



An Energy Mix

Durham University
24th May 2017

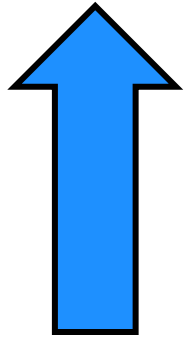


Durham
University

Durham Energy Institute

**Institution of
MECHANICAL
ENGINEERS**

Improving the world through engineering



Stats in April

- Impressions:
 - 900,000
- Followers:
 - 3,500
- Profile visits:
 - 7,000

FOLLOW US ON



Michael Peake Retweeted you 21h

Jan 20: GB electricity currently: wind 0.7%, coal 28.0%, nuclear 16.9%, gas 46.7%, hydro 0.9%, imports 1.6%, other 5.1%. Demand ~46 GW



Richard Betts liked a Tweet you were mentioned in 24h

Jan 20: @richardabetts @myGridGB You don't have to be a genius to realise #nuclear is the only reliable low carbon energy. Batteries are a joke!



Drax @Draxnews · Jan 20
@myGridGB and Biomass 4.4%. Great if you can add reliable, renewable biomass in to future tweets and your useful app itunes.apple.com/us/app/my-grid...



[View details](#)



Alan Poirier @alan_poirier · Jan 18
@myGridGB @RogTallbloke Same story everywhere. Renewables=unreliables. ets.aeso.ca/ets_web/ip/Mar...



[View conversation](#)



Nicolahh @Nicola230573 · Jan 18
@myGridGB we're an island surrounded by bloody water. FFS use it and stop the EU from pillaging our waters



[View conversation](#)



MyGridGB
@myGridGB

Today saw 4 records.

Highest ever solar generation: 26%

Highest ever renewable generation: 47%

Highest ever low carbon generation: 71%

#wow!

2017	PCT	
Solar max	26.25%	09/04/2017 14:33:43
Wind max	40.59%	19/03/2017 05:33:43
Intermittent Renewables max	46.98%	09/04/2017 15:33:43
Low carbon max	70.93%	09/04/2017 15:33:43

RETWEETS

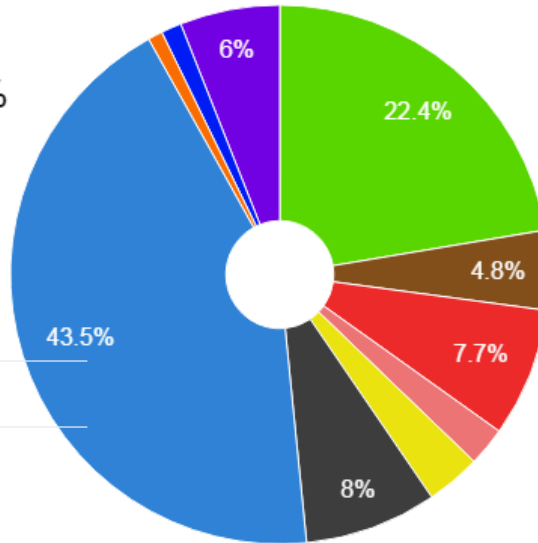
139

LIKES

85



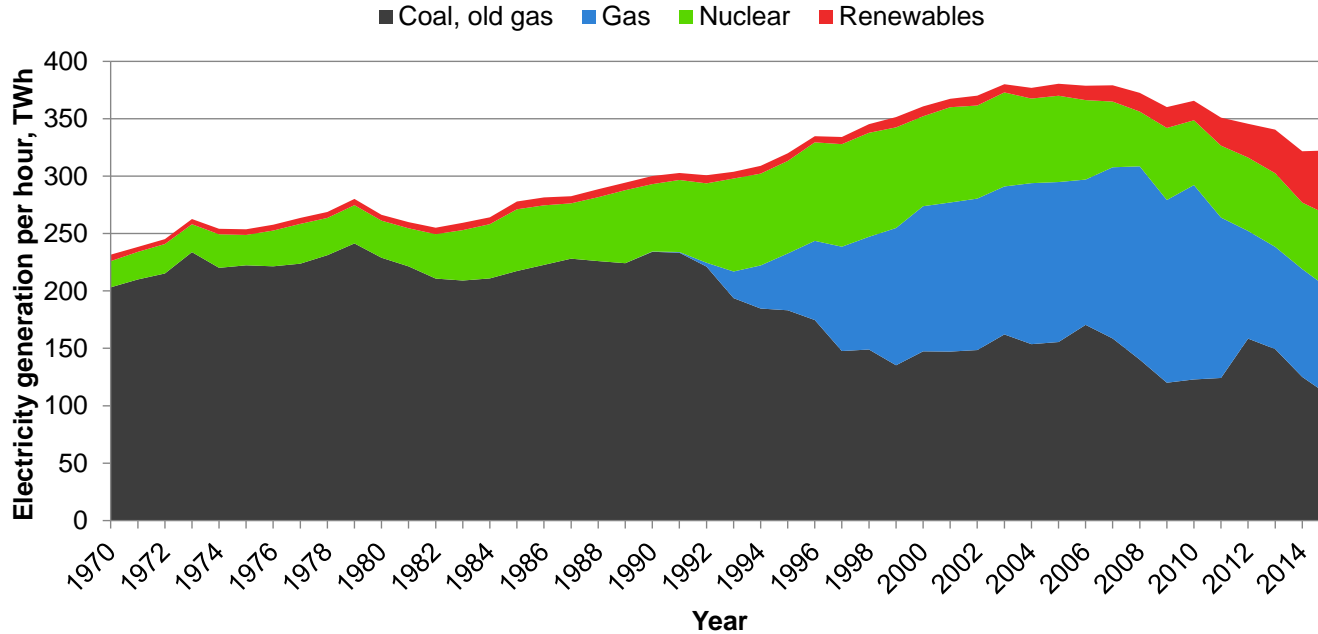
GB electricity generation over 15 months from Mon 22 February 2016 to Mon 22 May 2017

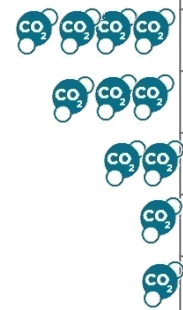
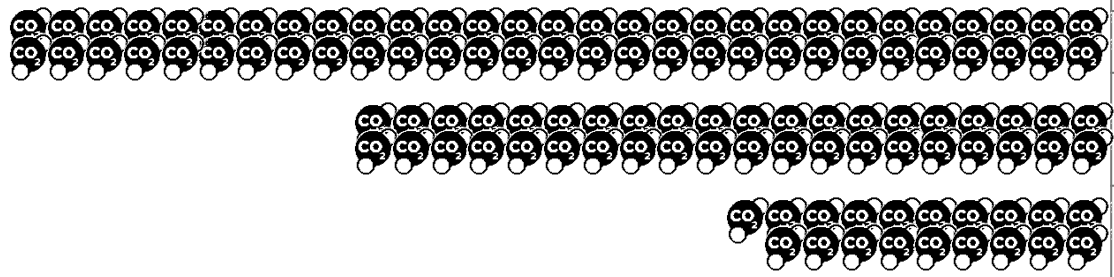


- Nuclear, 66.0 TWh (22.4%)
- Biomass, 14.1 TWh (4.8%)
- Wind, 22.9 TWh (7.7%)
- Embedded Wind, 6.9 TWh (2.3%)
- Solar, 9.7 TWh (3.3%)
- Coal, 23.5 TWh (8.0%)
- Gas, 128.5 TWh (43.5%)
- Storage, 2.6 TWh (0.9%)
- Hydro, 3.6 TWh (1.2%)
- Imports, 17.7 TWh (6.0%)



GB electricity supply: 1970 - 2015. Source: DUKES, MyGridGB

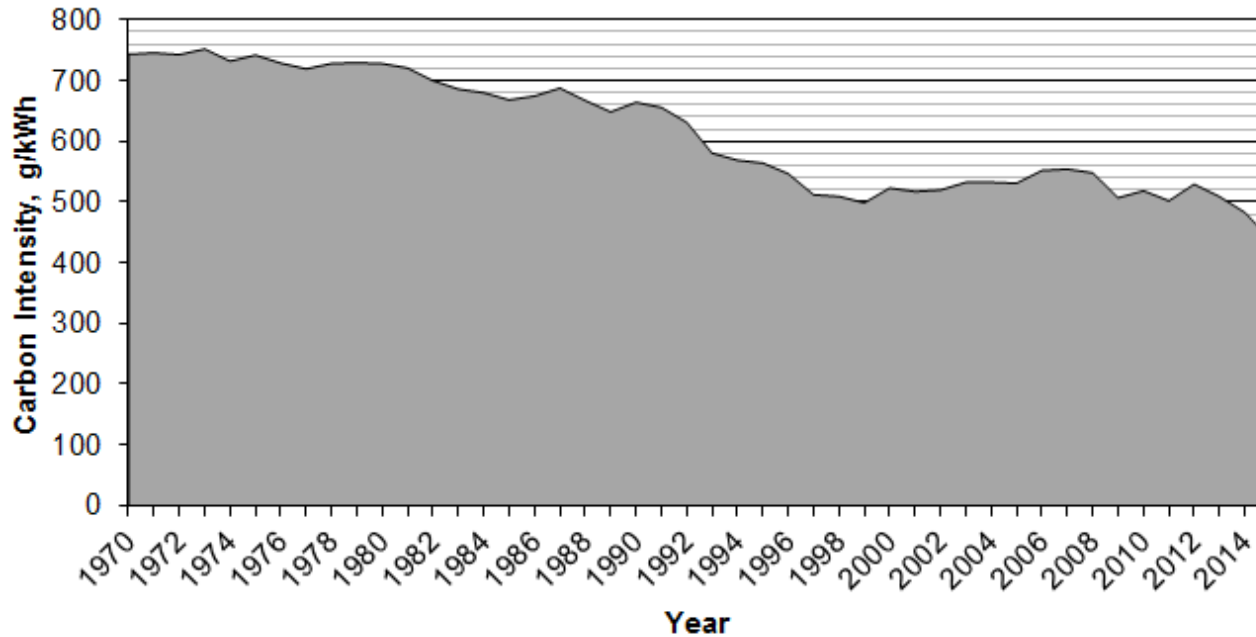


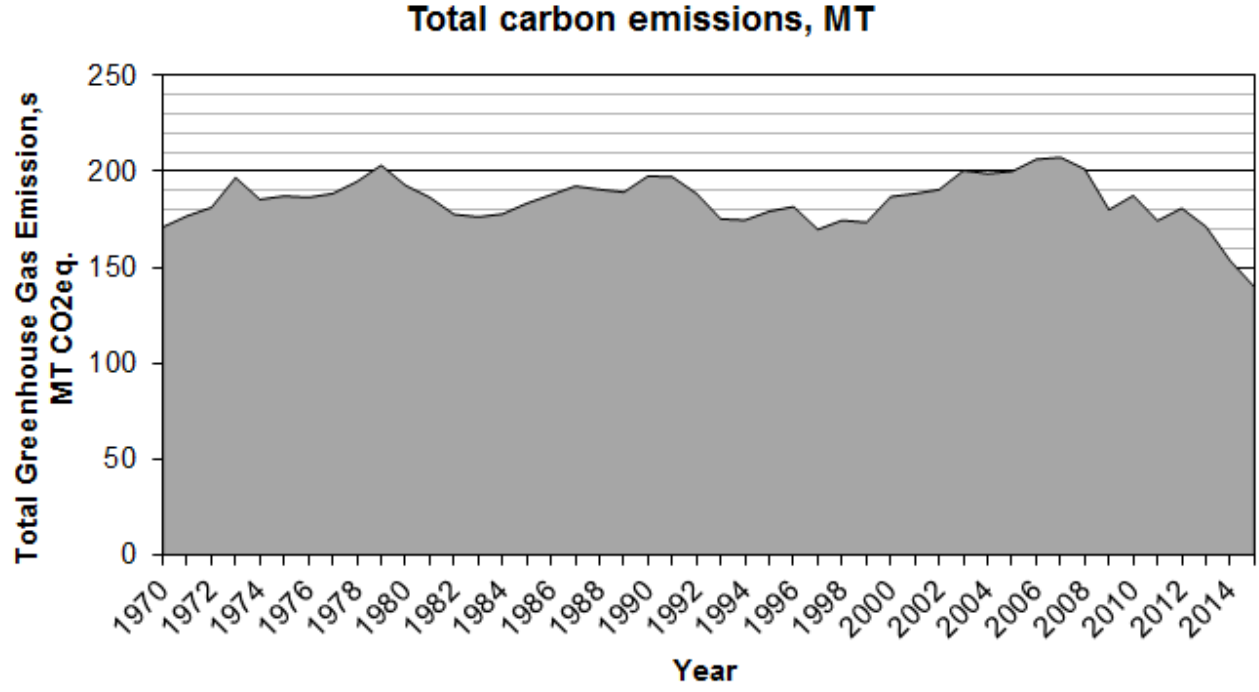


Technology	Carbon factor, gCO2/kWh
Coal	820
Gas – Combined cycle	490
Biomass – dedicated	230
100 g CO2/kWh	
Solar PV – rooftop	41
Geothermal	38
Hydropower	24
Nuclear	12
Wind	11-12



Carbon Intensity of Electricity 1970 - 2015

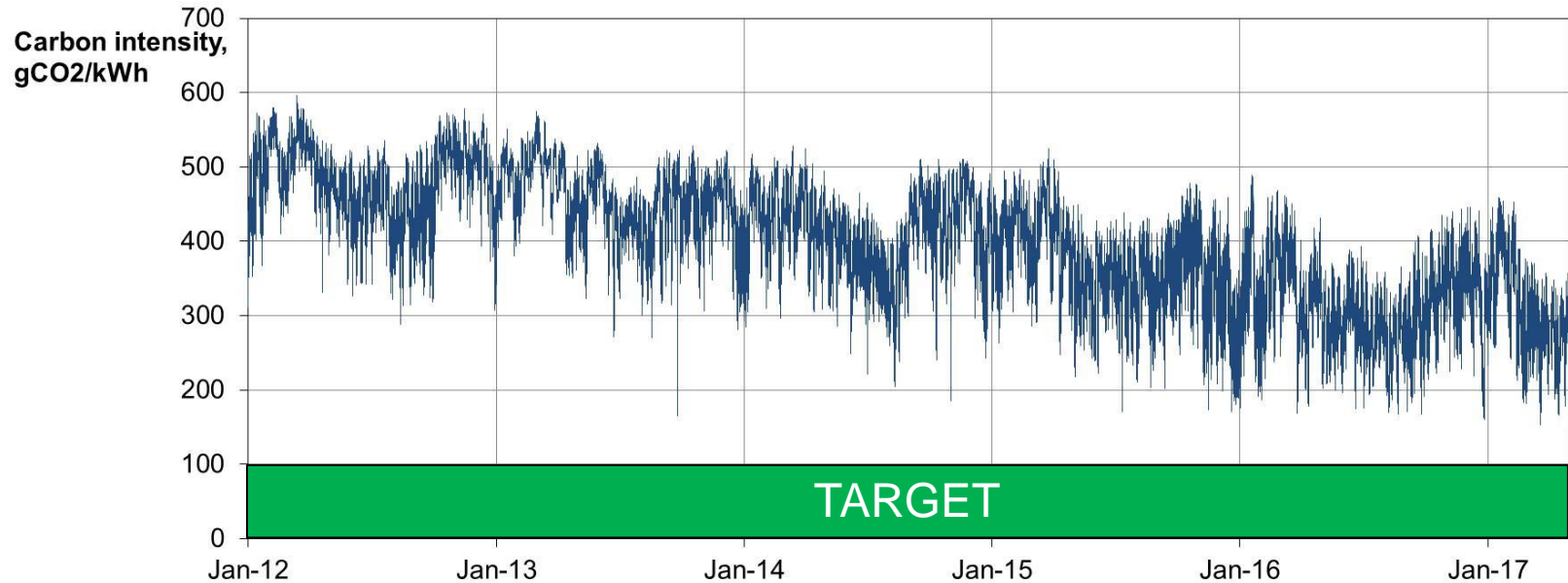






Carbon intensity of electricity in Great Britain, Jan 2012 - May 2017

Sources: MyGridGB, GridWatch





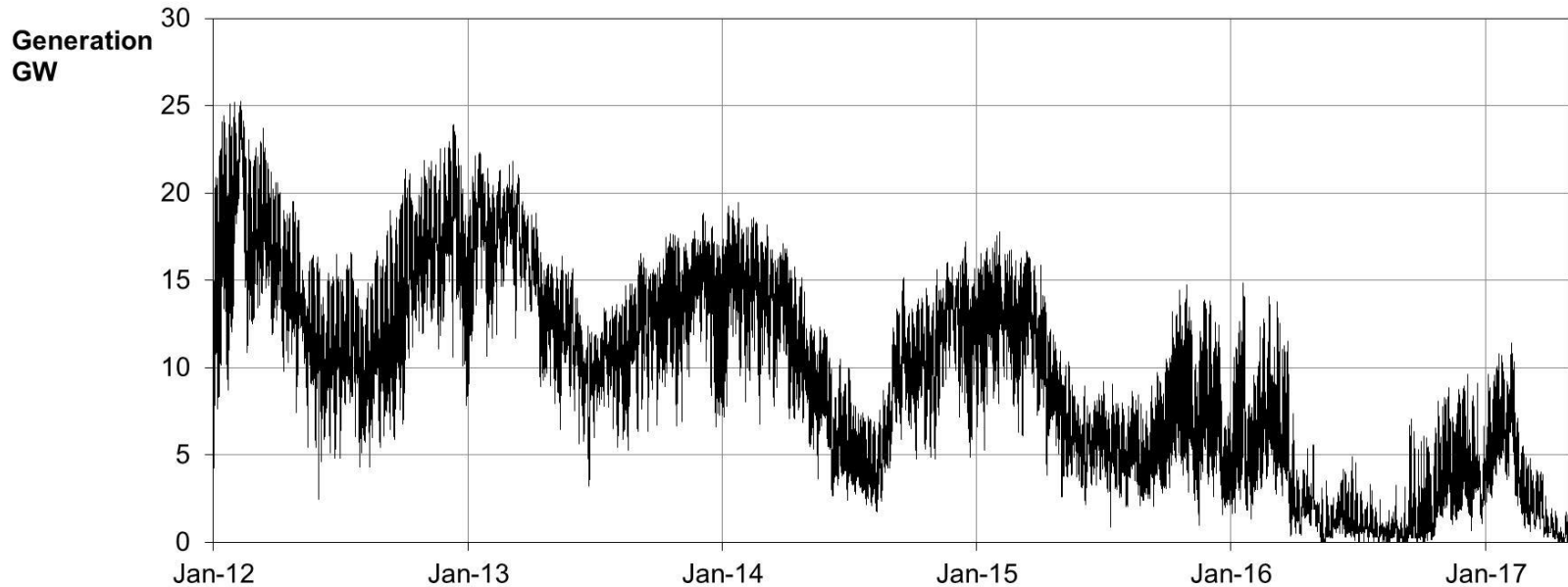
Contribution of renewable energy to GB electricity so far in 2017	23.9%
Highest ever penetration of renewable energy in GB electricity	47% 9 th April 2017
Highest ever penetration of low carbon electricity in GB electricity	72% 15 th April 2017
Hours without coal in 2017	2016: hours without coal – 210
Hours without coal in 2017	2017: hours without coal - 228





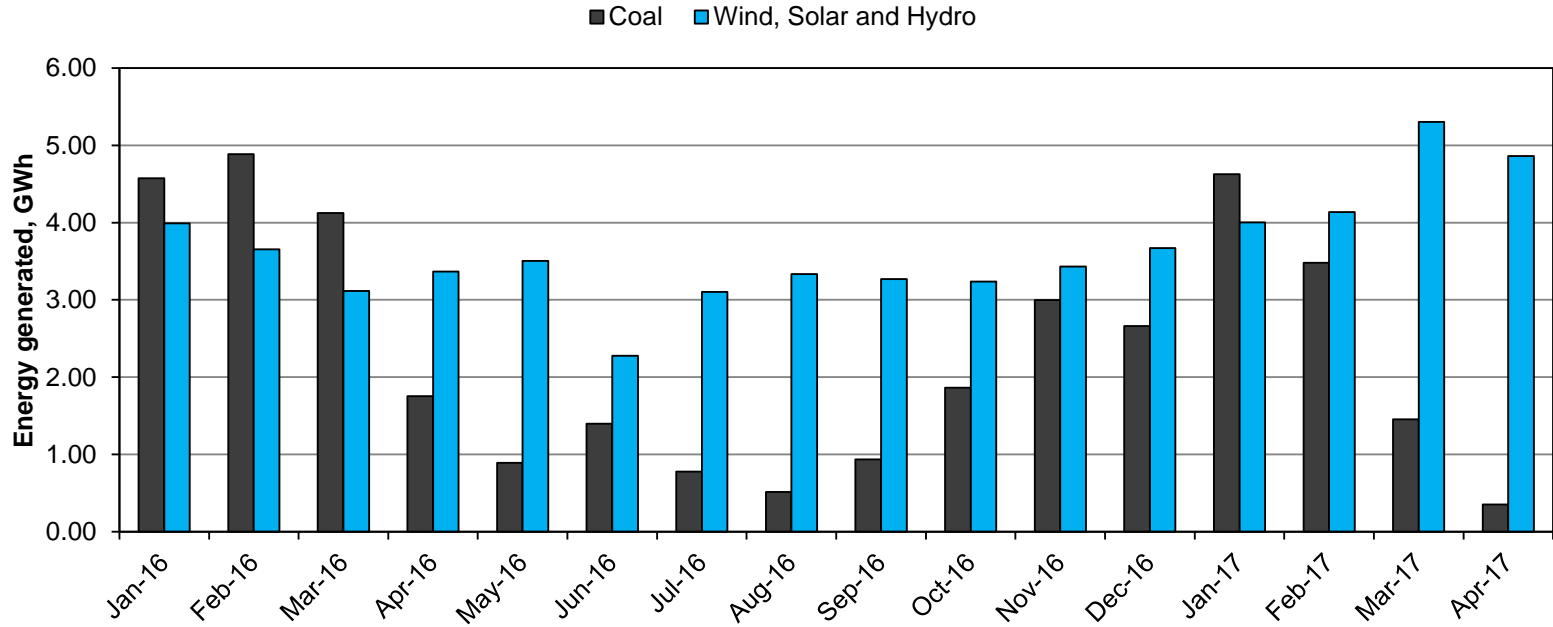
Coal generation in Great Britain, Jan 2012 - May 2017

Sources: MyGridGB, GridWatch





Electricity from Coal and Renewables per Month - www.mygridgb.co.uk



UK energy

+ Add to myFT

UK generates a day's electricity without coal

Share of power from the fossil fuel fell to zero on Friday for first time since 1882



© Bloomberg

Twitter, Facebook, WhatsApp icons and a 'Save' button with a '172' notification.

APRIL 22, 2017 by: **Pilita Clark**, Environment Correspondent

Britain has gone a full day without turning on its

Coal

British power generation achieves first ever coal-free day

National Grid hails milestone as other sources like gas, nuclear, wind and solar allow UK to keep lights on with all coal-fired powerplants offline



Coal-free days are set to become increasingly common as gas and renewables play an increasing role. Photograph: Chris Ratzliff/Bloomberg/Getty Images

Social media sharing icons (Facebook, Twitter, Email) and view counts (51,306, 1,025).

This article is 1 month old

Georgia Brown

Saturday 22 April 2017 01:44 BST

Friday was Britain's first ever working day without coal power since the Industrial Revolution, according to the National Grid.

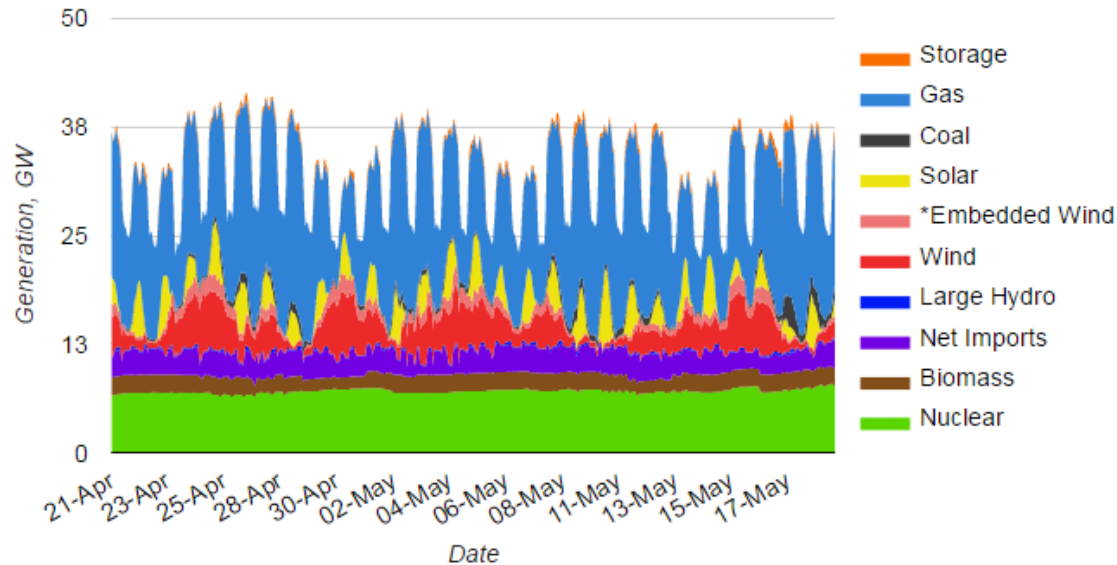
The control room tweeted the milestone on Friday. It is the first continuous 24-hour coal-free period for Britain since use of the fossil fuel began. West Burton 1 power station, the only coal-fired plant that had been up and running, went offline on Thursday.

A tweet from @NGControlRoom: 'National Grid can confirm that for the past 24 hours, it has supplied GB's electricity demand without the need for #coal generation. pic.twitter.com/vgyWEUyqZ4 April 21, 2017'

Mobile app interface for MailOnline News. Includes navigation tabs (Home, Showbiz, Femail, Sport), a featured article snippet about coal-free power generation, and social media sharing options.



Hourly GB electricity generation over 28 days Fri 21 April 2017 to Fri 19 May 2017

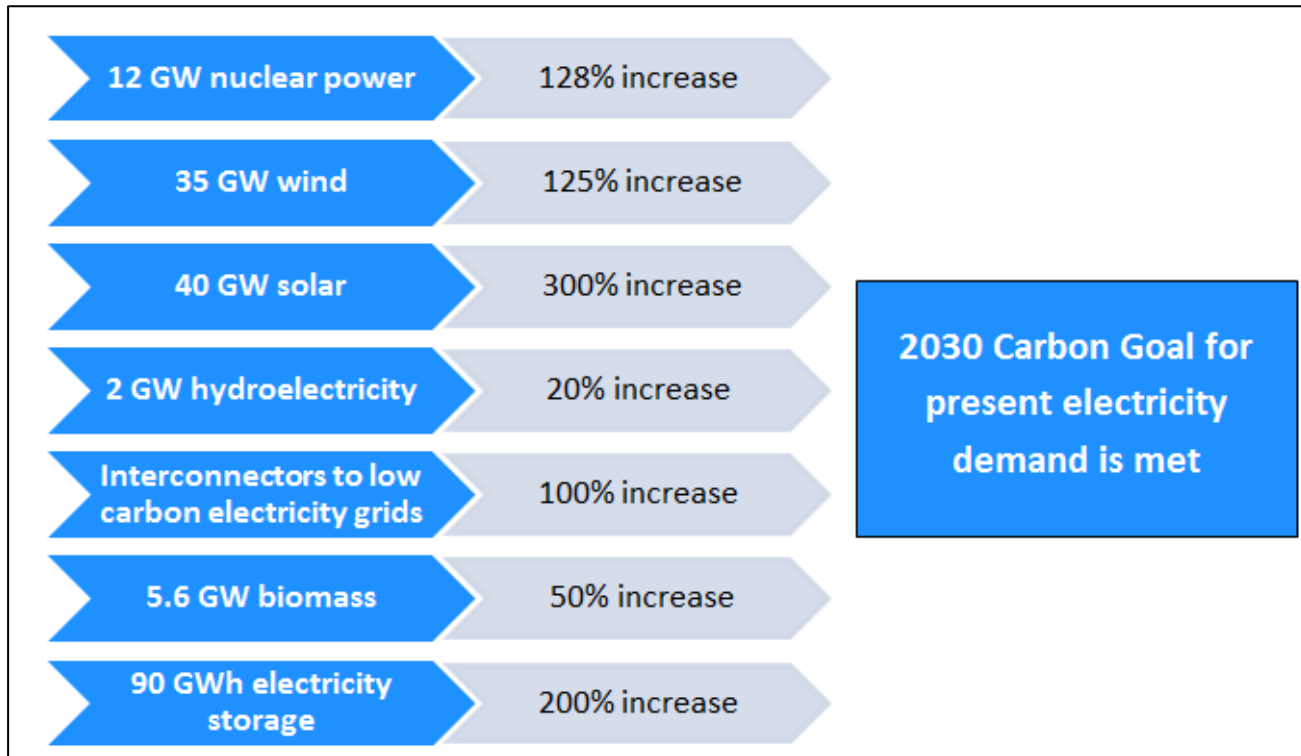


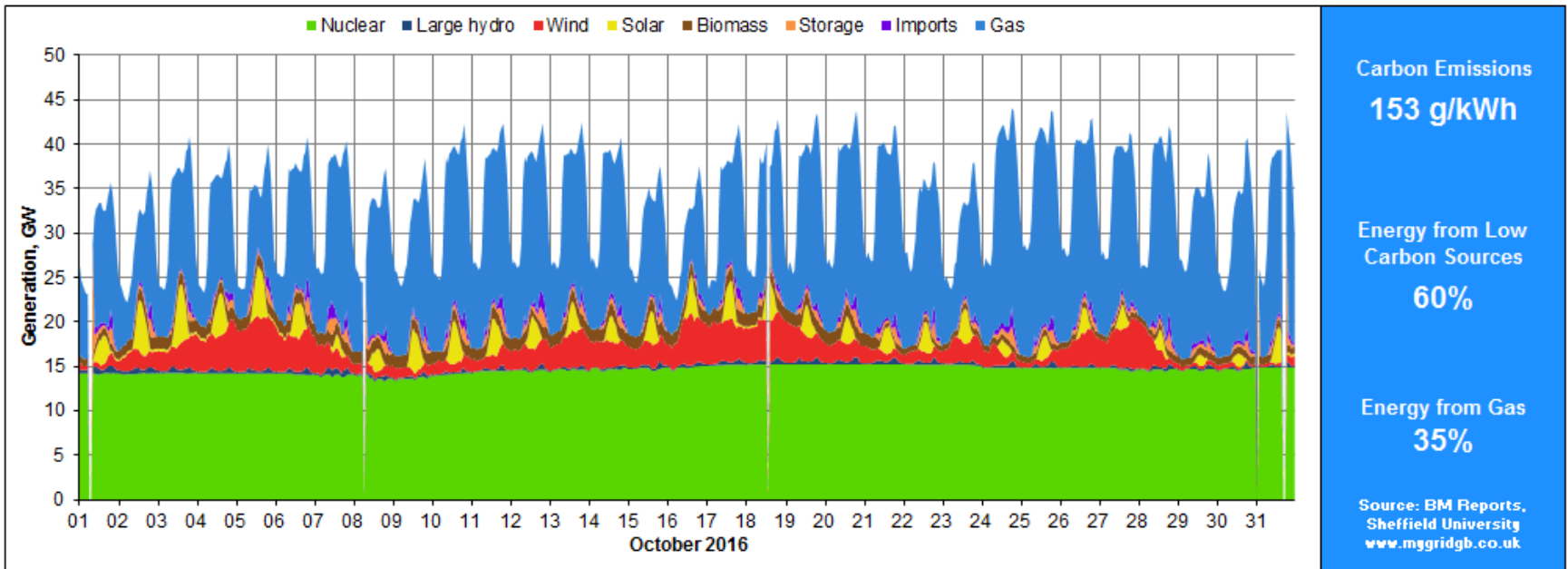
Source: www.MyGridGB.co.uk, Elexon Portal, Sheffield University

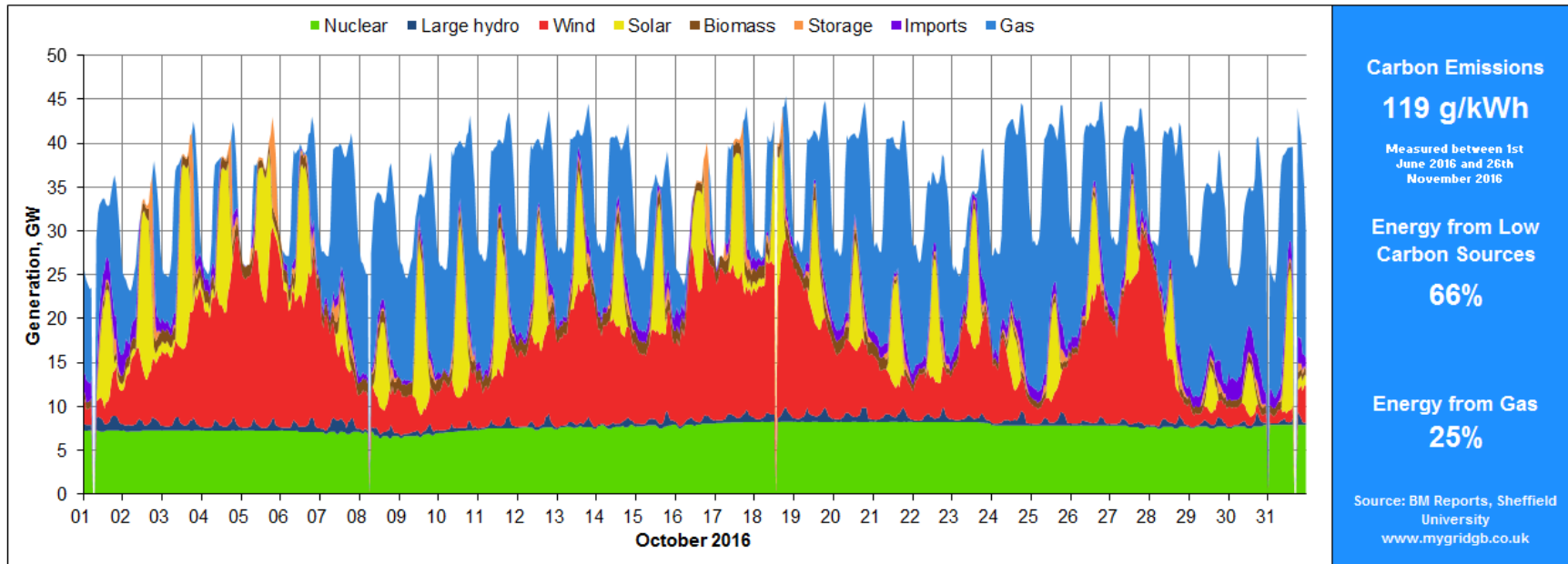


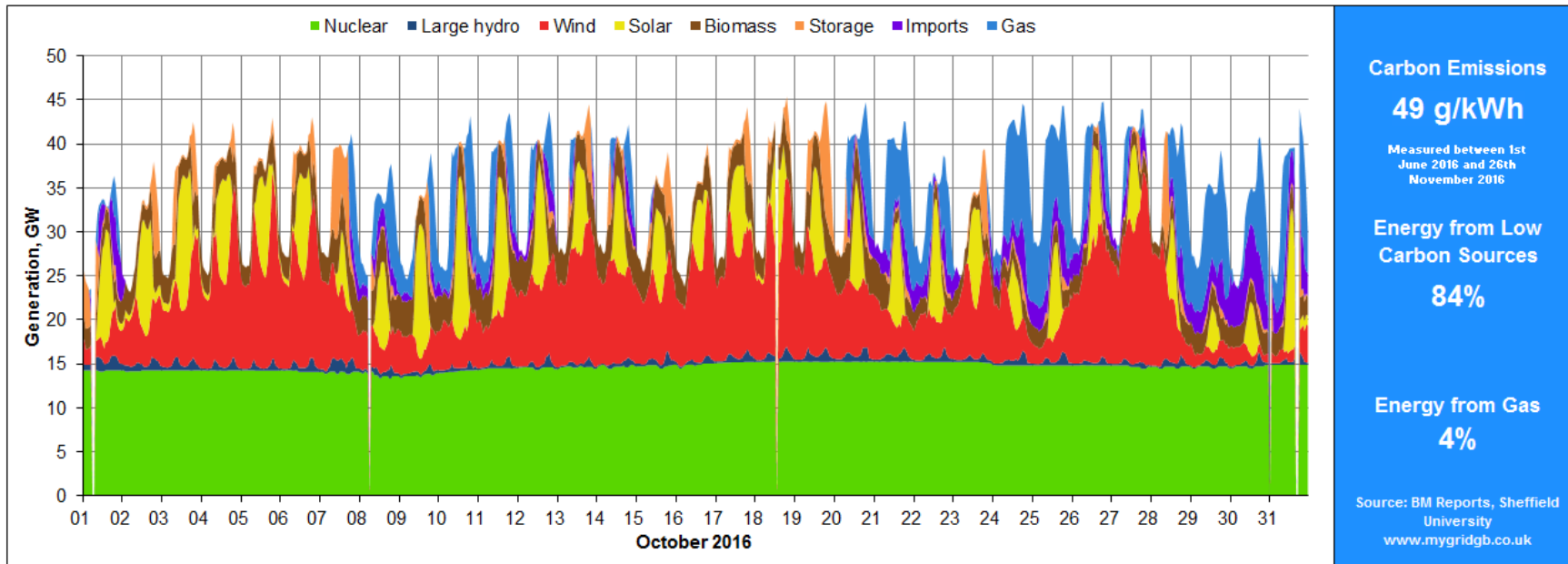
MyGridGB

A Manifesto for Clean Energy



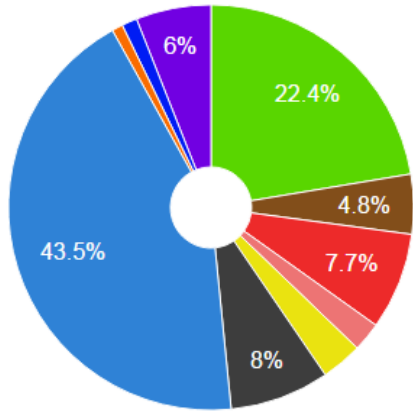






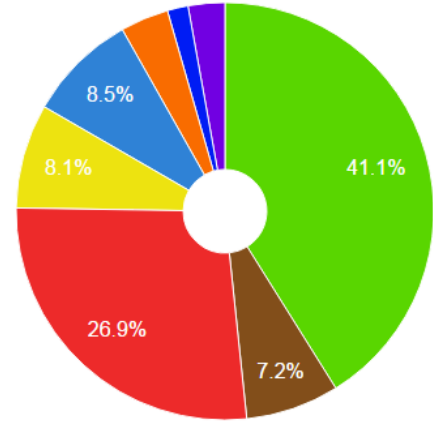


Actual Electricity Mix

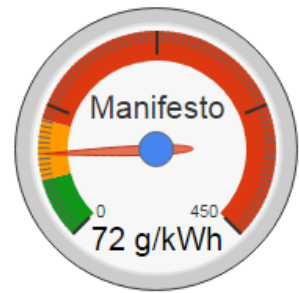
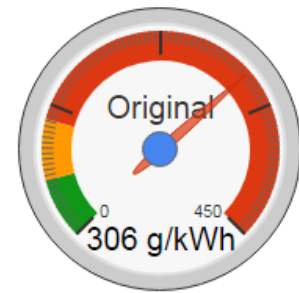


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- Imports, 17.7 TWh (6.0%)

Electricity Mix: Manifesto



- Nuclear, 41.1%
- Biomass, 7.2%
- Wind, 26.9%
- Solar, 8.1%
- Gas, 8.5%
- Storage, 3.7%
- Hydro, 1.6%
- Imports, 2.8%



www.mygridgb.co.uk/manifesto



The biggest incentive for renewable energy

The store-age

New energy



- The project is expected to cost about £16 billion - which has increased from the original £14 billion cited by the developers.
- The "strike price" - the guaranteed rate to be paid for electricity produced at the Somerset site - will be £92.50 for every megawatt hour of electricity for 35 years, almost 50 per cent above current wholesale market energy price levels.

Source:

<http://www.telegraph.co.uk/news/earth/energy/nuclearpower/10392978/Hinkley-Point-nuclear-plant-10-things-to-know.html>

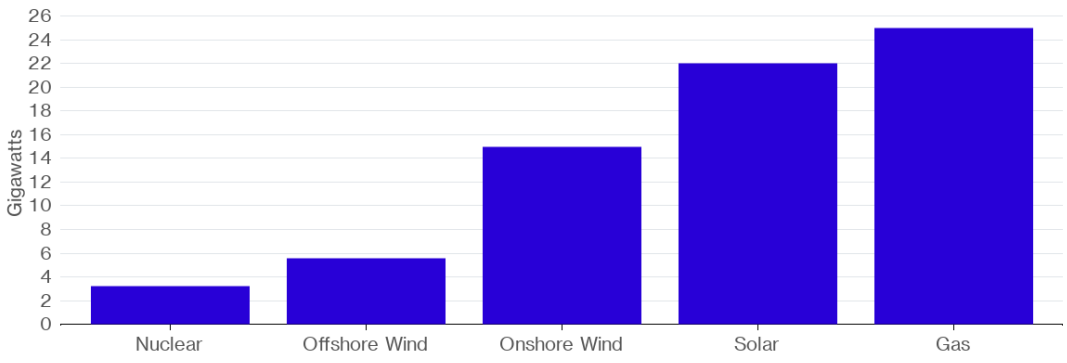
It will deliver 7% of our electricity





The biggest incentive for renewable energy

For 18 Billion Pounds, Britain Could Build...



Source: Bloomberg New Energy Finance
 Note: Figures reflect capacity, not annual electricity output which depends on how often the units work



Bloomberg Markets

Offshore Wind Could Replace Hinkley in U.K. at Same Cost



Offshore Wind Could Replace Hinkley in U.K. at Same Cost

by Jess Shankleman

August 16, 2016, 4:00 AM GMT+1 Updated on August 16, 2016, 12:49 PM GMT+1

- Britain would need 830 turbines to replace atomic plant
- U.K. could install 5.7 gigawatts offshore for Hinkley costs



The store-age

Stunning new lows in cost of large-scale solar and battery storage

By Giles Parkinson on 24 May 2017

A new contract signed by a utility in Arizona has set a new low price for large-scale solar power in that country, but more importantly has also smashed expectations of the combined cost of large-scale solar and battery storage. [Print](#)

Tucson Electric Power (TEP) this week announced it would buy solar energy from a new 100MW solar plant at the historically low price of less than US3c/kWh – less than half of what it had agreed to pay in similar contracts over the last few years.

The project will also include 30MW/120MWh of battery storage, and the company says that the power purchase agreement for the combined output is "significantly less" than US4.5c/kWh – nearly two-thirds cheaper than the previous such contract struck in Hawaii, and well below the cost of a gas-fired peaking plant.



"This new local system combines cost-effective energy production with cutting edge energy storage, helping us provide sustainable, reliable and affordable service to all of our customers for decades to come," said Carmine Tilghman, senior director of Energy Supply and Renewable Energy for TEP.

According to Utility Dive in the US, the solar and storage array – to be built by NextEra – represents a major cost reduction for combined solar and storage facilities since the signing of the last significant PPA — which was a \$US0.11/kWh Hawaii contract signed only in January this year.

UK DNO investigates the future of storage after ‘unprecedented’ applications

UK distribution network operator Western Power Distribution (WPD) has launched a consultation seeking views on the potential growth of energy storage on its distribution network after receiving an ‘unprecedented’ 8GW of applications in the last 18 months.

[Read full article here.](#)

Enel buys up lucrative UK project in “one of the most advanced markets” for battery storage

Italian energy company Enel has agreed terms to buy Element Power’s 12.5MWh battery storage project, which secured one of the most highly remunerated contracts in last year’s Enhanced Frequency Response (EFR) tender by the UK’s transmission system operator National Grid. [Read full article here.](#)

National Grid brings ‘exciting new chapter’ for energy storage with auction launch

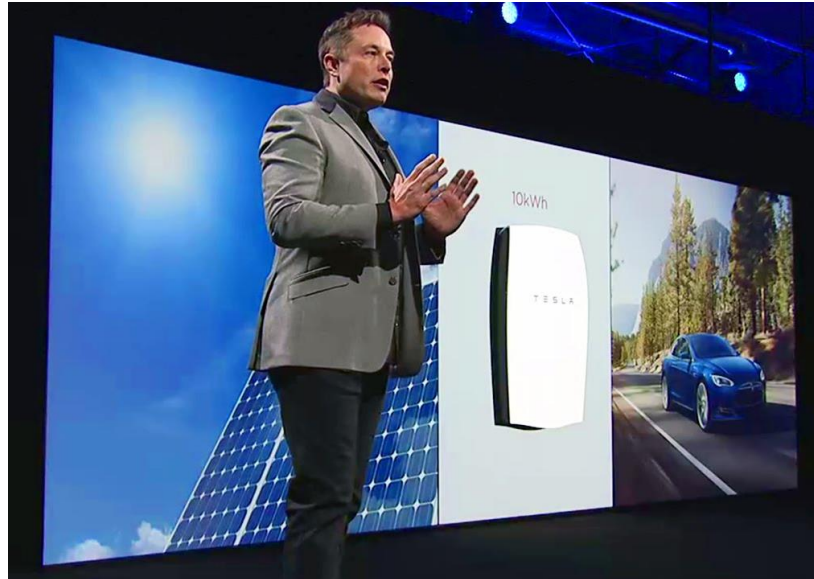
26 August 2016, source [edie newsroom](#)

National Grid has awarded seven firms including Vattenfall, Low Carbon and EDF Energy Renewables four-year contracts to provide balancing services to the network in the UK’s first 200MW Enhanced Frequency Response (EFR) auction.



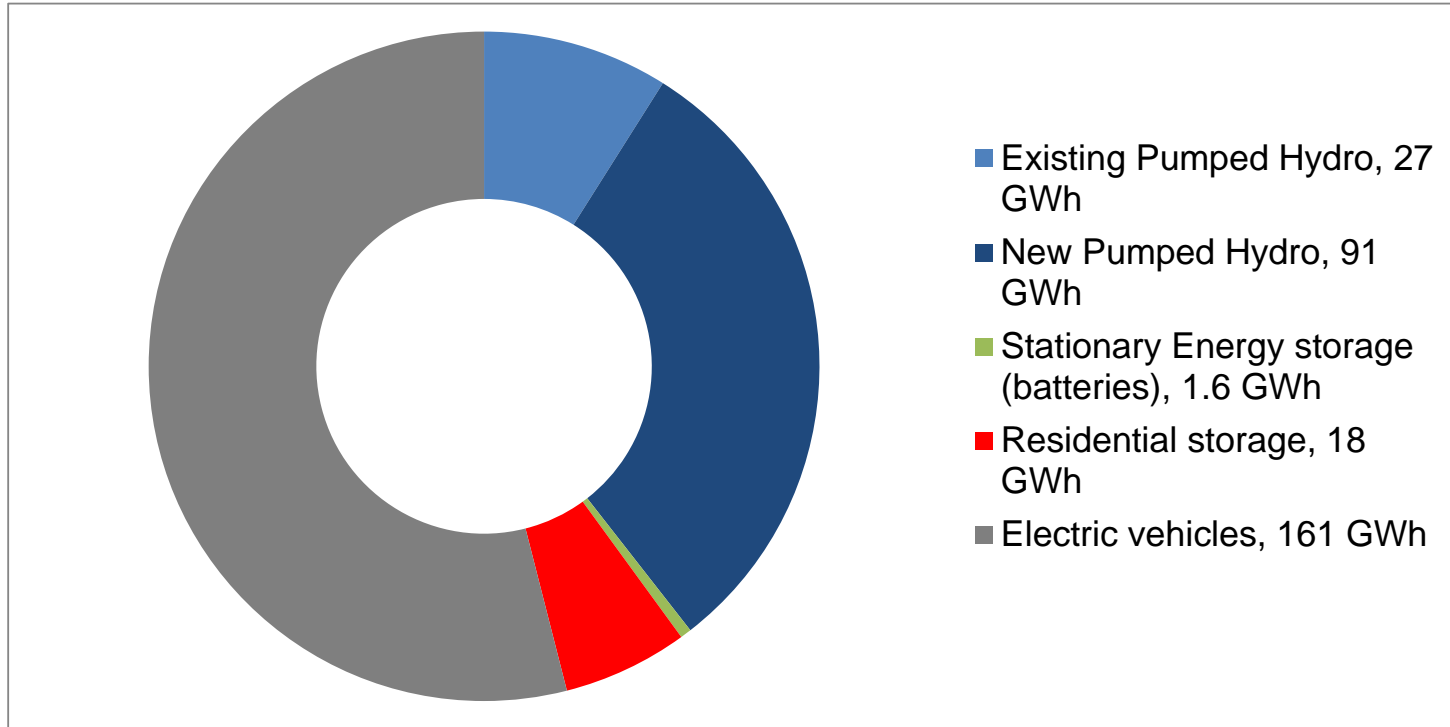


The store-age



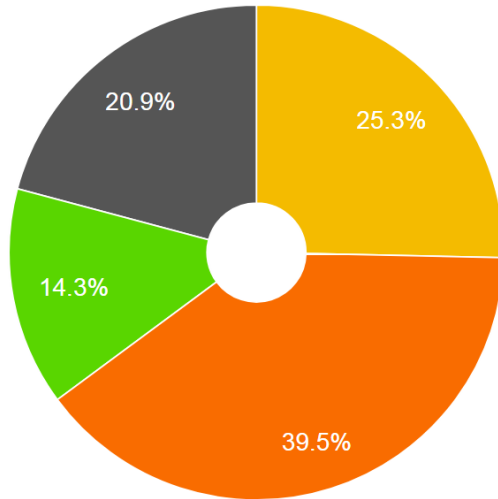


An energy storage mix





Electricity supply in a MyGridGB smart home



- Residential Solar, 25.4%
- Residential Battery, 39.5%
- Low carbon electricity from grid, 14.3%
- High carbon electricity from grid, 20.9%





Renewable Energy Is Unstoppable, Declares Financial Times

May 19th, 2017 by [Steve Hanley](#)



With more than 2.2 million readers a day, the *Financial Times* is the [newspaper of record](#) for economists, business leaders, and government policy makers worldwide. *Think Progress* claims *FT*, as it is known to its readers, is the “most important business read” and “the most credible publication in reporting financial and economic issues” for global professional investors, business leaders, and policy makers according to surveys.

On May 18, its [lead story](#) was entitled: *The Big Green Bang: How Renewable Energy Became Unstoppable*. It begins with a question, one that should leave fossil fuel industry leaders feeling glum — “Is the 21st century the last one for fossil fuels?” Before we start rejoicing, keep in mind there are still 83 years left to go in this century and the fossil fuel industry intends to extract and sell every molecule of fossil fuels it can find before the end times for oil, natural gas, and coal arrive. By the time 2101 gets here, the earth may have been unalterably changed to the point where human existence as we know it is no longer possible.

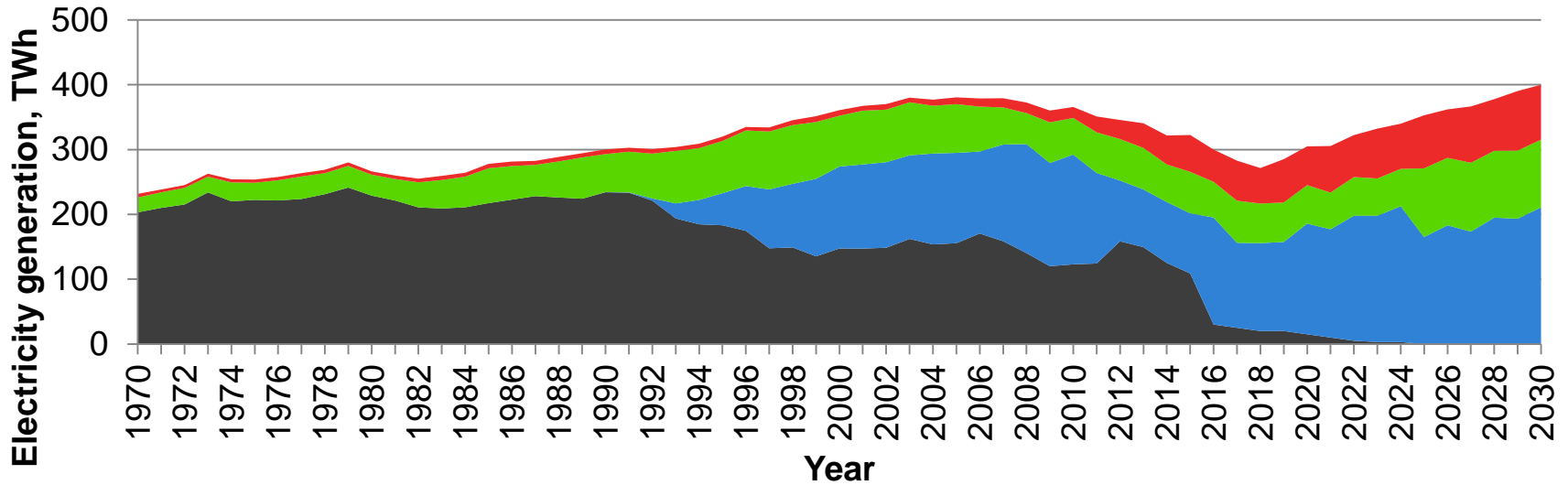


Headwinds



GB electricity supply: 1970 - 2015. Source: DUKES, MyGridGB

■ Coal, old gas ■ Gas ■ Nuclear ■ Renewables



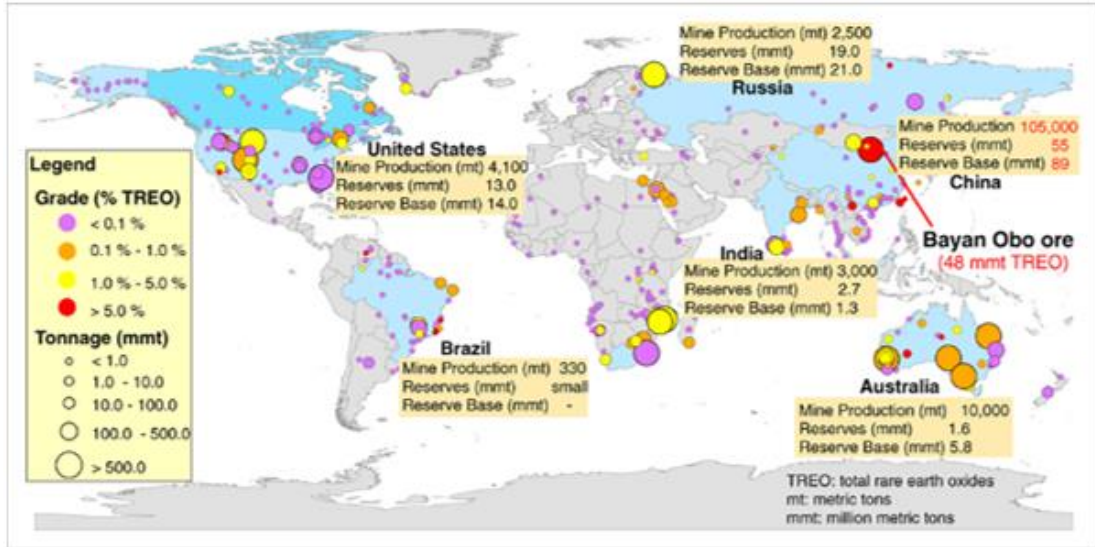
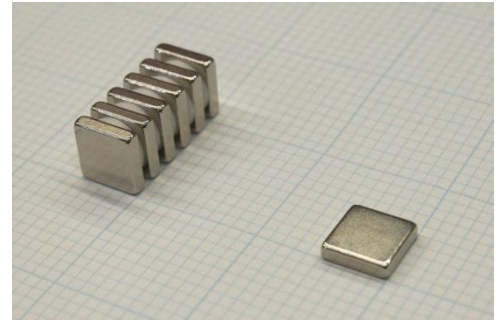


Figure 1 Distribution of areas with a significant reserve and production of Rare-Earth Elements (REE's). (Huang, et al., 2016) (Data Compiled from: (Humphries, 2013) (Orris & Graunch, 2002) (Weng, et al., 2015))





- Neodymium is used in wind turbines due to its high magnetic field strength.
- There is irony in the fact that there are heavy environmental and human damaging consequences caused by the mining of neodymium and other rare earths, such as
 - decreasing biodiversity,
 - high carcinogen concentration in water and soil,
 - as well as many other more toxic compounds and elements



Electrification
of heat

Electric
vehicles

Flexibility

Stability

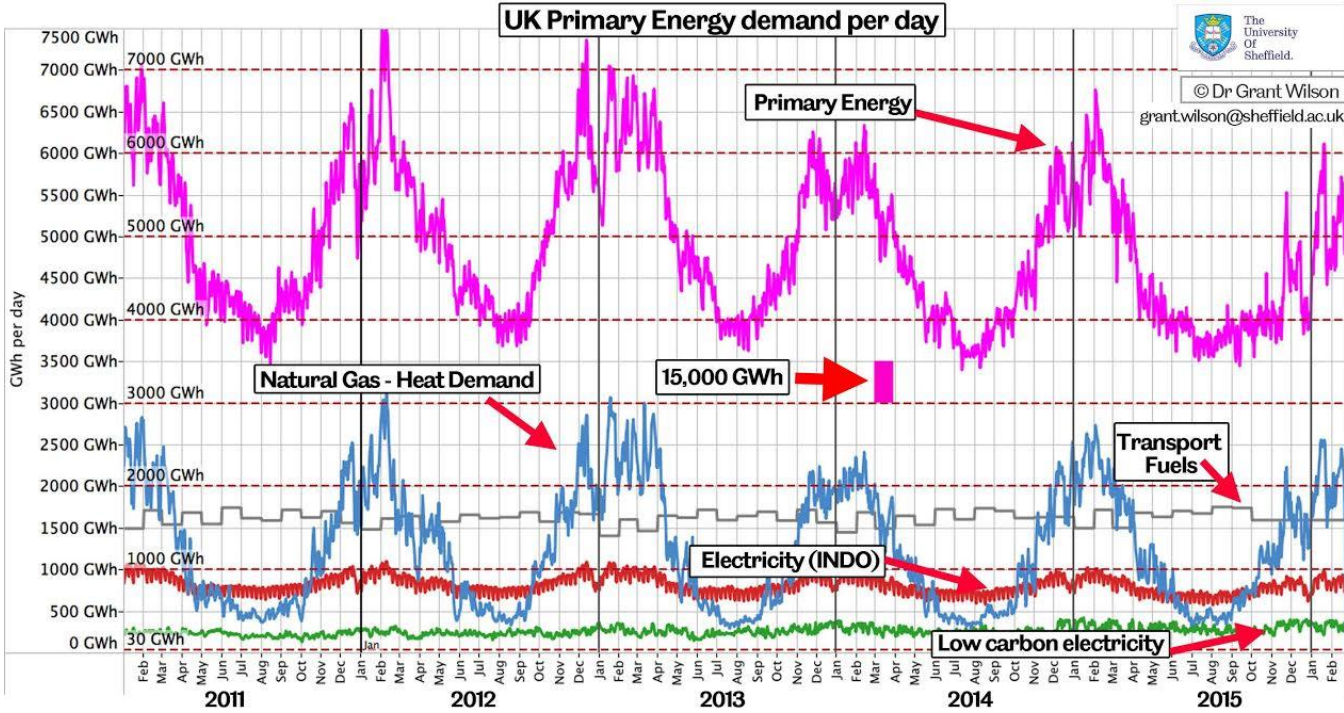
Resource

Engineers

Political
uncertainty

National
infrastructure
investment

System
security





MyGridGB

Thank you for listening

Dr Andrew Crossland

a.f.crossland@gmail.com