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Prospects for shale gas in the UK

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 - Energy security
 - Affordability
 - Climate change
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 - Implications for climate change and the environment
- **Conclusions**



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■ Key energy challenges



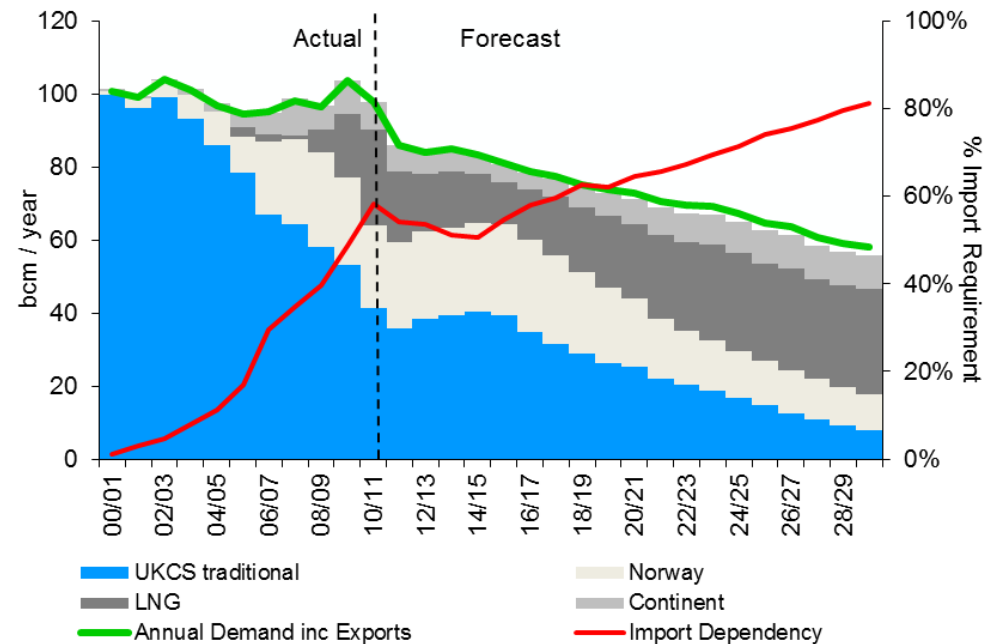
1. Energy security

Resources constraints:

- Domestic conventional gas resources declining: UK CS from ~100 bcm in 2000 to ~39 bcm in 2014 (DECC, 2015a)

- Import dependency: ~50%

- Increasing reliance on LNG, mostly from Qatar



Source: National Grid (2012)

Power generation capacity constraints:

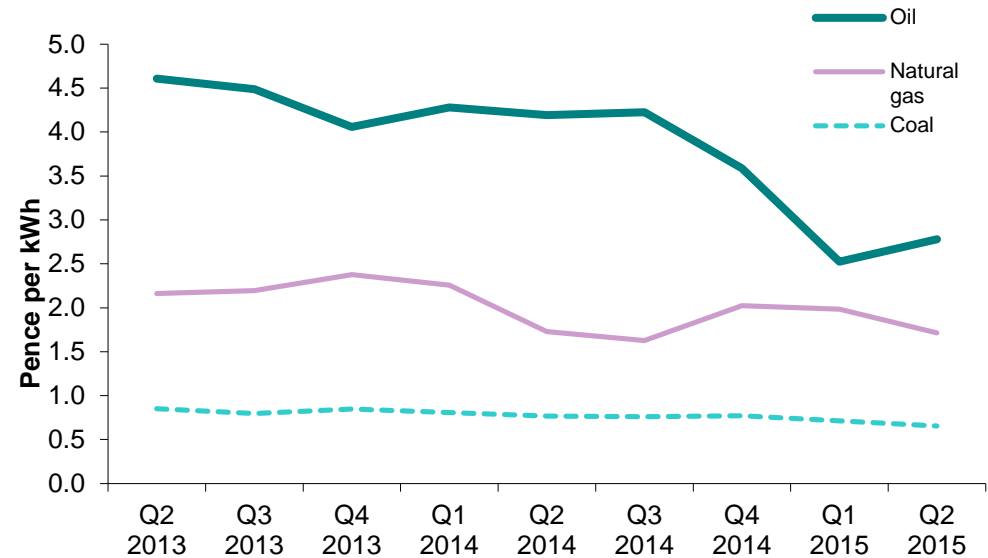
- >1/5 of capacity to be retired within the next 10 years
- Low level of spare capacity (5% margin foreseen this winter)



2. Affordability

- Segmented gas market: low US gas prices are not flowing to the UK
- Over the past 5 years the average gas price used by major power producers has increased by 19% (DECC 2015b)
- Higher prices → higher consumer bills

Average real fossil fuels prices paid by
UK power producers, 2013-2015

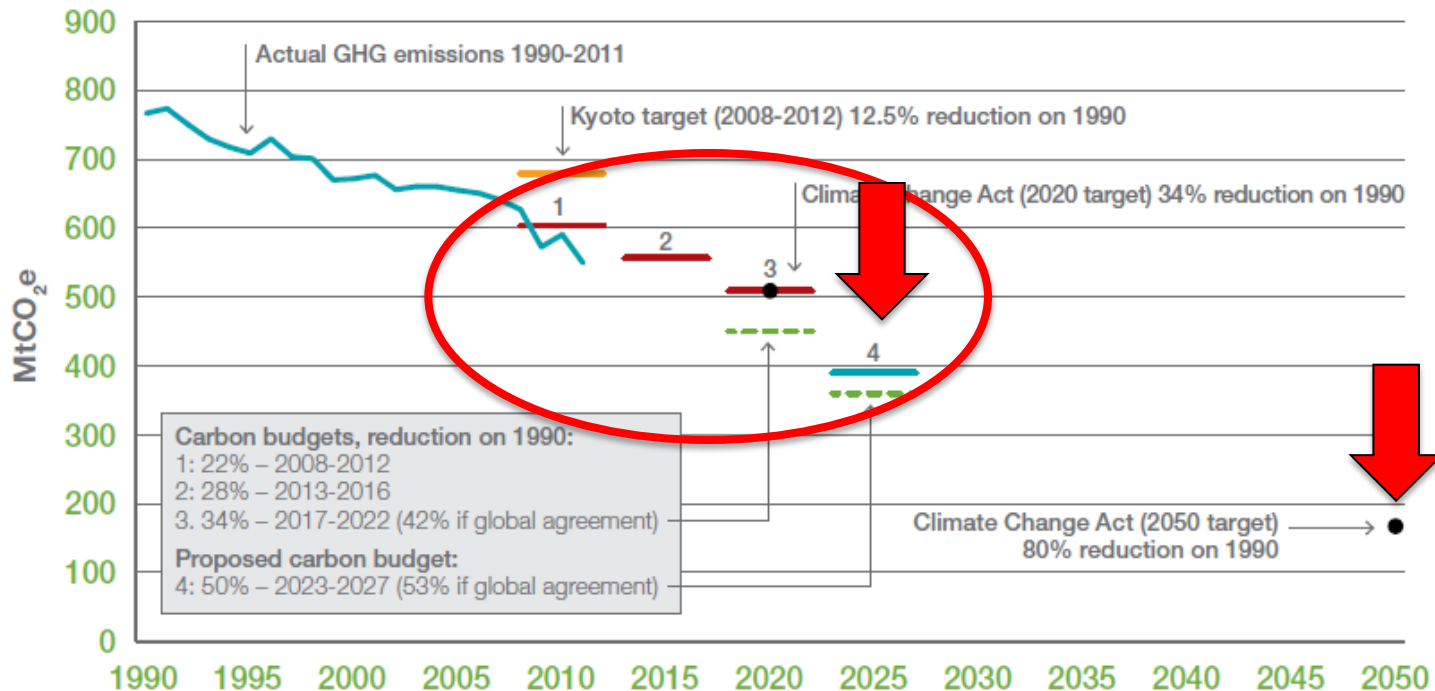


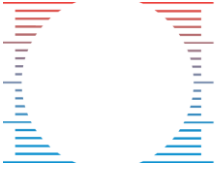
Source: DECC (2015)



3. Climate change

- 2008 Climate Change Act: **-80% GHG by 2050** vs 1990 levels
- 4th Carbon Budget: **-50% GHG by 2025**
- 5th Carbon Budget: indicative **-60% GHG by 2030**





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- **The role of conventional and shale gas**



How much shale gas?

Shale gas is not a game changer

The Telegraph, 10 Dec 2012

150 bcm

200 tcf

Britain has shale gas for 1,500 years, but
bills won't be lower

The Times, 9 Feb 2013

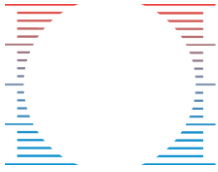
1,300-1,700 tcf

No shale gas potential in Weald basin,
concludes British Geological Survey
The Guardian, 23 May 2014

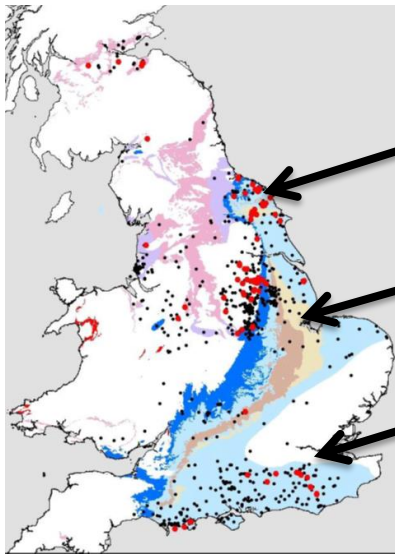
Shale gas firm finds 'vast' gas resources in
Lancashire
BBC, 21 Sept 2011

??

- **Different units:** cubic meters, cubic feet (1bcm = 35bcf)
- **Different indicators:** gas in place, technically recoverable resources (TRR), proven reserves



Estimated shale gas potential in the UK



	<i>Estimate (bcm)</i>	EIA	Cuadrilla	BGS/DECC
Midland Valley	Gas in place	n/a	n/a	2,270
	TRR	n/a	n/a	n/a
Bowland Shale	Gas in place	2,690	5,660	37,600*
	TRR	540	900-1,200**	80-200
Weald Basin	Gas in place	60	n/a	0
	TRR	30	n/a	0
Total UK	Gas in place	2,750	5,660	39,870
	TRR	570	900-1,200	n/a

Source: DECC (2011)

* Central estimate (Andrews, 2013)

** Based on Cuadrilla's assumption that 15 -20%of gas in place could be extracted (ECC, 2012).

TRR: ~ 10-15% of gas in place (Cuadrilla)

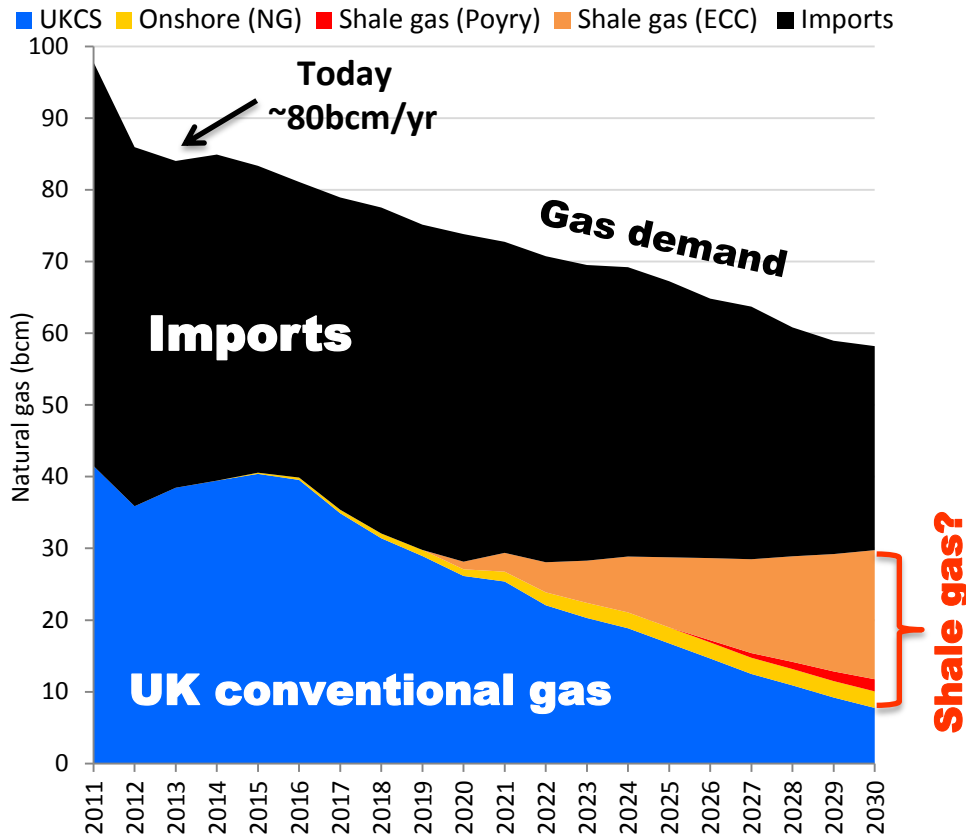
Proven reserves : not assessed yet. ~14-18% of TRR (IPCC); 10% of TRR (US)

- UK yearly gas demand: 77 bcm in 2014 (DECC, 2015c)
- Proven reserves (Cuadrilla) for max ~ 2-3 years? More?

Sources: EIA (2011), Cuadrilla (2011), BGS/DECC: gas in place from Andrews (2013, 2014) and Monaghan (2014); TRR from DECC (2012e)



Implications for energy security



- Domestic conventional gas resources depleting
- UK net importer of gas
- **Domestic shale gas** can reduce the need for foreign gas

But:

- Even highest (available) estimates suggest shale gas **at best replacing depleting conventional reserves** → imports likely to remain at current levels



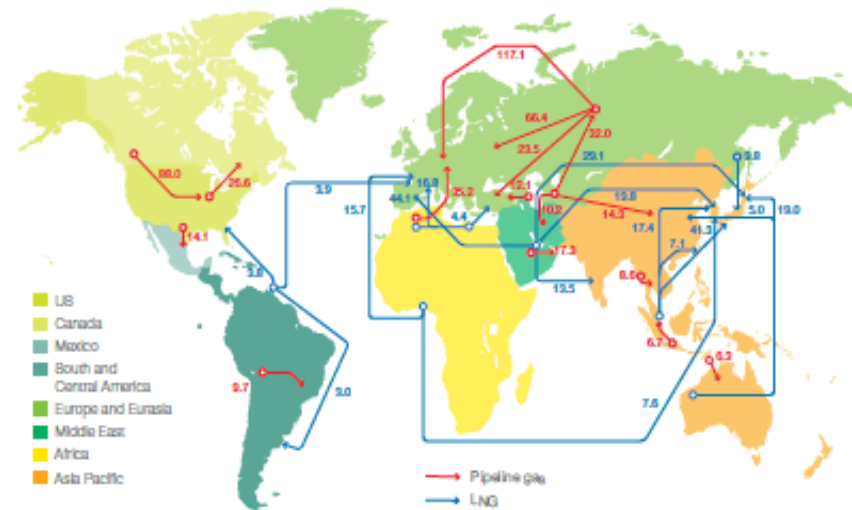
Implications for affordability: Gas prices

Future gas prices **are uncertain**

- **Natural gas is a regional market:** prices are set at regional not global level
- **Large uncertainties about effect of global shale gas production on prices**
- **UK shale gas reserves too small to affect domestic gas prices** (influenced by EU prices)
- **IEA does not expect EU gas import prices to decrease**

70-80p/therm in 2035 (but may be lower?)

in 2015 1Q ~50p/therm (EC 2015)



Source: BP (2012)



Implications for climate change and the environment

Local impacts of shale gas:

- Water pollution;
- Earthquakes;
- Traffic and noise etc.

Limited. Can be mitigated, but need adequate technology and regulation

→ Issues of social acceptability:

- Higher population density compared to US;
- No royalties to land owners – unlike the US;
- Landscape/visual impacts;

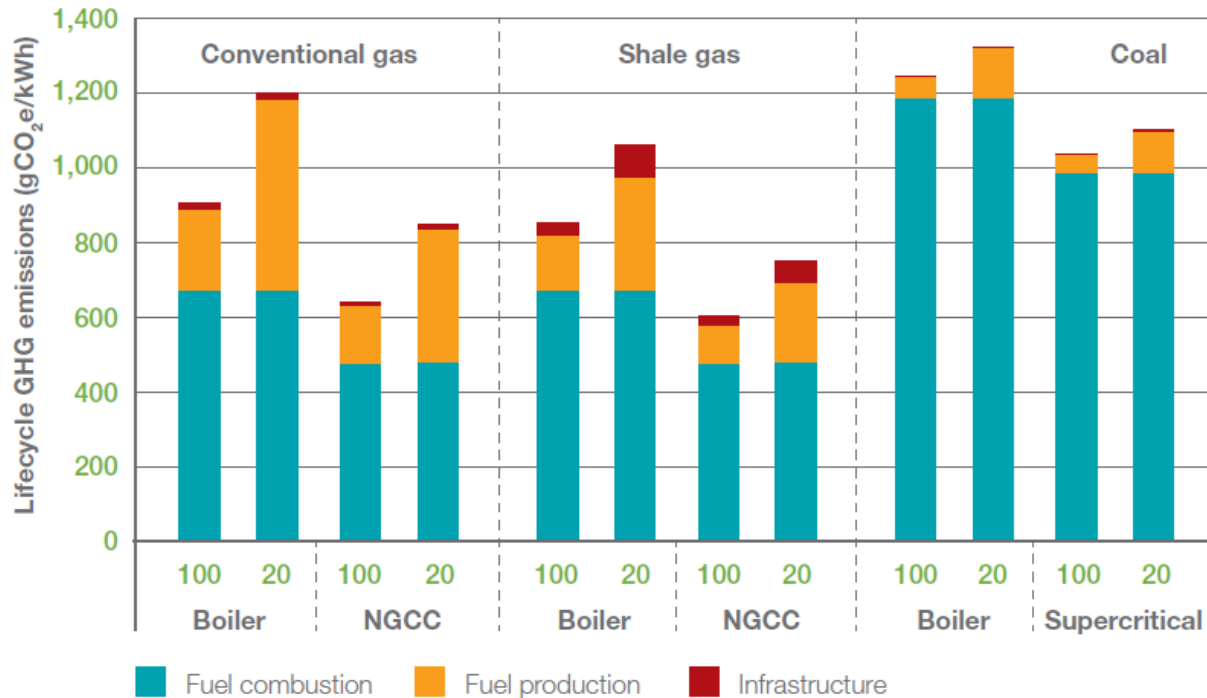
Careful planning needed, not all areas exploitable





GHG: fugitive emissions from shale gas

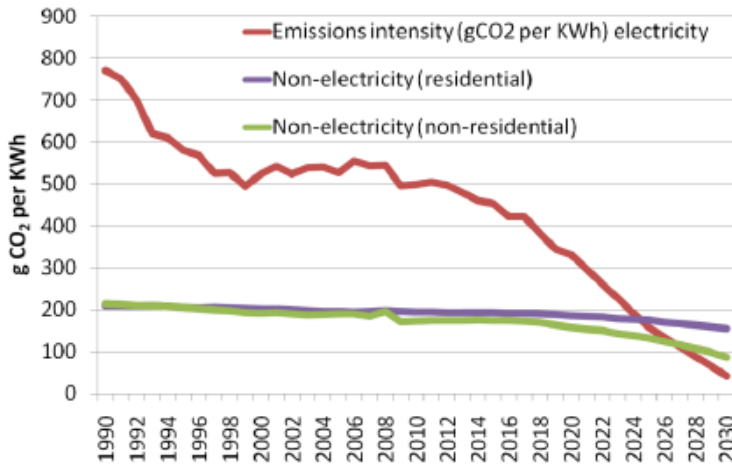
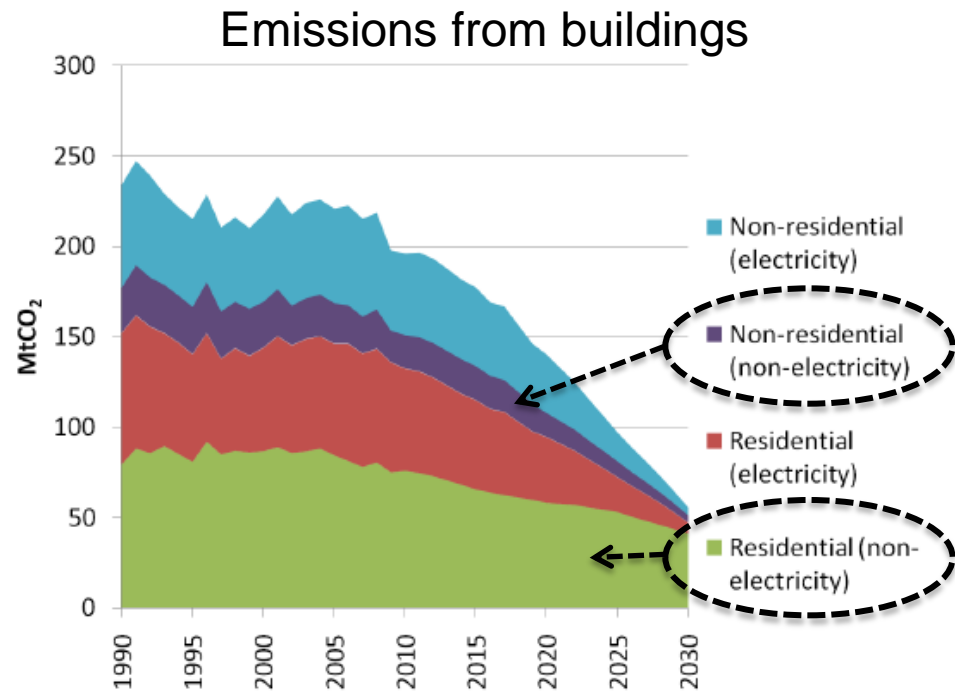
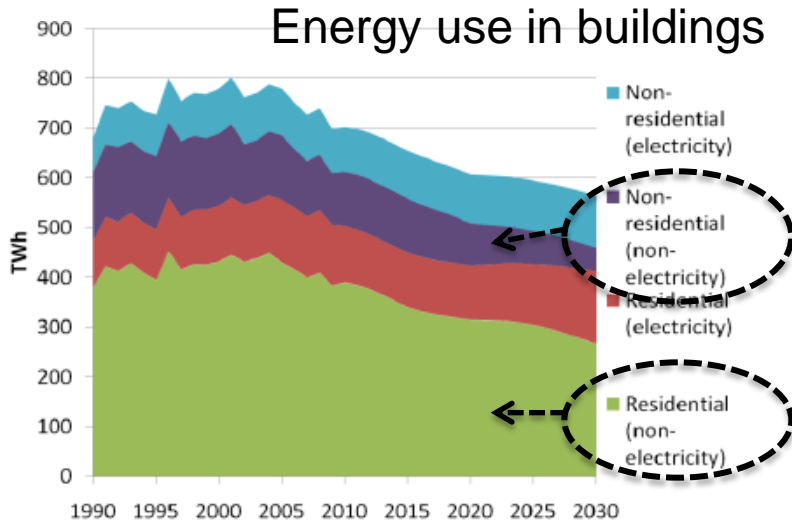
- Conventional and unconventional gas **lifecycle emissions are of similar magnitude (if managed well)**



Note: NGCC = Natural Gas Combined Cycle
Source: Bassi et al (2013)



Long run: gas remains significant for heating



Power sector decarbonisation

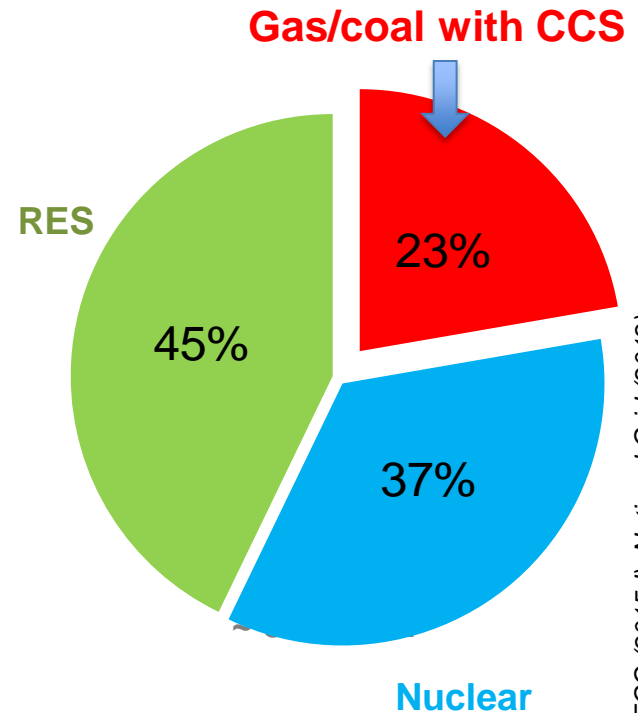
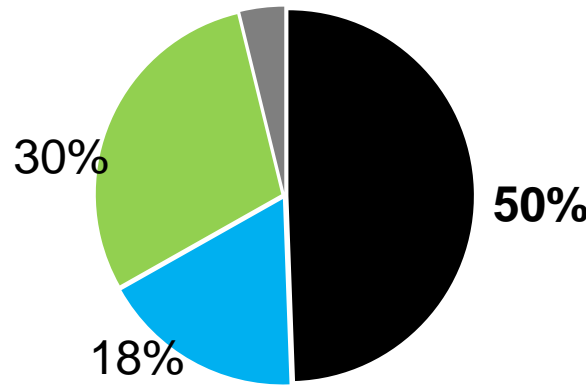
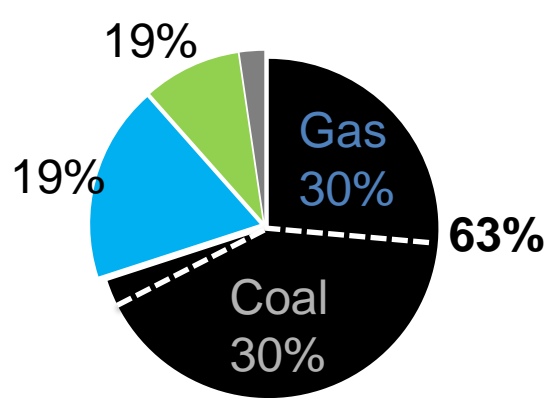


Long run: Power sector decarbonisation

2014: 19% electricity from RES; 7% of total energy

2020: aim 30% electricity from RES; 15% of energy (EU target)

2050: full decarbonisation?



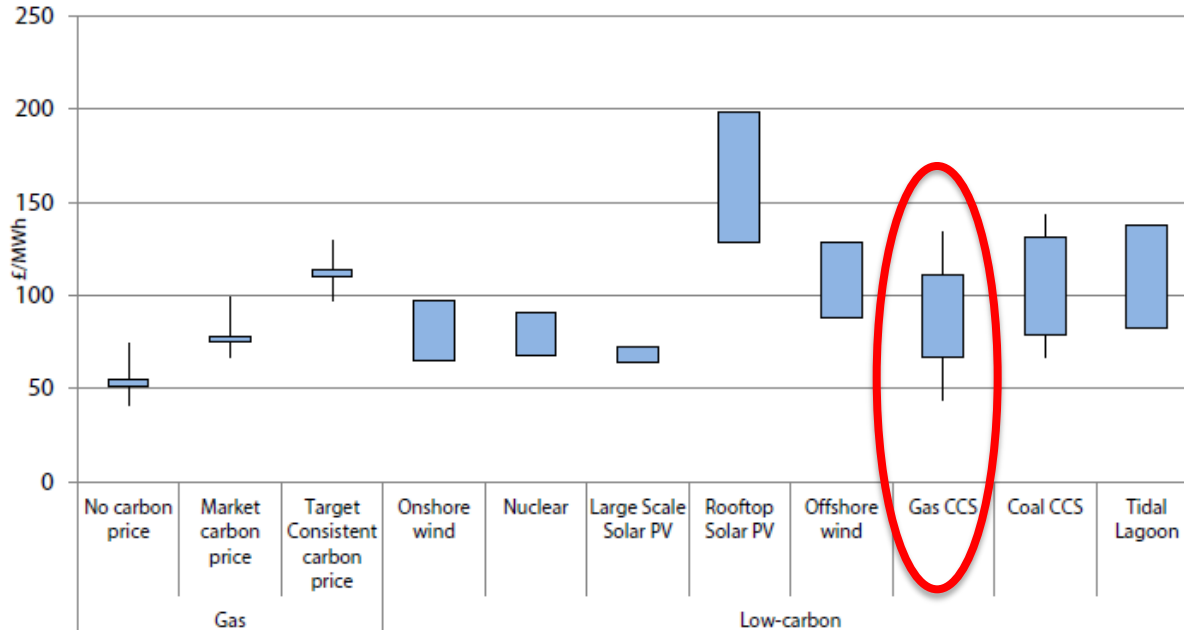
Electricity sources:

- Unabated fossil fuels
- CCS
- Nuclear
- RES
- Imports



Opportunity for Gas-CCS

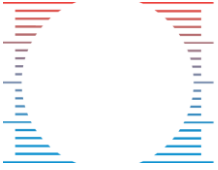
Excepted cost of generation by technology (2030)



Source: CCC (2015)

- Gas-CCS levelised cost in the range of/cheaper than offshore wind
- Cheaper than unabated gas if target-consistent carbon price

➤ Gas strategy should go hand-in-hand with a **CCS strategy**



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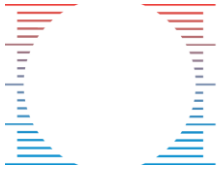


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■ Conclusions



- **Scope for gas is in the short term**, as it replaces coal and provides flexibility
- **Shale gas** can help meet UK energy demand, but **reserves may be limited**
- UK shale gas is **unlikely to affect gas prices** – mostly affected by EU gas market.
- Shale gas should be developed **within environmental and social constraints** to minimise impacts and public opposition
- In the long term the power sector needs to be further decarbonised **to meet climate change mandatory targets**.
- No single winner → we need a **coherent portfolio of energy policies**, including energy efficiency, RES, nuclear, and flexibility measures (e.g. demand management) + **CCS if gas is to remain a player post 2030**



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Thank you

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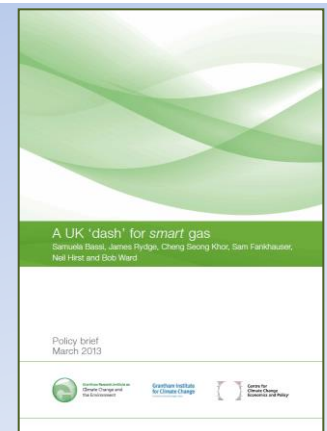
Grantham Research Institute on Climate Change and the Environment (LSE)

A UK 'dash' for *smart* gas

*By Samuela Bassi, James Rydge, Cheng Seong Khor, Sam Fankhauser,
Neil Hirst and Bob Ward*

Grantham Research Institute (LSE) & CCCEP, Grantham Institute (Imperial College)

Available at: <http://www.lse.ac.uk/GranthamInstitute/publication/a-uk-dash-for-smart-gas/>





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