Why Europe needs natural gas … at least for now

BIEE's annual Autumn gas seminar, October 2016

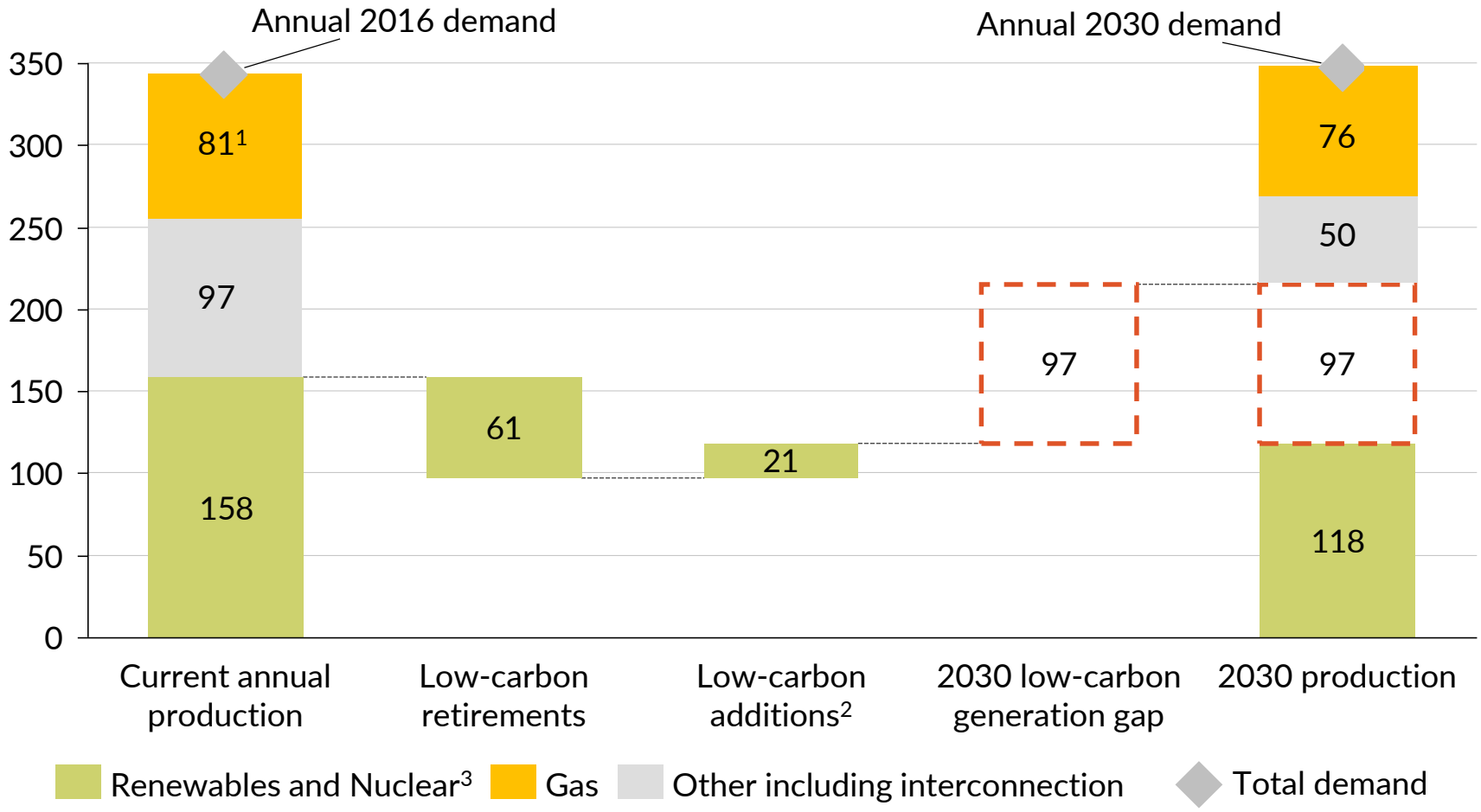
Dr. John Feddersen, Co-founder and CEO, Aurora Energy Research

Overview

- Given current carbon targets, we need only very small declines in gas use in the UK and Europe to 2030
- Reducing gas consumption beyond levels required to meet carbon targets would be relatively expensive
- Ultimately, we need approximately net zero emissions. Removing gas from power is possible. Removing gas from heat is very difficult

We don't need to reduce gas much in power: Gas use can be kept roughly constant to 2030 to hit CCC's 100g/kWh target

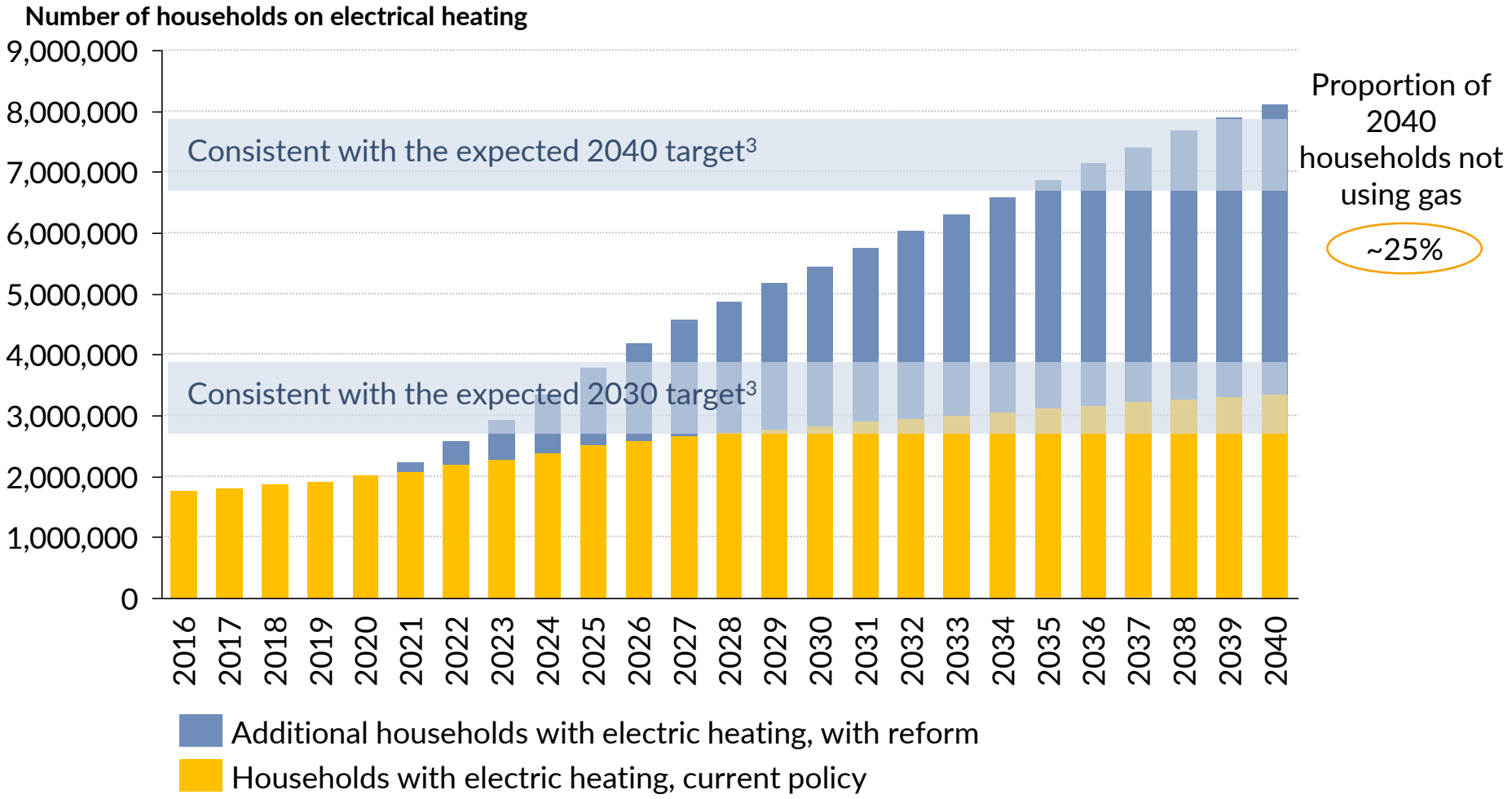
Electricity production,
TWh



Notes: 1. Average output of 2013, 2014, and 2015 2. Reflects generation from renewable capacity secured through Renewables Obligation and Contracts for Difference schemes.
3. Renewables include bioenergy, hydro, marine, offshore wind, onshore wind, and solar PV

Source: Aurora Energy Research

Relatively little electrification of residential heat is required to hit expected 2040 carbon budget; much less for 2030



1. We assume 33.25m households by 2040. 2.We estimate that at least 75% of heating would need to be carbon-free in order for the UK to reach its 2050 target. The horizon of our analysis does not extend to 2050, but we estimate that even with the proposed reform would be insufficient on its own to reach the target and further policy measures would be required in the 2040s. 3. Aurora estimates.

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Heat pumps are Government's current preferred choice for long-term decarbonisation of heat production…

	CAPEX	Efficiency	Lifespan	Technology	Subsidy
Air-Source Heat Pumps (ASHP) 	£7,000 - £14,000 £1,000/kW	COP[1]: 2 – 3 (200% - 300%)	20 years	Absorbs heat from air into a fluid which is compressed to drive up the temperature. Similar to air-conditioning mechanism.	✓ RHI @ 7.51p/kWh
Ground-Source Heat Pumps (GSHP) 	£13,000 - £25,000 £2,000/kW	COP: 3 – 4 (300% - 400%)	20 years	Absorbs heat through pipes buried in the ground. Pipes can be laid horizontally or vertically (vertical borehole) dependent on space limitations.	✓ RHI @ 19.33p/kWh
Electric Storage Heating 	£2,500 - £3,500 £400/kW	~100%	10 years	Heat stored within bricks heated overnight in the storage unit is dissipated slowly throughout the day.	✗

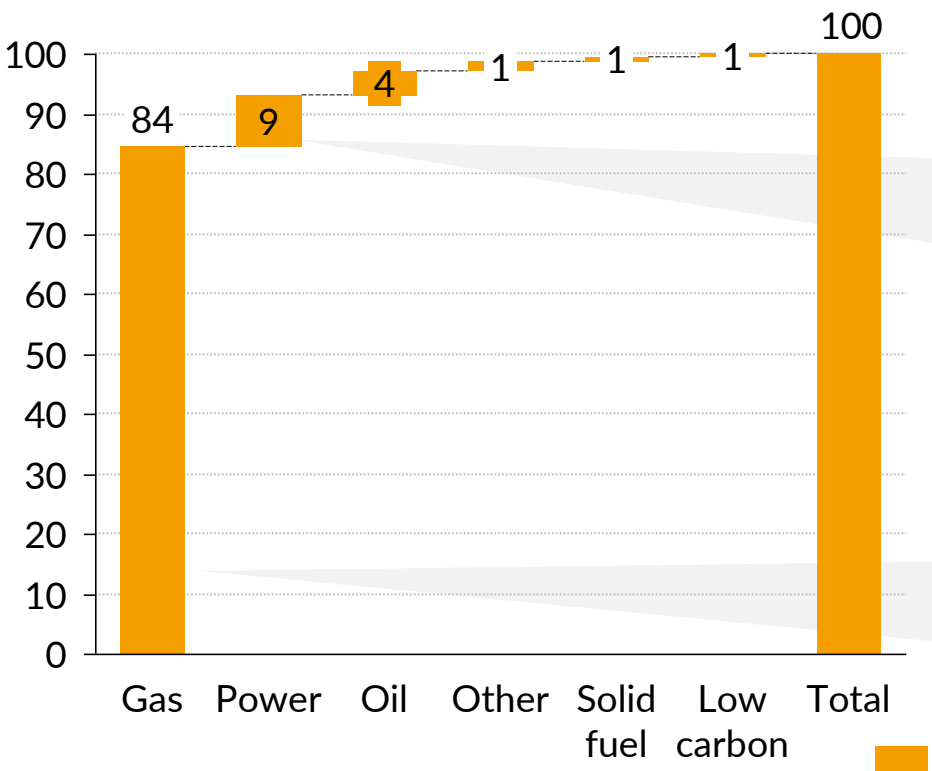
1. The Coefficient of Performance (COP) is a ratio of heating provided to work required. A COP of 2 implies that it takes 1kw of electricity to generate 2 kw of heat

Sources: Committee on Climate Change, GSHp.org, easy-greendeal , storageheaters.com

...however, it is relatively very expensive for most households to switch to heat pumps

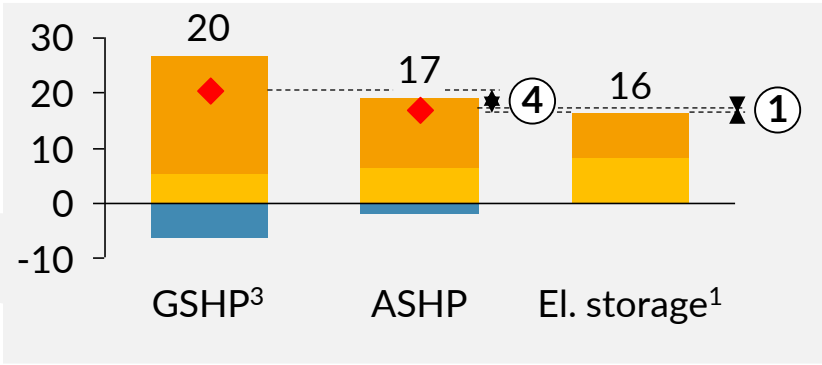
To achieve substantial proliferation, heat pumps would need to eat into the market share of gas and resistive power heating

Residential heating by fuel type

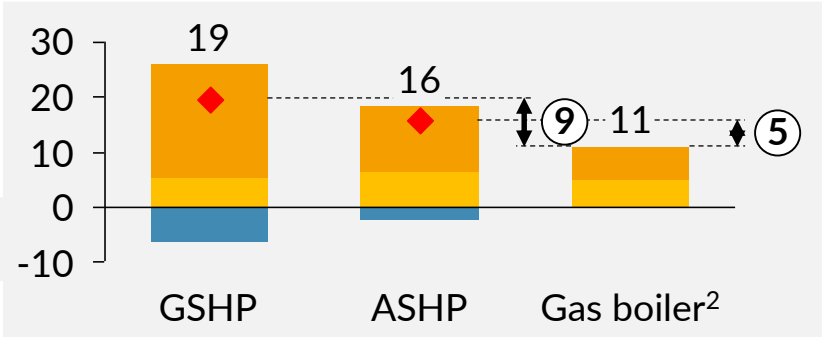


This appears unlikely right now - their economics are unfavourable, even despite generous subsidies[5]

Cost of switching from el. storage, £k NPV 2016



Cost of switching from gas boiler, £k NPV 2016



CAPEX Fuel RHI Total incl. subsidies

1. Represents the cost of keeping electric storage. 2. Represents the costs of keeping gas heating. 3. In the vast majority of cases GSHP is unsuitable to replace storage heating, since storage heaters are used predominantly in flats without outside areas necessary to install GSHP. It is included here for indicative purposes. 5. Comparison for a 80m2 house.

Source: Aurora Energy Research

In power, solar and storage are making enormous strides. Battery costs will continue to decline rapidly…

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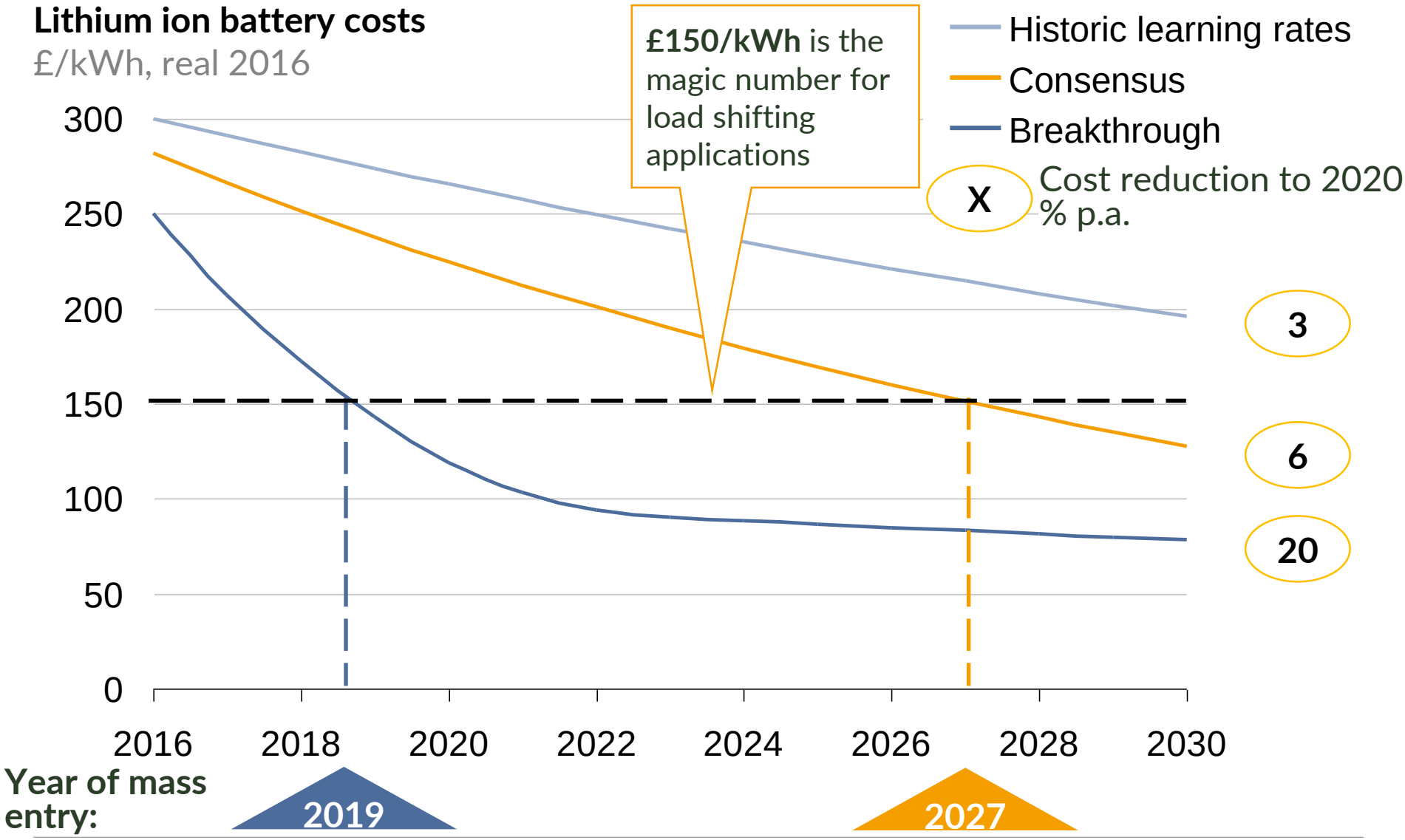
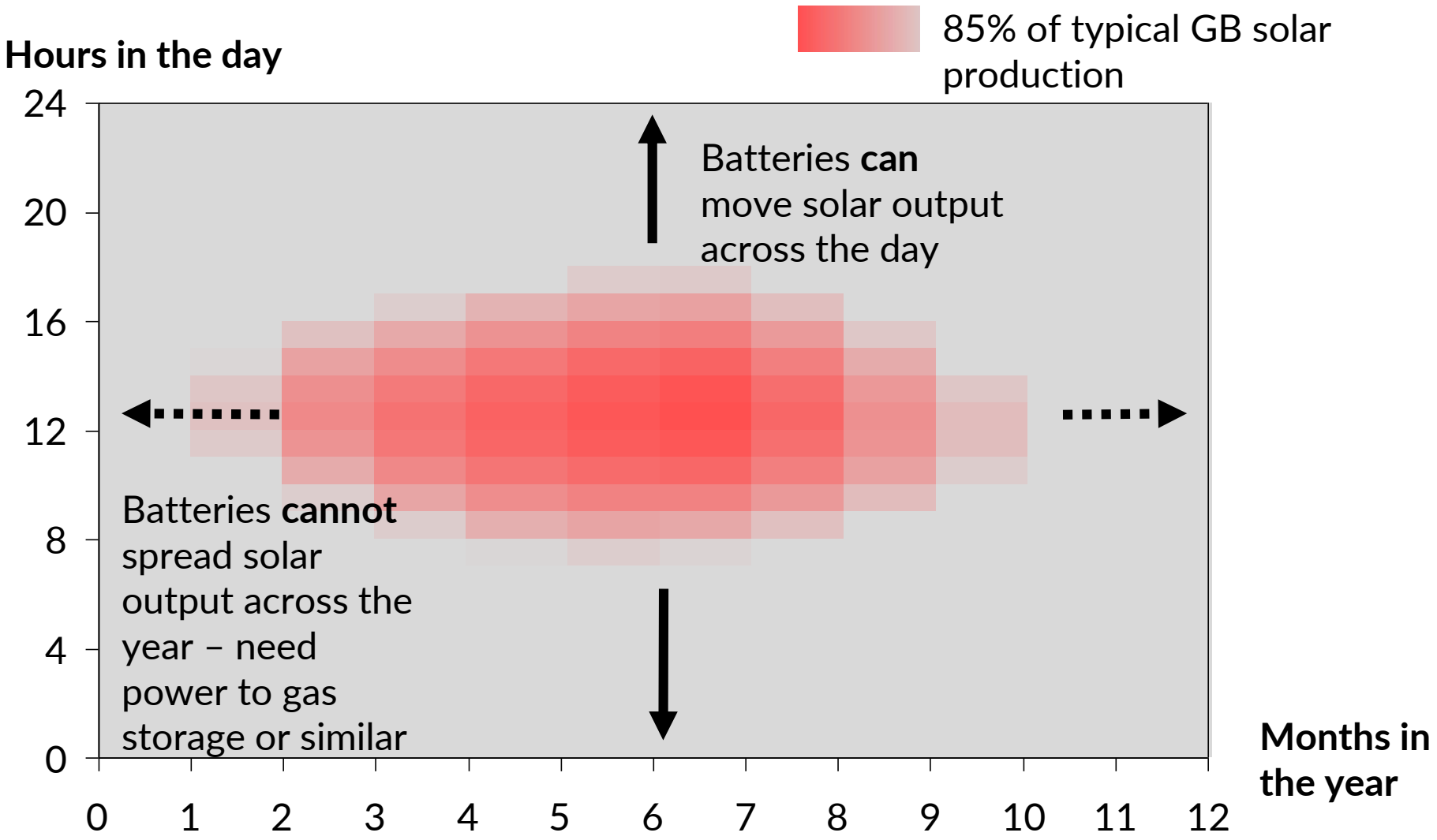


… but, batteries cannot provide economic inter-seasonal storage. Gas is the obvious solution at least to 2030



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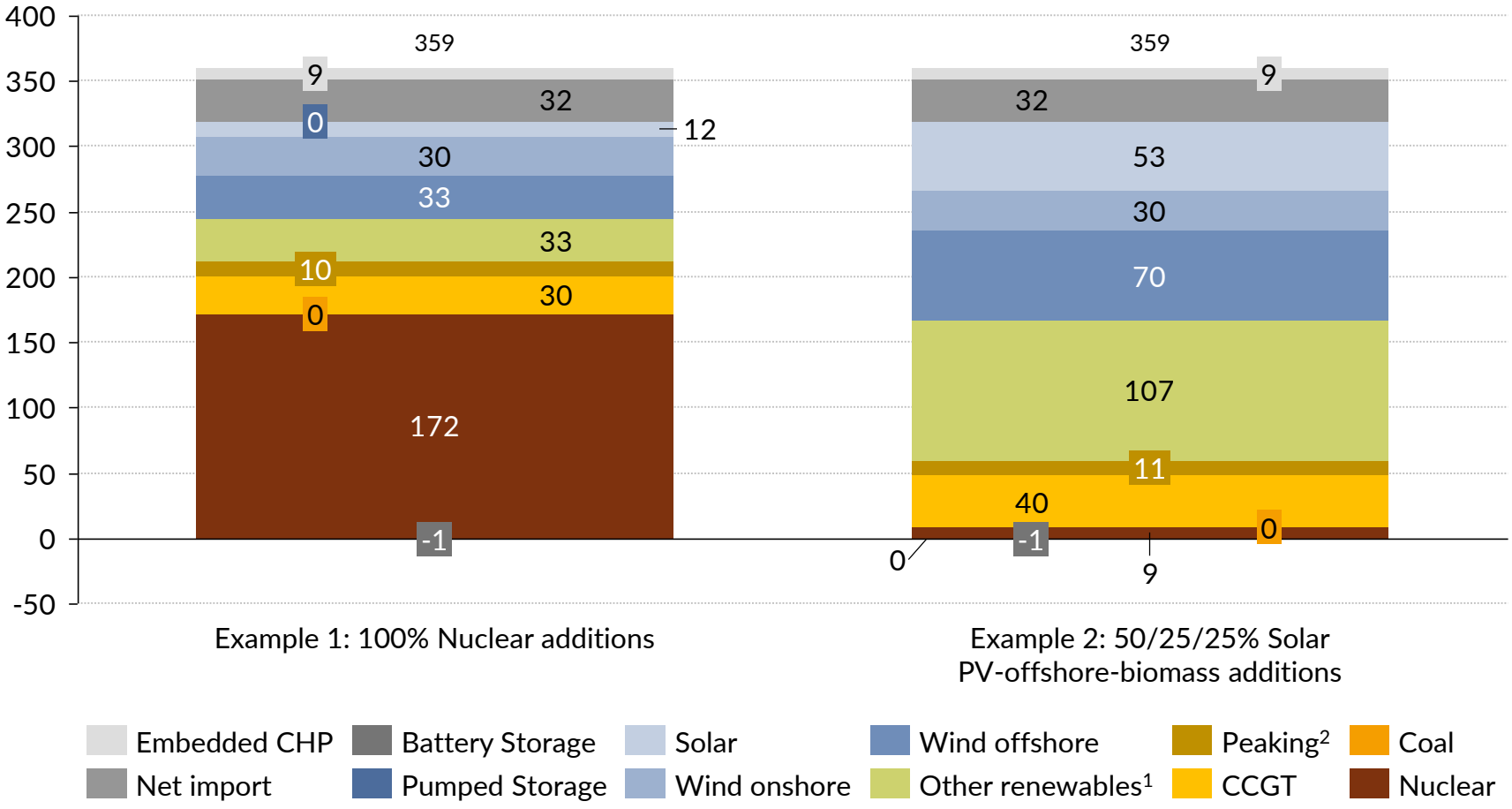
Removing gas from power is possible. Moderate gov't support can ensure 50g/kWh target is met in 2040

2040 Generation output from different technologies, TWh



Notes: 1. Other renewables include biomass, hydro, and marine. 2. Peaking includes OCGT, reciprocating engines, and DSR.

Source: Aurora Energy Research

Removing gas from heat is very difficult. The three most-attractive options at present are very unattractive

- **Heat pumps:**
  - Very expensive
  - At least double winter peak power demand (much more for air-source HPs)
  - Most economically plausible as housing stock turns over (~1% per annum)

- **Hydrogen:**
  - Very carbon-intensive to produce currently. Need CCS
  - Electrolysis can be carbon free, but requires lots of power
  - Massive new investment in transport and consumption infrastructure required

- **Use gas network during peak periods only and use power off-peak:**
  - Avoids need for winter peak power, uses existing asset
  - Potentially limit scope to high-density areas
  - Hybrid heat pumps can use gas and power