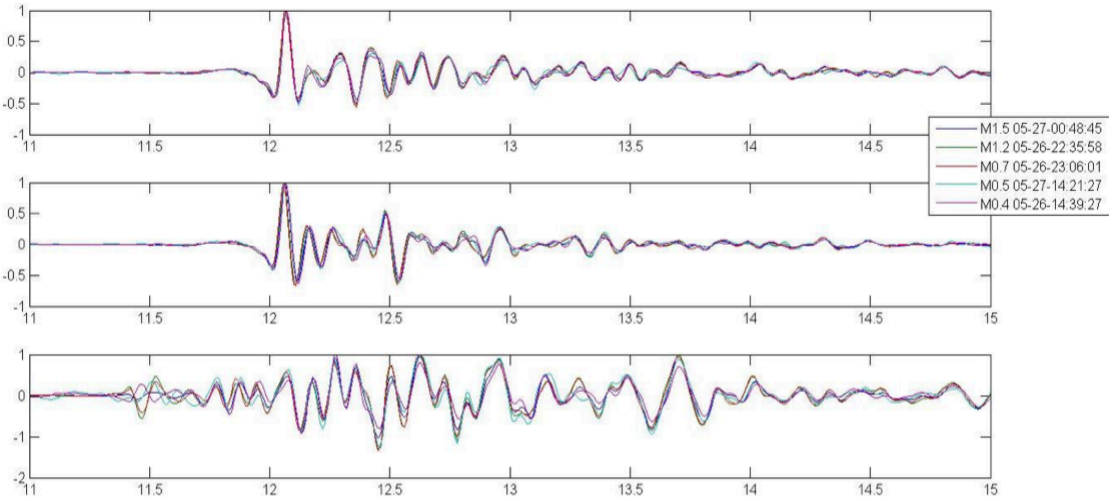


Figure 15. Sequence of 5 Seismic Events from Preese Hall scaled to a common amplitude

This sequence was studied in some detail and reported by Eisner et al (2013), (I was one of the authors of that multi-author communication). In total, fifty-two seismic events ranging between ML -2 and ML 2.3, with waveforms similar to the seismic events of April 1, 2011 and May 27, 2011 were identified following injections on 31st of March and the 26th and 27th of May with remarkably low seismic activity in the period between and after injections.

Only two weak events (M -1.2 and -0.2) were found after May 27, 2011 until 2 August 2011 when another event of magnitude less than 0.0 ML occurred, indicating a rapid decline in seismicity after the end of the injections, another indication of causality. Similarly, only three weak events were observed between the two injection periods and no event was detected during the stimulation of the stage 3. The detection threshold had been improved by the installation of the local Keele and BGS stations on April 12, 2011 and so it is clear that the catalogue from the regional stations is complete down to ML 0.0 The event of August 2nd 2011 was very similar to the May 27th event(s) indicating that there was still some residual if small readjustment taking place on the fault and the orientation was determined with reasonable accuracy despite the small magnitude as strike, dip and rake 40^{o}; 70^{o}; and -$150^{o,}$, a steeply dipping fault oriented more or less SW-NE, in agreement with the main regional fault trends as seen in Figure 14. Analysis of data from the regional station KESW (Keswick) showed that there had been 6 small events of magnitude exceeding 0.2 ML prior to the larger event of 1st April, but during the early part of the hydraulic fracturing when pressures were above 7000 psi.

When we look at the events of 26th and 27th May 2011 (Table 2) in Time sequence rather than in Magnitude sequence as in Figure 15 we can see that the first movement on this fault (with the assumption that all of these lie on the same fault which is justified by the similarity of the waveforms) we see that the first indication was an event of magnitude only 0.4ML, followed by a larger event of 1.2 ML some 8 hours later and then in reasonably close succession events of 0.7 and 1.5ML just before and after midnight on the 26/27 May 2011. A final event of magnitude 0.5 occurred later in the afternoon of 27th May

Day	Month	Year	Min	Sec	Magnitude
26	5	2011	14	39	0.4
26	5	2011	22	35	1.2
26	5	2011	23	6	0.7
27	5	2011	0	48	1.5
27	5	2011	14	21	0.5

Table 2. Five large events of 26th and 27th May 2011 arranged in order of temporal occurrence

The implications are that a small event of magnitude 0.4 (with a downwards first P-Wave motion on the vertical component shown in the lower plot) was the initial indication that this fault was being stimulated and then the subsequent larger events, indicating that a longer length of the fault was being stimulated, have an upwards first P-wave motion.

Subsequent seismic reflection surveying (they were also advised by me to do this prior to fracking as well!) showed that it was likely that the fracking stimulated a fault, a few hundred metres ahead of the frack point (Figure 16).

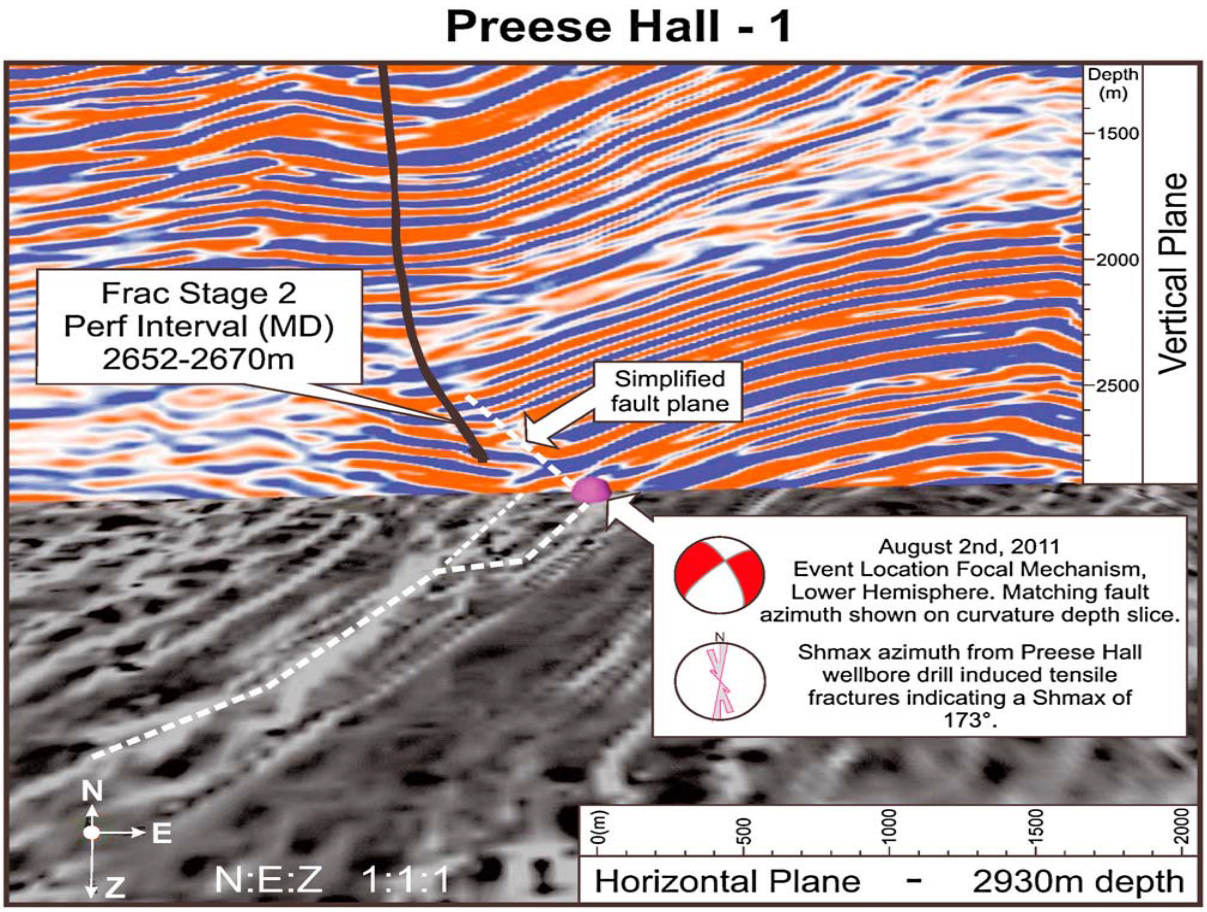


Figure 16. 3-D Seismic reflection data showing the relationship between the wellbore and the fault which was presumed to be the location of the induced seismicity. (Cuadrilla)

I was asked to be part of a team examining the events and reporting to DECC (Green, Styles, Baptie 2012) and in this lengthy report we proposed the following:

We recommend a detailed analysis of potential seismic

*hazards **prior** to spudding the well. This should include:*

- *Appropriate baseline seismic monitoring to establish background seismicity in the area of interest.*
- ***Characterisation of any possible active faults in the region using all available geological and geophysical data***
- *Application of suitable ground motion prediction models to assess the potential impact of any induced earthquakes*

We will return to this recommendation later but note that the Canadian Regulations also recommend

- ***Assess faults, lineations, background seismicity and other possible cases of induced seismicity in the area***

Based on the work of Warpinski et al (2011) in the USA we noted that there seemed to be a distinct change in seismic character at about 0.5 ML, as shown in the following two Figures 17 and 18, and suggested that this point should be the level at which caution should be applied to the fracking operations.

The UK Government (DECC now BEIS) decided that the 0.5 ML limit (Figure 19) should be THE stopping point at which fracking activities should be suspended against our advice that 1.5 ML would be a more appropriate threshold. This seems at first glance to be a prudent decision in order to give maximum protection against significant population-disturbing seismicity but as I will explain this has significant implications concerning the size of the faults which are therefore defined to be of significance and the ability of current seismic reflection techniques to detect faults of those dimensions.

There has been a large body of work done on the relationship between Earthquake Magnitude and the length of the fault slip which has caused that event (Zoback 2012) and as Figure 20 shows, for a 0.5 ML event, that length is only just in excess of 25 metres, perhaps as large as 40 metres, depending on the amount of actual slip which took place.

This is a very small fault and what is most concerning is that the throw (vertical displacement of that fault (not the slip) is of the order of 0.01 to 0.001 of the length, i.e. a throw of less than 0.5 metres (Figure 21). While it is possible to detect and measure that throw at rock outcrop scale the resolution of seismic reflection data is of the order of 10 metres, 5 at the very best and potentially worse. So, the principal technique which we have available for investigating the subsurface in an area which is to be Fracked cannot detect the scale of fault which is capable of producing an earthquake which would stop operations.

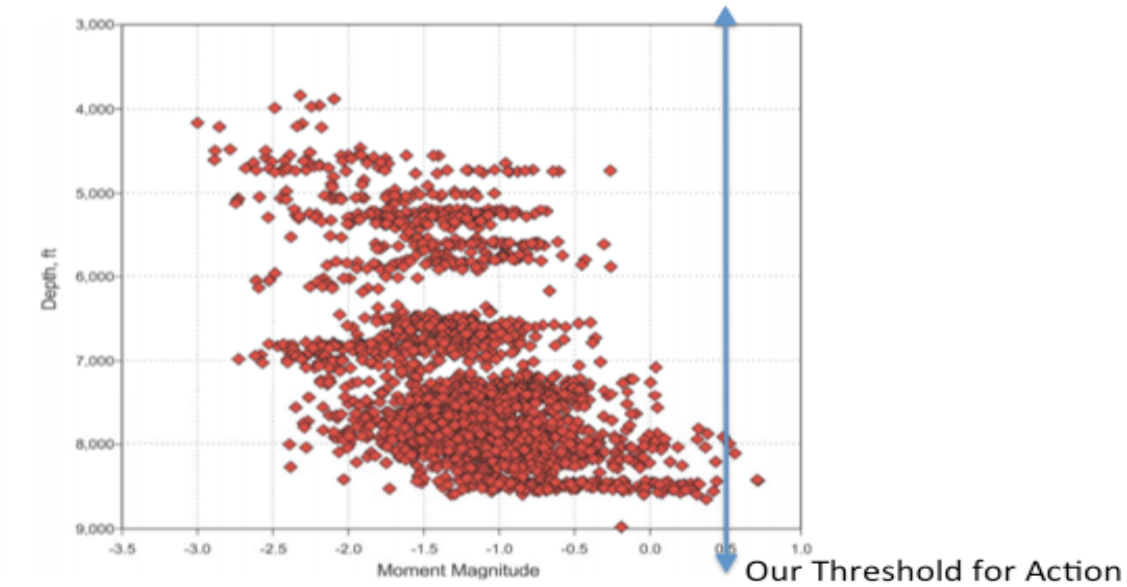


Figure 17 'Normal' microseismic activity from US fracking (after Warpinski et al 2011)

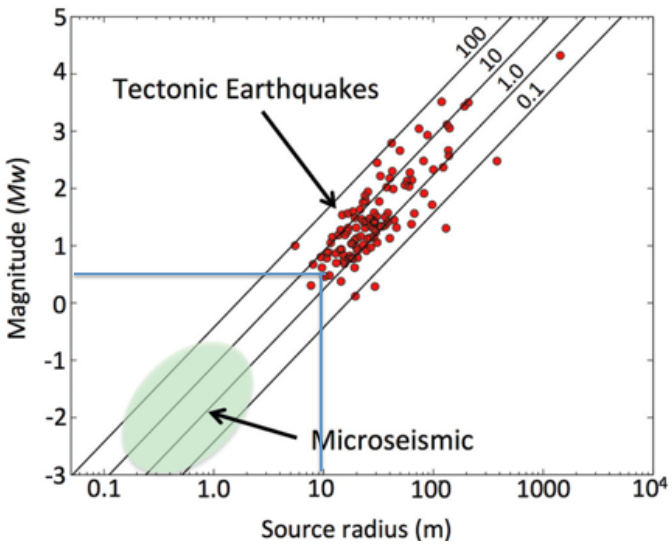


Figure 18 Discrimination between 'normal' microseismic events and induced (fault involved) seismic events and the 0.5ML threshold

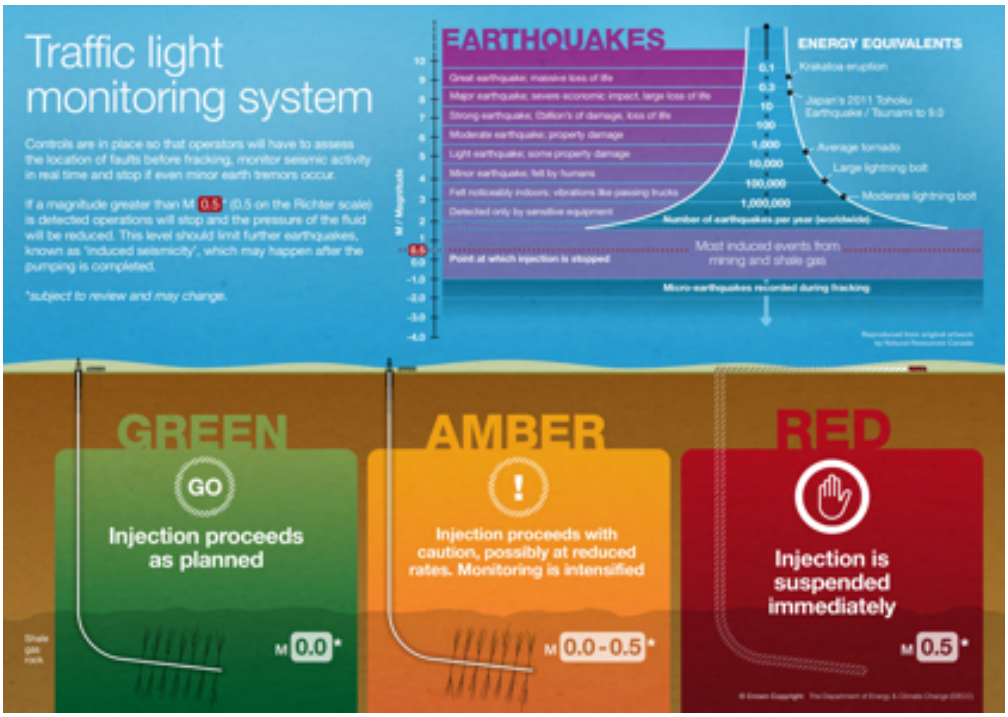


Figure 19. DECC Traffic Light Threshold Regulation.

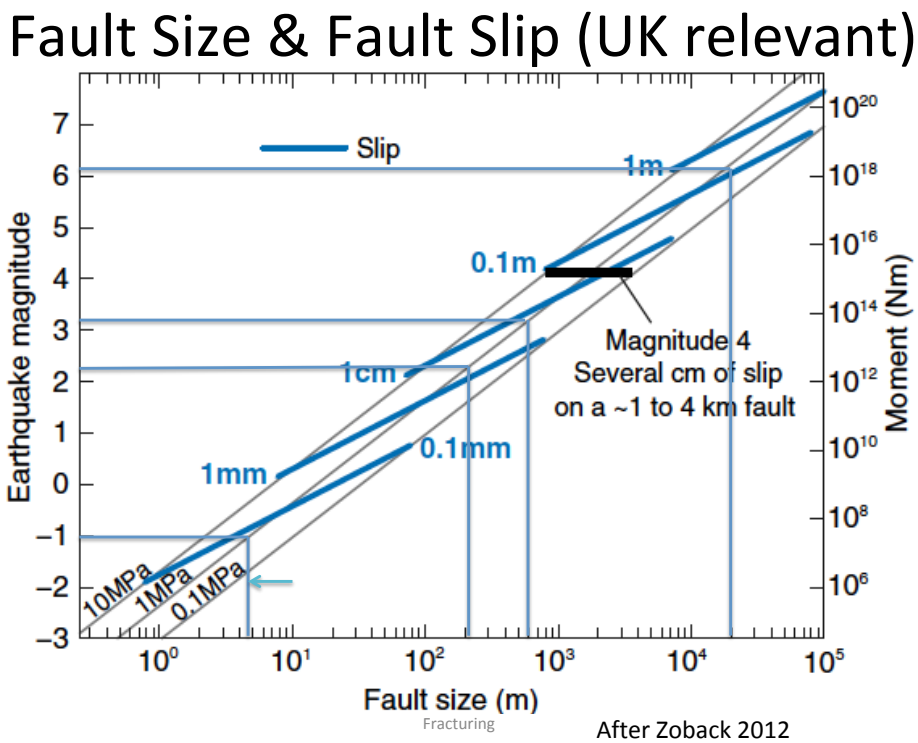


Figure 20 Fault dimensions for a variety of Earthquake magnitudes (after Zoback and Gorelick 2010)

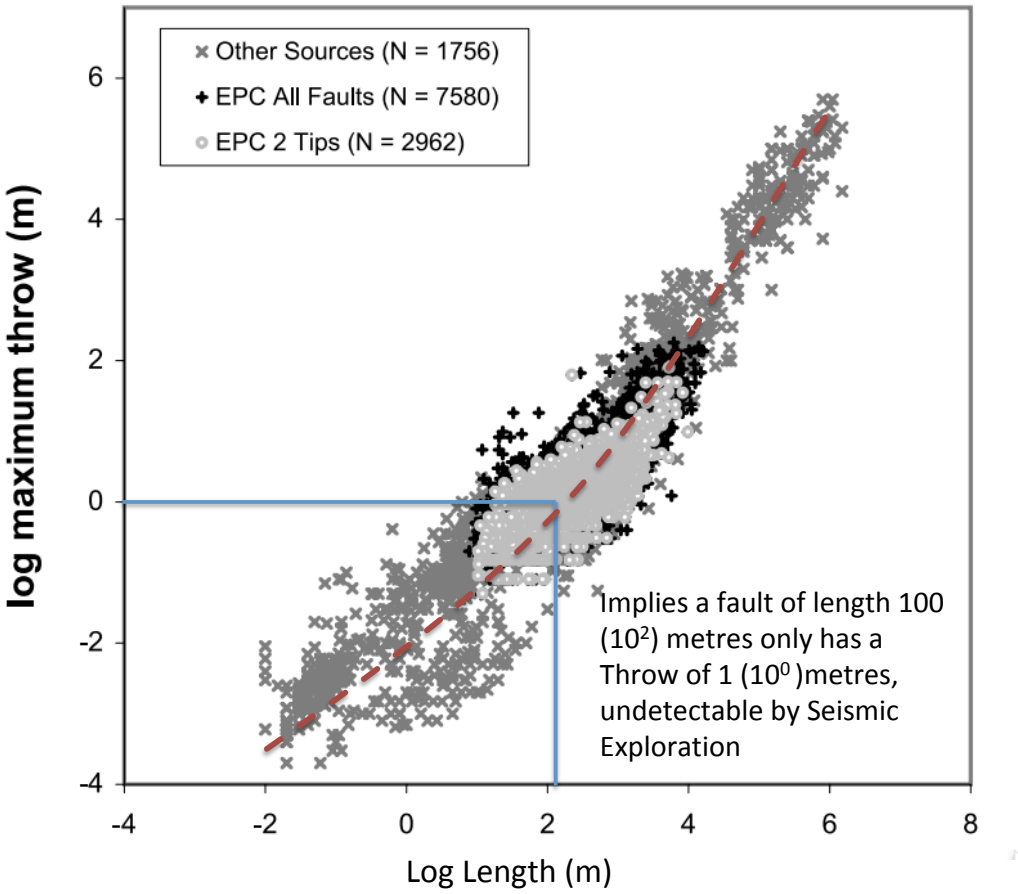
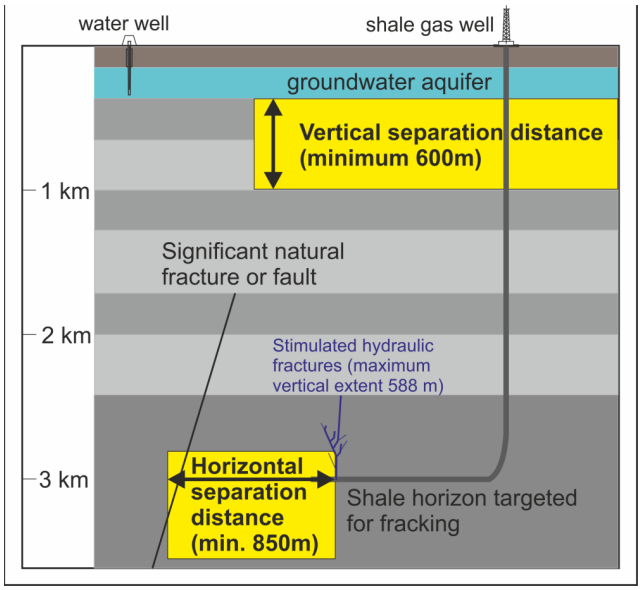


Figure 21. Relationship between Fault Length and Fault throw for faults measured underground in the East Pennine Coalfield (Bailey et al. 2002)

Respect Distances

Subsequent to this work, Professor Richard Davies (Durham) and myself, Professor Peter Styles (Keele), were asked by the Prime Minister's Office (David Cameron as was) to make recommendations as to the vertical (from aquifers) and horizontal (from faults) distances, which we considered, should be observed for incident-free fracking. Those recommended respect distances are shown in Figure 22 and are 600 metres vertically beneath an aquifer and 850 metres horizontally from a fault.

Note that implementation of this requires the detection and mapping of the appropriate faults which on the basis of the previous discussion should include those which might give rise to a 0.5 ML earthquake i.e. 40 metres long and with a 0.5 to 1 metre throw!!!.



In No 10 I told then of your work and the 850 m respect distance. Refine needs more gold nuggets of research like this to keep interest levels up.

Very best wishes
Richard (Davies)

Figure 22 Respect Distances as advised to no. 10 Downing Street in February 2015. (Davies and Styles 2015 pers. comm.)

A subsequent paper by Wilson et al (2018) has confirmed this as an appropriate set of respect distances.

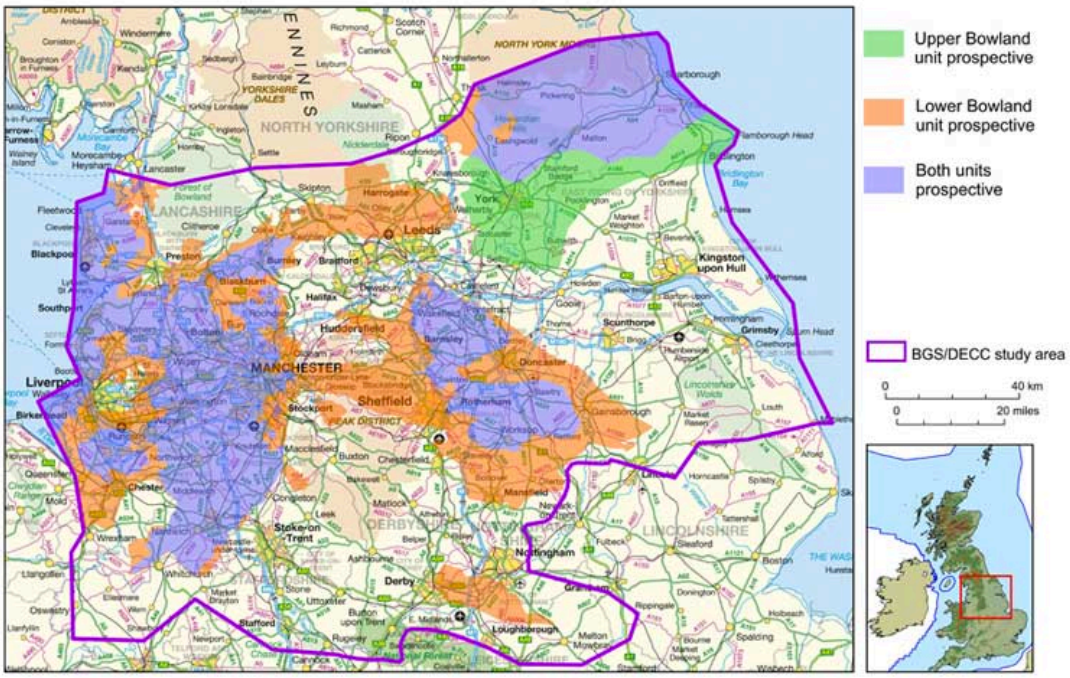


Figure 23. BGS Estimates of the principal resource areas for shale gas in the North of England. (BGS and Smith, Turner and Williams 2011)

Shale Gas Resources, Licenses and the Coalfields of the UK

The British Geological Survey has carried out a comprehensive assessment of the shale gas potential of the North of England and the areas considered are shown in Figure 23. Figure 24 shows the extent of the Yorkshire Coalfield and also the number of mine entries in Northern England and, as would be expected from the close stratigraphic relationship between the Coal Measures and the Bowland Shale, there are very strong similarities between the areas in Figures 23 and 24.

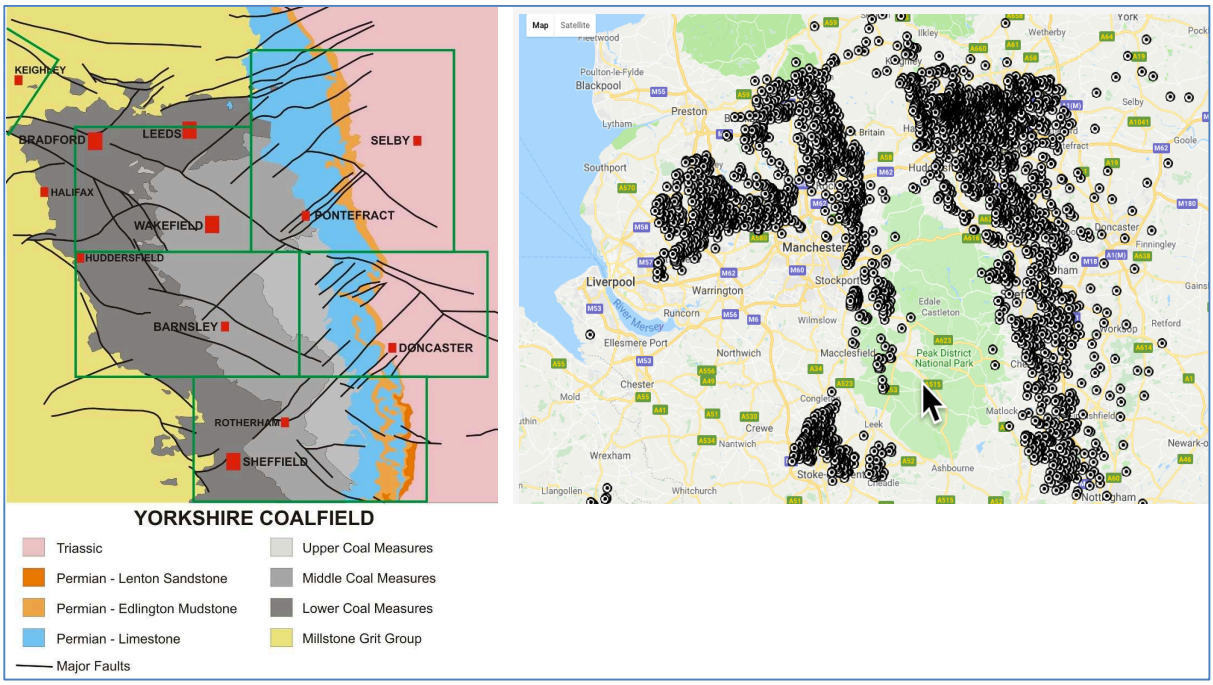


Figure 24 Yorkshire Coalfield (Left), Old mines Northern England (Right

A significant number of licenses have been applied for and been allotted in the Yorkshire and Nottinghamshire Coalfields, mainly because BGS flagged some areas which were especially prospective. Many of these lie over, or very close to, previously-worked coal mines. Figure 25 shows two geological cross sections across the Pennines and eastern region and it is clear that in many, if not all areas, coal overlies the Bowland Shale.

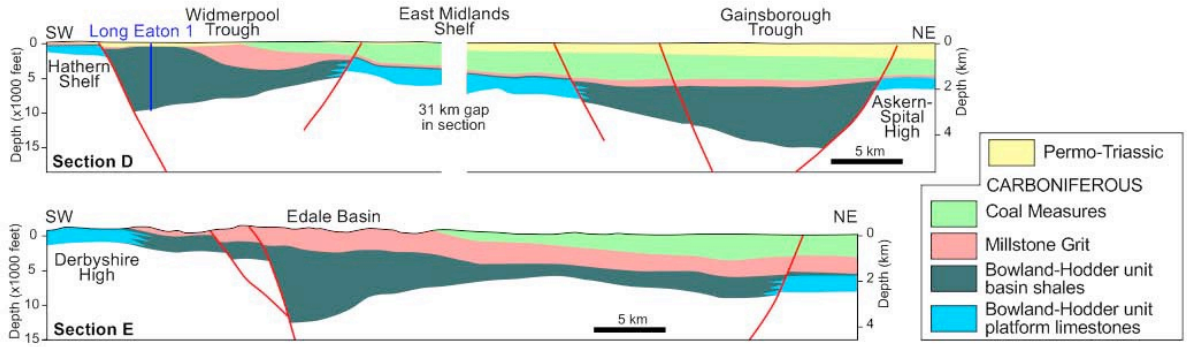


Figure 25 Geological Cross- Sections across Derbyshire and Yorkshire (BGS)

I have looked at a number of these applications and they, probably as they have been advised, have used BGS geological maps and existing seismic reflection data of early vintage (BP acquired mostly) to formulate their planning applications. BGS surface fault maps are excellent but are limited as to the scale of faulting they show and as I have previously explained in detail, surface seismic reflection CANNOT resolve the scale of faulting which might give rise to seismic events which would curtail shale gas operations under the regulations.

However, it does not seem to have been noted that all coal-mined areas in the era of the National Coal Board (and probably earlier) were mapped in great detail (a few tens of centimetre scale) underground because of mine safety and in order to track the changes in seam level as faults were crossed, and mine fault maps exist in the archives of the Coal Authority. Before I took the Chair of Geophysics at Keele University in 2000, from 1988 to 2000 I was Senior Lecturer and then Reader in Geophysics and led the Applied Geophysics Research Group at Liverpool University. While there I worked closely with the Fault Analysis Group, led by Professor Juan Watterson and then by Dr John Walsh (now Professor John Walsh of Dublin University). Their research was in the statistics of fault distributions which are fractal in nature.

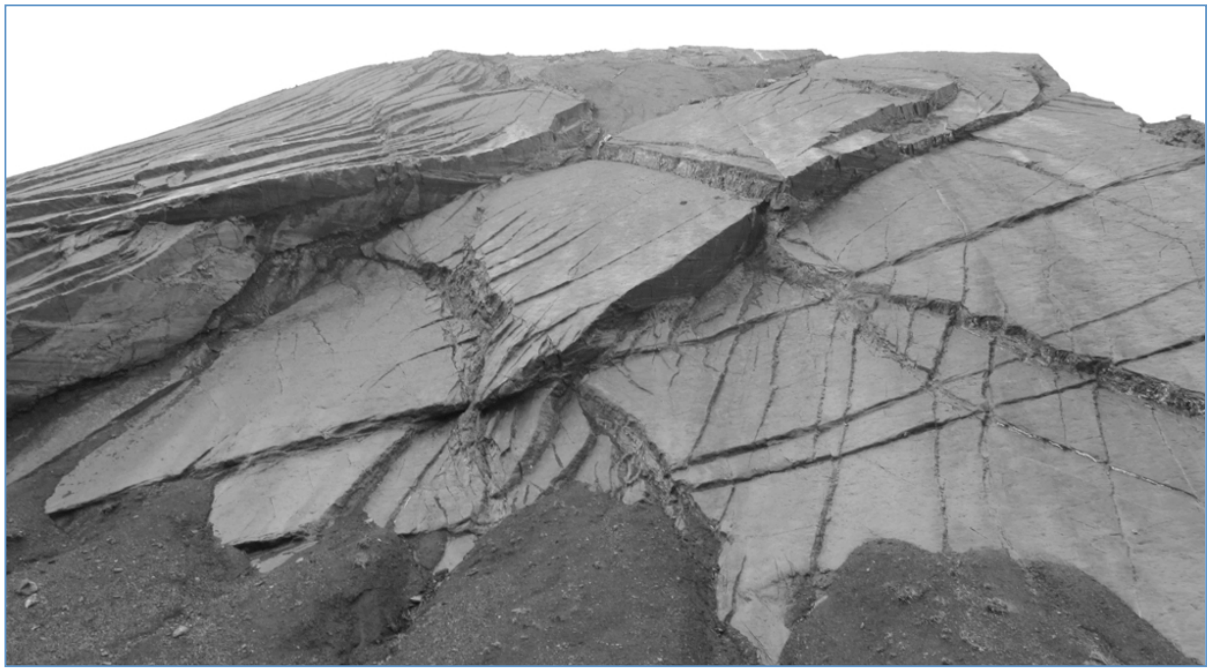


Figure 26 Spire Slack open-cut coal mine, Central Valley Scotland. An exposed face at Spire Slack open-cut coal-mine, showing the fracture and fault networks down to a few cm, which are fractal in nature, with discontinuities. The exposed face is in the Lower Limestone and is approximately 50 m high. Some residual coal can be seen in the foreground

This can clearly be seen in Figure 26, which is of an exposed, worked, opencast coal mine face in Scotland which shows the intersecting, anastomosing faults which are present over a wide range of scales, even in a small area. '*Big Faults have little Faults upon their backs to bite them and little Faults have lesser Faults and so (almost) ad infinitum!!*'

Bailey et al (2002) of the Fault Analysis Group made a special study of the East Pennine Coalfield, mapping all faults with throws greater than 1 metre (which would give an earthquake which would significantly exceed the threshold of 0.5ML!) I have overlain these on the BGS Geological Map (Figure 27) with the BGS main faults shown in Black and with the underground faults high-lighted in white. It is clear that there are many, many more faults of significant (seismically) size than are indicated on even the most detailed BGS maps. Historic and recent earthquakes are shown as red and white circles from our own studies and those of the British Geological Survey and it is clear that these fall on, or close to these smaller faults in many cases. While individual faults will vary in definition as they transfer across

different lithologies, i.e. they are much better marked in brittle formations such as Limestones and Sandstones than they are in more ductile formations such as siltstones and shales, they are clearly important in any consideration of the structural complexity which is present at any site which is considering shale gas activities in the vicinity of worked coal seams. As an example, I show three proposed borehole sites from INEOS licence areas and it is clear that there are faults much closer to some of the proposed borehole locations than 850 metres and that some have experienced historic, almost certainly mining-induced, seismic events) .

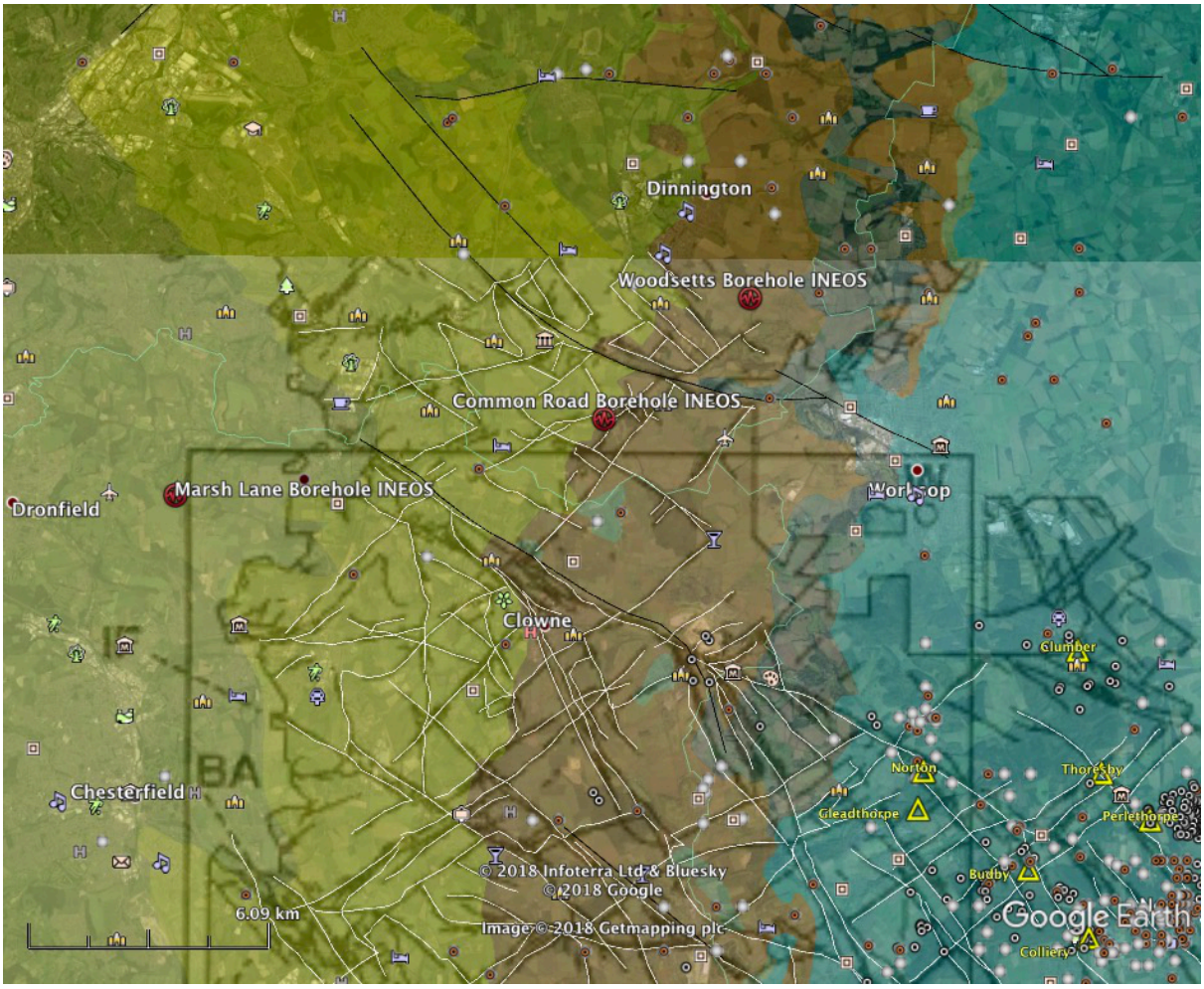


Figure 27 Geological Map with Faults (black) from BGS and Faults (highlighted white) from underground mine maps. Historic, mainly mining-induced seismic events are shown with white and red dots and fall on the small mapped faults as well as the large ones and sometimes within a few kilometres of the proposed boreholes.

It is interesting that Baptie et al (2016) in a report to the Scottish Government on:

"Unconventional Oil and Gas Development: Understanding and Monitoring Induced Seismic Activity"

while they do not show detailed examples of maps of sub-surface faulting, as we have done here, recognised its importance and also stated in agreement with the conclusions of this current report that:

> "*As such, small displacement faults have mostly been recorded in surface coal mines, or underground coal workings. In some circumstances, mining information can therefore provide a greater level of understanding of faulting in a particular coal seam for example. An examination of mine plans following coal extraction by Jones (2004; pages 112, 115, 117, 118, 119) provides an indication of the fault intensity in the subsurface of some of the Scottish coalfields:*
>
> > *Ayrshire Coalfield: Intensively faulted*
> >
> > *Douglas Coalfield: Faulting is significant and may be closely spaced.*
> >
> > *Clackmannan and North-East Stirlingshire coalfields: Faulting is neither severe nor closely-spaced*
> >
> > *Fife Coalfield: Faulting is neither severe nor closely-spaced*
> >
> > *Lothian Coalfield: Faulting is not severe but may be closely-spaced"*

It is evident that this information already exists for the United Kingdom, albeit buried in the archives of the UK Coal Authority at present, and should be considered to be an integral part of the geological database which is considered as part of the planning process for shale gas or indeed any deep underground activities in areas where coal mines have been worked in the UK.

Conclusions

1. Although little seismic data exists from fracking operations in the UK at present a great deal of coal-mining, induced seismicity data does exist and has a great deal of relevance as it shows that pre-existing faults can be and have been stimulated by coal mining and have generated seismic events up to about 3ML.

2. Current UK Seismic Traffic Light Thresholds postulate a cessation and subsequent modification (or even halting) of fracking activities if an earthquake of magnitude 0.5 ML occurs. This size of event corresponds to a movement of only a few millimetres on a short fault segment of a larger fault, or even on an individual fault of only about 40 metres length and with a throw of less than a metre, which cannot be detected on any current seismic reflection data acquired as part of an exploration programme for Shale Gas planning, and such small faults are not shown on BGS maps**.**

3. In many areas, proposed Shale Gas activities lie beneath historic coal mine workings which have already experienced subsidence and sometimes fault rejuvenation. In these mined-out areas however, we DO have detailed geological information especially with regard to faulting as this was mapped with high-precision underground as part of mine safety and for planning.

   Indeed: Jones et al (2004) in a comprehensive BGS report on "UK Coal Resource for New Exploitation Technologies Final Report" Sustainable Energy & Geophysical Surveys Programme Commissioned Report CR/04/015N state:

4. When this detailed mine mapping data is plotted together with locations of historic and relatively recent seismic events it is clear that they lie close to or on these smaller faults in many instances.

5. These, small but potentially active faults, which are capable of generating seismic events which would exceed the Traffic Light Thresholds, can be seen to occur much closer to proposed borehole sites than the 850 metres respect distance proposed by Davies and Styles (2015) to UK Government and Wilson et al (2018)

6. It is critical that this high resolution, carefully mapped data set should be included in any planning process for unconventional oil and gas activities.

Professor Emeritus Peter Styles, FGS CGeol., FRAS CSci, FIMMM

2 May 2018

References

Bailey, W. R., Manzocchi, T., Walsh, J. J., Keogh, K., Hodgetts, D., Rippon, J., Neil. P. A. R, Flint. S., Strand, J. A. (2002). The effect of faults on the 3D connectivity of reservoir bodies: A case study from the East Pennine Coalfield, UK. Petroleum Geoscience, 8(3), 263-277.

Baptie B., Segou M., Ellen R. And A. Monaghan. (2016). Unconventional Oil and Gas Development: Understanding and Monitoring Induced Seismic Activity. British Geological Survey Open Report, OR/16/042, 92pp.

Bishop I, Styles P. and Allen M., (1993) Mining-induced seismicity in the Nottinghamshire Coalfield, Quarterly Journal of Engineering Geology, 26, 253-279.

Clarke, H., L. Eisner, **P. Styles**, and. P. Turner (2014), Felt seismicity associated with shale gas hydraulic fracturing: The rst documented example in Europe, Geophys. Res. Lett., 41, doi:10.1002/2014GL062047

Davies, R., S. Mathias, J. Moss, S. Hustoft, L. Newport. 2012. Hydraulic fractures: How far can they go? Marine and Petroleum Geology 37(1):1-6.

Davies, R., Foulger, G., Bindley, A. and Styles, P., (2013) Induced seismicity and hydraulic fracturing for the recovery of hydrocarbons, Mar. Pet. Geol., 45, 171-185, DOI: 10.1016/j.marpetgeo.2013.03.016

Eisner E., Halló M., Janská E., Opršal I., Matoušek P., Clarke H., Turner P., Harper T., **Styles P.** (2013) , Lessons learned from hydraulic stimulation of the Bowland Shale, SEG Houston 2013 Annual Meeting, DOI http://dx.doi.org/10.1190/segam2013-0239.1, Pages 4516-4520.

Ellsworth W.L., 2013. Injection-Induced Earthquakes, Science 341 no. 6142 .

Fraser A. J., and Gawthorpe R. L. (1990), Tectono-stratigraphic development and hydrocarbon habitat of the Carboniferous in northern England, Geological Society, London, Special Publications 1990, v. 55, p. 49-86

Green, C.A., **Styles, P**., Baptie, B.J., 2012. Preese Hall Shale Gas Fracturing: Review and Recommendations for Induced Seismic Mitigation. Available at:

http://www.decc.gov.uk/assets/decc/11/meeting-energy-demand/oil-gas/5055-preese-hall-shale-gas-fracturing-review-and-recomm.pdf Accessed 27 October 2012.

Grigoli F., Cesca, S A., Rinaldi A. P., , A. Manconi A, López-Comino J.A., ClintonJ. F., Westaway R., Cauzzi C., Dahm T., Wiemer S., (2018)., The November 2017 Mw 5.5 Pohang earthquake: A possible case of induced seismicity in South Korea, Science 26 Apr 2018:DOI: 10.1126/science.aat2010

Jones N. S., Holloway S., Creedy D. P., Garner K., Smith N. J. P., Browne, M.A.E. & Durucan S. (2004), UK Coal Resource for New Exploitation Technologies Final Report, Commissioned Report CR/04/015N.

Royal Society and Royal Academy of Engineering. (2012), Shale gas extraction in the UK: a review of hydraulic fracturing. Available at: http://www.royalsociety.org/policy/projects/shale-gas-extraction and raeng.org.uk/shale.

Smith, N, Turner P. and Williams G., (2011), UK data and analysis for shale gas prospectivity, Geological Society, London, Petroleum Geology Conference series, 7, 1087-1098, 4 January 2011, https://doi.org/10.1144/0071087

Styles, P., Flynn Z., and Toon S.M., (1999) Integrated Microseismic Monitoring and Numerical Modelling for the Determination of Fracture Architecture Around Longwall Coal Mines for Geomechanical Validation. ECSC Research Agreement No: 7229-AF/013"Application of Geophysical and Geodetic Techniques to the Determination of Structure and Monitoring of the Surface"

Styles., P., (2014) Shale Gas and Hydraulic Fracturing: A Review of the Environmental, Geological and Climate Risks, Emirates Centre for Strategic Sustainability Research in "CONVENTIONAL FOSSIL FUELS: The next hydrocarbon revelation?", Emirates Centre for Strategic Research, 61pp.

Styles P. and Baptie, B., 2012., Induced Seismicity in the UK and its Relevance to Hydraulic Stimulation for Exploration for Shale Gas., https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48331/5056-background-note-on-induced-seismicity-in-the-uk-an.pdf

Warpinski, N. R., J. Du, and U. Zimmer (2012), Measurements of hydraulic-fracture-induced seismicity in gas shales, SPE Production and Operations, 27(3), 240-252.

Westwood RF, Toon SM, **Styles P**, Cassidy NJ. (2017). Horizontal respect distance for hydraulic fracturing in the vicinity of existing faults in deep geological reservoirs: A review and modelling study. Geomechanics and Geophysics for Geo-Energy and Geo-Resources. vol. 3(4), 379-391

Wilson, M. P., Davies, R. J, Foulger G. R., Julian B. R., , **Styles P.,** Gluyas J. G., Almond S., (2017), Anthropogenic earthquakes in the UK: a national baseline prior to shale exploitation, Marine and Petroleum Geology, Published Online August 2015-11-26

Wilson, M. P. and Worrall, F. and Davies, R. J. and Almond, S. (2018) 'Fracking : how far from faults?', Geomechanics and geophysics for geo-energy and geo-resources. https://doi.org/10.1007/s40948-018-0081-y

Zoback . M. and Gorelick S.M. (2012) Earthquake triggering and large-scale geologic storage of carbon dioxide, PNAS June 26, 2012. 109 (26) 10164-10168; https://doi.org/10.1073/pnas.1202473109

Science should underpin fracking policy in the UK

ReFINE:

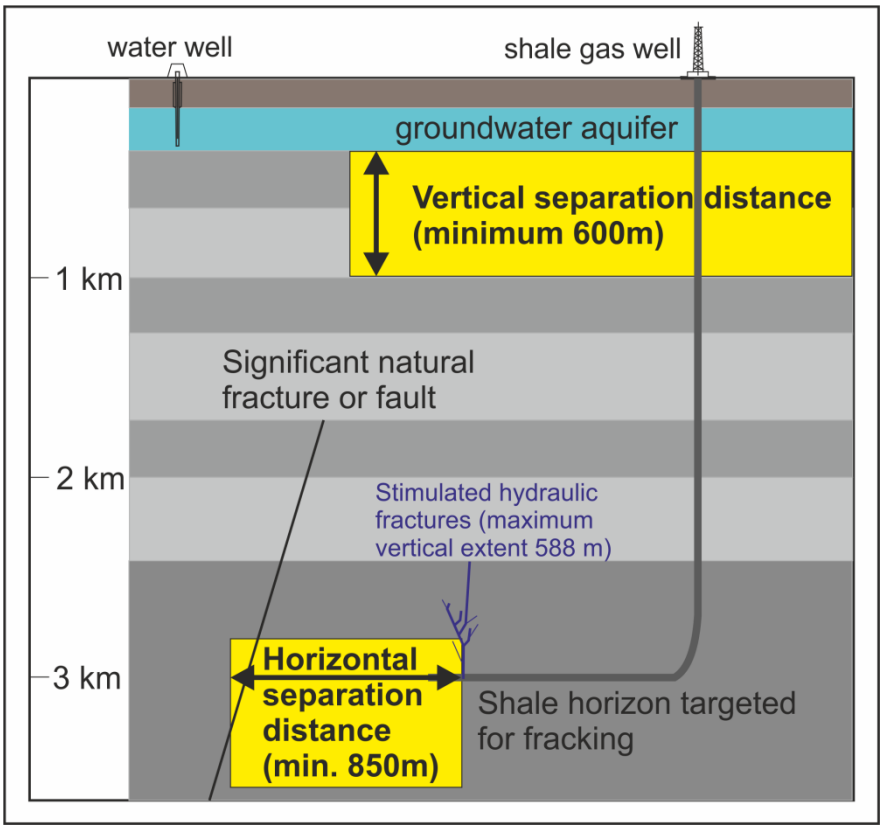
ReFINE is the leading independent research consortium on fracking, led jointly by Newcastle University and Durham University, working to address the current gaps in our knowledge and public concerns about the fracking process.

We have been active in this area for 4 years, and our team comprises academics from US and UK universities. We are in regular contact with the Department for Energy and Climate Change, the Environment Agency, and energy companies.

Earthquakes and water contamination:

Regulation should include geological **respect distances,** between locations where stimulated hydraulic fracturing ('fracking') is taking place, and both overlying aquifers that could be contaminated and nearby faults that could cause earth tremors.

Our research[1] shows that the tallest fractures generated by stimulated hydraulic fracturing ('fracking') are less than 600 metres high. To minimize the chances of such fractures providing pathways by which overlying aquifers could become contaminated, we recommend a minimum vertical distance of 600 metres between the shale being fracked and an aquifer. We call this the 'vertical respect distance' (Figure 1).



Our research[2] shows that fracking does cause earth tremors. To reduce the chances of triggering an earthquake, 3D seismic imaging should be carried out[3], and a 'horizontal respect distance' between the location of fracking and a significant fault needs to be defined. This will depend on the size of the fault, but new research led by Keele University indicates that the horizontal respect distance should be at least 850 metres (Figure 1).

Hydrocarbon wells and drilling:

Our research[4] shows that, despite modern well design and practices, hydrocarbon wells can leak and cause fugitive emissions of greenhouse gases. Our new survey work indicates that, of 50 onshore UK wells monitored, 26% are leaking methane at very low rates (roughly equivalent to that produced by low numbers of grazing livestock).

Around 2150 onshore oil or gas wells have been drilled in the UK. Because companies merge or become insolvent, between 50 and 100 of these wells are 'orphaned' and up to 53% have an unclear ownership[4]. On this basis we recommend:

1. A one-off, UK-wide 'MOT' of all UK onshore wells that can be located. ReFINE has started this process.
2. A survey every five years after decommissioning of wells drilled for shale exploitation.
3. An investment fund be established for the cost of remediating future leakage of shale wells.
4. A review of existing well ownership and development of a policy for tracking subsequent well ownership.
5. The establishment of a public database showing fugitive emissions data and a record of incidents occurring at active well sites.

Professor Richard Davies
Newcastle University

Dr Liam Herringshaw, Professor Fred Worrall, Mr Sam Almond
Durham University

Professor Peter Styles
Keele University

[1]Davies, R.J., Mathias, S. A., Moss. J., Hustoft, S., & Newport, L., 2012, Hydraulic fractures: how far can they go? Marine and Petroleum Geology: 37, 1-6.
[2]Davies, R.J., Foulger, G., Bindley, A., & Styles, P., 2013, Induced Seismicity and Hydraulic Fracturing of Sedimentary Rocks. Marine and Petroleum Geology: 45, 171-185.
[3]Clarke, H., Eisner, L., Styles, P., & Turner, P., 2014, Felt seismicity associated with shale gas hydraulic fracturing: The first documented example in Europe. Geophysical Research Letters: 41, 8308–8314.
[4]Davies, R.J., Almond, S., Ward, R., Jackson, R. B., Adams, C., Worrall, F., Herringshaw, L. G., & Gluyas, J. G., 2014, Oil and Gas Wells and Their Integrity: Implications for Shale and Unconventional Resource Exploitation. Marine and Petroleum Geology: 48, 366-378.

[J-13-2017]
IN THE SUPREME COURT OF PENNSYLVANIA
MIDDLE DISTRICT

SAYLOR, C.J., BAER, TODD, DONOHUE, DOUGHERTY, WECHT, MUNDY, JJ.

BRIAN GORSLINE, DAWN GORSLINE, PAUL BATKOWSKI AND MICHELE BATKOWSKI	:	No. 67 MAP 2016
	:	
	:	Appeal from the Order of the Commonwealth Court dated September 14, 2015 at No. 1735 CD 2014
v.	:	Reversing the Order of the Lycoming County Court of Common Pleas, Civil Division, dated August 29, 2014 at No. 2014-0130
BOARD OF SUPERVISORS OF FAIRFIELD TOWNSHIP	:	
	:	ARGUED: March 8, 2017
v.	:	
INFLECTION ENERGY, LLC AND DONALD SHAHEEN AND ELEANOR SHAHEEN, HIS WIFE	:	
APPEAL OF: BRIAN GORSLINE, DAWN GORSLINE, PAUL BATKOWSKI AND MICHELE BATKOWSKI	:	

OPINION

JUSTICE DONOHUE **DECIDED: June 1, 2018**

In this discretionary appeal, we consider whether the Commonwealth Court erred in reversing the decision of the Lycoming County Court of Common Pleas, which, in turn, had reversed the decision of the Fairfield Township Board of Supervisors (the "Board") to allow for the drilling, construction, development and operation of unconventional natural gas wells as a conditional use in a district zoned Residential-

Agricultural ("R-A").[1] As the evidentiary record in this case does not support the Board's decision, and because the proposed use is not similar to any permitted use in the R-A district,[2] as required under the Fairfield Township Zoning Ordinance (the "Ordinance"), we reverse the decision of the Commonwealth Court.

Section 3.1 of the Ordinance defines an R-A district as follows:

> This District is generally intended for application to rural development areas where public and sewer facilities are not presently available and may not be available in the near or immediate future. The purpose of the regulations for this district is to foster a quiet, medium-density residential environment while encouraging the continuation of agricultural activities and the preservation of prime farmland. To this end, lot sizes are based upon the need to safeguard the health of the citizens by requiring ample space for the placement of on-lot sewage and water facilities, but yet providing for reduction of these minimum requirements where public sewer and/or water systems are developed. Industrial uses are discouraged in this district; compatible public and semi-public uses such as schools, churches, and recreational facilities are provided for; and higher density

[1] The natural gas wells in this case were being constructed to extract natural gas from Marcellus Shale. This is done by hydraulic fracturing, more commonly known as "fracking." As we previously explained in *Robinson Twp. v. Commonwealth*, 147 A.3d 536 (Pa. 2016) ("*Robinson II*"), fracking involves "pumping at high pressure into the rock formation a mixture of sand and freshwater treated with a gel friction reducer, until the rock cracks, resulting in greater gas mobility." *Id.* at 543 n.4 (quoting *Robinson Twp. v. Commonwealth*, 83 A.3d 901, 914-15 (Pa. 2013) (plurality) ("*Robinson I*")). In *Robinson I*, a plurality of this Court described fracking operations as an industrial use involving "air, water, and soil pollution; persistent noise, lighting, and heavy vehicle traffic; and the building of facilities incongruous with the surrounding landscape." *Robinson I*, 83 A.3d at 979. In a concurring opinion, Justice Baer was even more descriptive, explaining that "these industrial-like operations include blasting of rock and other material, noise from the running of diesel engines, sometimes nonstop for days, traffic from construction vehicles, tankers, and other heavy-duty machinery, the storage of hazardous materials, constant bright lighting at night, and the potential for life-and property-threatening explosions and gas well blowouts." *Id.* at 1005 (Baer, J., concurring).

[2] The Ordinance divides Fairfield Township, Lycoming County, into three zoning districts: R-A, General Commercial, and Industrial. *See* Ordinance, § 3.1.

> residential development may be permitted under certain conditions.

Id.

Inflection Energy, LLC ("Inflection") submitted to the Board a "Zoning and Development Permit Application" (the "Application") seeking permission for a "drilling, completion, production and operation of multiple gas wells" use on a 59.877-acre parcel of land located on Quaker State Road in Montoursville, Pennsylvania and owned by Donald and Eleanor Shaheen (the "Shaheen Pad"). Application, ¶ 4. The Shaheen Pad is located in Fairfield Township's R-A district. The Application proposed to improve the existing farm access road with a stone access drive from Quaker State Road/T-855 to the pad site, a level pad, well head, and a temporary water impoundment area with sediment and erosion controls.

Because the Ordinance does not identify "drilling, completion, production and operation of multiple gas wells" as a permitted or conditional use[3] in the R-A district, the township zoning officer referred Inflection's Application to the Board for further

[3] Permitted uses in an R-A district include: accessory uses or structures; agriculture; single-family detached dwellings; essential services (which require no permit); family-based group homes; family daycare homes; forestry activities; home occupation; hunting camps or seasonal dwellings; and "no impact" home-based businesses. Ordinance, § 4.2.1. Conditional uses that are allowed in an R-A district include: agricultural businesses; bed and breakfast inns; cluster subdivision or planned residential development; daycare centers; multi-family dwellings; multi-family housing developments; townhouses; two-family dwellings; funeral homes; group care facilities; hospitals, hospital administration and support uses; manufactured or mobile home parks; nursing, retirement or assisted living facilities; parking lots and garages; professional offices; public service facilities or public or quasi-public uses; commercial recreation; and public recreation. *Id.*, § 4.2.2; *see also id.*, § 12.1 (setting forth general criteria that apply to conditional uses).

consideration pursuant to section 12.18 of the Ordinance, sometimes referred to as its "savings clause." Section 12.18 provides in full as follows:

> Whenever, under this Ordinance, a use is neither specifically permitted [n]or denied, and an application is made by an applicant to the Zoning Officer for such a use, the Zoning Officer shall refer the application to the Board of Supervisors to hear and decide such request as a conditional use. The Board of Supervisors shall have the authority to permit the use or deny the use in accordance with the standards governing conditional use applications set forth in Section 14.2 of this Ordinance. In addition, the use may only be permitted if:
>
> > **12.18.1** It is similar to and compatible with the other uses permitted in the zone where the subject property is located;
> >
> > **12.18.2** It is not permitted in any other zone under the terms of this Ordinance; and
> >
> > **12.18.3** It in no way is in conflict with the general purposes of this Ordinance.
>
> The burden of proof shall be upon the applicant to demonstrate that the proposed use meets the foregoing criteria and would not be detrimental to the public health, safety and welfare of the neighborhood where it is to be located.

Ordinance, § 12.18.

The central issue in this appeal is whether the Board erred in finding, and the Commonwealth Court erred in affirming, that Inflection satisfied the requirement in subsection 12.18.1 that the proposed use was "similar to" other uses allowed in the R-A district. In its Application, Inflection did not identify any use allowed in the R-A district that it considered to be "similar to" the drilling and operation of industrial shale gas wells.

At the first of two public hearings on Inflection's Application, Inflection presented Thomas Erwin ("Mr. Erwin"), its senior field operations manager, as an expert in the

design, permitting and development of natural gas wells. Mr. Erwin testified that the Shaheen Pad would be 300 by 350 feet in size during drilling and completion of the gas wells, and after drilling and completion it would be reduced to approximately 150 by 150 feet. N.T., 10/7/2013, at 12. He described the property as being used to farm corn, unimproved by houses, and including a stream and wetlands. *Id.* at 10-11. There was one residence within 1000 feet of the Shaheen Pad and over 125 residential drinking water wells and a large residential development within 3000 feet of the pad. *Id.* at 23-24. Mr. Erwin was uncertain as to how many gas wells would ultimately be drilled on the Shaheen Pad. He believed it likely that two wells would be drilled initially, and depending on the results, Inflection could subsequently drill more. *Id.* at 12-13. He testified that Inflection would also construct a two-million-gallon water impoundment area and an eight- by twelve- by twenty-foot building to house a separator. *Id.* at 13, 15.

Mr. Erwin testified that Inflection had received approval for four other gas wells in the R-A district in Fairfield Township, but provided no other information about these wells or the approval process related thereto. *Id.* at 20. A neighboring resident, however, testified to her knowledge that the other wells were "much further from residential areas" than the proposed Shaheen Pad – testimony the Board found to be credible. N.T., 11/4/2013, at 67; *see* Board Op., Findings of Fact, ¶ 42.

With respect to the issue of similarity of use in connection with subsection 12.18.1 of the Ordinance, counsel for Inflection asked Mr. Erwin two questions regarding whether Inflection's proposed use may constitute a "Public Service Facility" use. The Ordinance, which permits "Public Service Facility" uses (as conditional uses) in all three of Fairfield's zoning districts, defines the term as follows:

> The erection, construction, alteration, operation or maintenance of buildings, power plants or substations, water treatment plants or pumping stations; sewage disposal or pumping plants and other similar public service structures by a utility, whether publicly or privately owned, or by a municipal or other governmental agency, including the furnishing of electrical, gas, communication, water supply and sewage disposal services.

Ordinance, § 2.2. In response to counsel's questions, Mr. Erwin offered the following contradictory responses:

> [Counsel for Inflection]: And what is the proposed use in that district? What do you plan on --
>
> [Mr. Erwin]: Oil and gas development.
>
> [Counsel for Inflection]: And is that proposed use classified as a public service facility under the [O]rdinance?
>
> [Mr. Erwin]: No.
>
> [Counsel for Inflection]: It fits the definition as a public service facility under the Fairfield Township Zoning Ordinance, is that correct?
>
> [Mr. Erwin]: Yes.

N.T., 10/7/2013, at 8. Mr. Erwin was not asked to explain his inconsistent answers, including how the proposed use could not be classified as a "public service facility," yet simultaneously met the Ordinance's definition of that term. Mr. Erwin offered no other testimony relevant to the similarity of use issue.

At the second hearing, in response to questions posed by members of the public that were beyond the scope of Mr. Erwin's expertise and knowledge, Inflection presented geologist Thomas Gillespie, its director of regulatory affairs and environmental and health safety, as an expert in water resources and gas development.

N.T., 11/4/2013, at 6. Mr. Gillespie offered no testimony or evidence relevant to the similarity of use issue.

At both evidentiary hearings, neighboring residents, many of whom were knowledgeable about oil and gas development activities (either from working in the industry or from their familiarity with other wells), cross-examined Inflection's two witnesses (Mr. Erwin and Mr. Gillespie) and also testified in opposition to Inflection's Application. The residents offered testimony regarding the negative impact the proposed use would have on those who lived near the Shaheen Pad; the absence of criminal background checks for nearly all of the individuals working on the Shaheen Pad; sediment control; the potential for a "controlled kick;"[4] the lack of protections for the neighboring residents' drinking water and wetlands; prior DEP citations received by Inflection and other companies conducting fracking activities in the area; the potential for earthquakes; and a study by researchers from Duke University concluding that Pennsylvania's waterways contain excess levels of radioactivity because of fracking activities. *See id.* at 45-46, 78-79; N.T., 11/4/2013, at 14, 32, 36, 38, 42, 45-48, 57; *see also* Gorsline Exhibit-1.

The Board approved the Application by a two-to-one vote, granting Inflection a conditional use permit for its proposed gas wells use, contingent upon Inflection's compliance with certain conditions designed to minimize the harmful effects of the drilling. The Board found that Inflection's proposed use was not an allowed use in any

[4] A "controlled kick" is the burning of excess gas at a well that has "flames shooting out the top." N.T., 10/7/2013, at 38. The testifying resident had observed this occurring at another gas pad operated by Inflection. *Id.* Mr. Erwin stated that Inflection did not "anticipate doing it" at the Shaheen Pad, but acknowledged that Inflection "did not anticipate doing that" at the other facility either. *Id.*

of the township's three zoning districts and was thus governed by the savings clause in section 12.18. The Board broadly found, without explication or explanation, "that the criteria for review set forth in Section[] 12.18 … [has] been sufficiently satisfied[.]" Board Op., Conclusions of Law, ¶¶ 3, 20. The Board made no specific findings in support of this conclusion of law, and with respect to subsection 12.18.1, it neither referenced the subsection nor identified any permissible use in the R-A district that it found to be similar to the use proposed by Inflection.

Brian Gorsline, Dawn Gorsline, Paul Batkowski and Michele Batkowski (collectively, "Objectors"), local residents of the Pines Development in Fairfield Township, appealed the Board's decision to the Lycoming County Court of Common Pleas. *See* 53 P.S. 11002-A(a) (providing for land use appeals to be taken to the court of common pleas in the judicial district in which the land is located). The trial court held oral argument but did not take any additional evidence. The trial court first acknowledged that its standard of review with respect to zoning decisions when it does not take additional evidence is that the findings of the governing body below "shall not be disturbed by the court if supported by substantial evidence." *Gorsline v. Bd. of Supervisors of Fairfield Twp.*, 40 Pa.D&C.5d 478, 482 (C.P. Lycoming 2014) (citing 53 P.S. § 11005-A). With respect to similarity of uses (subsection 12.18.1), Inflection argued to the trial court that its drilling operation constituted a "public service facility." Citing to a lack of substantial evidence to support this conclusion, the trial court disagreed and reversed the Board's decision. *Id.* at 486-89. The trial court observed that the Board had offered no explanation regarding the manner in which Inflection's proposed fracking use was "similar to" a "public service facility," and noted that Inflection

would not be providing any public service, as it "is not constructing these wells to furnish natural gas to the residents of the Pines Development, or even Fairfield Township." *Id.* at 489-90.[5]

Inflection and the Shaheens (collectively referred to as "Inflection") appealed to the Commonwealth Court.[6] Referencing the Board's "detailed findings of fact," but citing to none, the Commonwealth Court found that the common pleas court erred in concluding that Inflection had not met its burden of proof on the question of whether the proposed use was similar to permitted uses in an R-A district under section 12.18.1. *Gorsline v. Bd. of Supervisors of Fairfield Twp.*, 123 A.3d 1142, 1151 (Pa. Commw. 2015). Instead, the intermediate appellate court found that Inflection's proposed use was similar to and compatible with a "public service facility" use and/or an "essential service" use based on its prior decision in *MarkWest Liberty Midstream & Resources, LLC v. Cecil Twp. Zoning Hrg. Bd.*, 102 A.3d 549 (Pa. Commw. 2014) ("*MarkWest*"), which it found to be "directly on point." *Gorsline*, 123 A.3d at 1151-52.

In *MarkWest*, the applicant filed an application for a special exception to operate a natural gas compressor station in Cecil Township's (Washington County) light industrial district. *MarkWest*, 102 A.3d at 553. The local zoning ordinance provided that in order for MarkWest to obtain the special exception, it had to show that its use, inter

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[5] The trial court further found, based on the evidence presented before the Board, that the evidence was insufficient to support the Board's finding that the proposed use would "in no way" conflict with the general purposes of the Ordinance as required by section 12.18.3 and that there was substantial evidence presented that "the use will adversely affect the health, welfare and safety of the neighborhood." *See Gorsline*, 40 Pa.D.&C.5th at 490-503.

[6] The Board did not appeal the decision, but filed a brief in support of Inflection.

alia, was "of the same general character" as uses permitted in the light industrial district. *Id.* at 554. In its application, MarkWest asserted that its use was "of the same general character" as an "essential service" use, as defined by the local ordinance. *Id.* The record before the zoning board in *MarkWest* established that the proposed use was for the collection and transmission of natural gas to market – the company would not be drilling (fracking). *Id.* at 552 n.2, 557. The zoning hearing board denied the application; MarkWest appealed the decision and the Commonwealth Court reversed. The Commonwealth Court found that the phrase "of the same general character" in the ordinance did not require a level of similarity approaching an identity of uses, and was instead satisfied if the two uses were of the same "general" character. According to the Commonwealth Court, the natural gas compressor station use at issue was sufficiently similar to an "essential service" use and/or a "public service facility" use, as all three involved public facility uses furnishing gas service to the public pursuant to public regulation. *Id.* at 558-59.

In the case sub judice, the Commonwealth Court found that the Ordinance's definitions of "public service facility" and "essential services"[7] were similar to the definitions of the same terms in the ordinance at issue in *MarkWest*. *Gorsline*, 123 A.3d at 1152. It thus concluded, without elaboration or reference to any evidence of record, that "[p]recisely as in *MarkWest*, Inflection's proposed use satisfies the requirement set forth in 12.18.1 of the Zoning Ordinance that it 'is similar to and compatible with other

[7] The Ordinance defines "essential services" as: "Public utility facilities that do not require enclosure in building, including gas, electrical, steam, telephone, or water distribution systems; and including related equipment such as poles, towers, wires, mains, sewers, pipes, conduits, cables, fire alarm boxes, police call boxes, traffic signals, hydrants, and other similar equipment." Ordinance, § 2.2.

uses permitted in the zone where the subject property is located.'"[8] *Id.* The Commonwealth Court further held, again without discussion or citation to the record, that Inflection's evidence "was in no way rebutted, and the Board has already authorized Inflection's other wells in the R[-]A District." *Id.*

Objectors filed a petition for allowance of appeal to this Court, which we granted to address the following:

[8] In reversing the trial court's determination that Inflection had also failed to prove that its proposed use was in conflict with the general purposes of the Ordinance, as required by section 12.18.3, the Commonwealth Court indicated that no such conflict existed because the Ordinance "expressly authorizes the extraction of minerals." *Gorsline*, 123 A.3d at 1152. In so ruling, however, the Commonwealth Court cited to the definition of a "rural resource area," noting that the definition of this term refers to "mining, quarrying and other extractive industries." *Id.* at 1152 & n.10. While the Ordinance defines the term, however, it does not designate any of the township's zoning districts as a "rural resource area."

The Commonwealth Court also cited section 603(i) of the Municipalities Planning Code, which requires the "reasonable extraction of minerals," 53 P.S. § 10603(i). This requirement is apparently satisfied in the Ordinance pursuant to its allowance of "surface mining" as a conditional use in the Industrial district. Ordinance, § 6.2.3.12. Before the trial court, Objectors attempted to argue that Inflection could not seek a conditional use permit under the Ordinance's savings clause (section 12.18) because the Ordinance's definition of "surface mining" permitted the extraction of "minerals" and defined "minerals" to include "oil and natural gas." Ordinance, § 2.2. The trial court ruled, however, that "surface mining" did not include the drilling of underground mine openings, as Inflection proposed to do, and thus agreed with the Board that Inflection's proposed gas wells use was not allowed in any of its zoning districts (and thus subject to approval pursuant to the savings clause in section 12.18). *Gorsline*, 40 Pa.D&C.5d at 478. The parties did not appeal this ruling to the Commonwealth Court.

conclusion to that effect, the record contains no substantial

We address the final three issues raised by Objectors, which are interrelated and, we conclude, dispositive of this case. Because we may decide this case on non-constitutional grounds, we decline to decide Objectors' first issue, relating to this Court's decision in *Robinson I* based on a claimed violation of substantive due process rights and the Environmental Rights Amendment of the Pennsylvania Constitution (Article I, Section 27). *See Blake v. State Civil Serv. Comm'n*, 166 A.3d 292, 297 (Pa. 2017) (recognizing that constitutional questions should not be decided if the case can be resolved on alternative, non-constitutional grounds).

In their brief filed with this Court, Objectors assert that the Board made no findings of fact with respect to the requirements of subsection 12.8.1, and instead reached the bald conclusion that Inflection somehow satisfied its burden of proof without

identifying any similar permitted use in the R-A district. Objectors' Brief at 23, 28. Objectors contend that the record does not support the Commonwealth Court's conclusion that the propose use is similar to a "public service facility" use, and note that this was a legal conclusion made in the first instance by the Commonwealth Court, not the Board. *Id*. at 24. Inflection did not identify any similar use in its 170-page Application, and the only evidence presented to the Board regarding a potentially similar use ("public service facility") was Mr. Erwin's response to a leading question, which directly contradicted his prior response to essentially the same question. *Id.* at 24-26.

Objectors state that the Commonwealth Court's conclusion that *MarkWest* was controlling in this matter was error because it addressed a proposed use in a different zoning district that had a very different purpose.[9] *Id.* at 29-33. Further, to the extent the Commonwealth Court relied on the conditional use permits the Board previously granted for four other gas wells in the R-A district, Objectors assert that this too was error, as such reliance would effectively amend the Ordinance to allow for gas development in the R-A district without requiring Inflection to meet its burden of proof under the savings clause for a use not authorized in the district. *Id.* at 34-38.

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[9] The Delaware Riverkeeper Network, Clean Air Council, and Environmental Integrity Project ("Environmental Amici") and Peters Township, South Fayette Township, David M. Ball, and Brian Coppola ("Township Amici"), advance arguments, inter alia, in support of Objectors' claim that the Commonwealth Court's reliance on *MarkWest* was error. Environmental Amici argue that Commonwealth Court's reliance on *MarkWest* was erroneous because of the differences between (1) the ordinances at issue, (2) the activities (mineral extraction vs. facilitation of transport/processing of minerals), and (3) the districts themselves (light industrial vs. R-A). Environmental Amici's Brief at 33-34. Further, Environmental Amici note that the *MarkWest* court "relied heavily on an analysis of the testimony and the ordinance provisions," while the Commonwealth Court in the case at bar failed to do so entirely. *Id.* at 34-35. Township Amici advocate for this Court to reverse the decision in *MarkWest*, contending that the holding should be invalidated as "simply incorrect." *See* Township Amici's Brief at 29-33.

Inflection and the Board, conversely, both assert that the Commonwealth Court's decision is fully supported by the record and applicable law.[10] Inflection asserts that the Commonwealth Court's reliance on *MarkWest* was proper because of the similarity between the cases: both involved an application for a permit under the respective ordinance's savings clause; both ordinances required a consideration of similarity between the proposed use and the uses permitted in the zone; and the ordinances

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[10] *See* Board's Brief at 9 (adopting Inflection's brief on the issues addressed in this Opinion "in its entirety").

Amicus briefs in support of the Board and Inflection were filed by: (1) Robinson Township, Washington Township, and Mount Pleasant Township; (2) the County of Beaver, the County of Allegheny, and Rich Fitzgerald; (3) Pennsylvania State Association of Township Supervisors; (4) the Greater Pittsburgh Chamber of Commerce, the Washington County Chamber of Commerce, the Williamsport/Lycoming Chamber of Commerce, and the Pennsylvania Chamber of Business and Industry, (5) the International Union of Operating Engineers, Local 66 and the International Brotherhood of Electrical Workers, Locals 5, 81, 163, 712 and 812 ("Union Amici"); (6) Laborers' District Council of Western Pennsylvania; (7) the Marcellus Shale Coalition; (8) the Pennsylvania Independent Oil & Gas Association; and (9) the American Petroleum Institute. The majority of the arguments advanced by these amici support points made by the Board and Inflection in their briefs that do not pertain to the question of the similarity of uses or they raise new arguments not advanced by the parties in support of affirming the Commonwealth Court's decision.

Of relevance to the determinative question in this appeal, the Pennsylvania Independent Oil & Gas Association asserts that natural gas production is similar to a "public service facility" and identifies numerous consumer products that depend on oil and gas production. Pennsylvania Independent Oil & Gas Association's Brief at 9 & Appendix B. Union Amici assert that the Commonwealth Court correctly found that Inflection's proposed use was similar to a "public service facility" based on Mr. Erwin's testimony stating the same. Union Amici's Brief at 4-5. Union Amici further support the Commonwealth Court's reliance on *MarkWest* because in both instances, "the applicants demonstrated that their proposed uses were similar to other uses that were expressly permitted in the district at issue. *Id.* at 6 (citing *MarkWest*, 102 A.3d at 556). Lastly, Union Amici state that the Commonwealth Court did not base its decision solely on the fact that the Board had previously granted conditional use permits for gas wells, and that this evidence was properly considered because it corroborated the conclusion that the Board conducted the requisite analysis here. *Id.* at 7.

contained identical definitions of what constitute "public service facility" and "essential services" uses. Inflection's Brief at 29. Inflection further asserts that its proposed use in this case is similar to uses that are permitted by the Ordinance in an R-A district, including a "public service facility" use and an "essential services" use. *Id.* at 38. In so arguing, Inflection states that its proposed use will "serve the general public producing and piping natural gas to the public for their use and consumption." *Id.* at 39. Finally, Inflection argues that its proposed use is "identical to" other natural gas wells that have been granted conditional use permits by the Board within the R-A district, thus demonstrating that the Board, in reaching its decision in this case, "reasoned that the proposed use is 'similar and compatible with the other uses permitted in the zone.'" *Id.* at 36.

Whether a proposed use falls within a given category specified in a zoning ordinance is a question of law. *Southco, Inc. v. Concord Twp*., 713 A.2d 607, 609 (Pa. 1998). Thus, appellate review is limited to determining whether the lower court committed an error of law. *Id.* As with all questions of law, our standard of review is de novo and our scope of review is plenary. *See Buckwalter v. Borough of Phoenixville*, 985 A.2d 728, 730 (Pa. 2009). We may only disturb the Board's factual determinations if they are not supported by substantial evidence, and by "substantial evidence" we mean such relevant evidence as a reasonable mind might accept as adequate to support a conclusion. *Valley View Civic Ass'n v. Zoning Bd. of Adjustment*, 462 A.2d 637, 642 (Pa. 1983).

Based upon our review of the record in this case, we must conclude that the trial court correctly applied its standard of review in finding that the Board's decision to grant

Inflection's Application was not supported by substantial evidence. With respect to similarity of use, the trial court held that Inflection's limited testimony on this issue (from Mr. Erwin) was "conclusory and not supported by any factual evidence whatsoever." *Gorsline*, 40 Pa.D&C.5d at 488.

> [Mr. Erwin] testified that Inflection's proposed use was **not** classified as a public service facility under the Ordinance. Transcript, 10/7/13, at 8. Apparently dissatisfied with that answer, Inflection's counsel then asked the following leading question, "It fits the definition as a public service facility under the Fairfield Township Zoning Ordinance, is that correct?" After this prompting, [Mr. Erwin] said, "Yes." There was absolutely no explanation for [Mr. Erwin's] arguably inconsistent answers. The definition of a public service facility was not discussed or alluded to and no testimony was provided to show how Inflection's proposed use fits the definition. There was just a bald, conclusion statement that the use fit the definition of a public service facility.

Id. at 489 (emphasis in original). As a result, and in the absence of any findings of fact by the Board regarding similarity of use, the trial court concluded, and properly so, that Inflection had not met its burden of proof (substantial evidence) with respect to subsection 12.18.1 of the Ordinance.

In reversing the trial court's decision, the Commonwealth Court, without explanation or citation, insisted that the record contained "detailed findings of fact." *Gorsline*, 123 A.3d at 1151. As noted, however, the Board's decision contained no findings of fact whatsoever with respect to similarity of use. The Commonwealth Court further maintained that the trial court, in reviewing Mr. Erwin's testimony, improperly acted as the factfinder and substituted its credibility determinations for those of the Board. *Id.* We must again respectfully disagree. The Board made no credibility determinations with respect to the two questions posed to Mr. Erwin regarding "public

service facilities," as it did not even mention this testimony in its opinion. Thus, there was no possibility of "substitution." The trial court likewise did not make any credibility determinations of its own, as instead it merely concluded that the contradictory nature of Mr. Erwin's testimony provided no "substantial evidence" to support the Board's conclusion that Inflection had satisfied its burden of proof with respect to subsection 12.18.1.[11]

The Commonwealth Court's reliance upon its decision in *MarkWest* was error. We take no issue with the distinction in *MarkWest*, based upon the language of the local ordinance at issue in that case, between substantially identical uses and uses that are

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[11] Consistent with the Commonwealth Court, the learned Dissent insists that the trial court "inserted itself as the factfinder" by characterizing Mr. Erwin's testimony as "arguably inconsistent." Dissenting Op. at 4-5. Inconsistency aside, given Inflection's failure to develop a factual record regarding possible similarities between its proposed use and uses that are allowed in the R-A district, Mr. Erwin's conclusory answers at best amounted to unsupported lay opinion in response to leading questions that sought legal conclusions. As such, they lacked any evidentiary value with respect to similarity of use. The trial court explained its rejection of the testimony on this basis. 40 Pa.D&C.5d at 489 ("The definition of a public service facility was not discussed or alluded to and no testimony was provided to show how Inflection's proposed use fits the definition. There was just a bald, conclusion statement that the use fit the definition of a public service facility.").

The Dissent also lists other evidence in the record, including, inter alia, the project statement, an erosion and sediment control plan, an aerial photographic plat and Mr. Gillespie's testimony, as further support for the Board's decision. Dissenting Op. at 5. Conspicuously absent, however, is any reference by the Dissent to documentary evidence or testimony in these items of record that is relevant to the similarity of use issue. As noted above, for example, while Mr. Gillespie testified extensively at the second public hearing, he offered no testimony or other evidence relevant to the similarity of use issue.

Finally, I agree with the Dissent's recognition that in making land use decisions, municipal governing bodies should be permitted to bring to bear their expertise and knowledge of local conditions. Dissenting Op. at 5-6. They must do so on a sufficiently developed factual record, however, and their determinations with respect to questions of law (e.g., proposed uses) are subject to judicial review.

of the "same general character." *MarkWest*, 102 A.3d at 558-59. As explained herein, however, Inflection's proposed gas wells use is not, in any material respect, of the "same general character" as any allowed use in the R-A zoning district, including the "public service facility" and "essential services" uses referenced by the Commonwealth Court. *Gorsline*, 123 A.3d at 1152.

In summarily concluding to the contrary, the Commonwealth Court did not carefully examine the language of the two definitions. By its definitional terms, a "public service facility" involves "public service structures **by a utility** … or **by a municipality or other governmental agency**." Ordinance, § 2.2 (emphasis added). Likewise, "essential services" are the facilities and related equipment of a **"public utility."** *Id.* (emphasis added). Inflection is clearly not a municipality or a government agency, but rather is a private, for-profit commercial business. It is also not a public utility. In *Crown Communications*, this Court held that when a zoning ordinance (like the Ordinance at issue here) does not define "public utility," the term "shall be understood to mean any business activity regulated by a government agency in which the business is required by law to: 1) serve all members of the public upon reasonable request; 2) charge just and reasonable rates subject to review by a regulatory body; 3) file tariffs specifying all of its charges; and 4) modify or discontinue its service only with the approval of the regulatory agency. *Crown Communications*, 705 A.2d at 431–32; *see generally Robinson II*, 147 A.3d at 587. Unquestionably, Inflection's gas well operations do not satisfy any of these requirements.

Moreover, while Inflection now states that its proposed use will "serve the general public producing and piping natural gas to the public for their use and consumption,"

Inflection's Brief at 39, Inflection's use "for the general public" is materially different from the "public service facility" and "essential services" uses defined in the Ordinance. The word "public" in "**public** service facility" unquestionably refers to the local residents of Fairfield Township, as the definition of the term refers to, inter alia, power plants, water treatment plants, sewage disposal plants, and other similar public service structures, to furnish the public with "electrical, gas, communication, water supply and sewage disposal services." Ordinance, § 2.2. Likewise, the definition of "essential services" references gas, electrical communications, steam, fuel, or water transmission or distribution systems as are "necessary for the health, safety, and general welfare of the community." *Id.* As such, the public nature of "public service facility" and "essential services" uses is inherently **local** in nature – namely, to provide services for the benefit of residents in Fairfield Township's R-A district in connection with residential and agricultural uses in that district.[12] Inflection, conversely, while representing that it "serves the general public," offered no evidence, and the Board made no findings of

[12] In its brief filed with this Court, Inflection also argues that its gas wells use is similar to a "public or quasi-public use," which the Ordinance defines as follows:

> Uses or structures designed, intended or arranged for the use of service of the general public, although the fees and conditions of such use may be determined and regulated by the operator thereof, e.g., Banks, Post Offices, Churches, Cemeteries, Schools, Community Centers, Firehalls, Municipal building, Community Sewer and Water treatment facilities and other uses of the same general character.

Ordinance, § 2.2. As the uses set forth in this definition (e.g., banks, churches, schools) are clearly intended to be local in nature and for the benefit of the residents of Fairfield Township, we likewise reject Inflection's contention that this use is "similar to" its proposed gas wells use.

fact, that its extraction of natural gas is in any respect for the benefit of the residents of the R-A district, Fairfield Township, or even Lycoming County.

Fundamentally, the Ordinance was adopted "in consideration of the character of the municipality, its various parts and the suitability of the various parts for particular uses and structures," and its general purpose is to, inter alia, "encourage the most appropriate use of land, conserve and stabilize the value of property; provide adequate open spaces for light and air[.]" Ordinance, §§ 1.4.1; 1.4.2. This statement of purpose is echoed in the R-A zone definition, which reflects that such zones are meant to be quiet, of medium density, and supportive of residential and agricultural activities – while discouraging industrial uses. *See id.,* § 3.1. The Ordinance permits "public service facility" and "essential service" uses in the R-A district to promote residential and agricultural development in that part of the township. Ordinance, § 4.2.2.16. In other words, "public service facility" and "essential service" uses are allowed because they provide the necessary infrastructure for residential and agricultural development in the R-A district, including public utility services (water, sewage, electricity, natural gas, water treatment) as well as more general uses that support residential and agricultural development (e.g., hospitals, bed and breakfast inns, public recreation and agricultural businesses).

Seen in this light, Inflection's proposed use is plainly not of the "same general character as, or "similar to," "public service facility" or "essential services" uses. Inflection's proposed gas wells use provides no public or essential services to the residents of the R-A district, and provides no infrastructure that supports and promotes residential and agricultural development in Fairfield Township. Inflection's proposed

use is intended solely for Inflection's own commercial benefit, and not in any respect for the benefit of furthering the expressed goals of Fairfield Township's R-A district. It is not similar to a "public service facility" because it provides no public service to R-A residents, and it is not similar to "essential services" because it provides no services that are essential to residential and agricultural development in Fairfield Township.[13] Instead, it is a purely industrial use of the type the Ordinance expressly discourages in the R-A district.

Finally, the Commonwealth Court's reliance on the Board's prior grants of conditional use permits for other gas wells in an R-A district to satisfy subsection 12.18.1's requirement of similarity of use was also error. *Gorsline*, 123 A.3d at 1152 ("the Board has already authorized Inflection's other wells in the R-A District"). In this regard, we first note that the record in this case contains very little information about the previously permitted wells. Inflection's evidence regarding these other gas wells was limited to the following exchange between counsel for Inflection and Mr. Erwin:

> [Counsel for Inflection]: And you have received approval for other wells in that same zoning district in this Township?
>
> [Mr. Erwin]: Yes.
>
> [Counsel for Inflection]: Prior to this hearing?
>
> [Mr. Erwin]: Yes.
>
> [Counsel for Inflection]: And on how many occasions?

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[13] *See Cellco P'ship v. N. Annville Twp. Zoning Hearing Bd.*, 939 A.2d 430, 435 (Pa. Commw. 2007) (rejecting Verizon's contention that construction of a cellphone tower was "similar to" a "public utility exemption" because it would "advance Verizon's ability to compete in a marketplace," and "there is an important difference between public and commercial benefits").

> [Mr. Erwin]: I believe it's at four wells now. The Greg Harris well, Mussina, and the two Eck wells.

N.T., 10/7/2013, at 19-20. There was no evidence presented about the proposed uses claimed for these wells; the permitted use(s) the Board found to be similar to those proposed uses; whether public hearings were held regarding these other wells; if there were public hearings, what evidence was presented, if any, in opposition to the proposed uses (and by whom); or any details about the wells themselves, e.g., their location, their proximity to residences, etc. A neighboring resident testified that the other wells were not similarly situated to the Shaheen Pad, as they were located a greater distance from residential areas. N.T., 11/4/2013, at 67. In summarily concluding that Inflection had satisfied its burden of proof with respect to subsection 12.18.1, the Board did not mention its prior grants of other conditional use permits for gas wells uses. To the contrary, its only reference to these permits in its opinion was to identify the above-noted difference in location between the previously permitted wells and the Shaheen Pad. *See* Board Op., Findings of Fact, ¶ 42 (noting that "of the proposed well pad sites proposed by [Inflection] to date within the Township, the proposed Shaheen Pad is the closest in distance to a significant number of single family residential homes").

We must agree with the arguments of the Objectors on this issue. Because the Ordinance does not expressly authorize a gas wells use in any of the Township's three zoning districts, such a use cannot enjoy any presumption of being "similar to" uses that are permitted in those districts, and section 12.18 clearly places the burden of proof with respect to similarity of use on the applicant. The statutory language of section 12.18 neither states nor suggests that the issuance of prior site-specific conditional use

permits under that section of the Ordinance relieves an applicant of its obligation to satisfy its burden of proof with respect to section 12.18 in its entirety. A contrary decision would effectively raise a prior ruling to the status of a zone-wide amendment of the language of section 12.18, and would deprive local residents and property owners in the district of any meaningful opportunity to oppose the issuance of a new conditional use permit. Inflection may not bootstrap its prior granted conditional use permits into a presumption of validity of every subsequent application that it files.

Applying our standard of review, we hold that the Board's conclusion that Inflection satisfied its burden of proving that its proposed use was similar to a permitted use in an R-A district is not supported by the record. In so ruling, this decision should not be misconstrued as an indication that oil and gas development is never permitted in residential/agricultural districts, or that it is fundamentally incompatible with residential or agricultural uses. As the Dissent fairly acknowledges, in *Robinson I* a plurality of this Court recognized that the protection of environmental values is a "quintessential local issue that must be tailored to local conditions." Dissenting Op. at 10 n.6 (quoting *Robinson I,* 83 A.3d at 979). To this end, the Municipalities Planning Code permits the governing body of a municipality to amend its zoning ordinances to permit oil and gas development in any or all of its zoning districts. 53 P.S. § 10601. The governing body must, however, actually amend its zoning ordinances to permit drilling in designated areas, setting forth whatever limitations and conditions it decides are appropriate for the protection of its citizenry. What a governing body may not do, however, and what the Fairfield Township Board of Supervisors did in this case, is to permit oil and gas development in residential/agricultural districts without first enacting the necessary

amendments, based upon a clearly inadequate evidentiary record and no meaningful interpretative analysis of the language of its existing zoning laws.[14]

For these reasons, we reverse the decision of the Commonwealth Court.

Chief Justice Saylor and Justices Todd and Wecht join the opinion.

Justice Dougherty files a dissenting opinion in which Justices Baer and Mundy join.

[14] Contrary to the Dissent's contention, we do not take the position that oil and gas drilling development may never occur in a district unless a township amends its zoning ordinance to expressly allow the use, or that applicants may never seek a conditional use permit for this use pursuant to a local ordinance's savings clause. Where an applicant develops a sufficient evidentiary record to establish similarity of use, nothing prevents a local governing body from granting permission for a use not expressly allowed or disallowed in a particular district. Instead, we hold only that in the present case, given the stark differences between the proposed use and those uses expressly allowed in the R-A district (including "public service facilities" and "essential services") as well as Inflection's failure to even attempt to breach this divide through the development of a factual record, the Board erred in granting a conditional use permit under the Ordinance's savings clause.