



# GB Electricity Market Summary

## FULL YEAR 2016

Recorded Levels of GB Generation by Fuel (based upon Ofgem & NG Embedded Forecasts & FUELHH data):

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**GAS:** 14.5GW (+51%)  
**COAL:** 3.2GW (-63%)

**RENEWABLES:** 7.8GW (+5%)  
**INTERCONNECTIONS:** 2.0GW (-14%)

**NUCLEAR:** 7.6GW (+1%)

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## EXECUTIVE SUMMARY

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2016 saw a continued decline in levels of coal generation and the continued rise of renewables; with combined wind, solar, hydro and biomass providing the second largest source of electricity generation by fuel in 2016, after gas power stations and ahead of nuclear, coal or interconnections.

The GB coal fleet has seen a remarkable reversal in fortunes since 2012, with levels of generation dropping 80% over this period from 136.8TWh in 2012 to 27.9TWh in 2016; with this decline driven by lower gas prices and higher carbon taxes.

These higher carbon taxes hit coal stations harder than gas stations due to their higher carbon emissions and are a UK-only initiative that corrects the underpricing of the EU ETS carbon prices. This initiative has proven very effective in reducing carbon emissions in the UK market and has been the driving force behind the decline of coal in the GB power market.

As levels of coal generation have fallen, levels of gas-fired generation have increased by 53% from 2012 (from 82.9TWh) and by 51% from 2015 (84.4TWh) with levels of gas-fired generation totaling 127.0TWh in 2016.

Despite this rise in levels of gas-fired generation, overall fossil output remains well below 2012 levels, having seen a 29% decline. However, 2016 only saw a 2% decrease in the level of fossil fuel output to 154.9TWh (from 158.8TWh in 2015).

This represented a slowdown in the rate of decline of fossil fuels, and this came despite large growth in levels of solar capacity. Renewable schemes have been coming to an end or have seen reduced budgets and this, combined with lower than usual wind speeds, meant that overall growth in renewables output has slowed. The lower level of renewable growth facilitated the smaller reduction in fossil fuel generation.

The year saw tight margins as 2016 came to a close, with a large volume of capacity in the market existing in a service called Supplemental Balancing Reserve (SBR) that makes capacity available if required to keep the lights on, but not in the main commercial market. This meant that within the commercial sector of the market there was inadequate supply resulting in day ahead prices peaking as high as £999/MWh and some significantly high within day price activity, despite a low risk of the lights going out.

In late 2017 the Capacity Mechanism comes into operation which will ensure a minimum capacity whilst encouraging that full capacity is available to operate commercially and this should reduce the frequency of this high priced activity.

The shift from coal to gas has resulted in greatly reduced levels of estimated carbon emissions, which, coupled with the impact of the growth of renewables in recent years, has resulted in significant carbon savings beyond those in other European countries. Growth in renewable generation slowed in 2016 and it is unclear how large the future role of renewables will be and how this will impact remaining fossil plants.

In 2016, 41.2% (27.2% in 2015) of generation came from gas-fired plants, 22.3% (22.3%) from renewables, 21.6% (21.1%) from nuclear, 9.1% (24.0%) from coal stations and 5.8% (6.7%) from interconnection supplies.

## FUEL ACTIVITY

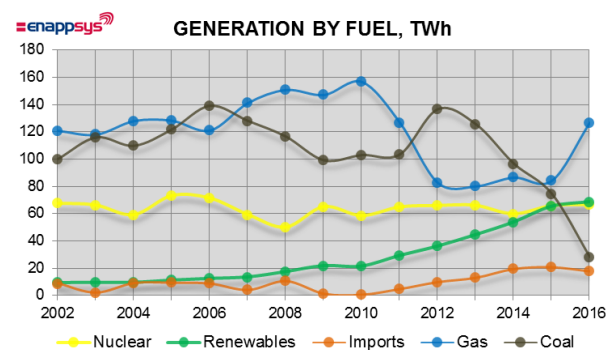
2016 saw major changes continue to occur within the GB power market as levels of coal generation continued their decline down to a total of 27.9TWh (from 74.5TWh in 2015 and 136.8TWh in 2012). This represents an 80% reduction in coal output over the four year period since 2012, and a 63% year-to-year drop between 2015 and 2016.

The greatest beneficiary has been gas-fired generators which saw levels of generation climb more than 50% from the previous year to 127.0TWh (up from 84.4TWh) as the generating costs at these plants fell relative to those at coal stations; aided by the falling oil prices (with oil and gas prices typically being linked).

Gas-fired power stations saw low levels of generation over the four year period from 2012-2015, and the increase in 2016 returned total gas output to levels close to those recorded at the peak back in 2010.

This activity occurred as the cost of generating at coal-fired power stations was higher than that at gas-fired power stations (a reversal of previous trends), which was driven by the combination of low gas prices and high carbon taxes.

Without any carbon taxes, coal would have remained the cheaper fuel type, but the combination of carbon taxes and the increased investment required to minimise emissions have been forcing lower efficiency coal stations out the market. The coal stations that remain are generally higher efficiency

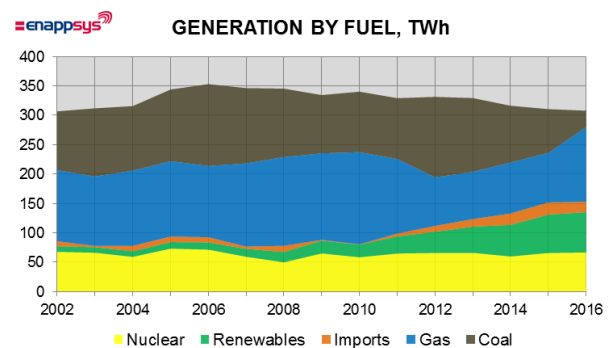


facilities or plants that have already seen higher levels of investment.

As a result, coal stations have been pushed to the margins of the market and have primarily been providing additional capacity to the system as required within day, whilst higher efficiency gas stations have been seeing increased levels of run hours and reduced numbers of starts.

This growth in levels of generation at gas power stations, at the expense of coal stations, has resulted in a large reduction in levels of carbon emissions. There was a large growth in levels of solar and biomass capacity, but otherwise levels of renewable output remained steady.

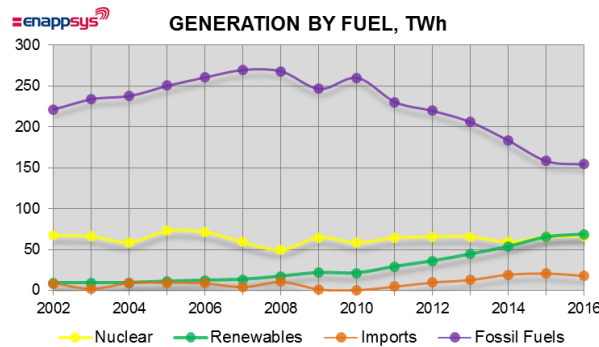
There were very high levels of wind generation as the year ended - with new records for levels of half-hourly, daily and weekly wind generation in late December – but wind speeds across the year have generally remained below average; with this resulting in decreased levels of wind generation against the levels noted in 2015.



With some renewables schemes now coming to an end and with reduced support for renewables available under remaining schemes, levels of renewable growth are starting to plateau following a strong five year climb.

Some new offshore wind farms are set to come online and provide a boost to levels of renewable capacity, but installation rates are expected to slow in future years.

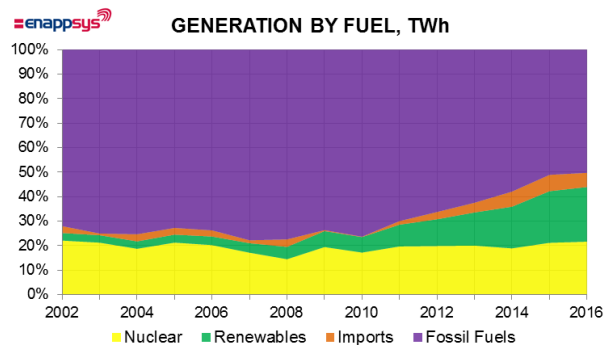
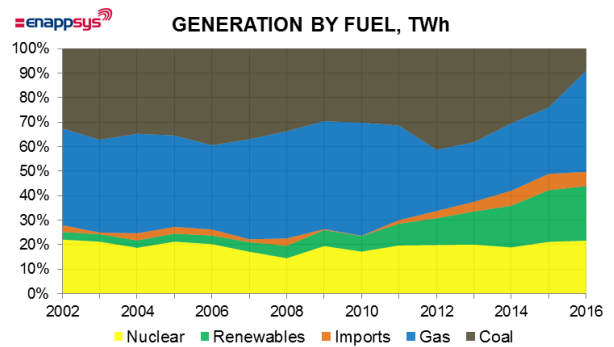
This has meant that renewable output totaled 68.6TWh in 2016, only 5% up from the 65.4TWh achieved in 2015 (having seen output levels rise 220% from 2010).



only 2% from 2015 having fallen by a total of 40% since 2010.

Nuclear plants saw output total 66.6TWh in 2016 (up 1% from 2015) as levels of availability across the nuclear fleet remained steady. Interconnectors saw imports decline 14% from 20.8TWh in 2015 to 17.8TWh in 2016 as France imported greater volumes of power due to nuclear outages.

In 2016, 41.2% of generation came from gas-fired plants, 22.3% from renewables, 21.6% from nuclear, 9.1% from coal stations and 5.8% from interconnections.



## Statistics

The following tables contain some of the key statistics relating to the 2016 and some previous years:

*GB Only (Excludes Northern Ireland)	2008	2009	2010	2011	2012	2013	2014	2015	2016
<b>TOTAL GENERATION BY FUEL (TWh)</b>									
Coal	116.59	99.10	102.95	103.48	136.84	125.74	96.65	74.46	27.92
Gas	151.00	147.32	156.89	127.01	82.86	80.23	86.72	84.35	126.98
Imports	10.62	1.32	0.58	4.77	9.88	13.02	19.48	20.75	17.81
Nuclear	49.93	64.97	58.44	64.75	65.81	65.93	59.74	65.68	66.58
Renewables	17.38	21.75	21.45	29.24	36.09	44.51	53.75	65.35	68.64
<b>TOTAL</b>	<b>345.52</b>	<b>334.46</b>	<b>340.30</b>	<b>329.24</b>	<b>331.48</b>	<b>329.43</b>	<b>316.34</b>	<b>310.58</b>	<b>307.93</b>
<b>SHARE OF GENERATION (%)</b>									
Coal	33.7%	29.6%	30.3%	31.4%	41.3%	38.2%	30.6%	24.0%	9.1%
Gas	43.7%	44.0%	46.1%	38.6%	25.0%	24.4%	27.4%	27.2%	41.2%
Imports	3.1%	0.4%	0.2%	1.4%	3.0%	4.0%	6.2%	6.7%	5.8%
Nuclear	14.5%	19.4%	17.2%	19.7%	19.9%	20.0%	18.9%	21.1%	21.6%
Renewables	5.0%	6.5%	6.3%	8.9%	10.9%	13.5%	17.0%	21.0%	22.3%
<b>INCREASE TO 2016 (%)</b>									
Coal	-76.1%	-71.8%	-72.9%	-73.0%	-79.6%	-77.8%	-71.1%	-62.5%	0.0%
Gas	-15.9%	-13.8%	-19.1%	0.0%	53.2%	58.3%	46.4%	50.5%	0.0%
Imports	67.8%	1246.7%	2965.2%	273.7%	80.3%	36.8%	-8.6%	-14.2%	0.0%
Nuclear	33.3%	2.5%	13.9%	2.8%	1.2%	1.0%	11.5%	1.4%	0.0%
Renewables	294.9%	215.7%	220.0%	134.7%	90.2%	54.2%	27.7%	5.0%	0.0%
<b>Fossil Fuels</b>									
Fossil Fuel Share	77.4%	73.7%	76.4%	70.0%	66.3%	62.5%	58.0%	51.1%	50.3%
Renewable Share	5.0%	6.5%	6.3%	8.9%	10.9%	13.5%	17.0%	21.0%	22.3%

## RENEWABLES

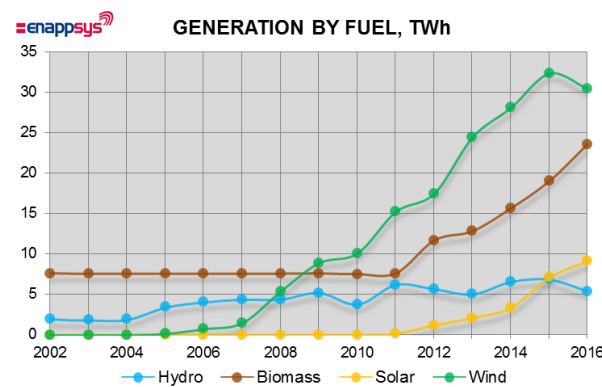
Growth in levels of renewable generation has been fairly consistent over the past four years, but this slowed heading into 2016 as levels of wind and hydro generation were lower than those in 2015 and as cuts to renewables subsidies let to a suppressed renewables build out.

These factors saw renewable generation total 68.6TWh in 2016 (up 5% from the 65.4TWh recorded in 2015). The largest provider of renewable generation continued to be wind farms, although total levels of generation from biomass were closer to total wind generation in 2016 than in previous years.

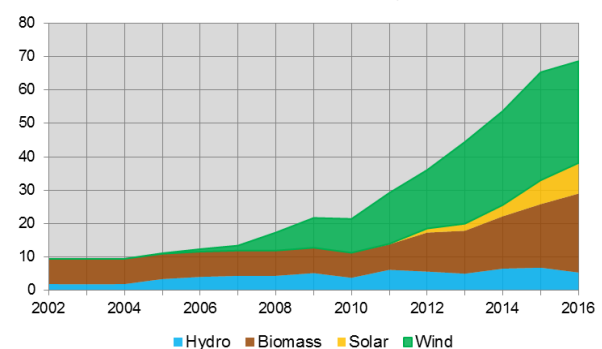
The decline in levels of wind generation came as 2016 was on average a less windy year than 2015, despite some very high levels of generation late in the year that resulted in new half-hourly, daily and weekly records for wind output.

At the same time, levels of wind capacity have grown at a reduced rate since renewable subsidy schemes have come to an end and as the focus shifts towards offshore wind farms.

Wind farms provided 30.5TWh (down 6% from 32.4TWh in 2015), providing 44.4% of overall renewables generation (down from the 49.5% in 2015).



enappsys GENERATION BY FUEL, TWh



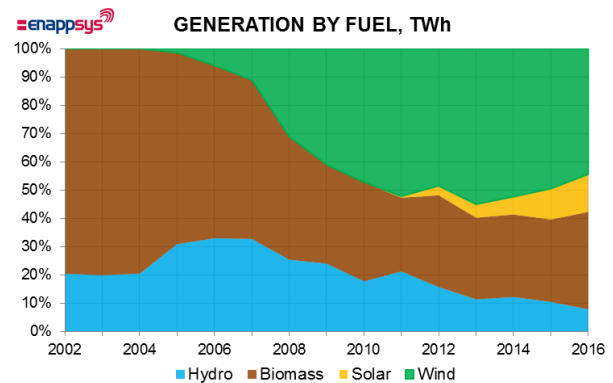
New offshore wind farms are set to come online to increase future levels of wind generation, but these projects take longer to build and so increases in wind output will be delayed until their completion. Onshore levels of wind capacity are less likely to see major increases under the current subsidy regime.

Biomass plants saw levels of generation climb 24% to 23.6TWh (from 19.0TWh in 2015) with biomass plants providing 34.4% of total renewable generation (up from 29.1% in 2015). This came as Drax units continued to convert to biomass with half Drax power station now burning biomass.



Supported by growth in levels of installed capacity, solar farms saw generation levels increase by 28% to 9.2TWh (from 7.1TWh); although levels of peak solar generation were much higher than average output levels.

While wind farms can produce power 24/7 during windy periods, solar farms provide most of their power during the peak sunlight periods of the day and so the peak solar output during the daytime delivered considerably more generation than that suggested by the average figures (peaking at 6.85GW in 2016 versus a peak of 10.6GW for wind in GB).



Despite hydro being the oldest form of renewable generation, with the first hydro plant being installed in 1881, only 7.9% of renewable generation was provided by hydro plants during the last 12 months.

In total, hydro plants provided 5.4TWh (down 21% from 6.8TWh in 2015) as weather conditions resulted in lower than usual levels of generation.

In 2016, wind farms provided 44.4% of renewable generation, biomass 34.4%, solar farms 13.3% and hydro plants 7.9%.

### Statistics

The following tables contain some of the key statistics relating to the year and some previous years:

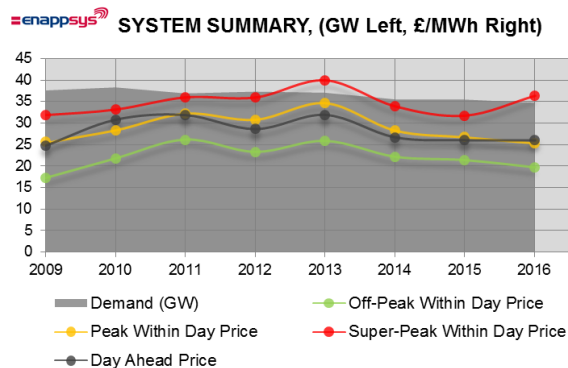
*GB Only (Excludes Northern Ireland)	2008	2009	2010	2011	2012	2013	2014	2015	2016
<b>TOTAL GENERATION BY FUEL (TWh)</b>									
Biomass	7.57	7.61	7.51	7.62	11.69	12.84	15.67	19.03	23.61
Hydro	4.41	5.22	3.80	6.21	5.68	5.06	6.56	6.84	5.40
Solar	0.00	0.00	0.01	0.16	1.21	2.12	3.39	7.13	9.15
Wind	5.40	8.92	10.12	15.26	17.51	24.49	28.13	32.35	30.48
<b>TOTAL RENEWABLES</b>	<b>17.38</b>	<b>21.75</b>	<b>21.45</b>	<b>29.24</b>	<b>36.09</b>	<b>44.51</b>	<b>53.75</b>	<b>65.35</b>	<b>68.64</b>
<b>SHARE OF RENEWABLE GENERATION (%)</b>									
Biomass	43.5%	35.0%	35.0%	26.1%	32.4%	28.9%	29.2%	29.1%	34.4%
Hydro	25.4%	24.0%	17.7%	21.2%	15.7%	11.4%	12.2%	10.5%	7.9%
Solar	0.0%	0.0%	0.0%	0.5%	3.4%	4.8%	6.3%	10.9%	13.3%
Wind	31.1%	41.0%	47.2%	52.2%	48.5%	55.0%	52.3%	49.5%	44.4%
<b>LARGEST RENEWABLE SOURCE</b>	<b>BIOMASS</b>	<b>WIND</b>	<b>WIND</b>	<b>WIND</b>	<b>WIND</b>	<b>WIND</b>	<b>WIND</b>	<b>WIND</b>	<b>WIND</b>
<b>INCREASE TO 2016 (%)</b>									
Biomass	212.0%	210.4%	214.3%	209.8%	101.9%	83.8%	50.7%	24.1%	0.0%
Hydro	22.5%	3.5%	42.1%	-12.9%	-4.8%	6.8%	-17.6%	-21.0%	0.0%
Solar			86983.3%	5755.5%	654.6%	332.0%	170.4%	28.4%	0.0%
Wind	464.0%	241.7%	201.1%	99.7%	74.1%	24.4%	8.3%	-5.8%	0.0%
<b>Total</b>	<b>294.9%</b>	<b>215.7%</b>	<b>220.0%</b>	<b>134.7%</b>	<b>90.2%</b>	<b>54.2%</b>	<b>27.7%</b>	<b>5.0%</b>	<b>0.0%</b>

## DEMAND, MARGIN AND PRICES

Levels of demand in 2016 totaled 305.2TWh (down 2% from 310.8TWh), as demand continued a downward decline from the peak levels that occurred back in 2010. This decline has been driven by reduced residential and industrial electricity usage.

As demand has fallen, prices have generally been on the decline, but with flat day-ahead prices and a 15% climb in within-day prices during the most extreme peak periods of the day. These price increases have resulted from increased levels of scarcity within the system that resulted in day ahead prices as high as £999/MWh on the tightest days.

These tight margins mainly stem from the large volumes of margin that exist in SBR that whilst



providing margin in the market are unable to be used commercially, creating a significant slice of minimum margin that cannot be used to temper high prices.

From next winter, the Capacity Mechanism will be in operation and this should result in more modest prices around peak periods.

Otherwise the decline in prices overall has come despite increased carbon

costs and has resulted from the very low gas and coal commodity prices.

### Statistics

The following table contains some of the key statistics relating to the year and some previous years:

*GB Only (Excludes Northern Ireland)	2009	2010	2011	2012	2013	2014	2015	2016
<b>WHOLESALE PRICES (£/MWh)</b>								
Day Ahead Price	38.54	47.92	49.61	44.54	49.69	41.55	40.51	40.47
Within Day Price (MIDP)	36.82	41.75	47.83	45.21	50.58	42.10	39.94	39.01
<b>WITHIN DAY PRICE BREAKDOWN (£/MWh)</b>								
Off-Peak Hours	26.84	33.88	40.69	36.23	40.21	34.46	33.24	30.62
Peak Hours (excl Superpeak)	39.90	44.12	50.17	47.95	53.96	44.03	41.58	39.43
Superpeak Hours	49.46	51.60	56.00	55.96	62.18	52.74	49.40	56.58
<b>DEMAND (MW)</b>	37,598	38,321	36,907	37,327	37,078	35,536	35,479	34,746
<b>DEMAND (TWh)</b>	329.4	335.7	323.3	327.9	324.8	311.3	310.8	305.2
<b>WHOLESALE PRICE INCREASE TO 2016</b>								
Day Ahead Price	5%	-16%	-18%	-9%	-19%	-3%	0%	0%
Within Day Price (MIDP)	6%	-7%	-18%	-14%	-23%	-7%	-2%	0%
<b>WITHIN DAY PRICE INCREASE TO 2016</b>								
Off-Peak Hours	14%	-10%	-25%	-15%	-24%	-11%	-8%	0%
Peak Hours (excl Superpeak)	-1%	-11%	-21%	-18%	-27%	-10%	-5%	0%
Superpeak Hours	14%	10%	1%	1%	-9%	7%	15%	0%
<b>DEMAND INCREASE TO 2016</b>								
	-8%	-9%	-6%	-7%	-6%	-2%	-2%	0%



## **NOTES ON THE REPORT**

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The figures used in the report refer to GB only, against DECC figures that refer to GB and Northern Ireland. This selection has been made since Northern Ireland is separated from GB and is more closely linked to the electricity grid of the Republic of Ireland.

Generation levels by fuel from 2009 are based upon National Grid FUELHH data, which gives the operationally metered totals by fuel, down to a 5 minute resolution.

Prior to 2009, individual plant data has been aggregated from our databased matching of National Grid fuel-type relationships.

To account for embedded wind and solar, the National Grid forecasts for these generators have been used as if they were output figures. Embedded hydro and biomass have been accounted for using analysis of Ofgem data on certificate awards.

Within this report, levels of offshore wind have not been split apart from the wind total. This is because this can only be reliably done using metered volumes at a generating unit level. This is not a publically available data stream and figures cannot be distributed. FPNs at wind farms do not correlate well with metered volumes and so cannot be used reliably.

Price and demand data primarily comes from Elexon (as does the FUELHH data), with the exception of the APX day-ahead prices.

## **ABOUT ENAPPSYS**

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EnAppSys provides services to companies in the energy and power markets, specifically by providing data, information and consultancy services.

The company has a GB power market database stretching back to 2002 and an online platform that provides readily available information ranging from forwards market prices to historic generator operations.

Enappsys is focused on providing information and analytical services covering the energy sector and is actively growing the business to provide products with enhanced analysis and forecasting capabilities and extending the geographic and sector coverage beyond the UK and the electricity market.

The company's business objective is to make available timely, optimal and insightful information, analysis and systems to the energy sector to ensure all sizes of company have the best available tools and information to make informed decisions and to optimise their business strategy.

To find out more about EnAppSys contact the company at [about@enappsys.com](mailto:about@enappsys.com) or visit the company's website at [www.enappsys.com](http://www.enappsys.com).