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Natural Gas in the UK – a stepping stone or an end point?

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Introduction

- The UK context
- Is gas ‘better’ than coal?
- Is UK shale gas ‘better’ than imported LNG?
- The role of gas alongside renewables ….
- Heat – the prospect of new technologies
- Unburnable carbon – the role of CCS?
- Conclusions

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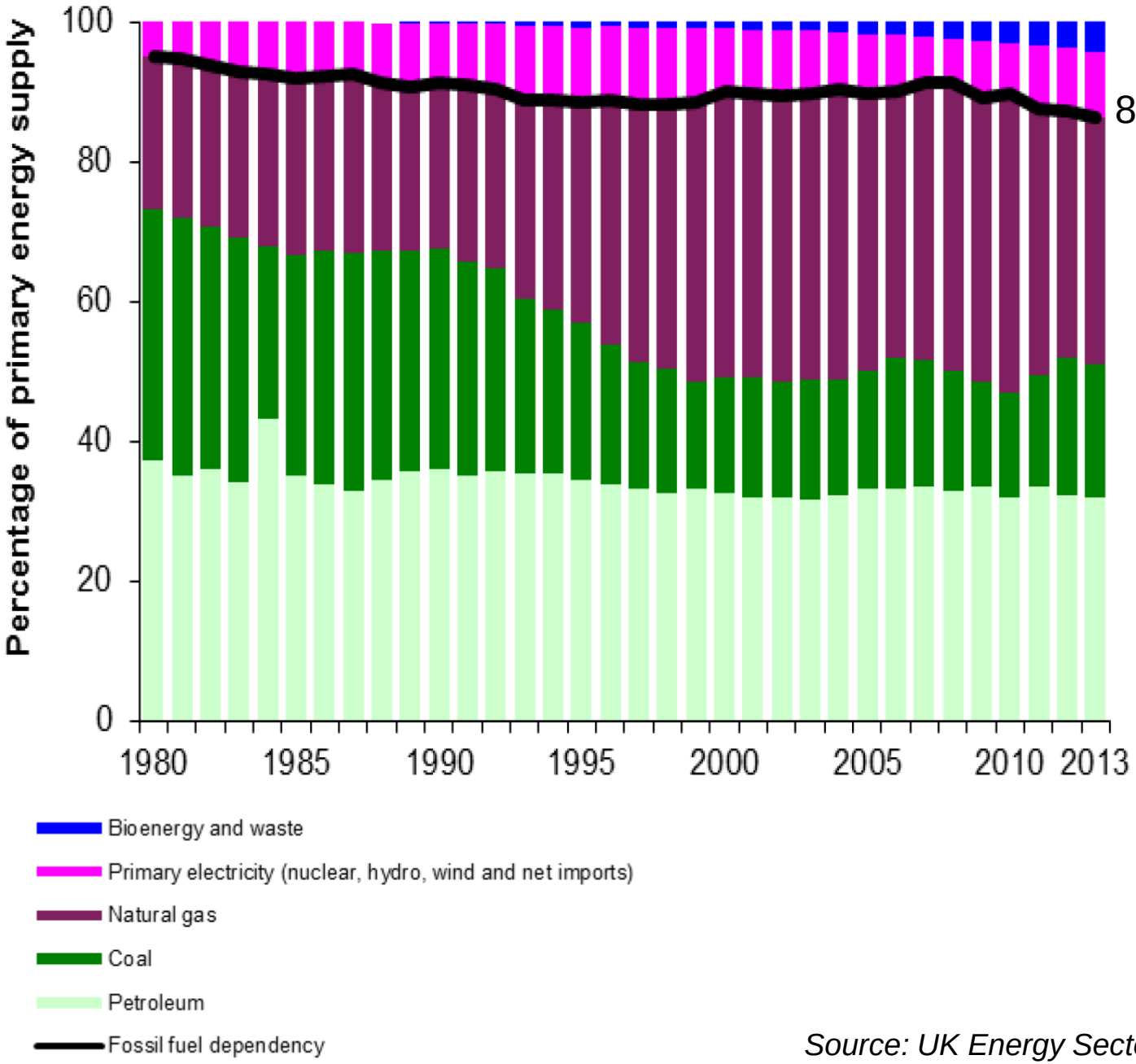
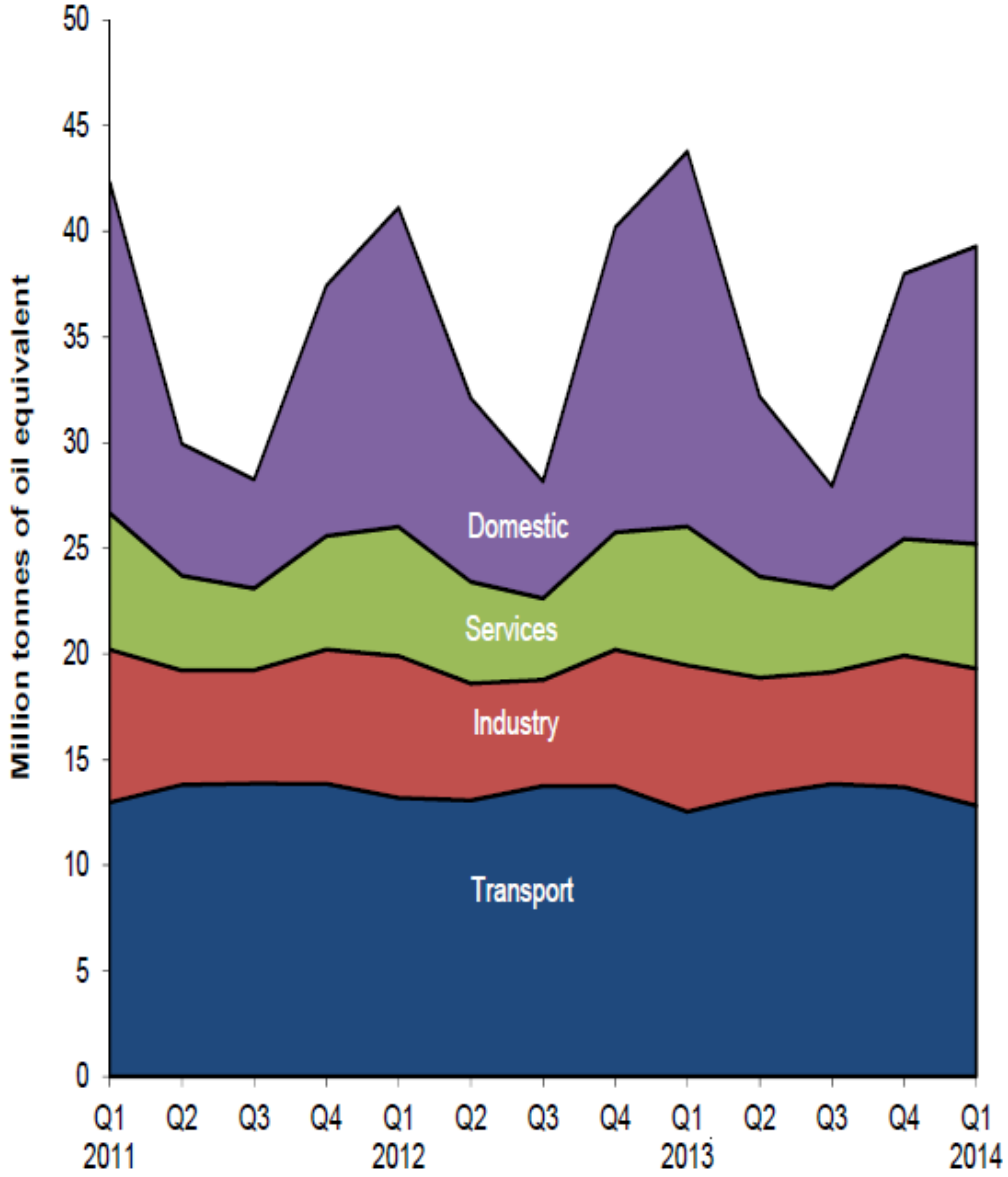
UK: Share of fuels contributing to primary energy supply



Source: UK Energy Sector Indicators. 2014. DECC.

Chart 1.4 Final energy consumption by user



UK Final energy consumption (DECC June 2014)

Heat: 39% UK CO_2

Power: 33% UK CO_2

Transport: 28% UK CO_2

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GREENHOUSE GAS EMISSIONS

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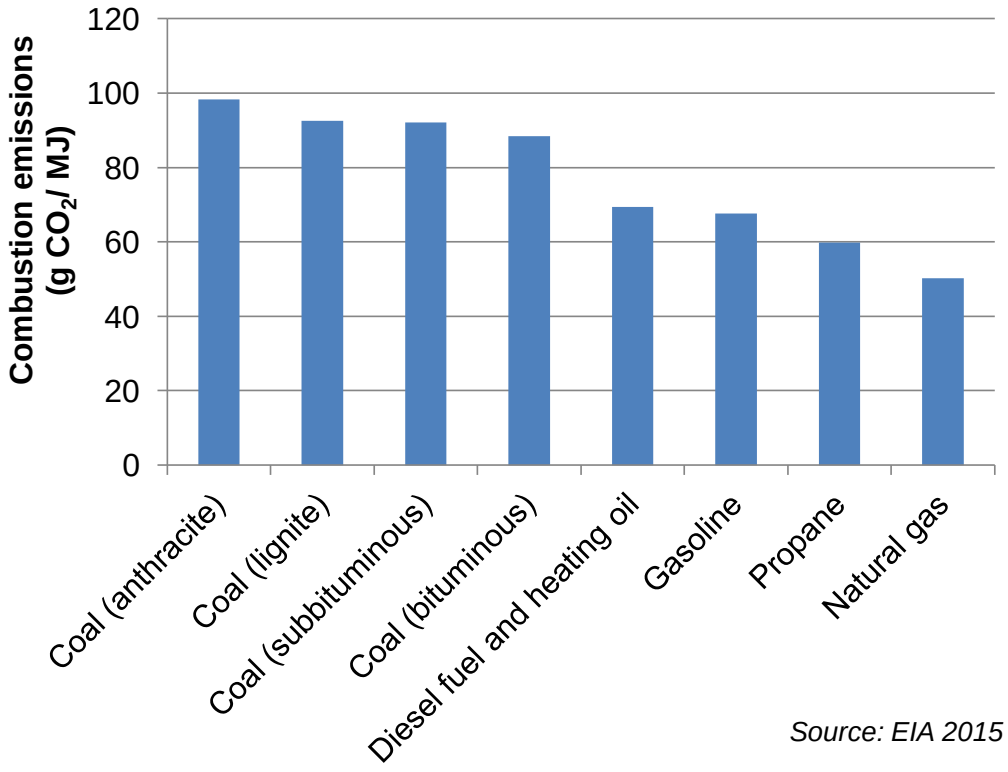
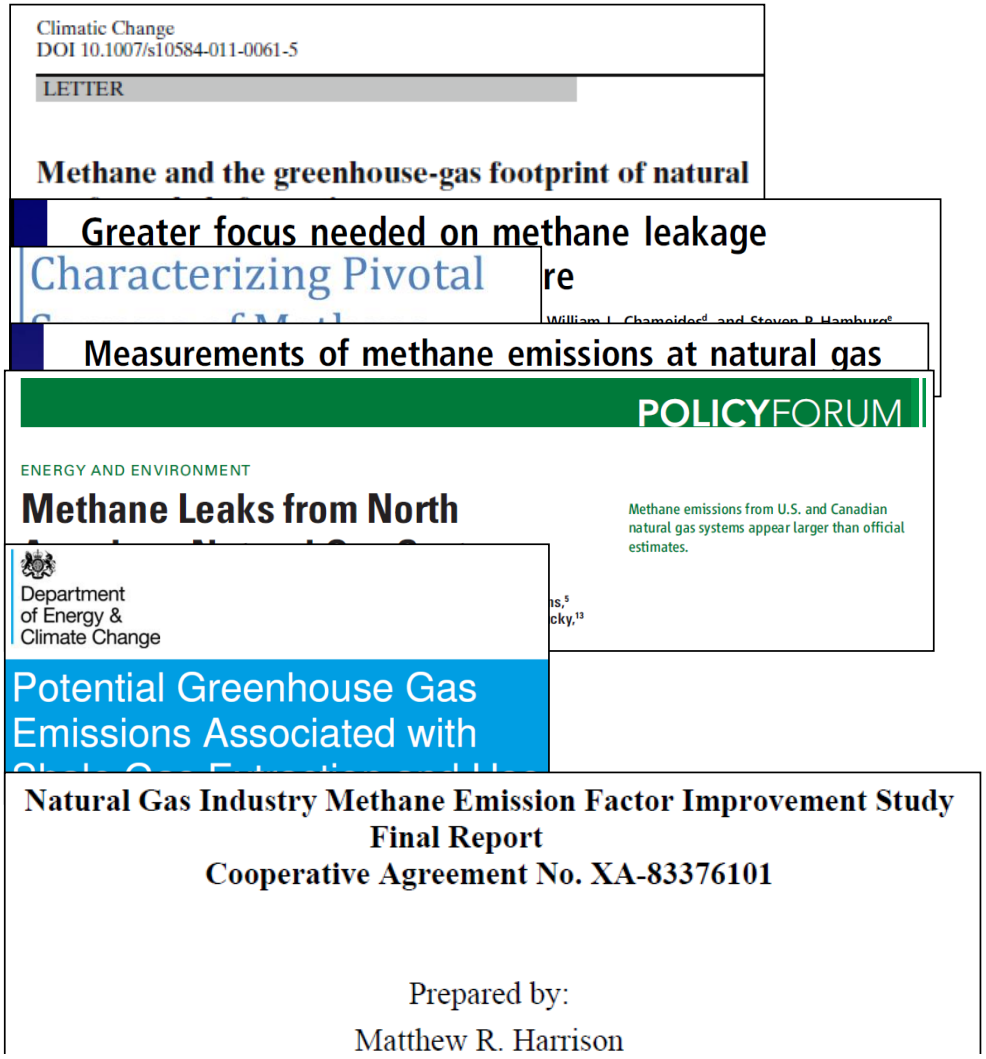
- Natural gas combustion produces **half the carbon dioxide** emissions compared to coal
- But this is not the full story…

1. **Supply chain emissions**
2. **Methane**
   - Strong greenhouse gas



Source: EIA 2015

PREVIOUS STUDIES



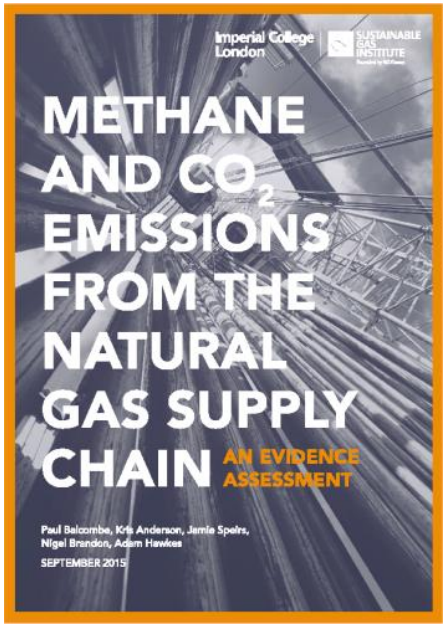
Motivation:

- US shale gas production increase
- In 2011, 1st estimate of greenhouse gas of shale: Natural gas may be worse than coal
- Prompted greater investigation
- Different conclusions and estimation methods
- *We need clarity*

… Plus many more

Methane and CO_2 emissions from the natural gas supply chain: an evidence assessment

24th September 2015



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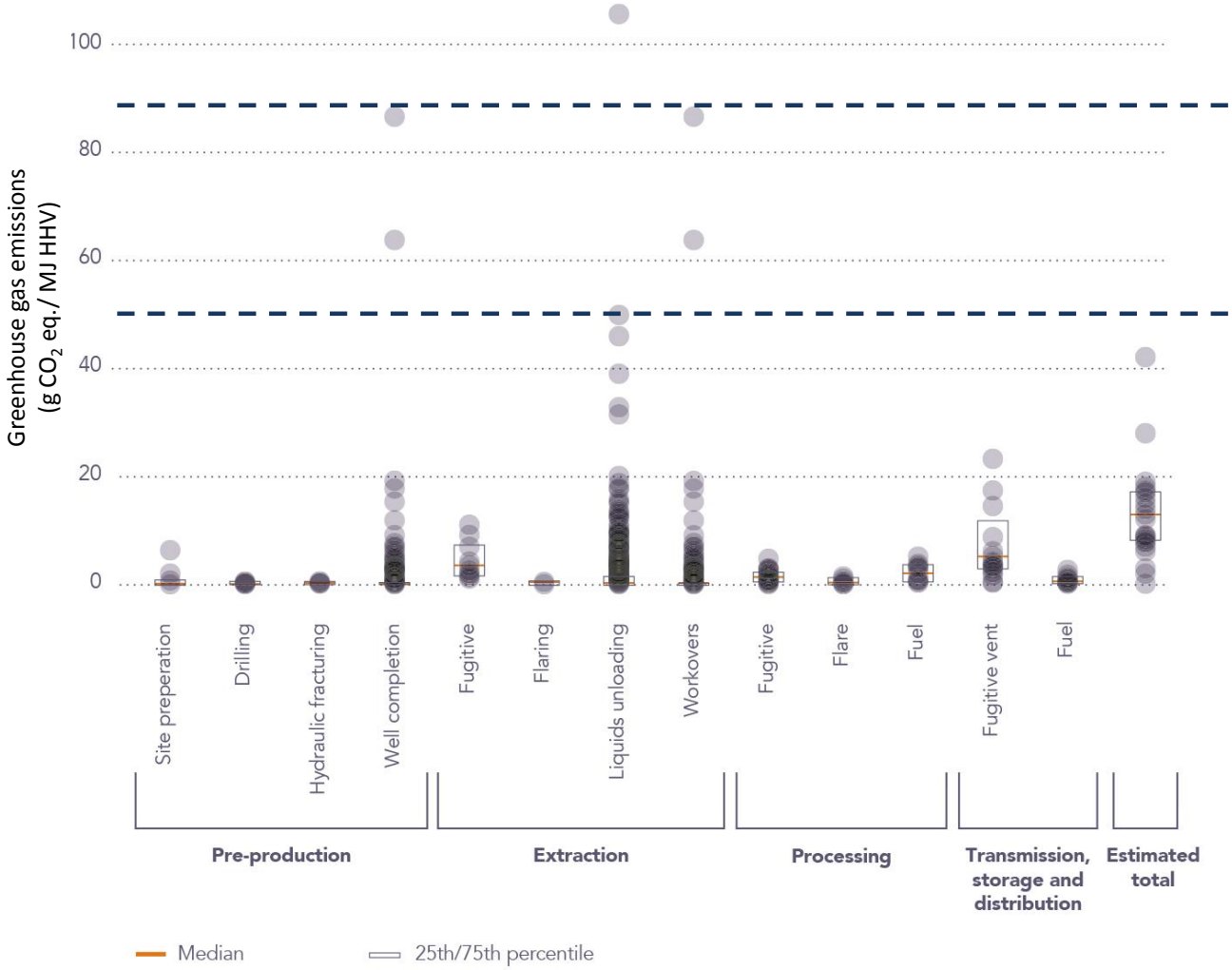
Download at: sustainablegasinstitute.org/white-paper-1

1. OVERALL GHG EMISSIONS



1. The range of reported estimates is vast

White paper: Section 3.1, page 19

OVERALL METHANE EMISSIONS

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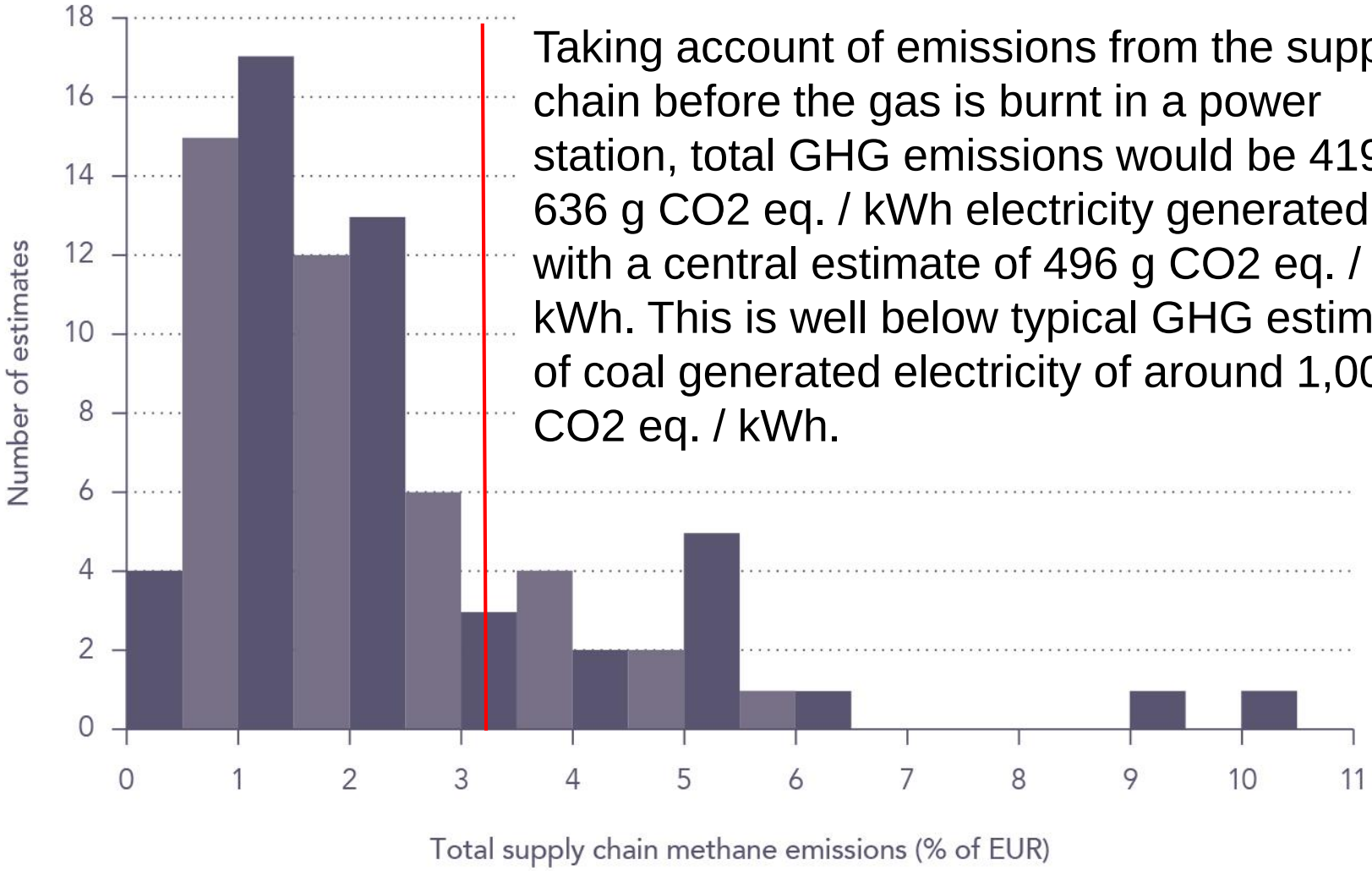

Taking account of emissions from the supply chain before the gas is burnt in a power station, total GHG emissions would be 419–636 g CO2 eq. / kWh electricity generated, with a central estimate of 496 g CO2 eq. / kWh. This is well below typical GHG estimates of coal generated electricity of around 1,000 g CO2 eq. / kWh.

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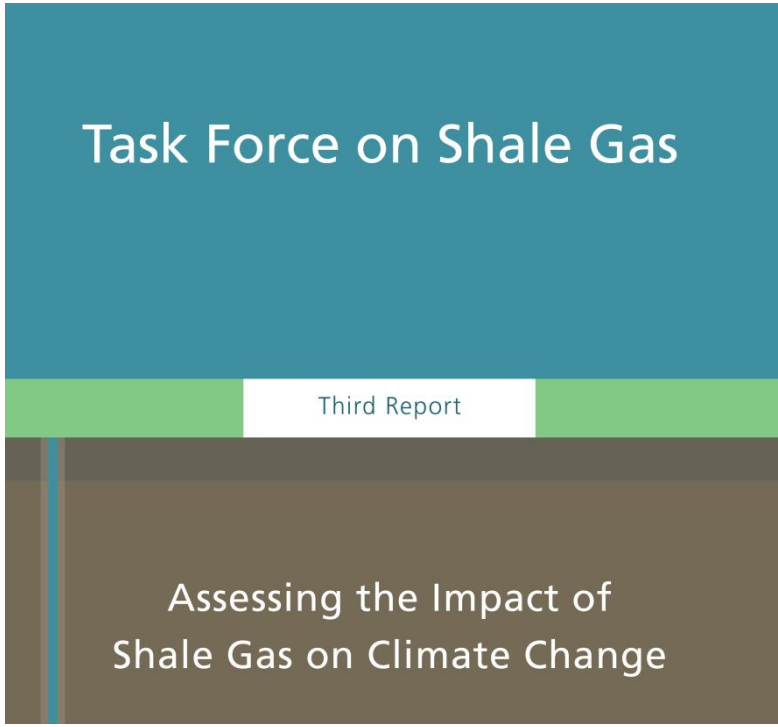
Shale Gas

The Task Force on Shale Gas has concluded that, properly produced and regulated, UK shale gas has a lower environmental footprint than imported LNG.

In addition the Task Force has encouraged the Government to expedite the development of a CCS industry in the UK that would grow concurrently with any shale gas industry.



https://www.taskforceonshalegas.uk/

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The need for energy storage in low C grids

• A whole systems analysis of the benefits that storage brings to the energy system against a range of future low carbon energy scenarios has been undertaken.

• The value of storage in the UK increases markedly towards 2030 and further towards 2050. Carbon constraints for 2030 and 2050 can be met at reduced costs when storage is available. The equivalent system savings can reach over £10bn per year in 2050.

• These very large costs demonstrate the scale of the challenge in delivering secure low carbon grids!

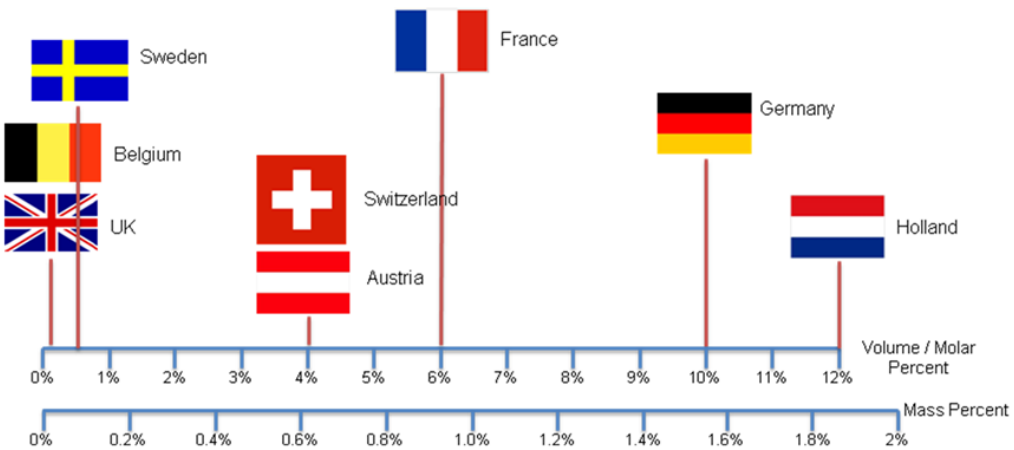
• So what is the role of natural gas in balancing the system whilst still meeting sustainability targets?

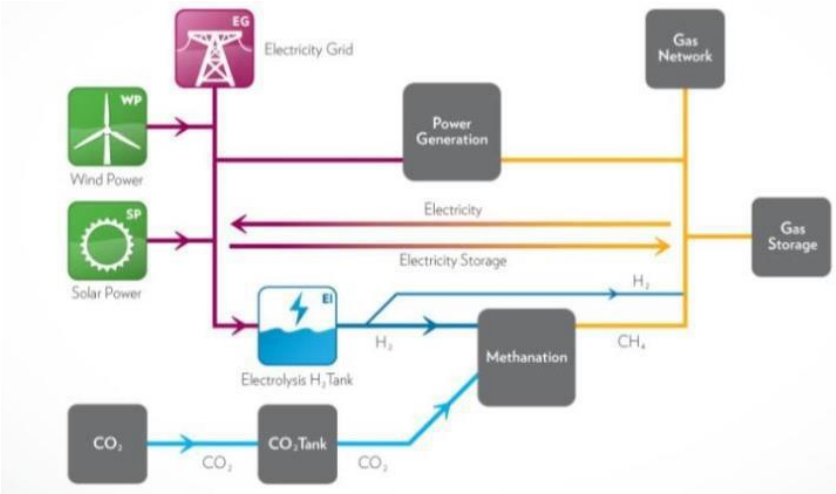
Strategic assessment of the role and value of energy storage systems in the UK Low Carbon Energy Future, Report for Carbon Trust; G Strbac et al, (2012) Energy Futures Lab Imperial College London.

Power to Gas (P2G)

• Generation of hydrogen using fast response electrolysis and its storage and/or injection into the gas network. 1MW 70% efficient electrolyser available from ITM Power. 11 P2G systems are currently operational in Germany.

• Generation of hydrogen for combination with CO_2 in chemical or biological methanation reactions, and injection of methane into the gas grid. Methanation reactors ~ 65% efficient. Produced methane costs predicted to be 4.2 & 28.2 p/kWh for biological & chemical methanation [ITM for DECC, 2013].





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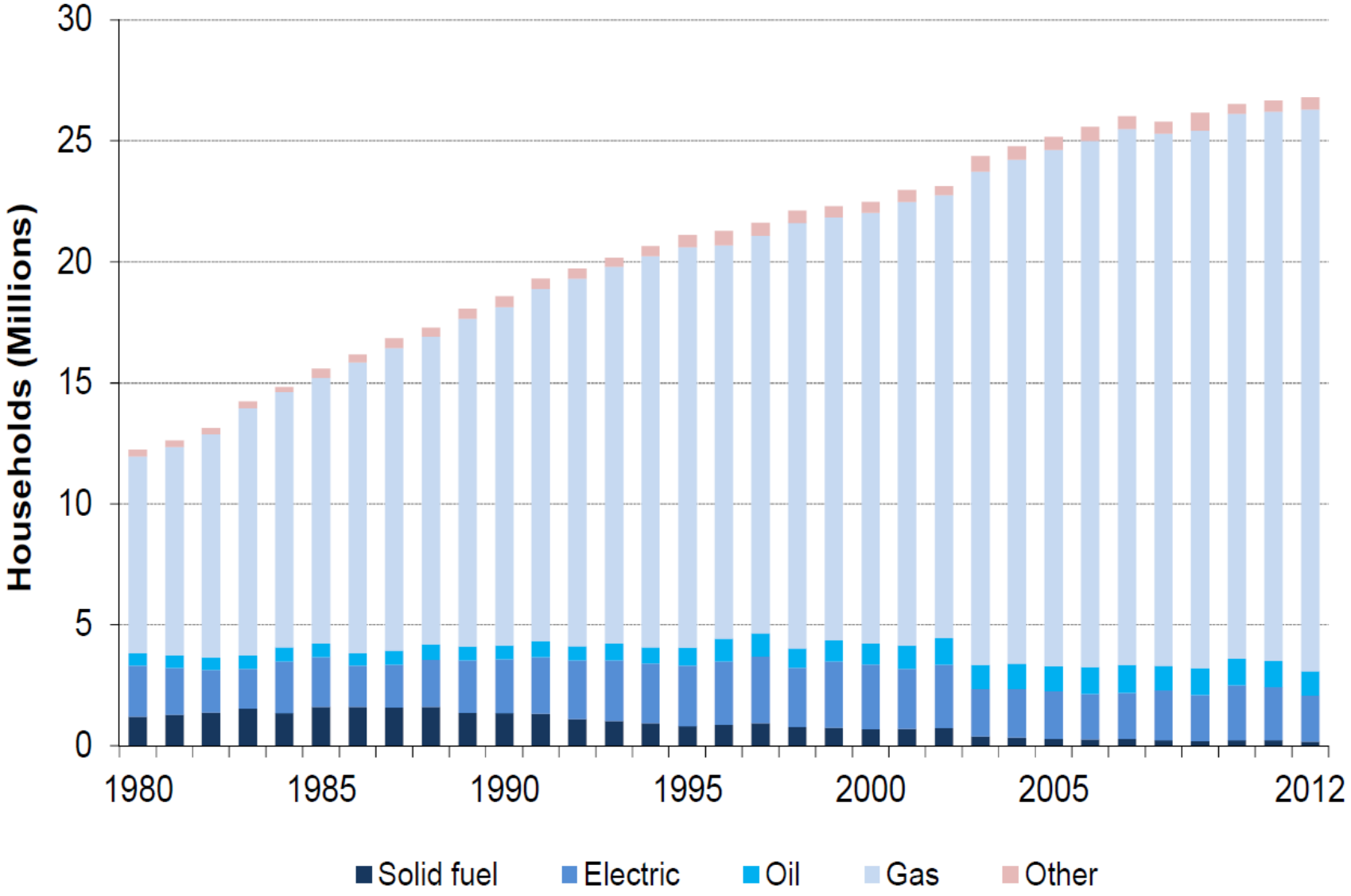
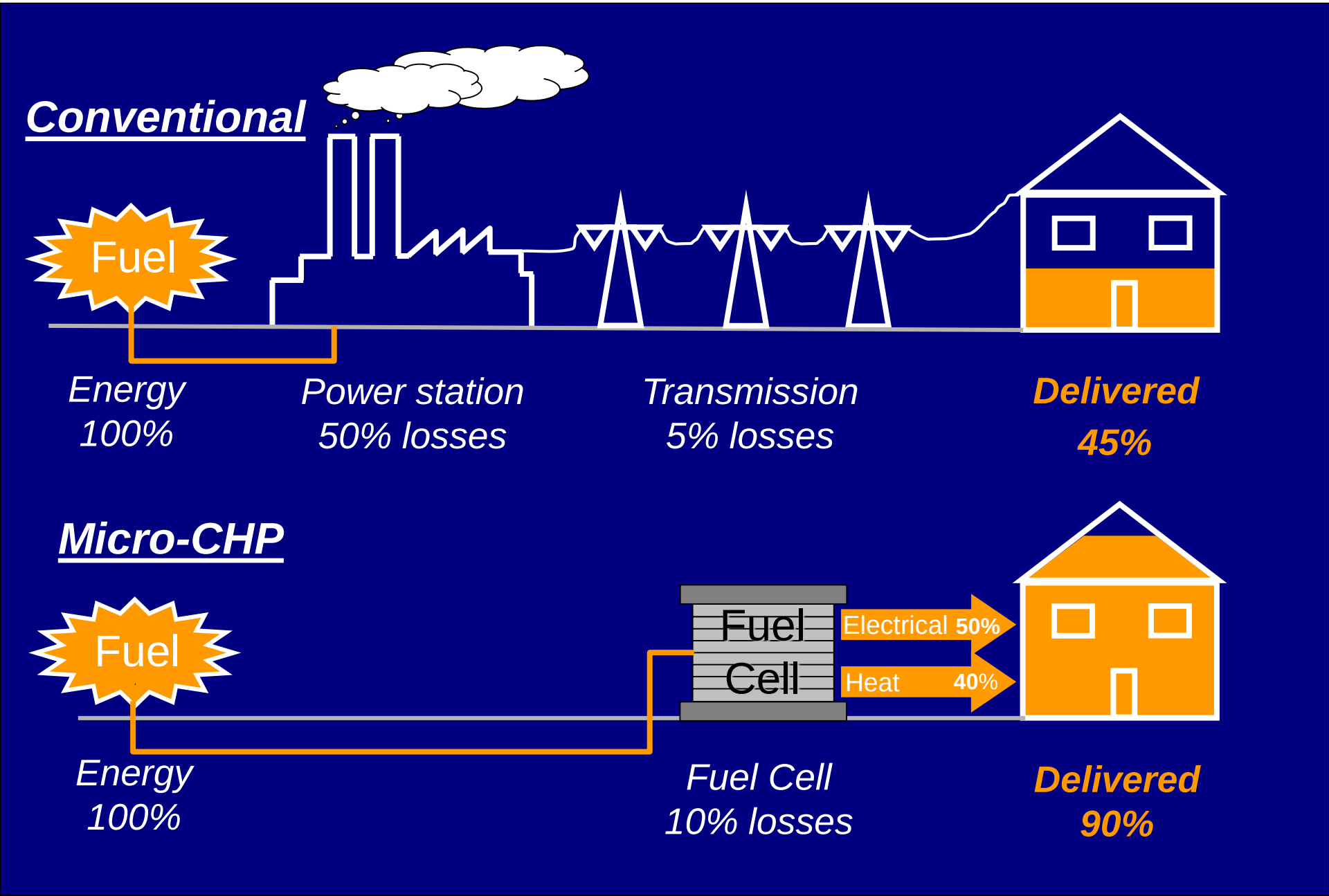
Home heating in the UK

2012: 97% of UK housing stock has central heating, of which 84% is gas fuelled



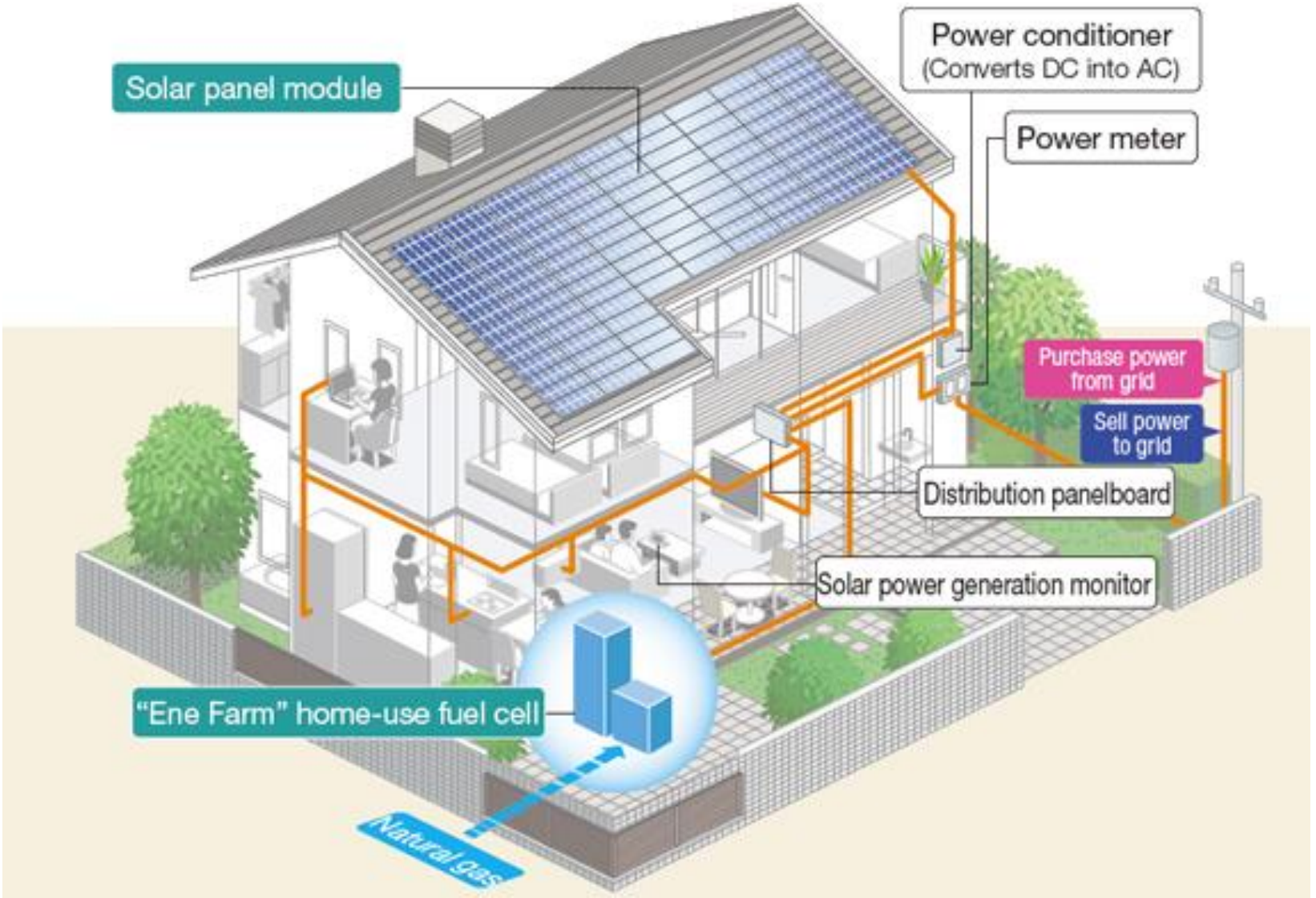
Source: UK Energy Sector Indicators. 2014. DECC.

Fuel Cell Boilers for the Home (micro-CHP)

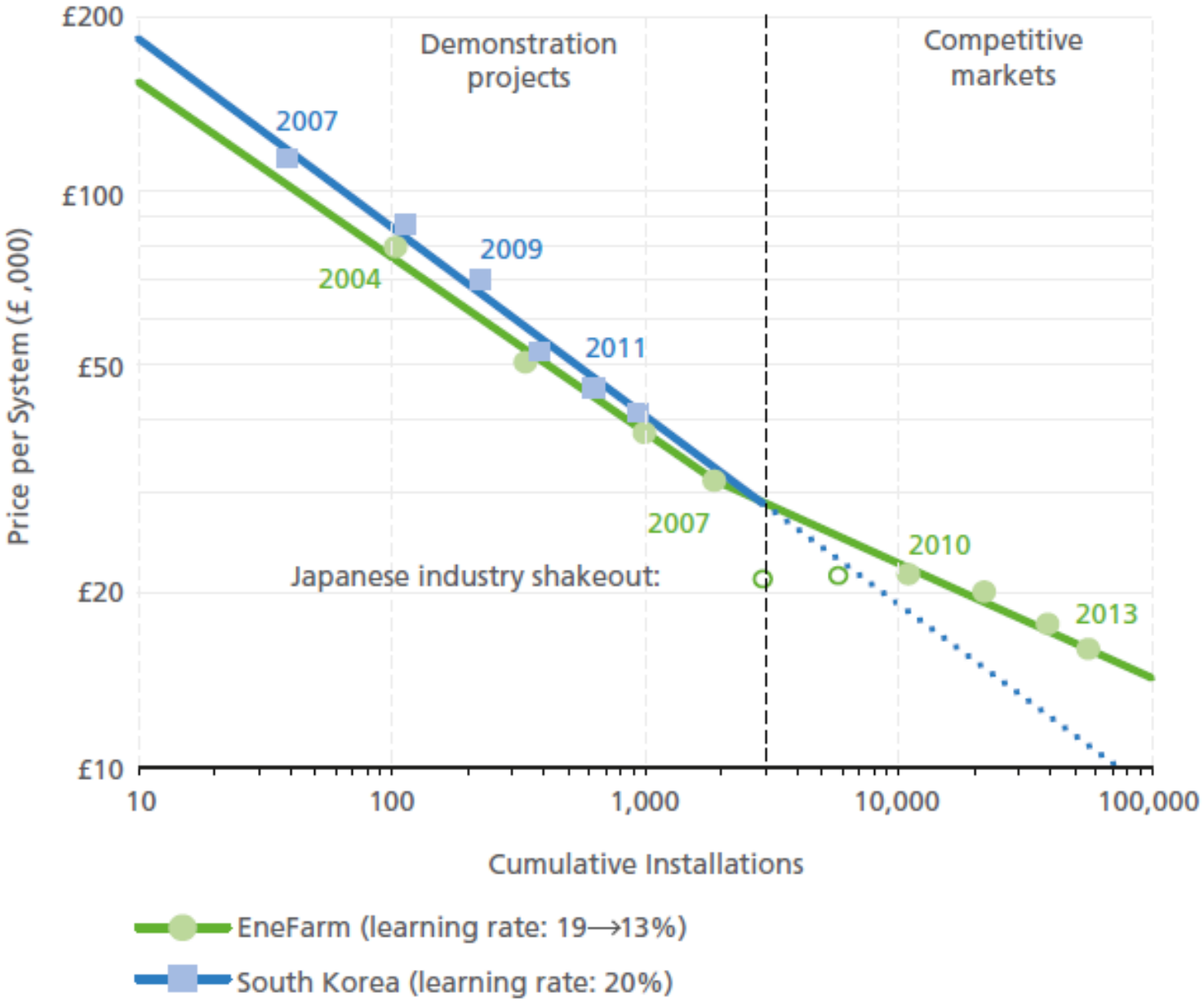


Japanese ene-farm programme

over 130,000 fuel cell mCHP units now sold in Japan



Costs of mCHP Fuel Cell Systems

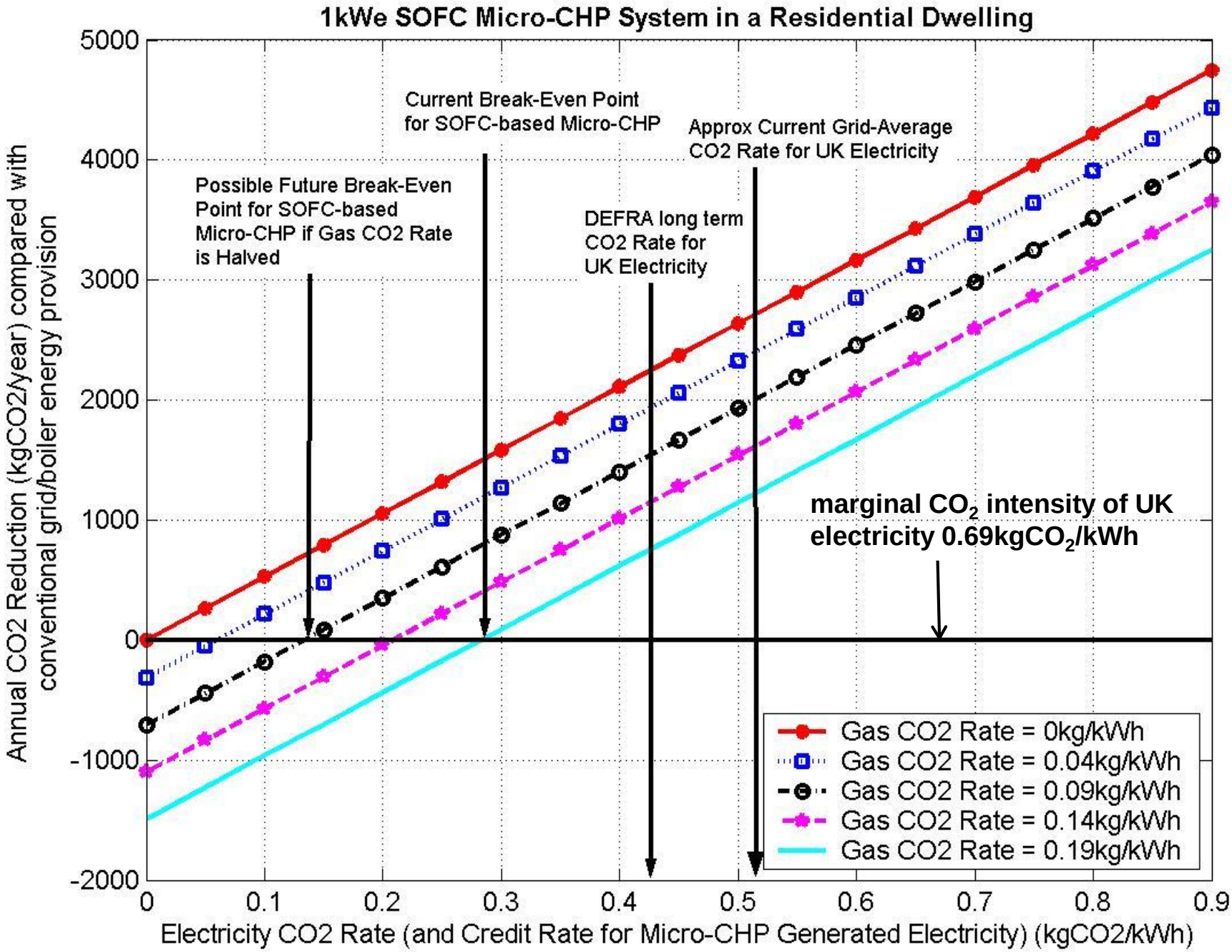


THE ROLE OF HYDROGEN AND FUEL CELLS IN PROVIDING AFFORDABLE, SECURE LOW-CARBON HEAT, P Ekins, P Dodds, A Hawkes et al, H2FC SUPERGEN White Paper, May 2014

‘Smart’ home energy management

“Nest v Hive v Tado: tech firms tussle over UK energy market
Energy management is the new battleground for technology companies”
Daily Telegraph, Oct 29th 2014

Google made headlines in 2014 when it bought California-based Nest Labs, a home automation company that designs and manufactures smart thermostats and smoke detectors, run by iPod-inventor Tony Fadell, for $3.2 billion (£2bn).



up to 5.5% of UK primary energy could be met by biogas from waste, representing 14.4% of gas consumption

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Unburnable Carbon and the role of CCS

Not all of fossil reserves can be converted to CO2 that is then released to the atmosphere if the world is to avoid a temperature rise > 2C. This is termed unburnable carbon. In all reported assessments, unburnable carbon sits between 49% and 80% of overall reserves.

Unburnable carbon ($GtCO_2$)	Burnable carbon ($GtCO_2$)	Overall remaining reserves ($GtCO_2$)	Timeframe	Reference
1360	1440	2800	2000-2050	M. Meinshausen et al. (2009)
"more than 2/3" >1907	less than 1/3 <953	2860	until 2050	IEA (2012)
2230	565	2795	2010-2050	Carbon Tracker Initiative (2011)
1960	900	2860	2013-2049	Carbon Tracker Initiative (2013)

Almost two-thirds of these carbon reserves are related to coal, 22% to oil and 15% to gas. Some form of carbon management is needed if these reserves are to be accessed

Conclusions

- The UK gas distribution network is a major strategic asset and offers a means of transporting and storing large amounts of energy.
- A move from coal to gas, including properly regulated UK shale gas, and more efficient utilisation of that gas, clearly makes sense in the short to medium term.
- But in the long term carbon mitigation is needed if gas is to play its full role in a low carbon energy system.
- The use of hydrogen for heating and/or transport fuels, from natural gas coupled with CCS, offers that prospect, but cost reduction and technology demonstration is clearly needed.