



Shale Gas and Scotland's Energy Future

- Local Context
- US Context
- Scotland to date
- Enablers for a Scottish shale gas industry

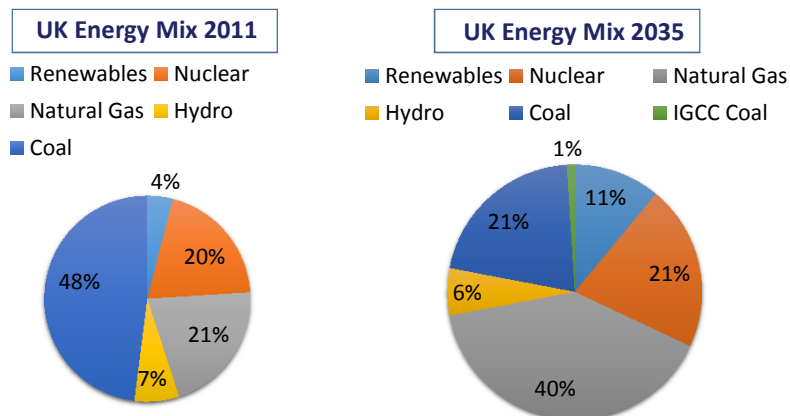
Why do we need gas?

- Heat energy and power generation
 - 80% of UK homes rely upon gas heating
- Feedstock
 - To make various plastics and chemical intermediates
 - These are used in everyday consumer items in our homes, including appliances, clothing, pharmaceuticals
- To support the switch to renewables
 - We need gas as feedstock, not just as an energy source
 - We need gas to support intermittent renewables energy production

Gas is half the carbon intensity of coal
The energy consumption by gas heating is 6 times the power generation capacity in the UK

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Gas plays a growing role en route to a low carbon future

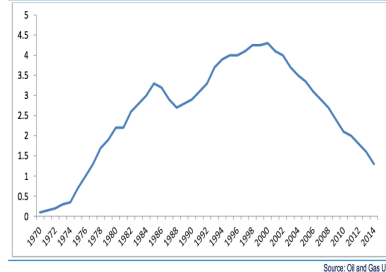


Source: DECC

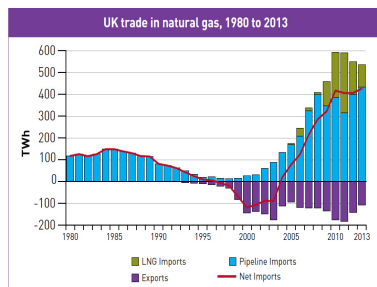
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Declining UK gas supply/demand balance

North Sea oil and gas production (million barrels/day)



Source: Oil and Gas UK

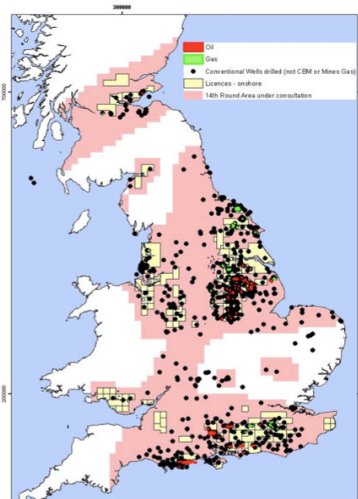


- Total North Sea gas and oil production has been steadily declining since 2000
 - A mature basin
- UK reliance on gas imports has steadily grown over the same period
 - The UK was self sufficient in 2000
 - ...but now imports over half it's natural gas demand
- Raises serious economic and security questions
 - UK wide energy security
 - UK wide jobs
 - Scottish balance of payments

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What is the scale of the Scottish opportunity?

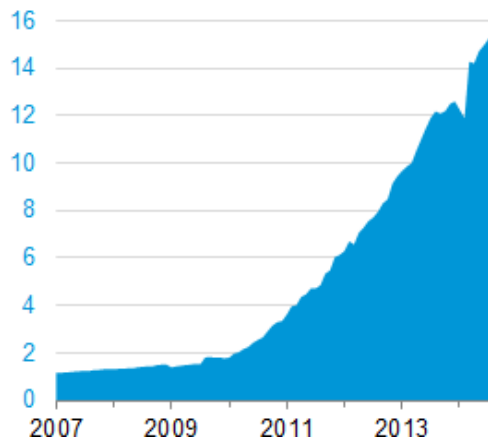
- Bottom line – we don't know for sure, but huge potential
- UK resource >400 years of current demand
 - Only a fraction recoverable, but this is still substantial
- Scotland resource 'moderate'
 - But still 6% of UK resource
 - Consumption is 10% of UK
- We need to explore and appraise this national resource
 - Not a silver bullet, but shale gas could provide 20-50% of UK gas demand for decades, alongside renewables growth



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The US “Shale Revolution”

Marcellus Region
Natural gas production
billion cubic feet per day



- One shale basin in the US (the Marcellus) has grown from 1 bcf/d in 2007 to over 15 bcf/day today
- Total UK gas demand is 8 bcf/day
- The Scottish basins are not as big or likely to be as productive - but they can still be material to the future energy mix

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US Ethane is on it's way to Europe

- INEOS has 2 of 4 European gas crackers
 - Only 4 of about 50 European crackers are gas crackers
- £450m invested in shipping and infrastructure
- Provides a feedstock option for Grangemouth
- But we still have significant energy and feedstock demands

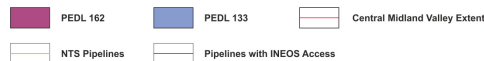
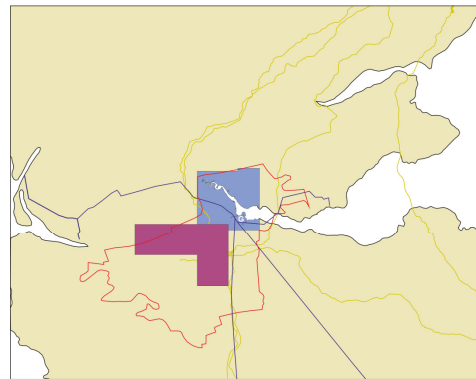


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Shale Gas development in Scotland

INEOS currently licenced Shale gas prospective areas in Scotland

- Total 731 km² = 181,000 acres
- In close proximity to gas infrastructure in the Central Belt, and to industrial gas consumers
- A development is possible with low societal impact



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What does a development look like?

- A hundred wells, maybe more if more area is prospective
- But spread over a wide area, with low impact at the surface
 - Individual 'pads' contain 8+ wells within an area the size of a football pitch
 - 2 – 4 km below the surface, the wells go horizontal for 2km and cover a large area
 - The pads can be located sensitively
 - There is maximum one pad every 12 - 15 km²
 - Once in production, the pad is silent and produces gas for 20 years
- There is some short term impact
 - It takes around 6 months to drill and frac the wells on each pad (maybe a little longer to begin until we grow efficiencies)
 - During this time, some truck movements, but we need to meet local planning guidelines
 - It is like a building site – some short term impact – but this is regulated by local planning conditions in the same way that any development is
- Benefits will be shared with the communities

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What will enable shale gas in Scotland?

- It all starts with the Rocks
 - The geology needs to be conducive to development
- Growth of key skills
 - Some skills are generic to the oil and gas industry (eg, well engineering)
 - In other cases, need to grow specific skills (eg, shale hydraulic fracturing engineering)
 - We must learn lessons from the US
- A cost effective supply chain
 - The onshore UK supply chain is currently small and expensive
 - Wells and fracs are at least 2-3 times US norms, or more
 - Scale and efficiency are needed for successful shale development
- And most critically – permission from society
 - There is a lot of misinformation out there
 - People are alarmed by the myths on water contamination, seismicity, amenity impact
 - The industry is generally not trusted, but environmental campaigners generally are



Trusted third party views are critical

Royal Society and Royal Academy of Engineering

The UK Government's Chief Scientific Adviser, Sir John Beddington FRS, asked the Royal Society and the Royal Academy of Engineering to review the scientific and engineering evidence and consider whether the risks associated with hydraulic fracturing (often termed 'fracking') as a means to extract shale gas could be managed effectively in the UK.

Summary of key findings;

- "The health, safety and environmental risks can be managed effectively in the UK. Operational best practices must be implemented and enforced through strong regulation."
- "Fracture propagation is an unlikely cause of contamination."
- "Well integrity is the highest priority. Robust monitoring is vital."
- "Seismic risks are low."
- "Regulation must be fit for purpose."



Strong and appropriate regulation is key

- DECC
- Environmental Regulations
 - Environment Agency (England, Wales & N. Ireland)
 - SEPA (Scotland)
- The Health and Safety Executive
- Local Planning Approval
- Scottish Government Planning Approval
- Independent Well Verification
- And – the Scottish Govt study outcome



Conclusion

- Scotland has shale gas reserves with commercial production potential, that could provide a significant boost to jobs, GDP and energy security
- These resources need to be proven via an appraisal program
- Given the rocks work, then the industry can develop the skills and supply chain to produce the gas safely and without damage to the environment
- Public education is critical, in order to earn our license to operate
 - Allay people's fears in respect of the scare stories
 - Demonstrate the benefit to the local communities, and to the nation





Thank You!

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