
THE ROYAL SOCIETY OF EDINBURGH
Options for Scotland's Energy Future
Prof Becky Lunn
University of Strathclyde
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JUNE 2015
OPTIONS FOR SCOTLAND'S GAS FUTURE
Executive Summary
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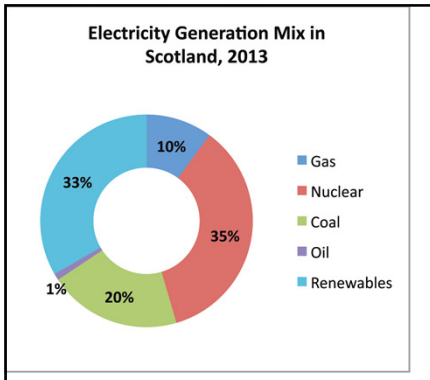
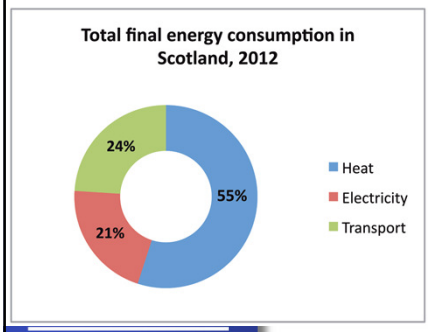




Scotland's Energy Mix

Coal-powered Longannet Station scheduled to close early 2016

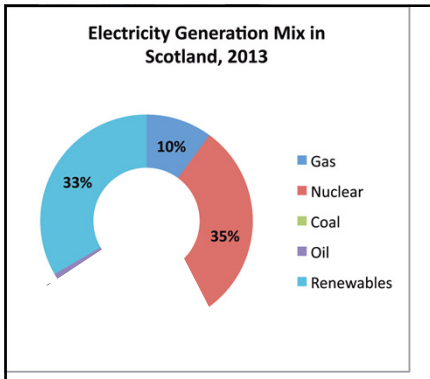
Scotland's only 2 nuclear power stations scheduled to be decommissioned by 2023

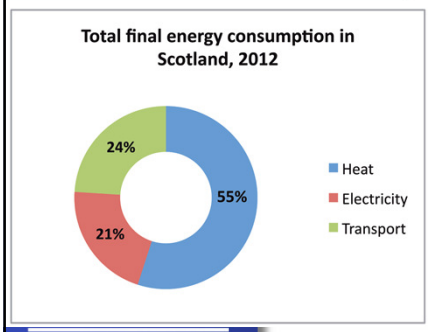
- Scotland set to import electricity from RUK

Need to import baseload energy as renewable generation is unsteady

Imported baseload will be gas-fired, coal-fired or nuclear

But energy does not just = electricity!





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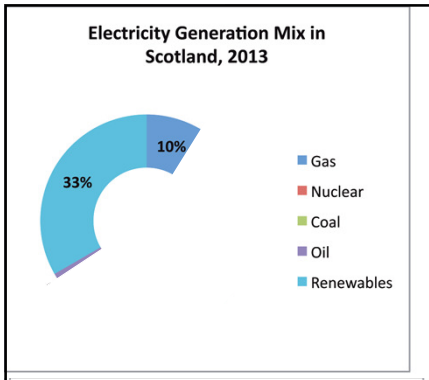

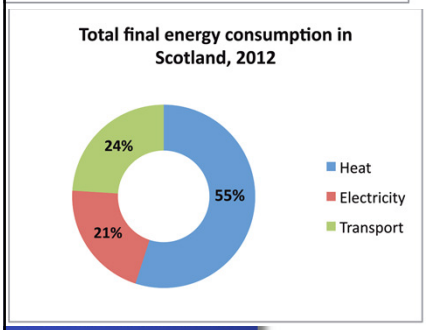

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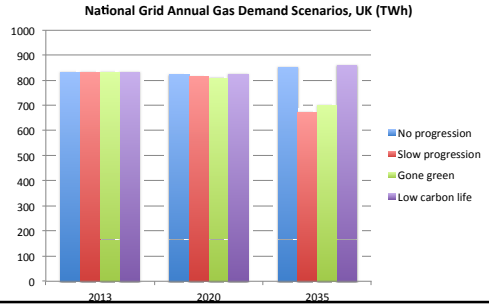
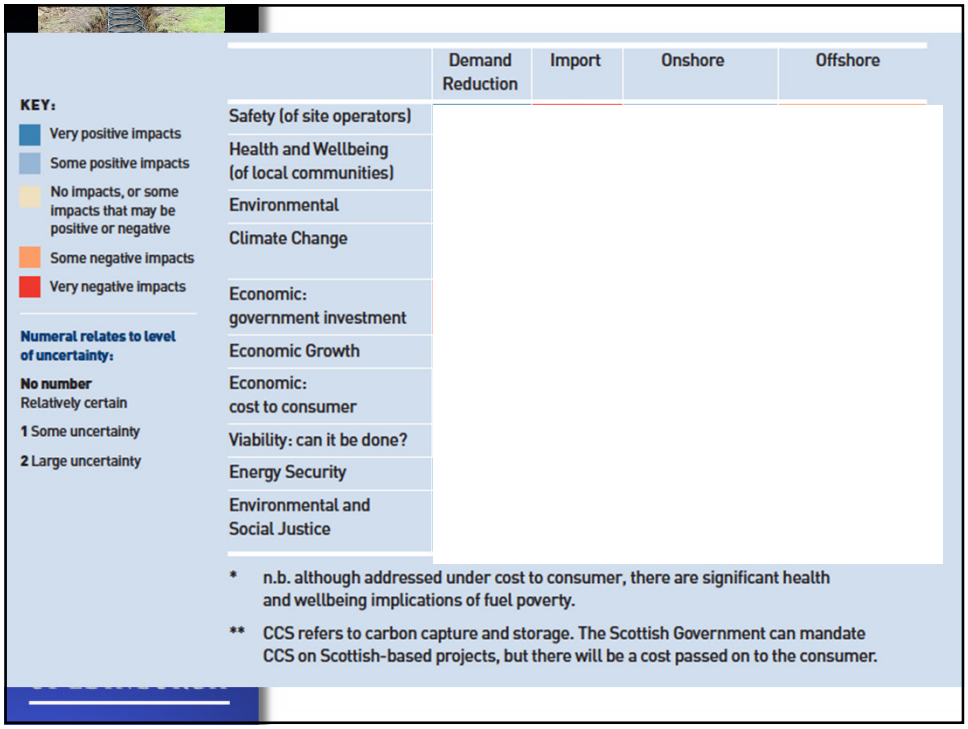
- Assume Scotland is largely successful in decarbonising generation by 2050
- Current gas consumption is 48,618GWh
- Still significant demand in 2030
  - National Grid predict max UK demand reduction of 19% by 2035
  - 19% reduction in Scotland ~ 39,400GWh
  - >10% of current natural gas consumption (5,594 GWh) = chemical feedstock





KEY:

- Very positive impacts
- Some positive impacts
- No impacts, or some impacts that may be positive or negative
- Some negative impacts
- Very negative impacts

Numeral relates to level of uncertainty:

No number Relatively certain

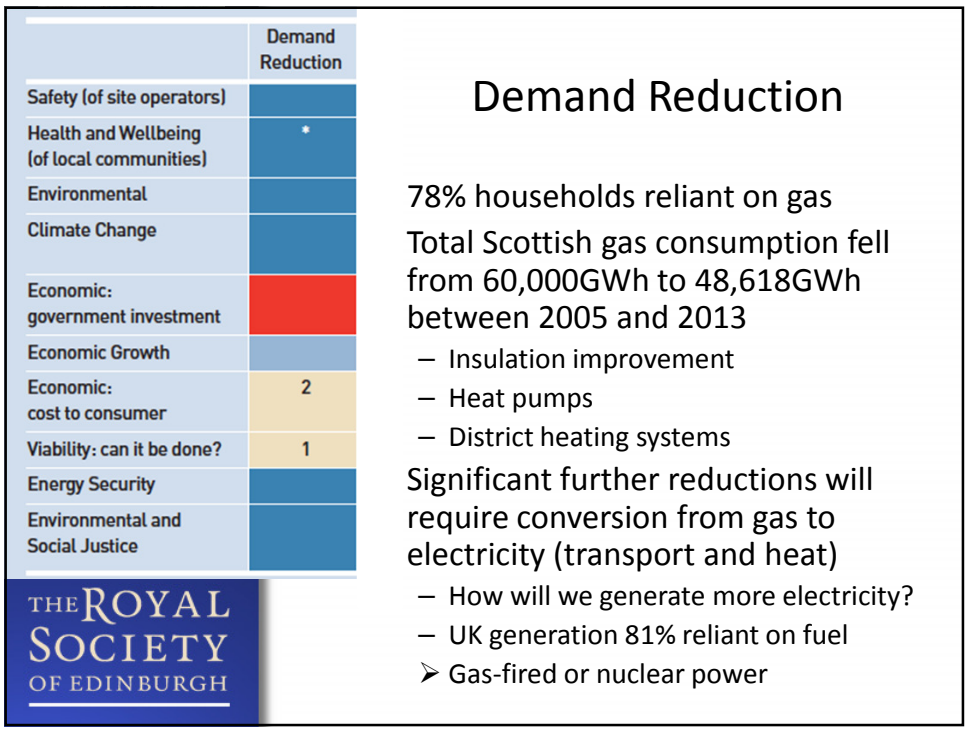
1 Some uncertainty

2 Large uncertainty

	Demand Reduction	Import	Onshore	Offshore
Safety (of site operators)				
Health and Wellbeing (of local communities)				
Environmental				
Climate Change				
Economic: government investment				
Economic Growth				
Economic: cost to consumer				
Viability: can it be done?				
Energy Security				
Environmental and Social Justice				

* n.b. although addressed under cost to consumer, there are significant health and wellbeing implications of fuel poverty.

** CCS refers to carbon capture and storage. The Scottish Government can mandate CCS on Scottish-based projects, but there will be a cost passed on to the consumer.



	Demand Reduction
Safety (of site operators)	
Health and Wellbeing (of local communities)	*
Environmental	
Climate Change	
Economic: government investment	
Economic Growth	
Economic: cost to consumer	2
Viability: can it be done?	1
Energy Security	
Environmental and Social Justice	

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Demand Reduction

78% households reliant on gas

Total Scottish gas consumption fell from 60,000GWh to 48,618GWh between 2005 and 2013

- Insulation improvement
- Heat pumps
- District heating systems

Significant further reductions will require conversion from gas to electricity (transport and heat)

- How will we generate more electricity?
- UK generation 81% reliant on fuel
  - ➢ Gas-fired or nuclear power

	Import
Safety (of site operators)	2
Health and Wellbeing (of local communities)	
Environmental	2
Climate Change	2
Economic: government investment	
Economic Growth	
Economic: cost to consumer	2
Viability: can it be done?	1
Energy Security	
Environmental and Social Justice	

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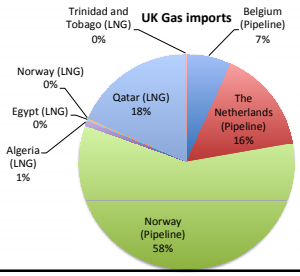
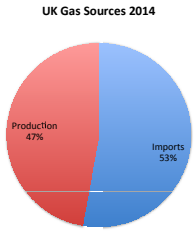
Gas Imports

- Import is via six UK pipelines, two of which are in Scotland
- European pipelines backfilled from Russia and N Africa
- LNG shipped in tankers to 4 terminals (2 Wales, 2 England)





Source: DECC, UK Energy research Centre

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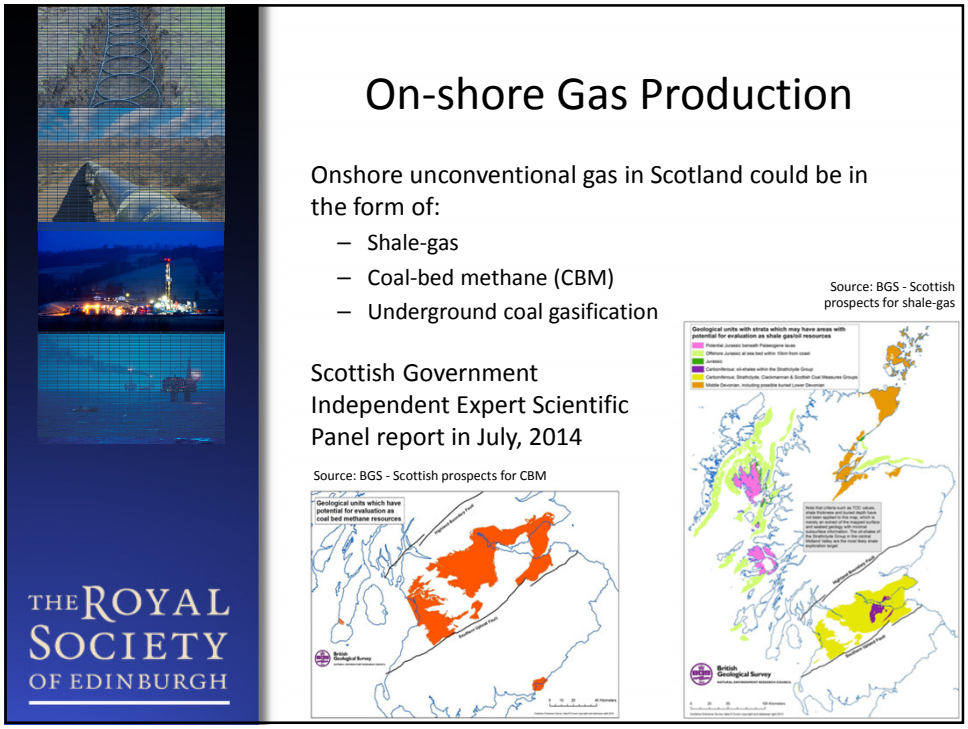
Carbon Capture and Storage

Progress is very slow …

Technology development:

- Peterhead currently in design phase (Shell, SSE)
- Scotland's only project will sequester 10 million tonnes of CO_2 over 10 years (1Mt pa) starting in 2020
  - Sequestering the output from 1 of 3 gas turbines at Peterhead in the Goldeneye Field
- Industrial-scale feasibility remains unproven



On-shore Gas Production

Onshore unconventional gas in Scotland could be in the form of:

- Shale-gas
- Coal-bed methane (CBM)
- Underground coal gasification

Scottish Government Independent Expert Scientific Panel report in July, 2014

Source: BGS - Scottish prospects for CBM

Source: BGS - Scottish prospects for shale-gas

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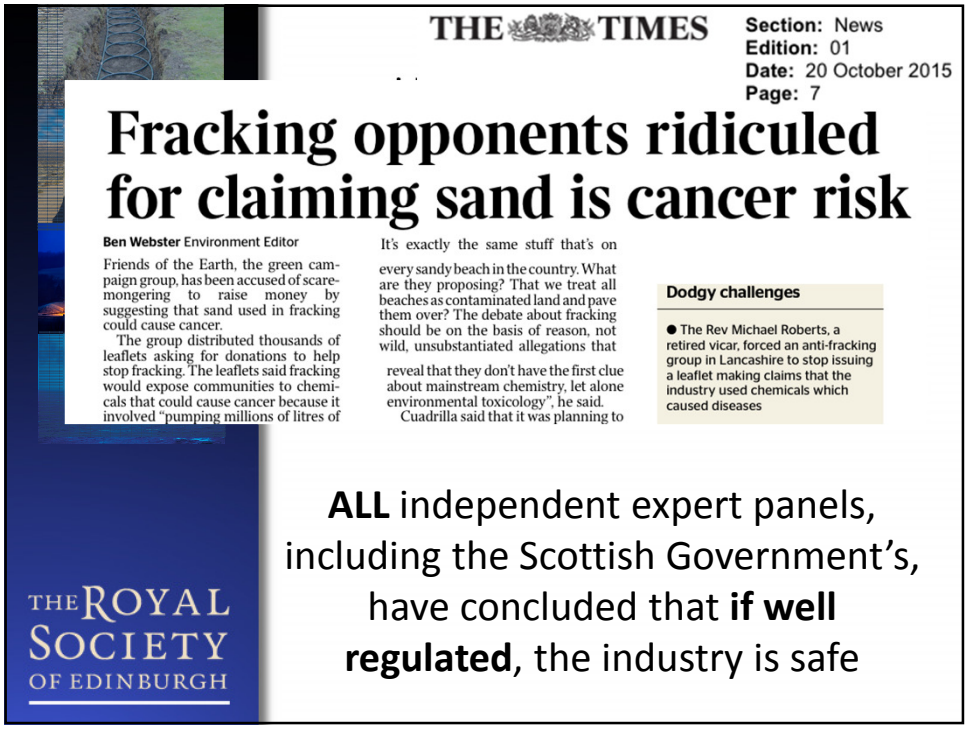

THE TIMES

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Edition: 01
Date: 20 October 2015
Page: 7

Fracking opponents ridiculed for claiming sand is cancer risk

Ben Webster Environment Editor

Friends of the Earth, the green campaign group, has been accused of scaremongering to raise money by suggesting that sand used in fracking could cause cancer.

The group distributed thousands of leaflets asking for donations to help stop fracking. The leaflets said fracking would expose communities to chemicals that could cause cancer because it involved "pumping millions of litres of

It's exactly the same stuff that's on every sandy beach in the country. What are they proposing? That we treat all beaches as contaminated land and pave them over? The debate about fracking should be on the basis of reason, not wild, unsubstantiated allegations that

reveal that they don't have the first clue about mainstream chemistry, let alone environmental toxicology", he said.

Cuadrilla said that it was planning to

Dodgy challenges

● The Rev Michael Roberts, a retired vicar, forced an anti-fracking group in Lancashire to stop issuing a leaflet making claims that the industry used chemicals which caused diseases

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ALL independent expert panels, including the Scottish Government's, have concluded that **if well regulated**, the industry is safe

	Onshore
Safety (of site operators)	
Health and Wellbeing (of local communities)	1
Environmental	
Climate Change	no CCS / CCS ** 2
Economic: government investment	2
Economic Growth	2
Economic: cost to consumer	no CCS 2 / CCS 2
Viability: can it be done?	2
Energy Security	
Environmental and Social Justice	

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UK/Scottish Shale-Gas

Key differences to US Industry

- No open surface ponds
- Limited flaring, venting only permitted as emergency safety measure
- Fracking fluids must be declared
- Mandatory microseismic monitoring
- Operations stop if microseismic events are increasing in magnitude
- Smaller number of well heads and more long horizontal wells
- Limits on the volume of water allowed per fracturing stage (less seismicity and smaller fractures)
- Landowners do not own resource so industry can not escalate rapidly

	Offshore
Safety (of site operators)	
Health and Wellbeing (of local communities)	
Environmental	
Climate Change	no CCS / CCS 2
Economic: government investment	2
Economic Growth	2
Economic: cost to consumer	no CCS 2 / CCS 2
Viability: can it be done?	2
Energy Security	
Environmental and Social Justice	

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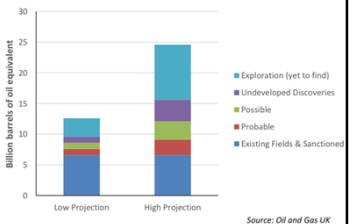
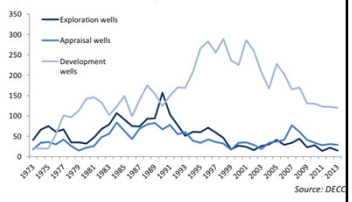
Off-shore Oil and Gas Production

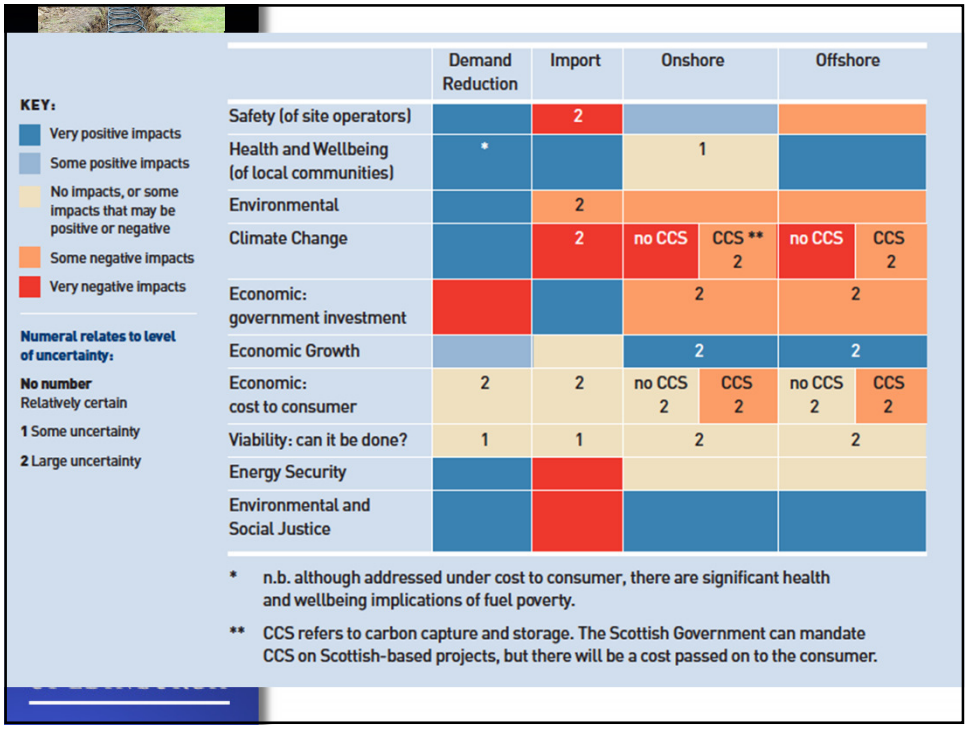
Further development in off-shore production could include:

- High pressure high temp HPHT
- Deep water development
- Extraction of tight gas



Exploration & appraisal activity declined steadily since 1990





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Environmental		2				
Climate Change		2	no CCS	CCS ** 2	no CCS	CCS 2
Economic: government investment			2		2	
Economic Growth			2		2	
Economic: cost to consumer	2	2	no CCS 2	CCS 2	no CCS 2	CCS 2
Viability: can it be done?	1	1	2		2	
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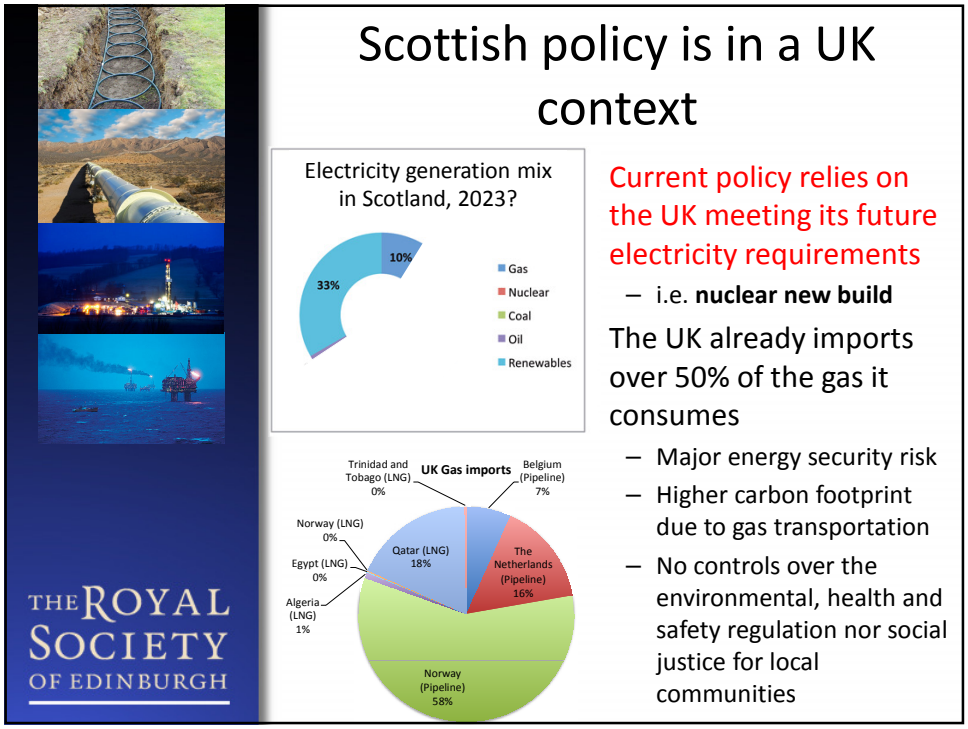

Scottish policy is in a UK context

Current policy relies on the UK meeting its future electricity requirements

- i.e. **nuclear new build**

The UK already imports over 50% of the gas it consumes

- Major energy security risk
- Higher carbon footprint due to gas transportation
- No controls over the environmental, health and safety regulation nor social justice for local communities

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The question we should be asking is NOT should we produce shale-gas?

The answer will be no…

But

How should the UK source its future energy requirements?

- Appetite for public involvement in decision-making (referendum)
  - strength of public feeling around ALL energy developments

RSE Recommendation: Public participatory decision-making should be used in reaching a verdict on which option, or options, Scotland takes forward. The decision-making process should be framed by our wider energy needs

If we say NO to domestic production of gas and nuclear, we are saying YES to something else…

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A publically-informed decision-making process in Energy Policy is **CRITICAL**

Crisis-led policy-making will result in poor decisions and poor regulation