



The UK voice for onshore oil and gas exploration

Planning for Shale Gas: An Industry Perspective

United Kingdom Onshore Oil and Gas



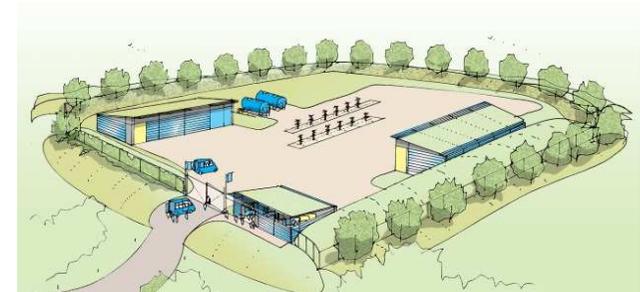
Agenda

- About UKOOG
- History
- What's there
- What it looks like
- The process
- Risks and regulation
- Why shale
- Where to find further information
- Appendices
 - Perspectives on some of the myths

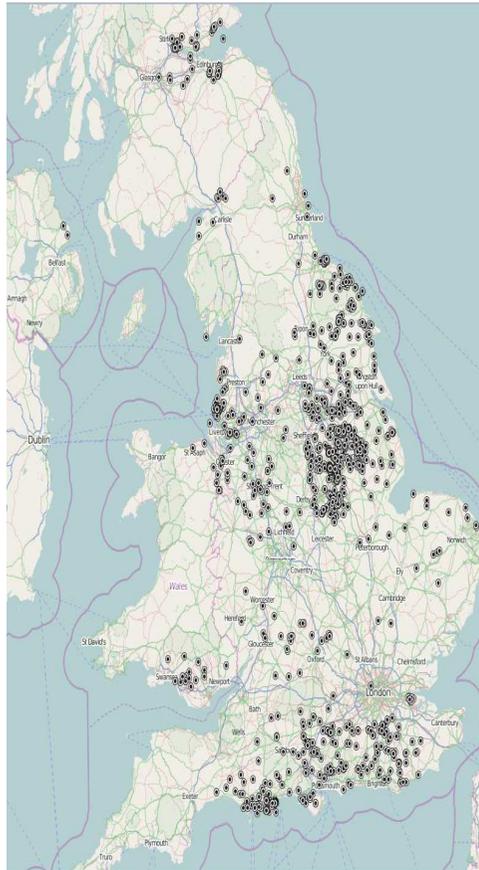


UKOOG

- UKOOG is the representative body for the UK onshore oil and gas industry. The organisation's objectives are to:
 - enhance the profile of the whole onshore industry (both conventional and unconventional);
 - promote better and more open dialogue with key stakeholders;
 - deliver industry wide initiatives and programmes; and
 - ensure the highest possible standards in safety, environment management and operations.
- UKOOG is a membership organisation fully funded by its members. Full membership is open to all UK onshore licence holders and operators, and associate membership is open to all suppliers to the UK onshore oil and gas industry.
- c.25 operator members (95% of onshore licences)
- c.50 supply chain members



UK onshore: Building on history

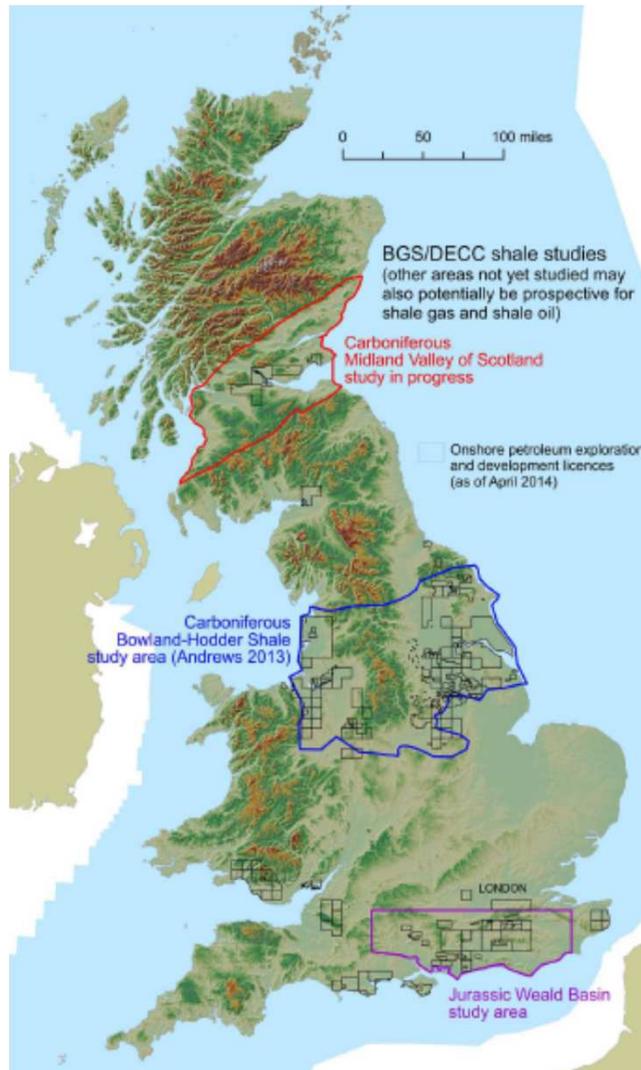


- First production from oil shales in Scotland in 1851
- First gas well 1896 Heathfield railway station in Sussex
- >2,100 wells drilled onshore
- Wytch Farm Largest onshore oilfield in Western Europe
- Sherwood Forest during WWII, 3.5 million barrels produced onshore during war
- Currently, 230 operating wells onshore
- 8 million barrels of oil equivalent per year – enough for 1 million cars



Onshore oil and gas industry has long history of operating safely in environmentally-sensitive sites and close to where people live

Shale gas potential: UK resources

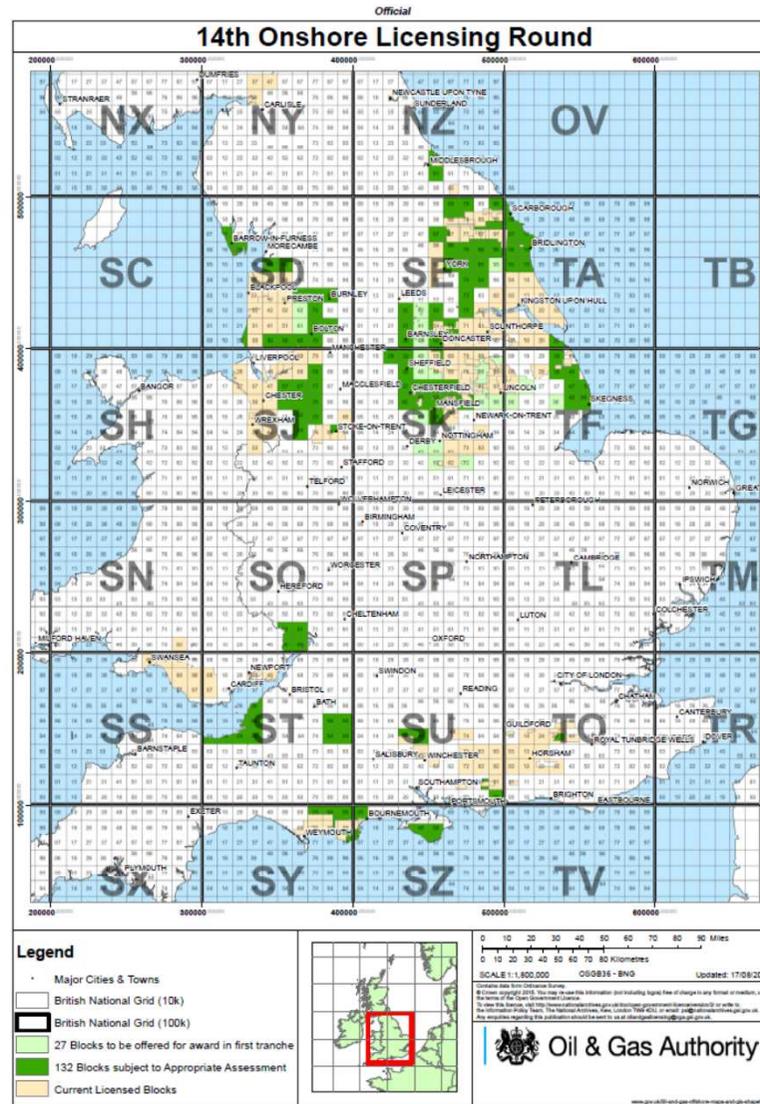


British Geological Survey assessments

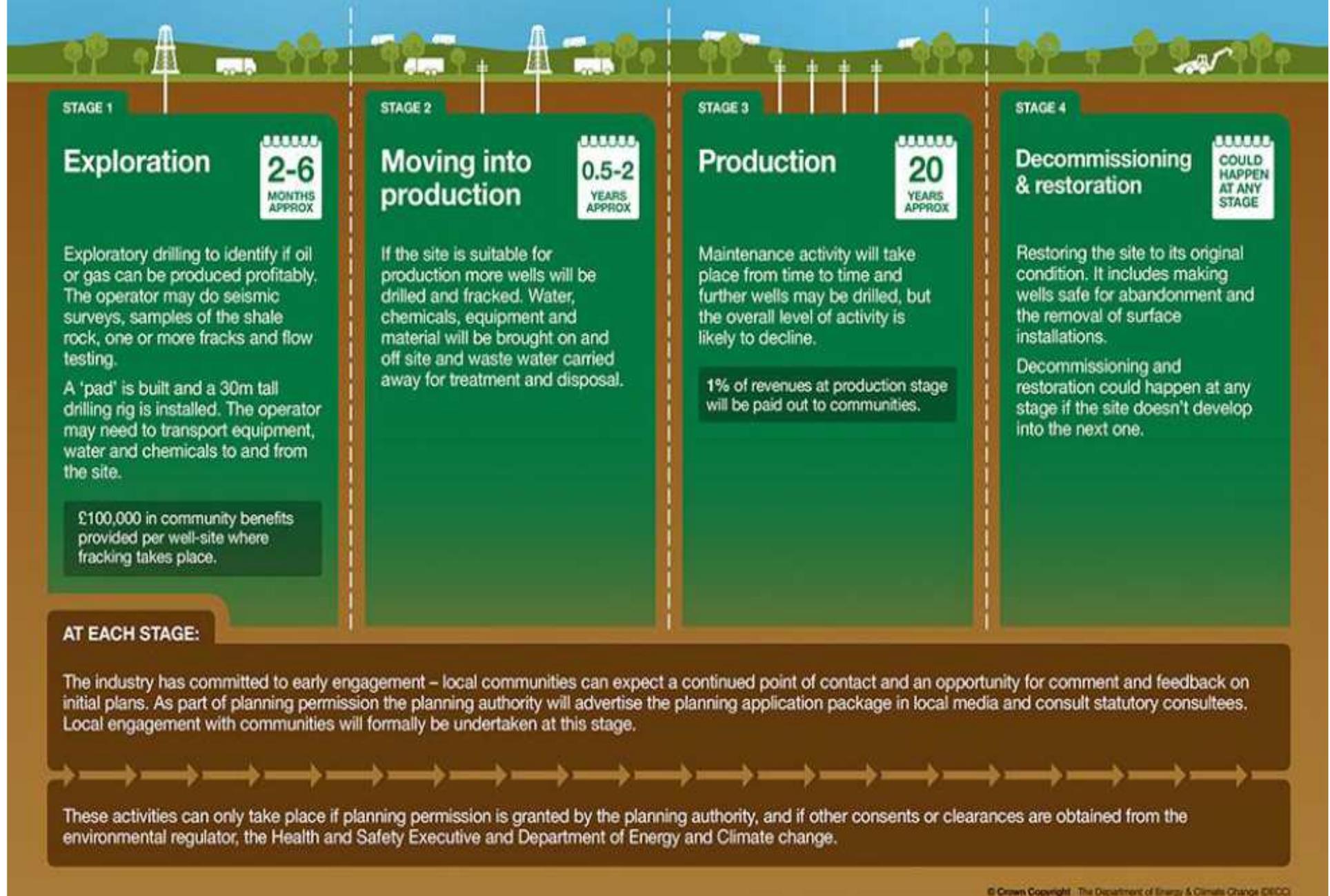
Study area	Shale gas resources (trillion cubic feet)	Shale oil resources (billion barrels)
Bowland	1,329.0	-
Weald	-	4.4
Midland Valley	80.3	6.0
TOTAL	1,409.3	10.4

10% of the shale gas resources equal to nearly 50 years of UK consumption

Onshore oil and gas: Licence areas



Stages of shale gas and oil



Shale gas potential: Production pad

Heat 400,000 homes at peak

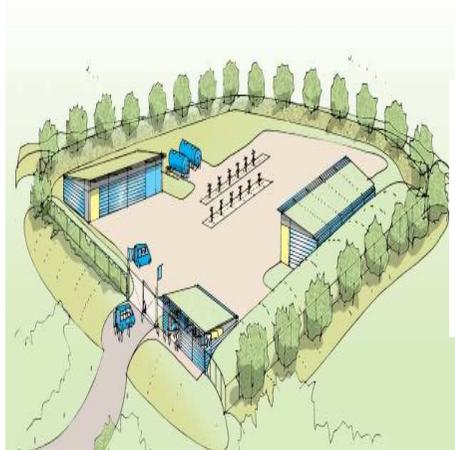
5 years drilling and fracturing schedule

2 hectares

Average of 6-17 two-way truck movements per day over first 5 years, depending on whether water can be piped in

Total capex and opex of c.£500 million

Context



=



=



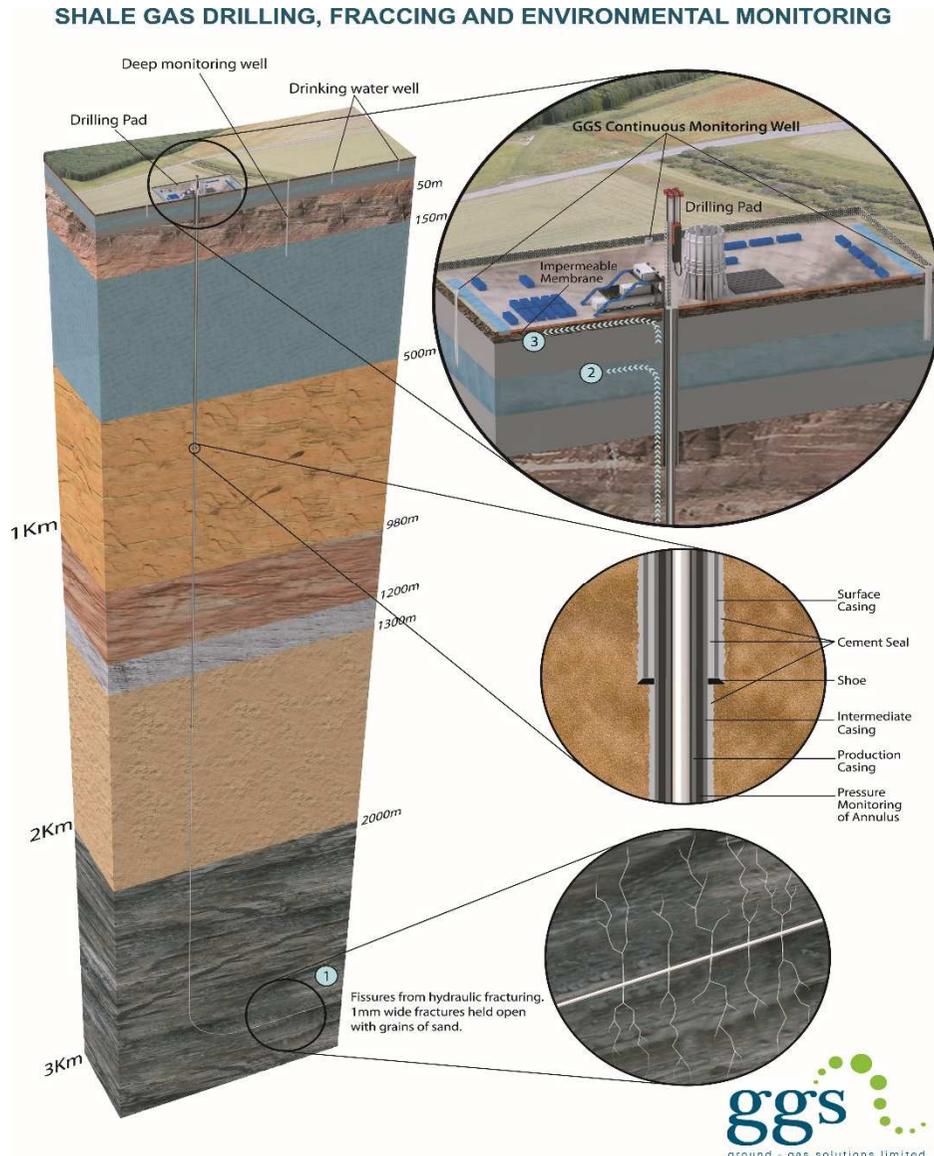
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87

1,520,000

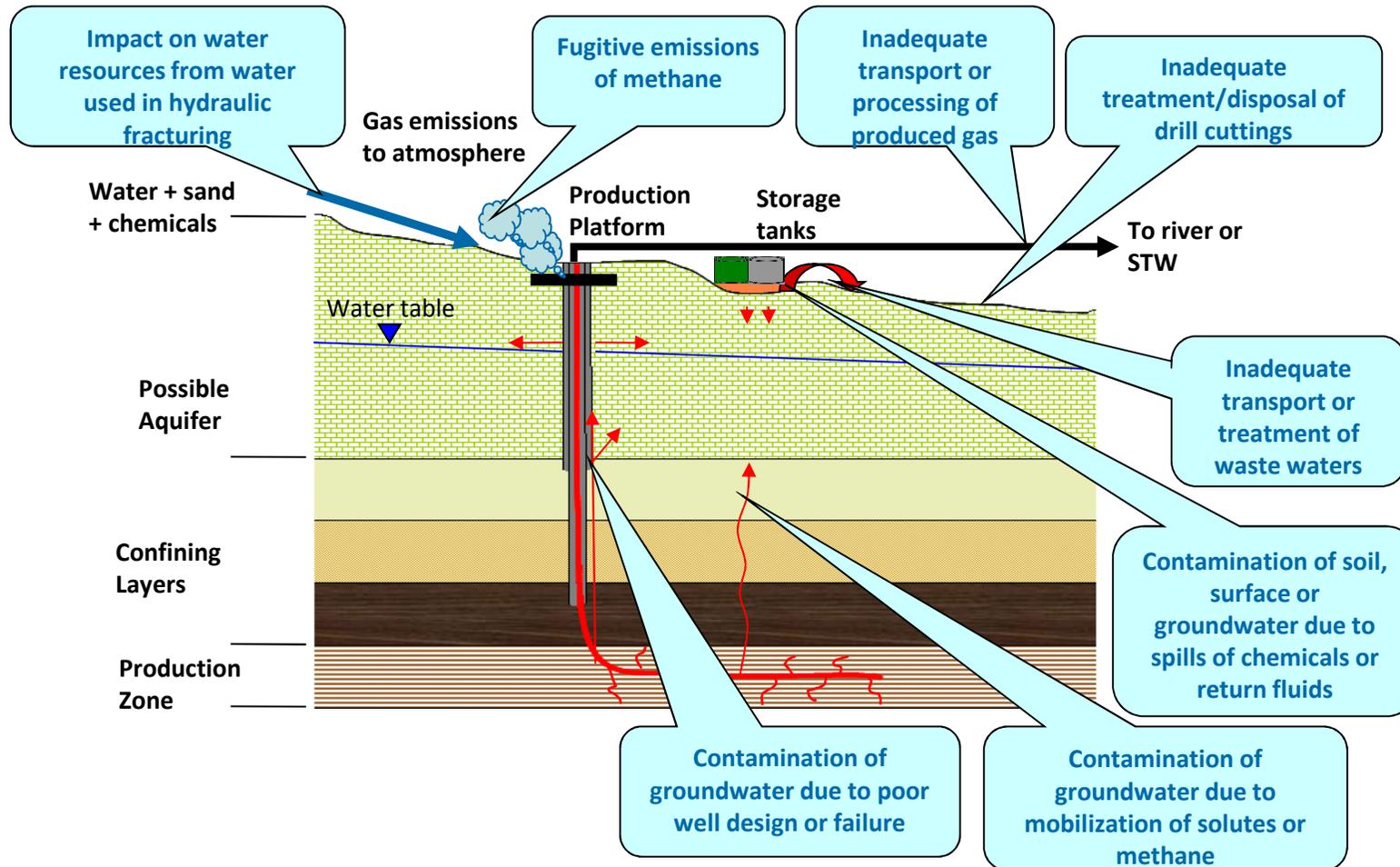
26 m	100 m	2.5 m
2 ha	1,450 ha	924 ha
2,900-20,000 trucks	7,800 trucks	7,600 trucks

Process

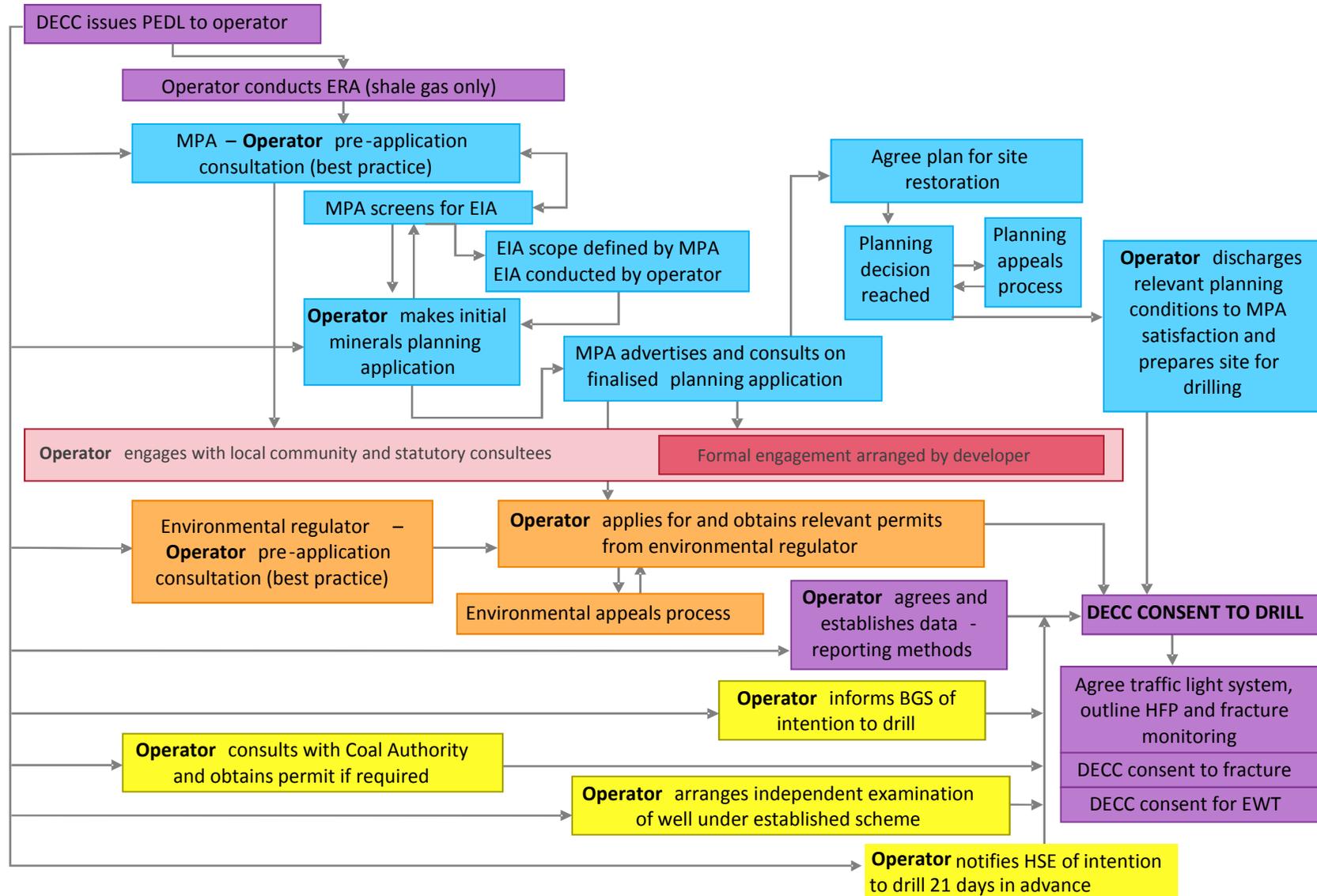


- Hydraulic fracturing is not a new technology and has been used to produce hydrocarbons since 1947
- Approximately 2.5million hydraulic fracture jobs have been completed worldwide and 60% of all new oil and gas wells are using the technology
- Hydraulic fracturing has been routinely used in the North Sea and Onshore UK conventional hydrocarbon basins (e.g. East Midlands) for 30+ years.

Potential risks



Regulatory roadmap

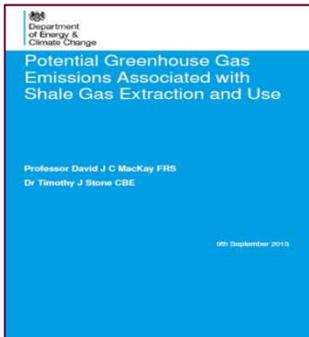


Infrastructure Act

- The environmental impact has been taken into account by the local planning authority
- Independent inspection of the integrity of the relevant well
- The level of methane in groundwater monitored 12 months before hydraulic fracturing*
- Arrangements for the monitoring of emissions of methane into the air
- Not within protected groundwater source areas*
- Not within other protected areas*
- Local planning authority taken into account the cumulative effects
- Substances to be approved by the relevant environmental regulator
- Local planning authority has considered whether to impose a restoration condition
- The relevant (water) undertaker has been consulted
- The public was given notice of the application

*secondary legislation

Third party review: Regulation



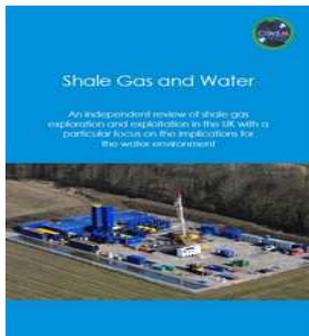
*The health, safety and environmental risks associated with hydraulic fracturing (often termed 'fracking') as a means to extract shale gas can be managed effectively in the UK as long as operational best practices are implemented and enforced through regulation. **The Royal Society & Royal Academy of Engineering, June 2012***

*If adequately regulated, local GHG emissions from shale gas operations should represent only a small proportion of the total carbon footprint of shale gas. **Mackay & Stone, DECC, September 2013***



*The technology exists to allow the safe extraction of such reserves, subject to robust regulation being in place. **Independent Expert Scientific Panel for Scottish Government 2014***

*The currently available evidence indicates that the potential risks to public health from exposure to emissions associated with the shale gas extraction process are low if operations are properly run and regulated. **Public Health England, October 2013***

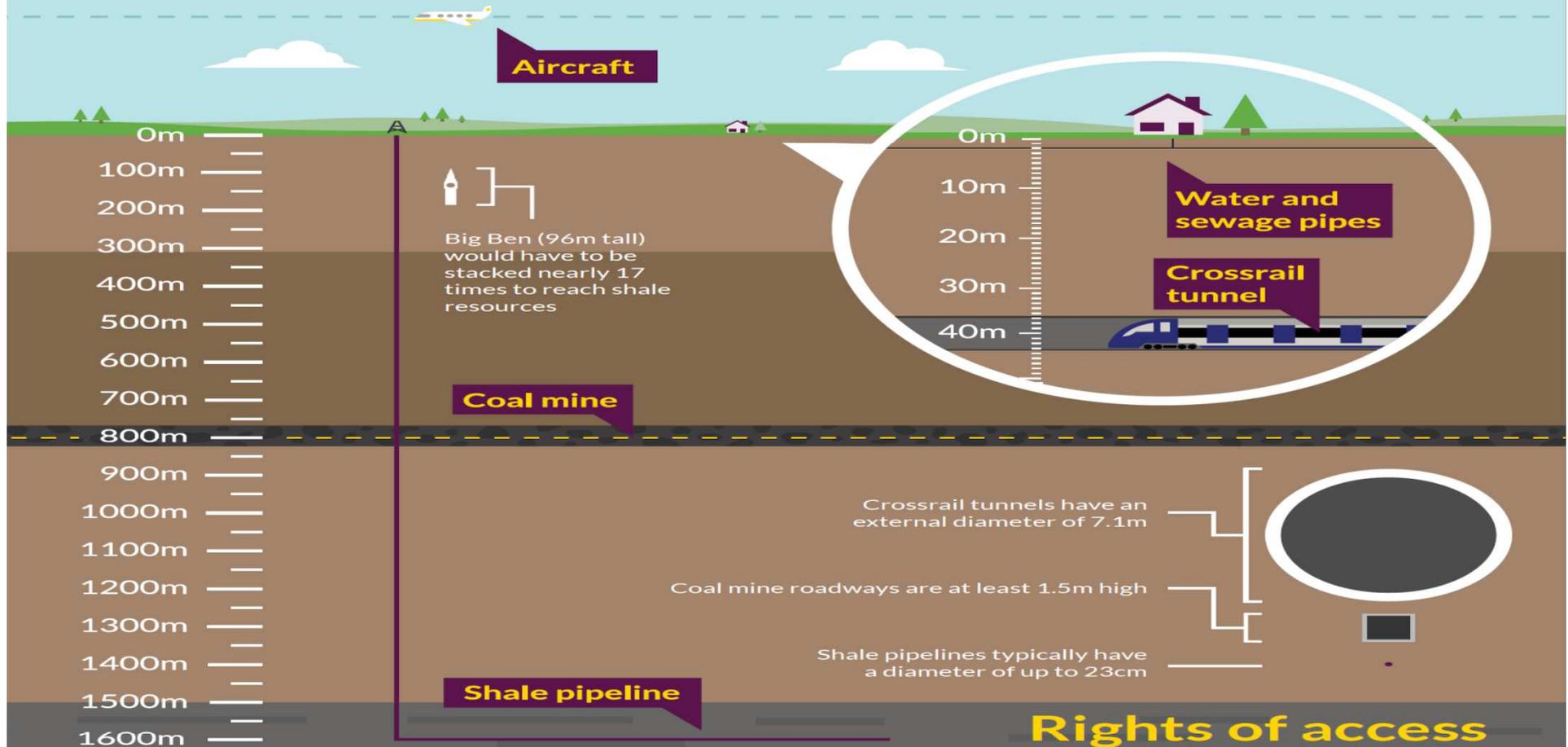


*Water UK has reviewed recent reports into shale gas extraction, and believes that while there are potential risks to water and wastewater services, these can be mitigated given proper enforcement of the regulatory framework. **WaterUK, November 2013***

*Compared to other fossil fuels the overall water use intensity of shale gas is low, ... claims by some opponents that the industry represents a threat to the security of public water supplies are alarmist. **CIWEM, January 2014***

How deep are shale resources?

Shale resources are usually 1,600 metres or more below the surface, twice the depth of the UK's deepest coal mine.




The 1982 Civil Aviation Act ruled that landowners do not have rights to restrict access to airspace above 305m


The water industry and Environment Agency have compulsory powers to lay new water and sewage pipes

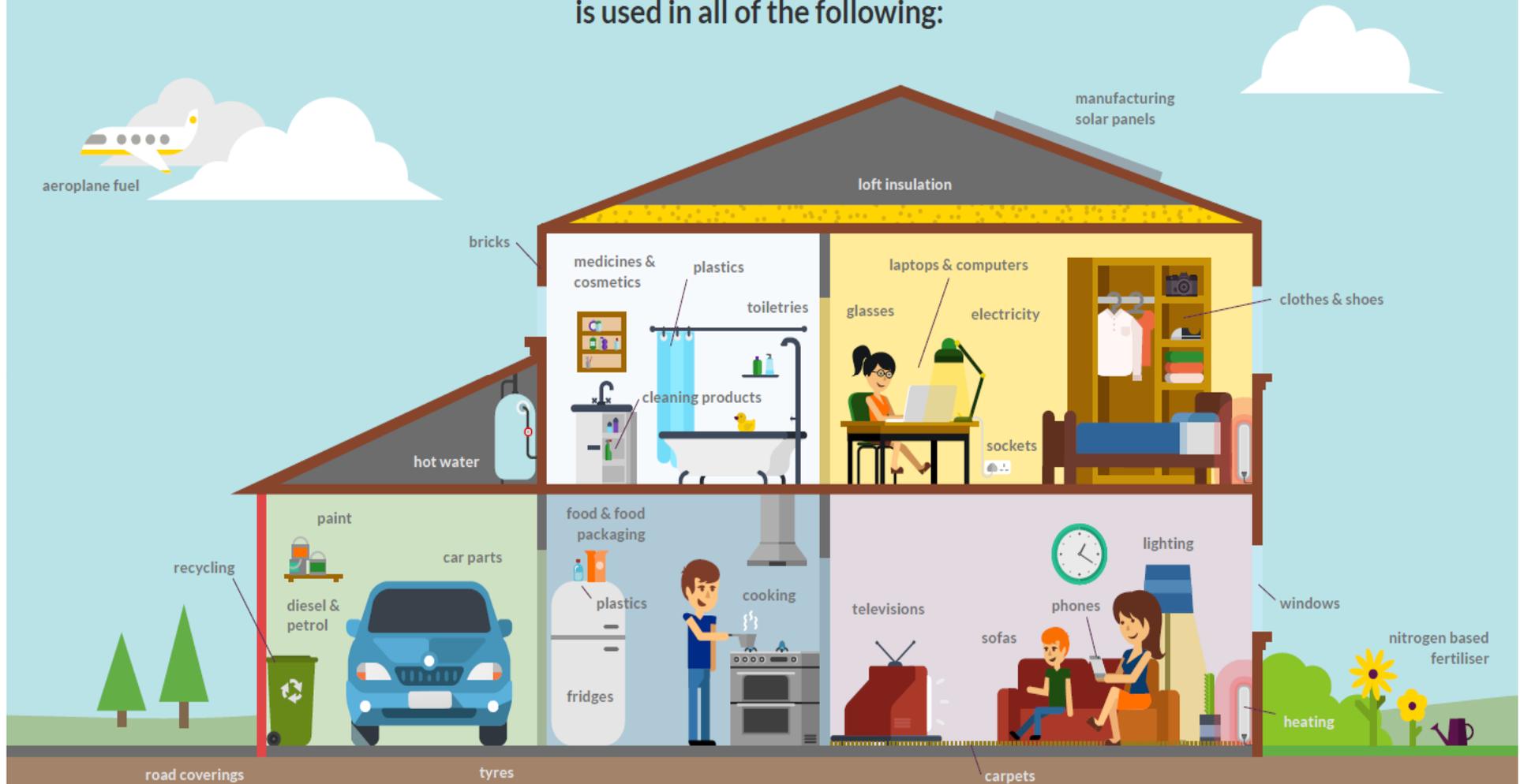

Crossrail access rights were acquired by compulsory purchase, as set out in the Crossrail Act 2008


Licensed coal operators have a right of access to underground land for coal mining operations, with no compensation provided


Currently rights of underground access to shale are obtainable via a lengthy and complex court procedure if agreement cannot be reached

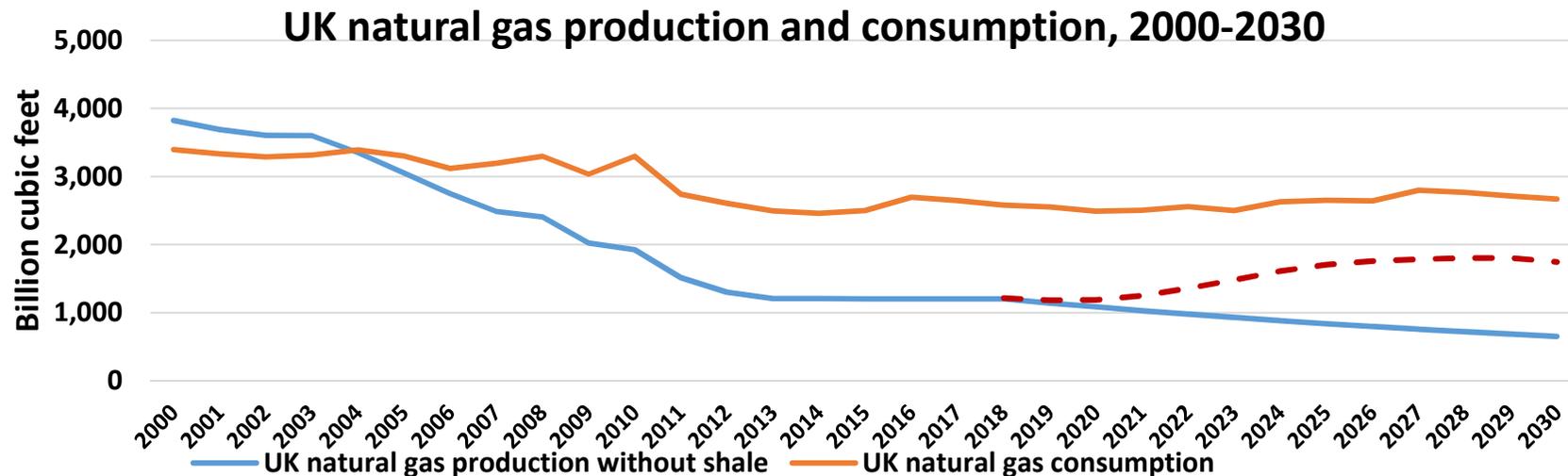
Thanks to oil and gas...

So many of the products we use and the things we do at home would not be possible without oil and gas and the compounds and materials produced from them. Oil and gas is used in all of the following:



Why home grown gas is so important

- **35%** of all energy consumed
- **c40%** of UK Electricity
- **83%** of UK household heating
- **61%** of UK household cooking
- UK chemical industry contributes **£20 billion** per year to the UK economy, provides direct and indirect employment for over half a million people (CIA)
- **Import dependency:** DECC: 75% by 2030; National Grid: 92% by 2035
- **CO₂:** LNG higher CO₂ than domestically-produced shale
- **Costs:** Net gas imports cost c.£6.5 billion last year, or £18 million a day. This could rise to £10 billion a year or more
- **Economy:** Imported gas does not create jobs or tax revenues in UK



Community engagement

- Engage **in advance of any operations or any application** for planning permission
- Provide **sufficient opportunity for comment** and feedback on initial plans
- Ensure that the local community **gains a clear understanding of the process including benefits and risks**
- Demonstrate considerate development
- Publish **transparent data**
- **Consider local employment**
- Put in place **benefit schemes**
- Confirm and **publish evidence each year** of adherence to charter;

Community Benefit Pilot Schemes

- **Pilot Schemes:**
 - For exploration sites that include hydraulic fracturing
 - £100,000 payment to local communities
 - UK Community Foundations a registered charity with a track record in working with local community will administer the scheme
 - Identify local communities
 - Create community panels
 - Create a trust for the money
 - Assist communities in identification of projects
 - Scheme arms length from the operator
 - The community decides solely on how the money is spent
- **Pilot scheme feedback will feed into the main production scheme:**
 - 1% revenue
 - £5m to £10m per site

Further Questions

- ‘Let’s talk about shale’ aims to collate questions from the public and have them answered by third party experts.
- As part of this, local clubs and groups were offered the chance to discuss the subject and ask questions of independent local speakers.





The UK voice for onshore oil and gas exploration

Planning for Shale Gas: An Industry Perspective *Appendices*

United Kingdom Onshore Oil and Gas



Some perspectives: Operating in sensitive areas

The onshore industry has a long established track record of developing oil and gas fields in sensitive areas, examples include:

- Site located in the South Downs National Park
- In the middle of a golf course
- In the middle of housing developments
- Adjacent to a local school
- Europe's largest onshore field- Wytch Farm- is located in and around the highly sensitive Poole Harbour area
- Pad drilling will help reduce the environmental impact



Referring to the “industrialisation of the north!” ...

“A two-hectare site could potentially support a 10-well pad and a production phase of 100 such pads would require just 200 hectares, or two square kilometres”

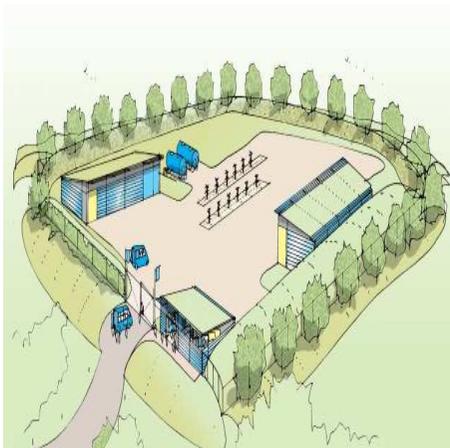
(Source: IOD Report April 2013)



Some perspectives: Scale

	Shale gas pad	Wind farm	Solar park
	(10 wells)	87 turbines, 174 MW capacity	1,520,000 panels, 380 MW capacity
Energy delivered over 25 years	9.5 TWh (chemical)	9.5 TWh (electric)	9.5 TWh (electric)
Number of tall things	1 drilling rig	87 turbines	None
Height	26 m	100 m	2.5 m
Land area occupied by hardware, foundations, or access roads	2 ha	36 ha	308 ha
Land area of the whole facility	2 ha	1450 ha	924 ha
Area from which the facility can be seen	77 ha	5200-17,000 ha	924 ha
Truck movements	2900-20,000	7800	7600

David Mackay FRS, <http://withouthotair.blogspot.co.uk/>



Some perspectives: Well integrity

- The process of well design, construction and fracturing operations are regulated by:
 - The Offshore Installation of Wells (Design & Construction) Regulations 1996 (DCR) – covering all wells (onshore or offshore) on the UKCS
 - In addition to DCR for onshore well sites is BSOR (Borehole Sites and Operations Regulations 1995)
- Additional guidance also exists from HSE, DECC, Environment Agency, UK Oil & Gas, UKOOG and relevant industry codes (ISO, API)
- As wells are drilled, each section is cased off with steel tubulars cemented in place
- Integrity of each section is tested to confirm hydraulic isolations
- By the time the well reaches deep shale formations, several sections of cemented casings can exist, isolating and protecting shallower formations that may contain aquifers/groundwater
- For the full life cycle of the well, a continuous programme of well integrity monitoring is in place

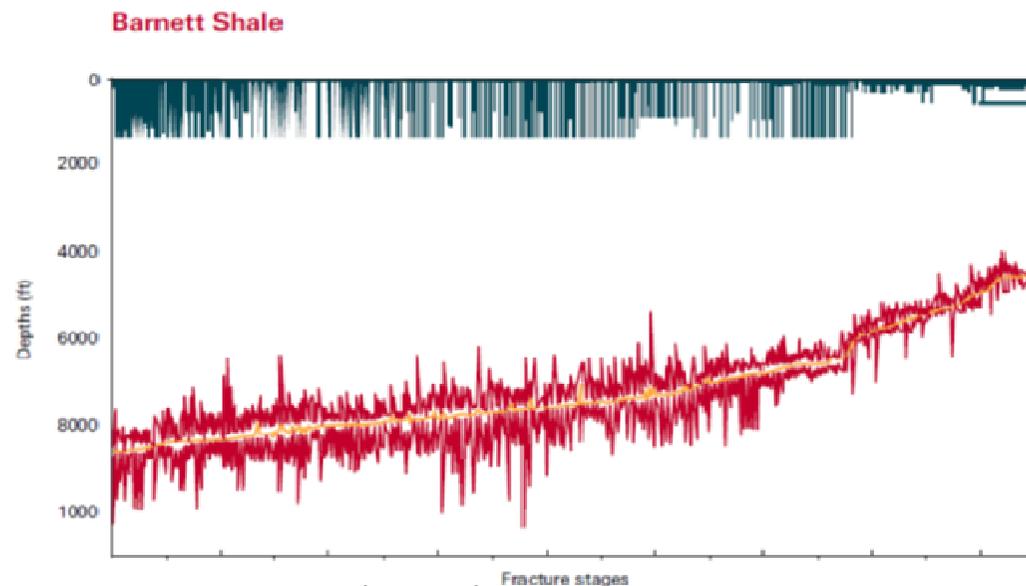


Some perspectives: Fracturing fluid and drinking water

- Hydraulic fracturing has been used in over 2 million wells world-wide since the 1940s. Comprehensive studies have found no historical cases in which hydraulic fracturing has contaminated drinking water

Concerns include:

- The extent that fractures may extend upwards from the host strata
- The potential for the injected fluids to migrate via these induced fractures into overlying aquifers



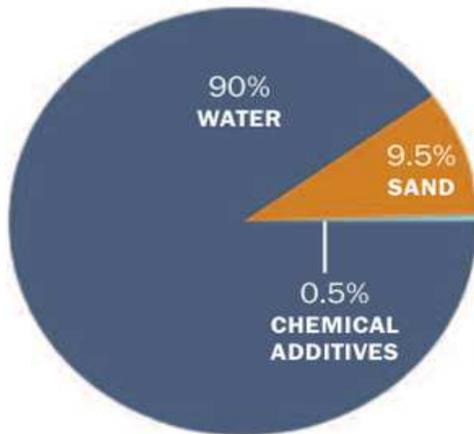
[Source: RAENG Shale Gas Extraction Report, June 2012]

Evidence includes:

- Micro fractures extend typically less than 180 metres upward from the well bore
- Layered sedimentary rocks provide natural barriers to the progression of the micro fractures

(Source: International Association of Oil and Gas Producers – Shale Gas and Hydraulic Fracturing)

Some perspectives: What's typically in fracturing fluid



Compound	Purpose	Common application
Acids	Helps dissolve minerals and initiate fissure in rock (pre-fracture)	Swimming pool cleaner
Sodium Chloride	Allows a delayed breakdown of the gel polymer chains	Table salt
Polyacrylamide	Minimizes the friction between fluid and pipe	Water treatment, soil conditioner
Ethylene Glycol	Prevents scale deposits in the pipe	Automotive anti-freeze, deicing agent, household cleaners
Borate Salts	Maintains fluid viscosity as temperature increases	Laundry detergent, hand soap, cosmetics
Sodium/Potassium Carbonate	Maintains effectiveness of other components, such as crosslinkers	Washing soda, detergent, soap, water softener, glass, ceramics
Glutaraldehyde	Eliminates bacteria in the water	Disinfectant, sterilization of medical and dental equipment
Guar Gum	Thickens the water to suspend the sand	Thickener in cosmetics, baked goods, ice cream, toothpaste, sauces
Citric Acid	Prevents precipitation of metal oxides	Food additive; food and beverages; lemon juice
Isopropanol	Used to increase the viscosity of the fracture fluid	Glass cleaner, antiperspirant, hair coloring



Some perspectives: Chemical disclosure

- Current regulations require chemical disclosure and reporting to the authorities
- Chemical substances are already registered and approved under the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) Regulation
- Shale gas operations will require additional disclosures

The UKOOG guidelines require operators to measure and publically disclose additional operational data on, for example:

- EA/SEPA approvals for fluids used.
- Material Safety Data Sheets information.
- Volumes of material, including proppant, base carrier fluid and chemical additives.
- The trade name of each additive and its general purpose in the fracturing process.
- Concentrations of each reportable chemical ingredient

UKOOG United Kingdom Onshore Operators Group
Shale Gas Well - Hydraulic Fracturing Fluid and Additive Component Transparency Service (HF FACTS)

Well Location		Well Description		Hydraulic Fracturing Fluid Data	
Country		Operator of Well		Water Volume (1) (Cubic Metres)	
Latitude		Name of Well		Max mass % of Total HF Fluid	
Longitude		DECC Well Registration No		Proppant (kilograms)	
Long/Lat projection		HF Completion Date		Max mass % of Total HF Fluid	
County		Well Depth (TVD Meters)		% of Water Volume - recycled/produced water	
Regulator Consents		Avgc frac perf depth (TVDm)		% of Water Volume - fresh water	
EA EPR Permit No				Max (mass %) Water+Proppant=	
Town & Country Planning consent					
DECC Hydraulic Fracture Programme approval					

HF Fluid Products		
Product Trade Names in Fracturing Fluid (if applicable)	Product Purpose in Well	Supplier(s)

HF Fluid Constituents			
Chemical Substance in Fracturing Fluid (2)	Chemical Abstract Service Number (CAS Number) (3)	Maximum Chemical substance Mass % in HF Fluid (4)	Comments

Notes:
 (1) Water utilized may be any combination of recycled water, produced water or fresh water.
 (2) All chemical additive substance data is provided by suppliers and is consistent with Safety Data Sheets.
 (3) See www.echa.europa.eu to find ECHA numbers; blank if confidential business information but regulator fully appraised.
 (4) Because maximum percentages are shown, total of water, proppant and HF chemical substance components may be greater than 100%.

Some perspectives: water usage

 Process	Water use per well	Duration of process and water use
Drilling	0.25 – 4MI	2 – 8 weeks
Hydraulic fracturing	7 – 23 MI	5 – 7 weeks
Production	0 MI – potential for reuse of returned water	5 – 20 years

= 1.4 to 4.6 ml per week, but only for 5 to 7 weeks per well

Process	Comparison	Duration
United Utilities water demand (Regional)	12,180 MI	1 week
National Groundwater abstraction	42,000 MI	1 week
National surface water abstraction	119,000 MI	1 week

Water taken from underground aquifers, rivers and lakes

Amount of water needed to operate a hydraulically fractured well for a decade is equivalent to the water used to run a 1,000MW coal-fired power plant for 12 hours or a golf course uses in a month

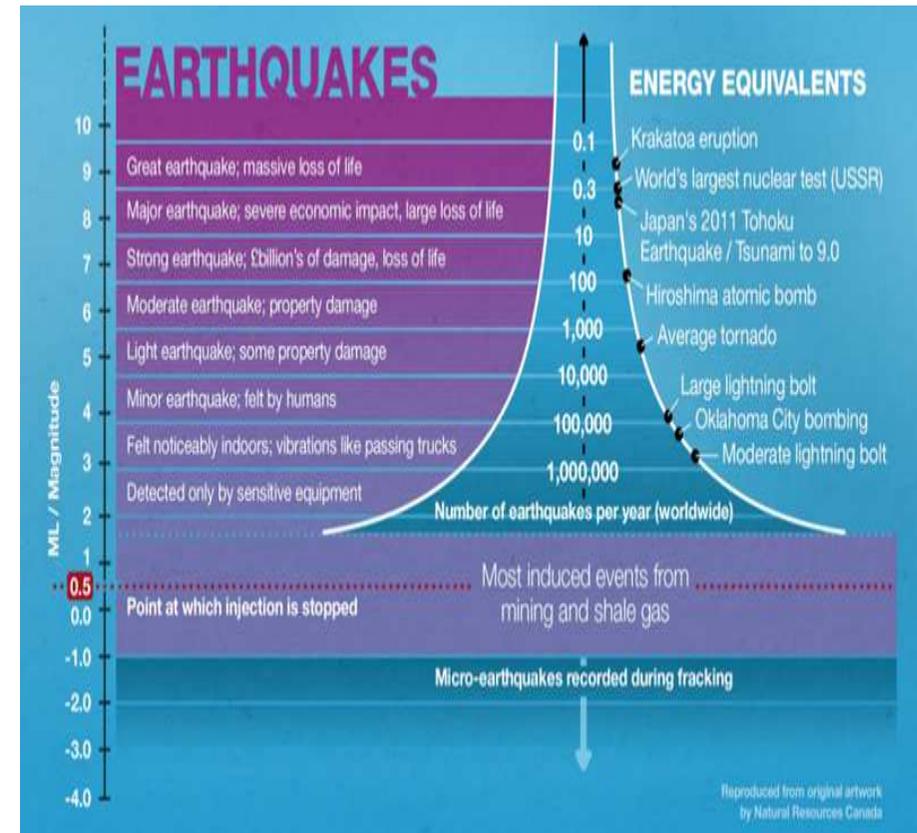
Some perspectives: Induced seismicity

- The Government, The Royal Academy of Engineering and the Royal Society and others have made recommendations in order to mitigate induced seismicity associated with hydraulic fracturing. These include:



Early warnings to prevent tremors

- Risk Assessment
- Best practise operating procedures via warning systems and local geological research
- A traffic light system, with all drilling activity stopped if very small tremors are detected (0.5 magnitude)



“most fracking-related events release a negligible amount of energy roughly equivalent to or even less than someone jumping off a ladder onto the floor...”

**Professor Richard Davies from
Durham University's Energy Institute**

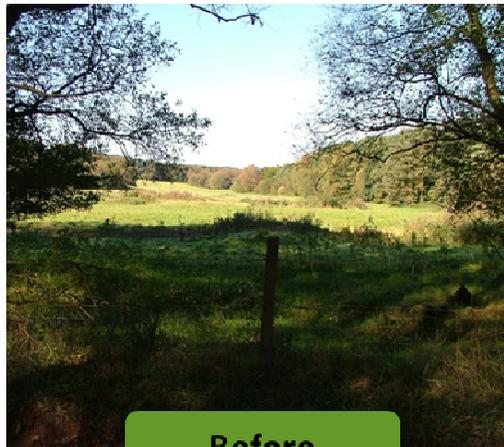
Some perspectives: Household insurance

- Damage as a result of earthquake, subsidence, heave and landslip are all covered, in general, under buildings insurance;
- There is, at present, little evidence to show a link between fracking and seismic activity that could cause damage to a well-maintained property, however, insurers will continue to monitor the potential for fracking, or similar explorations, to cause damage.
- We are not aware of any claims, to date, where seismic activity as a result of fracking has been mooted as a cause for damage;
- As in all locations, a reported history of subsidence (or indeed any other type of loss) in a location will be taken into account when offering and pricing insurance.



Some perspectives: Property values – RICS

- Fracking for shale gas is in its embryonic stage and therefore market evidence on its effect (if any) on property values has not yet emerged. RICS Valuation Professional Standards are based on current market evidence and therefore this issue will not be reflected in our members' valuations until it is reflected in the market.
- Currently there are few sales of property in areas directly affected by fracking therefore there is a limited data set on which valuers can draw. Should any market evidence emerge then our members will take note of this and reflect it in their valuation. Any commentary on any possible effects on property value therefore would be very premature, including the attempt to draw any parallels with other nations.
- RICS are keeping a watching brief on this and will provide an update with any further information that emerges.



Before



During

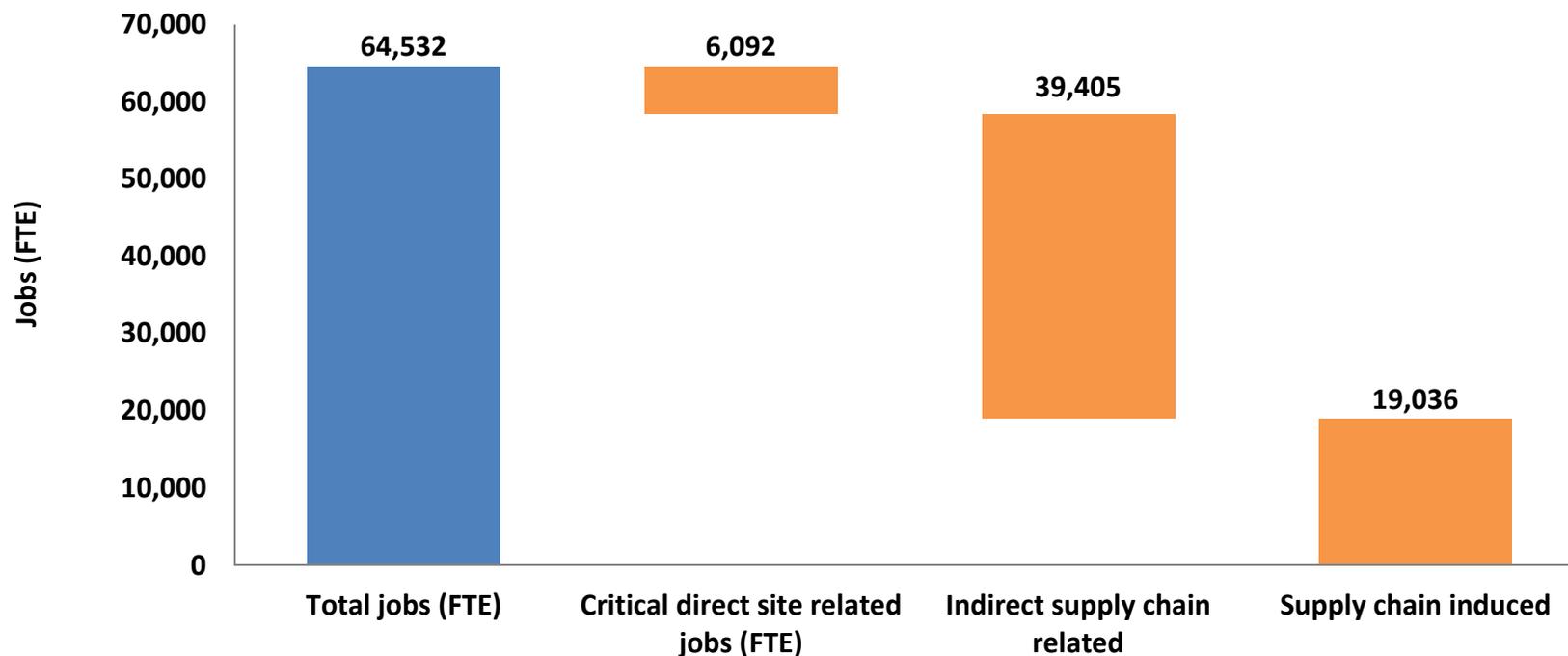


After

Shale gas potential: UK economy

- EY – £33bn investment over next two decades; 64,000 jobs at peak
- Petrochemical feedstock – chemical industry supports 500,000 jobs
- Ineos is buying shale licences to support Grangemouth and other facilities

Potential job creation from upstream shale gas activity



Its not 'shale versus renewables'

- Gas and renewables play different roles in the energy system – gas mainly used for **heat** (and some electricity); renewables mainly used for **electricity**
- Gas vital back-up to renewables – best form of electricity storage so far
- Not surprising that shale gas and renewables have grown together in the US

Between 2005 and 2013 electricity generation from wind increased by 678% in the 18 shale gas producing states, making up almost 60% of the total wind generation in the US



Carbon reduction

When assessing the role of shale gas production in meeting carbon reduction goals, we need to consider the UK in the medium term, the global 450 ppm objective, and the UK's longer term 80% carbon reduction target.

Shale gas production can contribute to all three:

- **2030: Fifth Carbon Budget** – UK shale replaces gas imports, emits less carbon than imported LNG, and supports sustainability efforts
- **2040: 450 parts per million** – IEA 450 ppm scenario sees global gas demand rise by 15% between 2013 and 2040, with world coal demand falling by 37%
- **2050: UK's 80% target** – Decarbonising heat can be achieved with methane converted to hydrogen and piped through city gas networks, or through fuel cell technology

Third party review: Climate change



*Shale gas production could have relatively low rates of methane leakage, similar to conventional natural gas production, if well regulated to ensure measures to stop methane leakage (e.g. 'green' completions). This would give it lower lifecycle emissions than our current liquefied natural gas (LNG) imports, and much lower than coal... UK shale gas production would reduce our dependence on imports and help to meet the UK's continued gas demand, for example in industry and for heat in buildings, even as we reduce consumption by improving energy efficiency and switching to low-carbon technologies. **Committee on Climate Change, September 2013***



*GHG emissions from energy supply can be reduced significantly by replacing current world average coal-fired power plants with modern, highly efficient natural gas combined-cycle power plants or combined heat and power plants, provided that natural gas is available and the fugitive emissions associated with extraction and supply are low or mitigated (robust evidence, high agreement). **Intergovernmental Panel on Climate Change, 5th Assessment Report, Working Group 3: Summary for Policymakers, 2014***



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info@ukoog.org.uk