# Energy Transition in the Power Sector in Europe: State of Affairs in 2016

Review on the Developments in 2016 and Outlook on 2017

**ANALYSIS**


*RES-Share of Gross Electricity Generation

# Energy Transition in the Power Sector in Europe: State of Affairs in 2016

## IMPRINT

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Review on the Developments in 2016 and Outlook on 2017

### AN ANALYSIS BY

Sandbag
40 Bermondsey Street | London, SE1 3UD

Agora Energiewende
Anna-Louisa-Karsch-Straße 2 | 10178 Berlin

Dave Jones

Mara Marthe Kleiner

Matthias Buck

Dr. Patrick Graichen

Contact:
dave@sandbag.org.uk
maramarthe.kleiner@agora-energiewende.de

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# Preface

Dear reader,

the energy transition – the transformation of the power sector from a fossil-based to a decarbonised world with renewables at the centre – is a joint European project. The power sector will play a crucial role in attaining the European climate targets, which aim to cut greenhouse gases by at least 40 percent by 2030 compared to 1990.

For this analysis, Sandbag and Agora Energiewende joined forces and present the state of affairs in the European power sector in 2016: Where are we coming from? Where do we stand today? Key topics include power generation, power consumption, $CO_2$ emissions and prices. Overall, it is clear that the current power system is not yet fully equipped to deal with the main challenges ahead: securing power supply at a reasonable price with as little emissions as possible. However, Europe is on the right path: almost 30 percent of the electricity produced already comes from renewable energy sources.

We hope you enjoy the reading!
Kind regards

**Patrick Graichen**
Director Agora Energiewende
**Dave Jones**
Carbon & Power Analyst Sandbag

## Key findings

1. **Gas replaced coal, and hence European power sector emissions fell drastically by 4.5%.** European coal generation fell by 94 TWh and gas generation increased by 101 TWh, resulting in 48 Mt less $CO_2$ emitted. Half of this happened in the UK, but also Italy, Netherlands, Germany and Greece saw switching from coal to gas. However, gas generation was far from reaching a record – it is still 168 TWh below the 2010 level, showing that more coal-gas switching is possible without new infrastructure.

2. **Renewables increased only slightly from 29.2% to 29.6% of the electricity mix, mainly due to bad solar and wind conditions. Radical price falls give hope for future growth.** Solar and wind conditions were generally below average in 2016, compared to well above average in 2015. However, with new capacity installed, overall generation still saw small increases. As to prices, 2016 saw record low renewables auction results with only 49,9 Euros/MWh for wind offshore and 53,8 Euros/MWh for solar, both in Denmark.

3. **Electricity consumption rises slightly by 0.5%, with European GDP rising by 1.7%.** Only two countries saw falls in electricity consumption in 2016, most had modest increases. Investment going into energy efficiency is apparently sufficient to prevent electricity consumption from rising but not enough for electricity consumption to begin structurally falling.

4. **The structural oversupply of the EU-ETS has passed the landmark of 3 billion tonnes of $CO_2$, as 2016 added another 255 million tonnes $CO_2$.** The reason is that ETS emissions are structurally below the cap – mocking the concept of a "cap-and-trade" system. To play a meaningful role in EU climate policy, the EU ETS needs to be fundamentally repaired.

5. **The outlook for 2017 is for further big falls in fossil generation – but whether this is coal or gas is uncertain.** 2016 gave a glimpse of the rapid falls in emissions that are possible with decreased coal production. But a coherent European policy approach to continually increasing renewables and to a just transition in the context of a coal phase-out is needed to ensure that the $CO_2$ reductions of 2016 are continued into the future.

# Inhalt

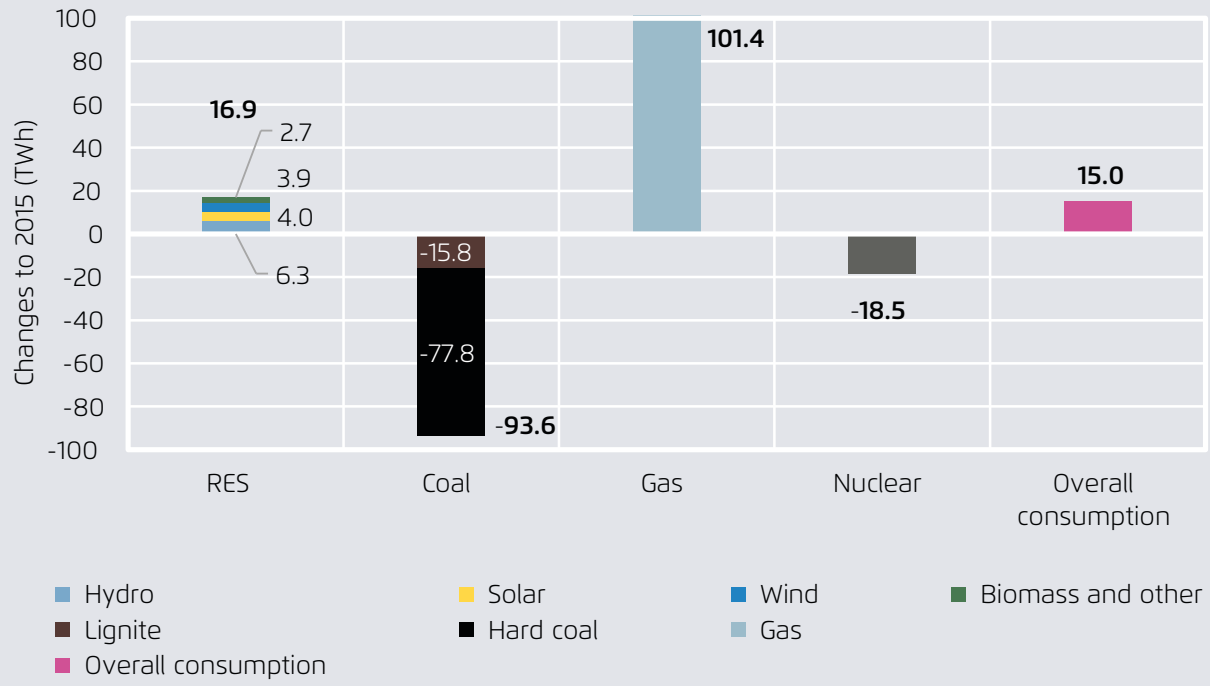
# 1 Summary of changes in 2016 versus 2015

In the following, we show what we think are the three most important graphics from the report. Figure 1 shows the changes by fuel type in Europe. Key aspects are very small changes in renewable generation in 2016, a huge fall in coal generation offset by a huge rise in gas generation, and a fall in nuclear generation.

Figure 2 shows the overall European electricity mix. Largest contribution of power came from renewables, followed by nuclear, gas, hard coal and lignite. Most striking changes can be seen among gas and coal – gas increased its share from 15.5 percent to 18.6 percent while coal's share dropped from 24.6 percent to 21.6 percent.

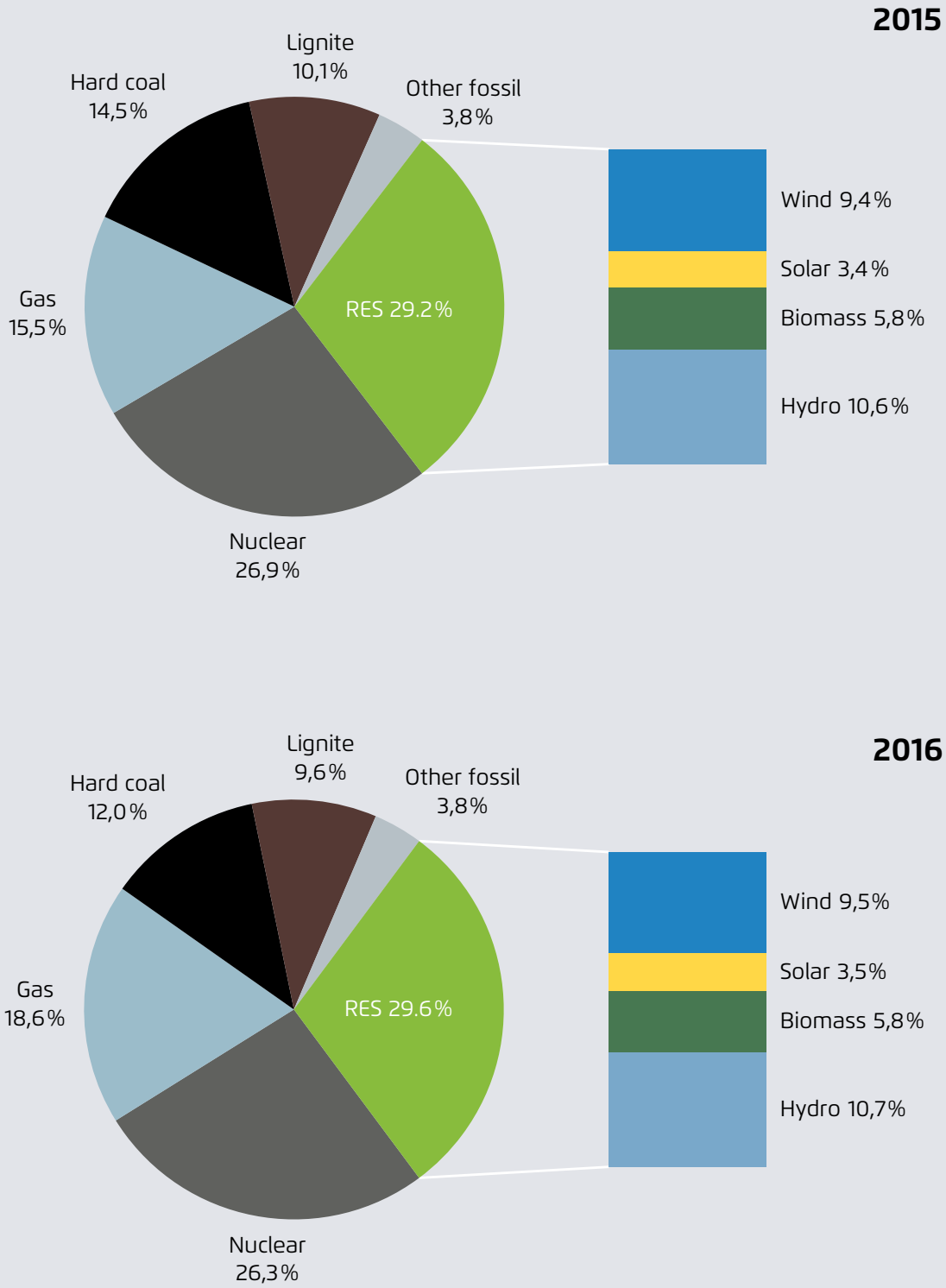
Figure 3 shows the power production by source since 2010. Most remarkably: despite the rapid rise in gas generation for the second year in a row, gas generation is still 168 Terawatt hours below levels in 2010. Factors driving the observed changes are explained in subsequent section of this report.

Changes in gross electricity generation and consumption 2015 to 2016 Figure 1



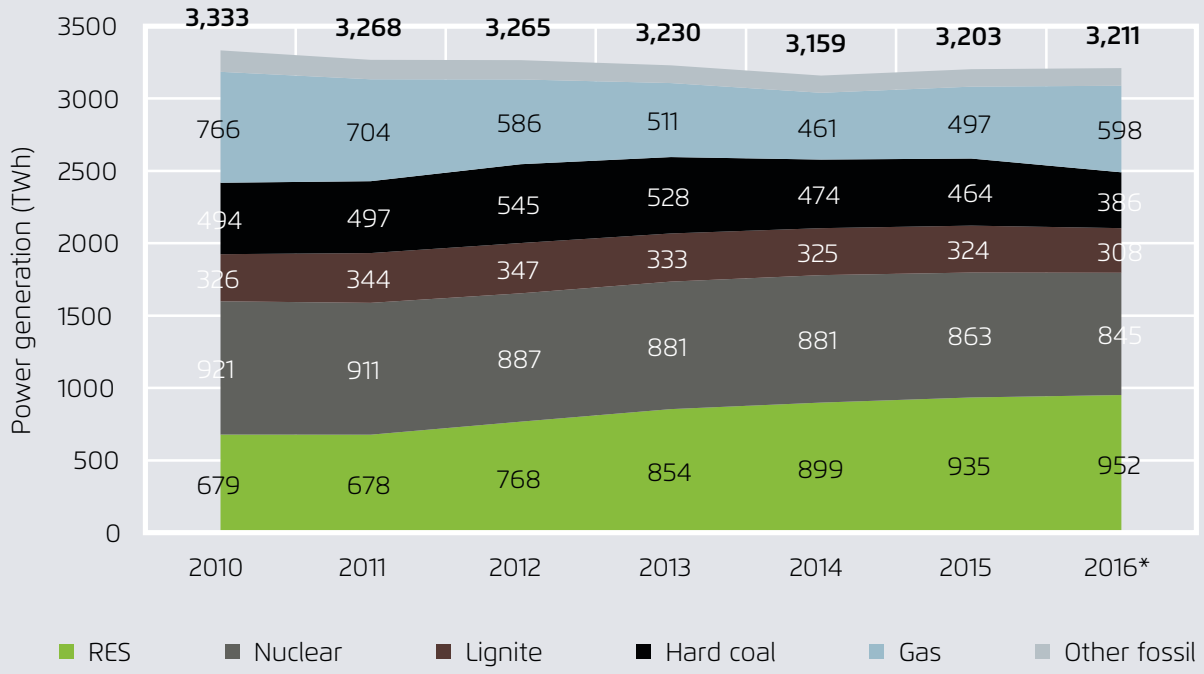

Own calculations

Generation mix in 2015 and 2016 Figure 2




Own calculations

Power generation since 2010–2016 Figure 3




Own calculations; *preliminary

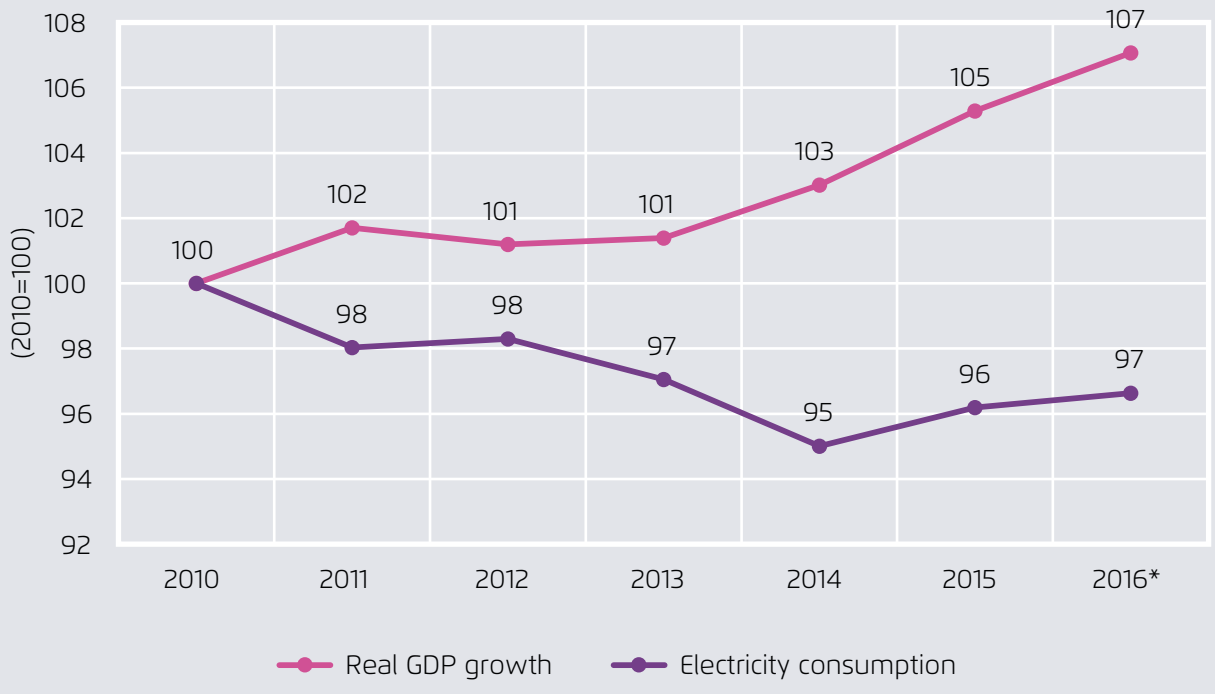
# 2 Efficiency gains only cover economic growth

Electricity consumption increased by 0.5 percent in 2016, falling in only two countries – in Germany and Italy. It is the second year in a row that electricity consumption has increased, now being back at 2013 levels. But that does not mean the trend is up – 2014 was, after all, the mildest year on record. Over the last six years, European real GDP has grown by 7 percent, and European electricity consumption has fallen by 3 percent – see figure 4.

Even across countries, electricity consumption seems quite unchanged throughout this decade. Although electricity consumption seems to be growing in eastern European countries and falling in western and southern European countries, the changes have been small – see figure 5. Poland and Bulgaria saw the fastest increases but only averaged 1 percent per year; Italy, Sweden and UK saw the biggest falls but only averaging 1 percent per year.

So, while it seems there is sufficient energy efficiency happening to keep overall European electricity consumption from rising significantly, it does not look like electricity consumption is structurally falling. The pick-up in the economy apparently does not increase energy efficiency investment to the level

Electricity consumption and gross domestic product of the EU — Figure 4

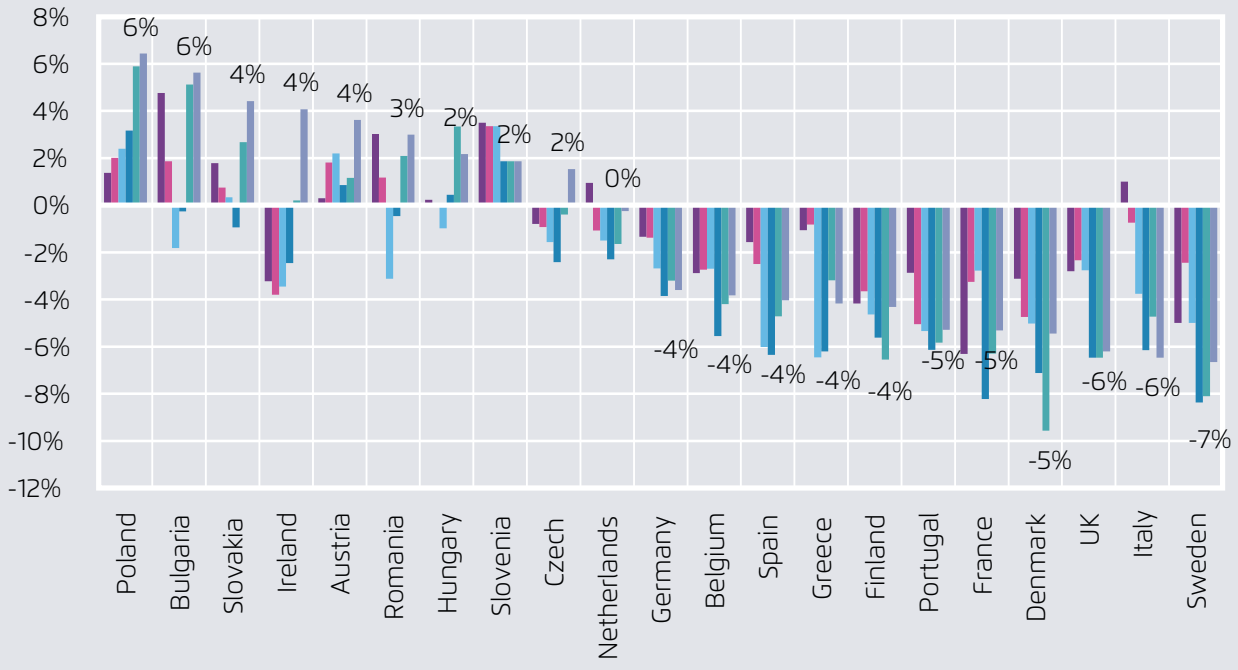



Eurostat 2017, own calculations; *preliminary

needed for reaching European efficiency targets. In order to compensate the increase in power consumption due to electrification of transport, heating and cooling, a renewed focus on energy efficiency is needed.[1]

1 It is worth mentioning a caveat: Although the data used for this report is the best publically available, the data quality is far from perfect. Specifically looking at small changes in electricity consumption can be subject to errors, because of the proportional effect of the data errors, and of annual weather patterns impacting electricity consumption.

Change in Electricity Consumption from 2010 to 2016 Figure 5




Own calculations

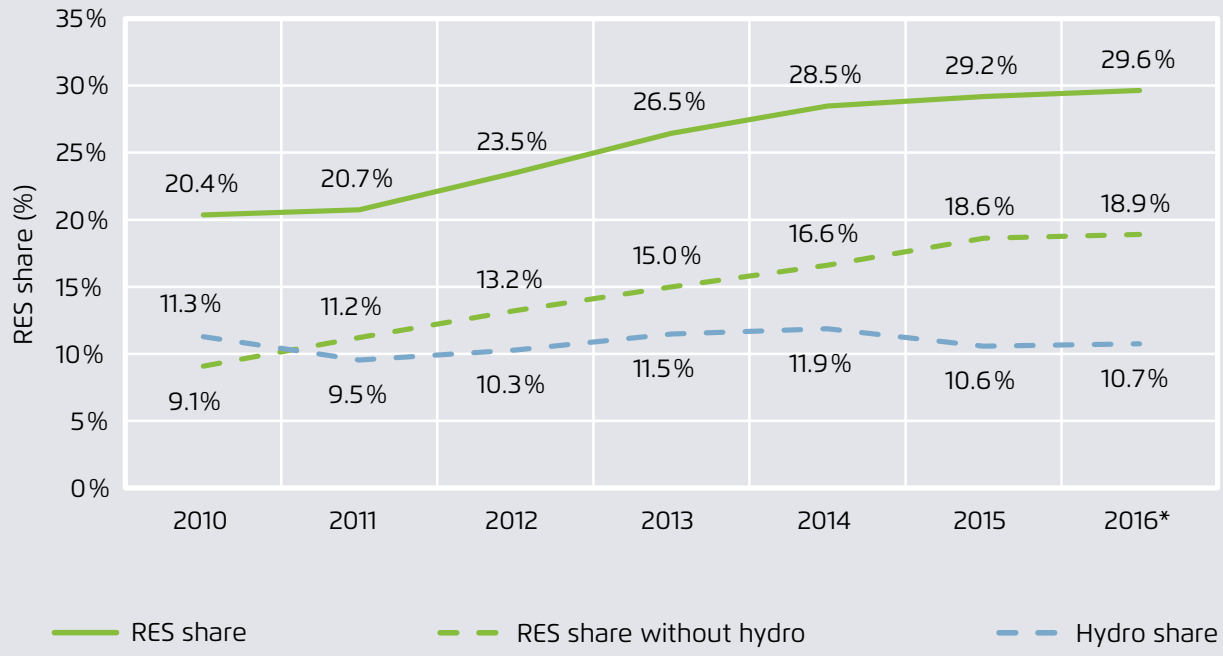
# 3 Renewables growth was below trend; but rapid price falls give hope for future growth

**Renewables generation pauses for breath after a bumper 2015, rising from 29.2 percent to 29.6 percent of all electricity generated[2]. Solar and wind conditions were generally below average in 2016, compared to well above average in 2015, which led to the huge jump in 2015, and the low growth in 2016. Because of the poorer weather conditions, it was perhaps a surprise that new capacity installations were still sufficient to enable renewable generation to slightly rise.**

The installation rate of new renewables was behind trend. Wind installations in 2016 probably did not beat last year's record but was in line with the 2010–2015 average. Solar installations hit the 100 Gigawatt landmark in 2016, but new installations were lower than 2015. Biomass also slowed significantly: biomass generation, which is less impacted by weather than solar and wind, saw its generation increase by only three Terawatt hours in 2016, compared to an average 11 Terawatt hours increase in 2010–2015.

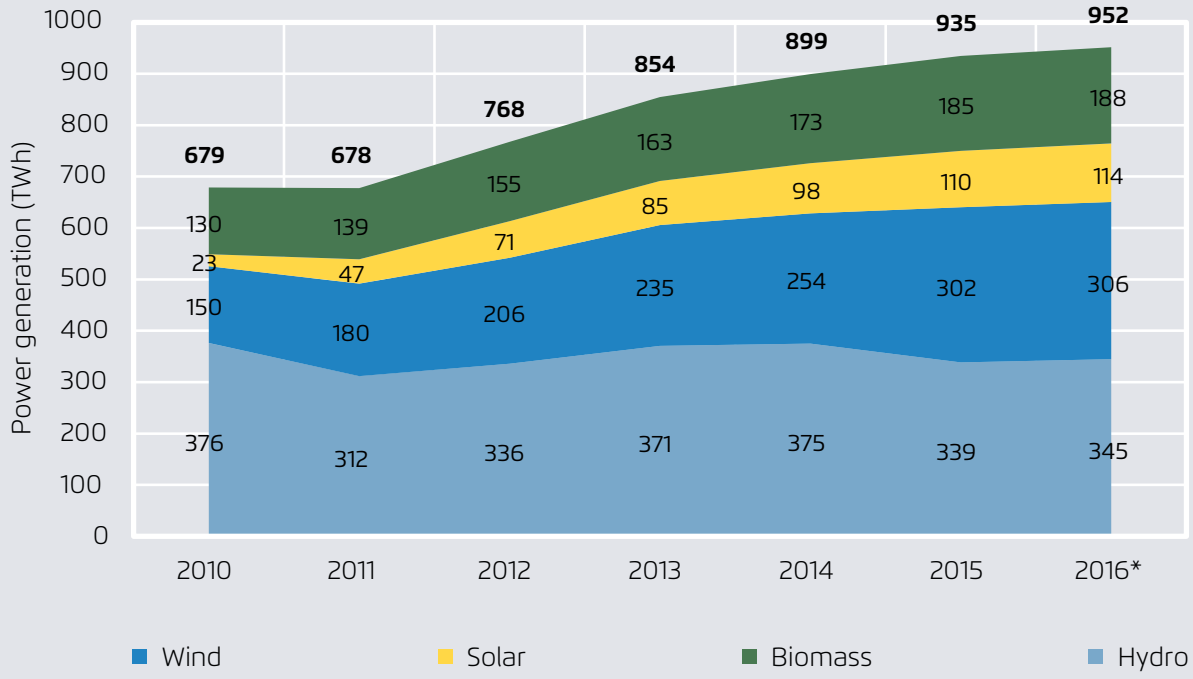
2 Figures are slightly different from EUROSTAT's official reporting of renewables electricity, which use "normalised hydro". Here, non-normalised data is used.

Renewables share of gross electricity production — Figure 6

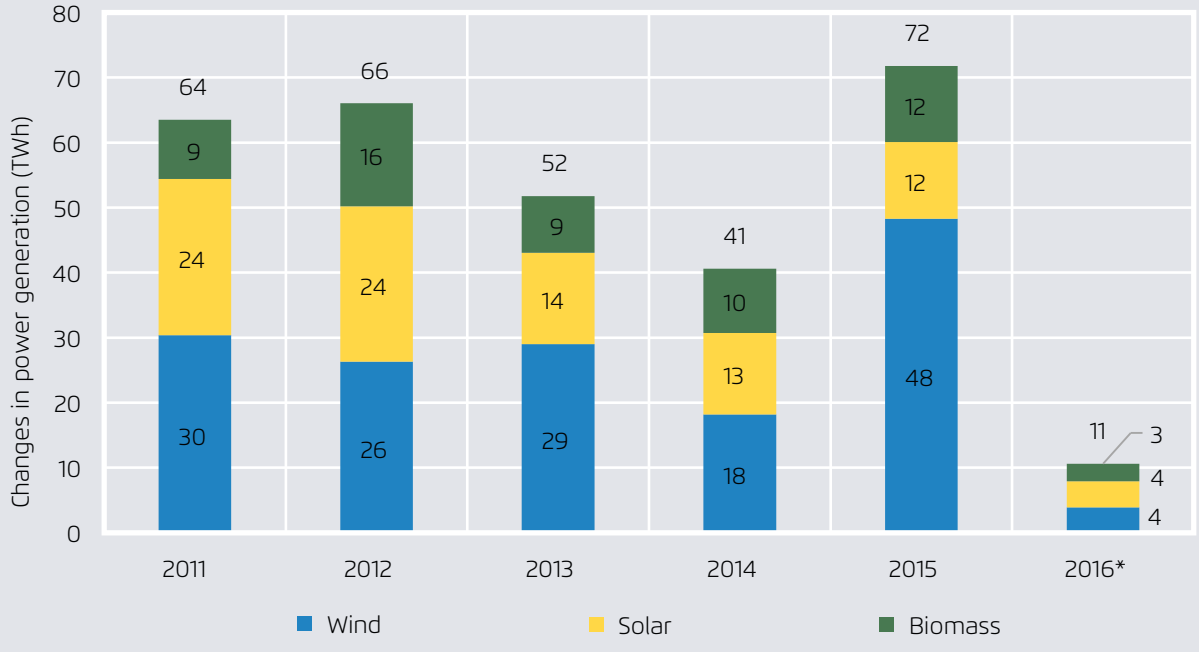



Own calculations; *preliminary

Renewable power production 2010-2016 Figure 7




Changes in renewable power generation (excluding hydro) 2011–2016 Figure 8




Own calculations; *preliminary

## 3.1 New installations in 2016

**Wind**: Up to now, no official estimates on wind capacity additions have been published for 2016. German installations fell from 6.0 Gigawatt in 2015 to 5 Gigawatt in 2016, so we assume that European-wide capacity additions will not hit the records of 2015, in which 12.8 Gigawatt were installed. However, the 2016 additions will be in line with the high levels of the past six years in which 10–12 Gigawatt were installed annually.

The biggest change in 2016 is the pick-up of wind offshore investment. According to data by Bloomberg New Energy Finance, in total 25.8 billion dollar was invested in European offshore wind. The outlook is also promising on future offshore wind, with Germany planning to deploy an average 730 Megawatt a year up to 2030, the UK having made a political commitment to install one Gigawatt a year in the 2020s and the Netherlands deploying 700 Megawatt a year up to 2020. [3]

**Solar**: Europe celebrated hitting a major landmark in 2016, with 100 Gigawatt now installed. In 2016, new solar installations fell slightly – from 8.2 Gigawatt in 2015 to around 7.3 Gigawatt, as estimated by SolarPower Europe in June[4]. The fall is mostly due to the abrupt end to the UK's subsidies for solar. This is well below the record for new installation of 23 Gigawatt set in 2011, and only just above half the 2010 to 2015 average of 13 Gigawatts per year. SolarPower Europe believe that growth will pick up again from 2017, but there remains a large difference between their low and high scenario even to 2020. Globally, solar capacity installations set a record: 70 Gigawatt in 2016, 17 Gigawatts more than in 2015. [5]

## 3.2 Falls in renewables prices

**Offshore wind:** Many observers were stunned at the huge declines in prices for offshore wind, which more than halved in price in 2016. In 2015, the best price signed for offshore wind was 103 Euros/MWh (Vattenfall's Horns Rev 3). In 2016, new records were constantly beaten, until November when Vattenfall signed for Denmark's Kriegers Flak at an incredible 49.9 Euros/MWh (before grid connection of around 5 Euro/MWh).

**Solar:** German solar auctions prices fell by 14 percent in 2016. They fell from 80 Euros/MWh in the December 2015 auction to 69 Euros/MWh in the December 2016 auction. Most stunningly, the cross-border German-Danish auction in December 2016 cleared at only 54 Euros/MWh.[6] SolarPower Europe calculated, that when you adjust the German prices for increased sunshine, the price would fall to 45 Euros/MWh in Madrid and Athens[7]. Elsewhere in the world, new records have also been seen, with Masdar and Abu Dhabi auctions both clearing at around an incredible 25 dollar/MWh.

Solar panel prices fell aggressively by 30 percent across 2016, mostly at the end of the year, signalling even more power price declines are yet to come.

## 3.3 Renewables generation in 2016

The generation from renewables (excluding hydro) increased by 11 Terawatt hours in 2016, compared to an incredible 72 Terawatt hours increase in 2015 – see figure 8. The renewable generation increases have averaged 51 Terawatt hours per year from 2010 to 2016.

3 See BNEF 2017: https://about.bnef.com/blog/record-30bn-year-offshore-wind-overall-investment/

4 See page 30 of SolarPower Europe's Global Market Outlook

5 See BNEF 2017: https://about.bnef.com/blog/record-30bn-year-offshore-wind-overall-investment/

6 Since all of this was won by one Danish investor, specific circumstances might have yielded this result. However, this does not alter the overall trend.

7 See page 37 of SolarPower Europe's Global Market Outlook

Solar and wind conditions were generally below average in 2016, compared to well above average in 2015. Because of the poorer weather conditions, it was perhaps a surprise that new capacity installations were still sufficient to even enable an overall increase in renewable generation. All renewable sources recorded very small increases in generation compared to 2015: wind by 1 percent, solar by 4 percent, biomass by 1 percent, and hydro by 2 percent.

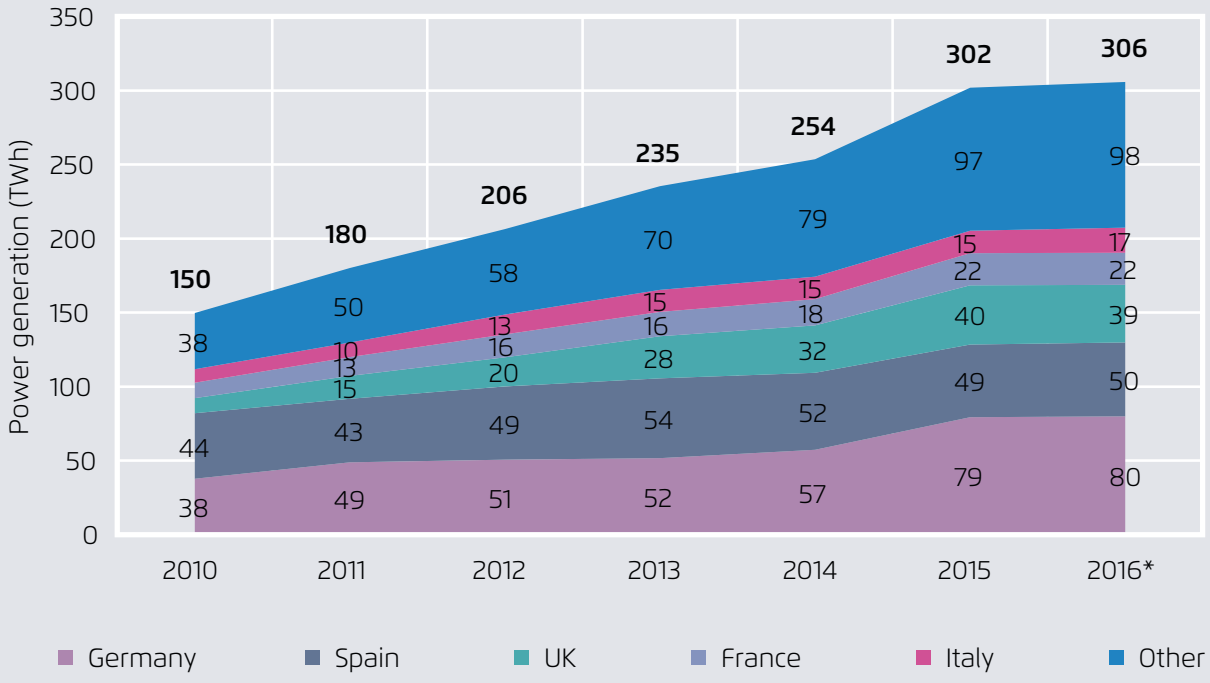
The changes since 2010 are dramatic. Wind generation has doubled from 150 Terawatt hours in 2010 to 306 Terawatt hours in 2016, solar generation has nearly quadrupled from 23 Terawatt hours to 114 Terawatt hours, and biomass has increased 44 percent from 130 Terawatt hours to 188 Terawatt hours.

This is shown by country in figure 9 and 10 below. Biomass generation growth has slowed dramatically in 2016, see figure 11.

Hydro power production varies throughout the years according to the rain conditions. Hydro recorded increases after the drought in 2015 across the Iberian peninsular, although this was offset by dry Nordic conditions – see figure 12.

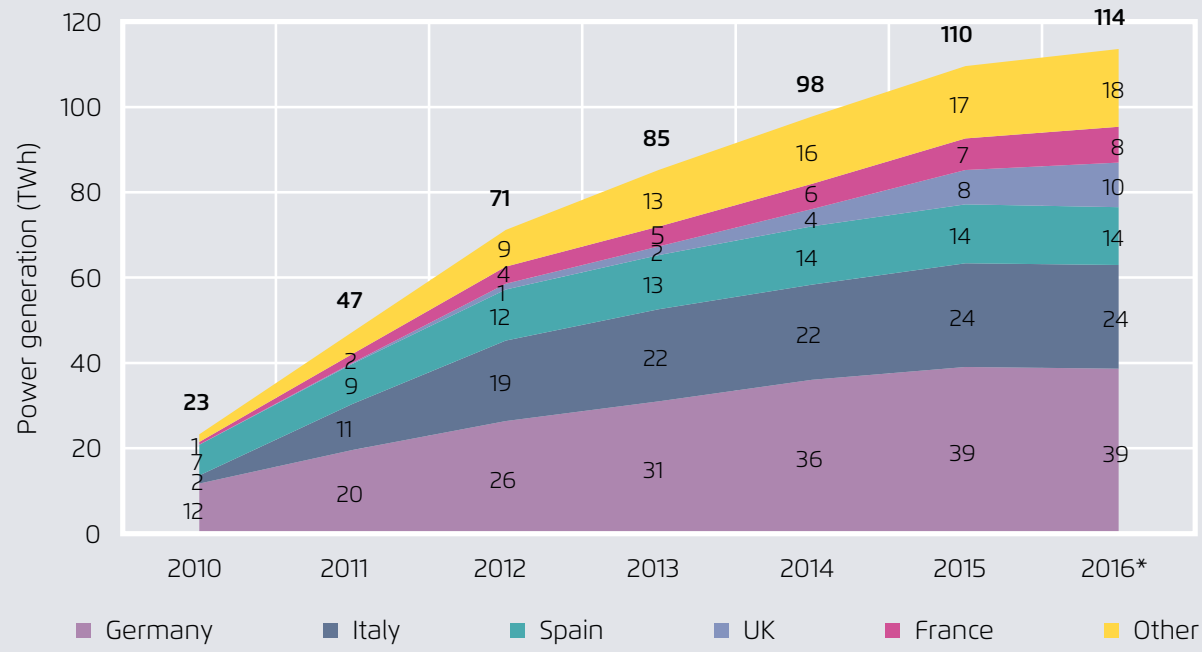
Nearly three quarters of the so-called "new renewables" (i. e. excl. hydro) were produced in only six countries – see figure 13. Germany was the main contributor (28 percent), followed by the UK (13 percent), Spain and Italy (11 percent each), France (6 percent) and Sweden (4 percent).

Wind power production 2010–2016: European total and top countries — Figure 9

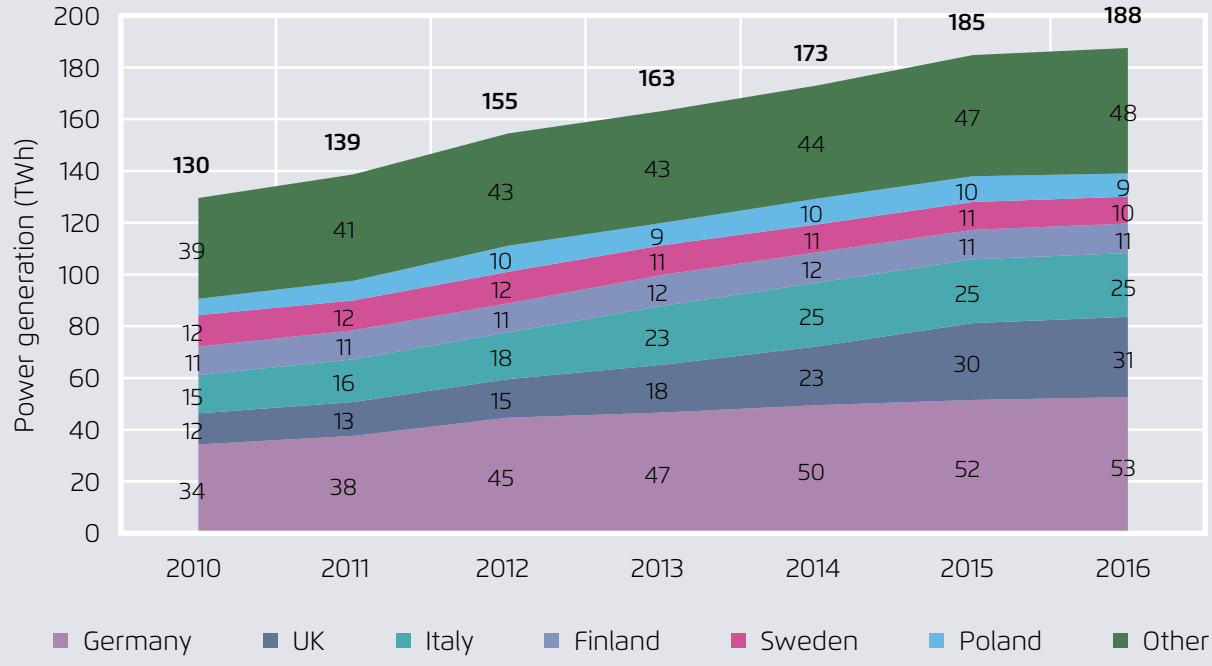



Own calculations; *preliminary

Solar power production 2010–2016: European total and top countries — Figure 10

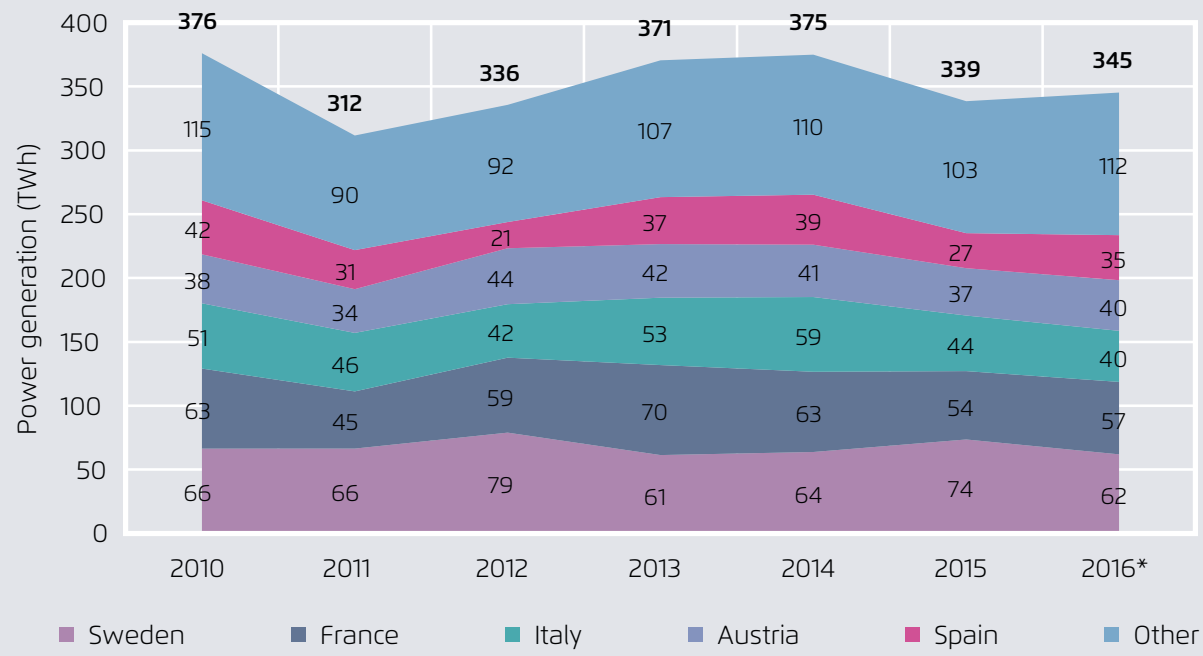



Biomass power production 2010–2016: European total and top countries — Figure 11

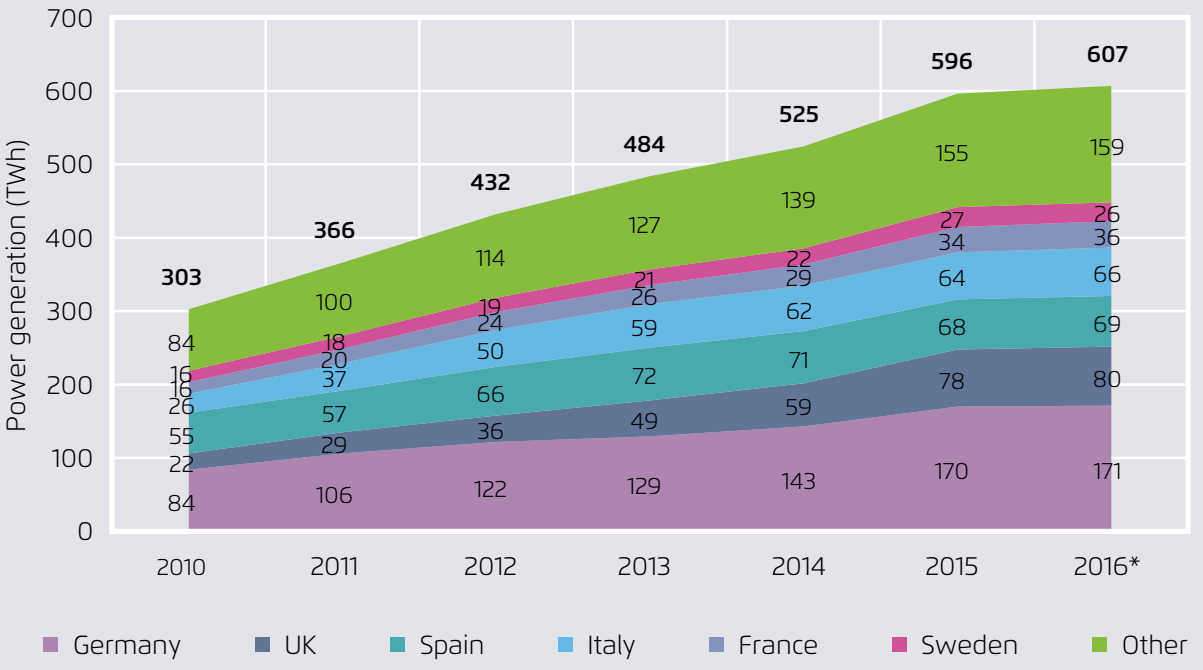



Own calculations; *preliminary

Hydropower power production 2010–2016: European total and top countries Figure 12




RES production (excluding hydro) 2010–2016: European total and top countries Figure 13



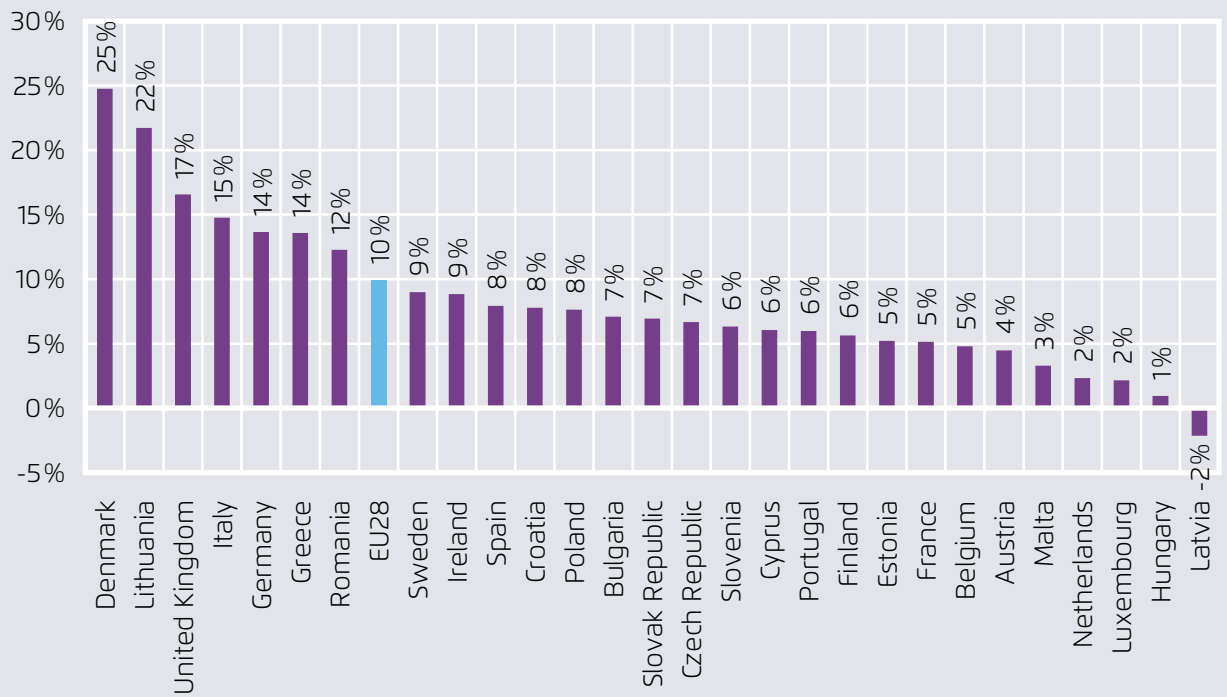

Own calculations; *preliminary

## 3.4 Growth by country

It is useful to recap how far Europe has come since 2010. Renewables increased from 20 percent to 30 percent of the electricity mix from 2010 to 2016 – a rise of 10 percentage points (pp) for Europe in total. However, this change has been very uneven by country.

Denmark saw the best growth of 25 percentage points, followed by Lithuania and, perhaps surprisingly for many, the UK was in third place with 17 percentage points. Germany and Greece both came in at 14 percentage points increase. Some of the worst performers were surprisingly western European countries – Netherlands at 2 pp, Austria at 4 pp, France and Belgium at 5 percentage points.

Increase of the share of Renewables in the electricity mix 2010–2016 (in percentage points) Figure 14




Own calculations;

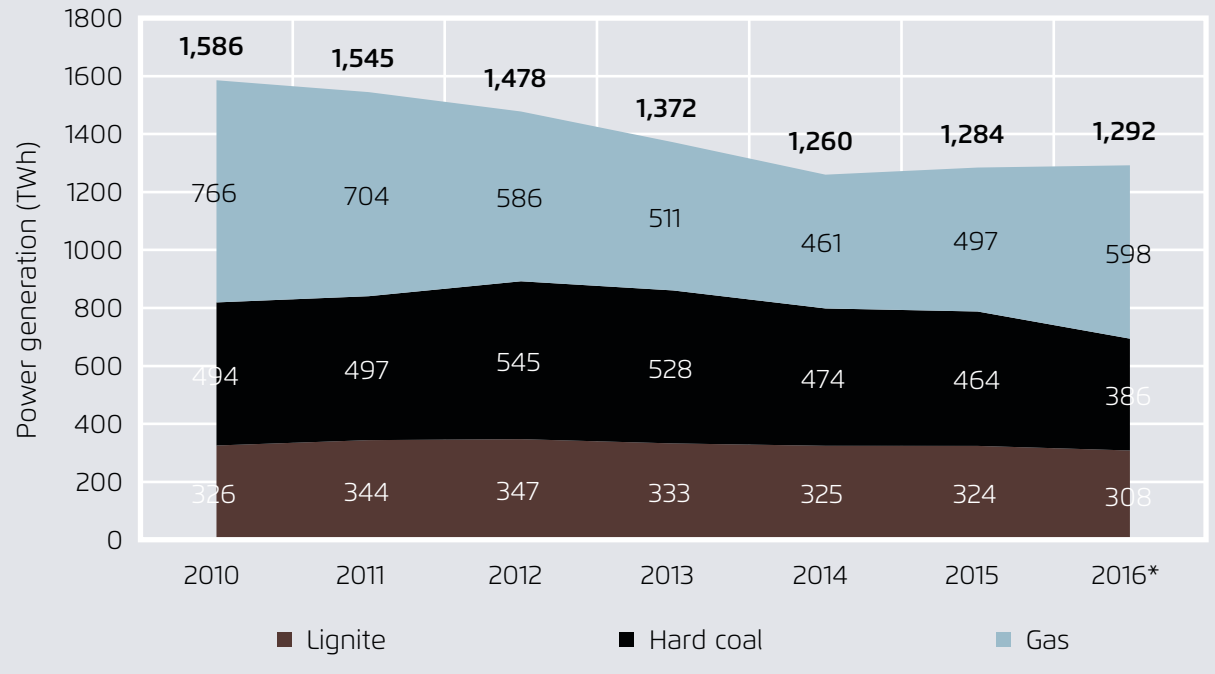
# 4 Power from conventionals 2016: The big shift from coal to gas

**The biggest change in the European electricity system in 2016 was a large shift from coal generation to gas generation, reducing coal generation by 94 Terawatt hours (12 percent) and increasing gas generation by 101 Terawatt hours (20 percent). This, alone, led to European power sector $CO_2$ emissions falling by 4.5 percent, to 1018 Mt $CO_2$, due to gas being less carbon-intensive than coal. Non-$CO_2$ pollutants would have fallen even more aggressively, since the difference between coal and gas is even larger for non-$CO_2$ pollutants than for $CO_2$.**

Coal generation fell by 12 percent, from 788 Terawatt hours to 694 Terawatt hours, reducing its share of the European electricity mix from 24.6 percent of the electricity mix to 21.6 percent. Of the 94 Terawatt hour fall in coal generation, 4/5th of it was hard coal generation falling, and only 1/5th of it was lignite generation falling. Half this change happened in the UK, where wind generation exceeded coal generation in 2016 for the first time.

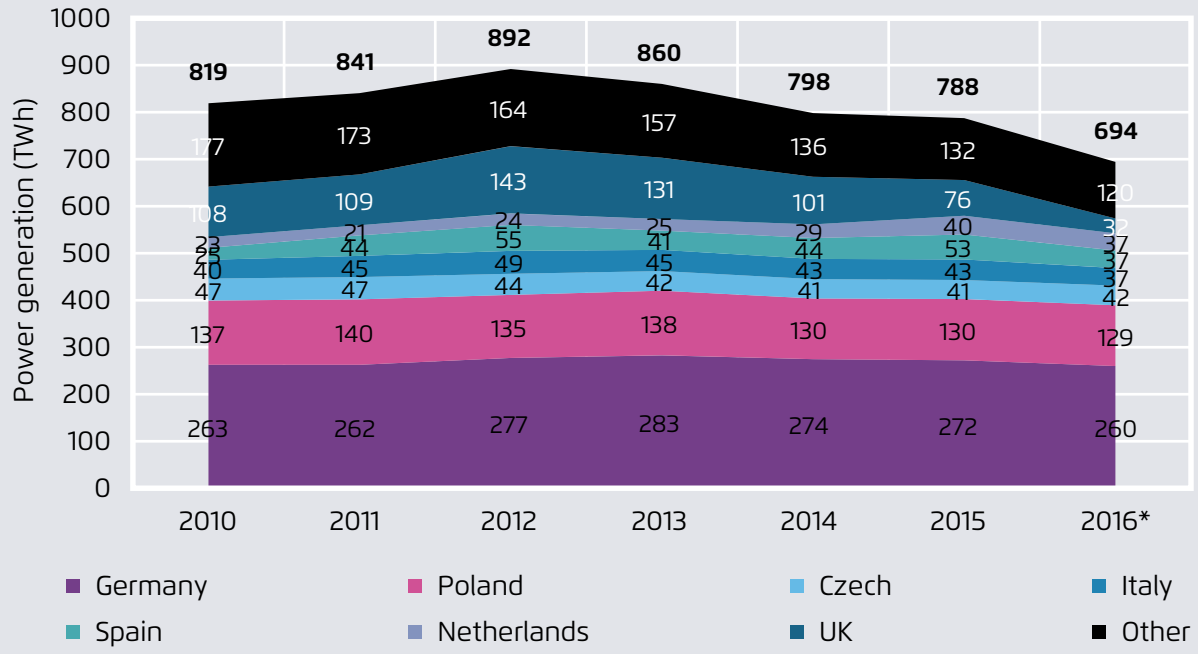
Gas generation increased by 20 percent, from 497 Terawatt hours to 598 Terawatt hours, increasing its share of the European electricity mix from 15.5 percent of the electricity mix to 18.6 percent. This was the second year in a row gas generation in Europe has risen, after four consecutive years of losses, as renewable generation has increased – see figure 17. However, despite this increase in 2015 and 2016,

Power production from hard coal, lignite and gas 2010–2016 Figure 15

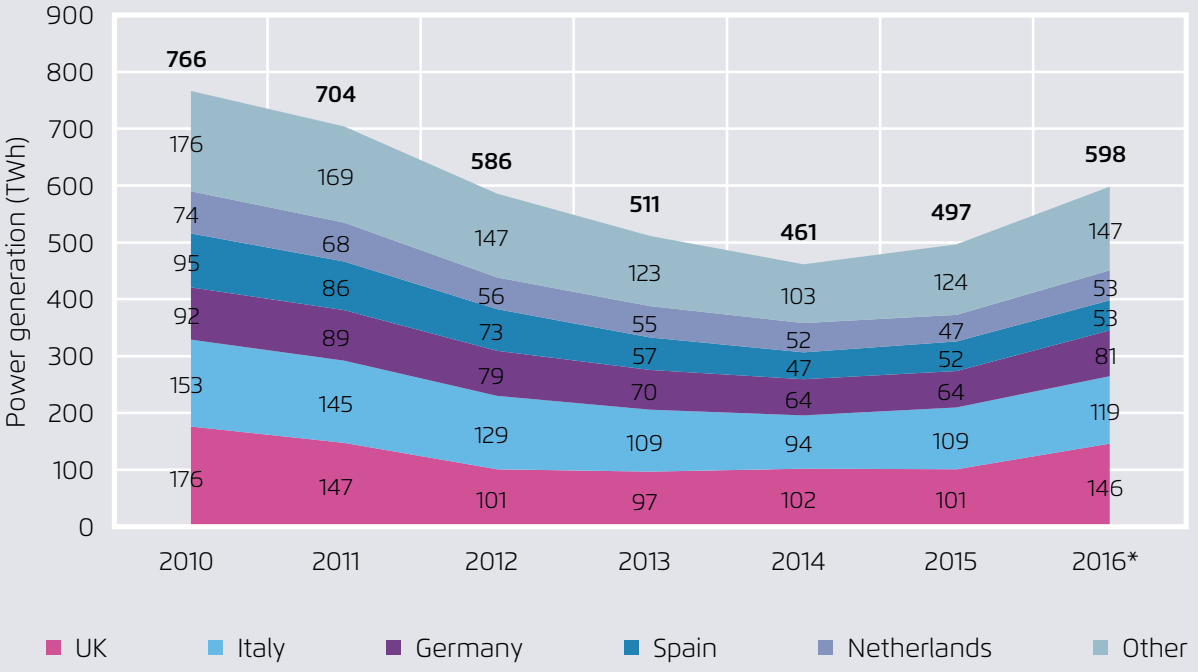



Own calculations; *preliminary

Coal power production (Hard Coal and Lignite) from 2010–2016: European total and top countries Figure 16




Power production from gas fired power plants 2010–2015: European total and top five countries Figure 17




Own calculations; *preliminary

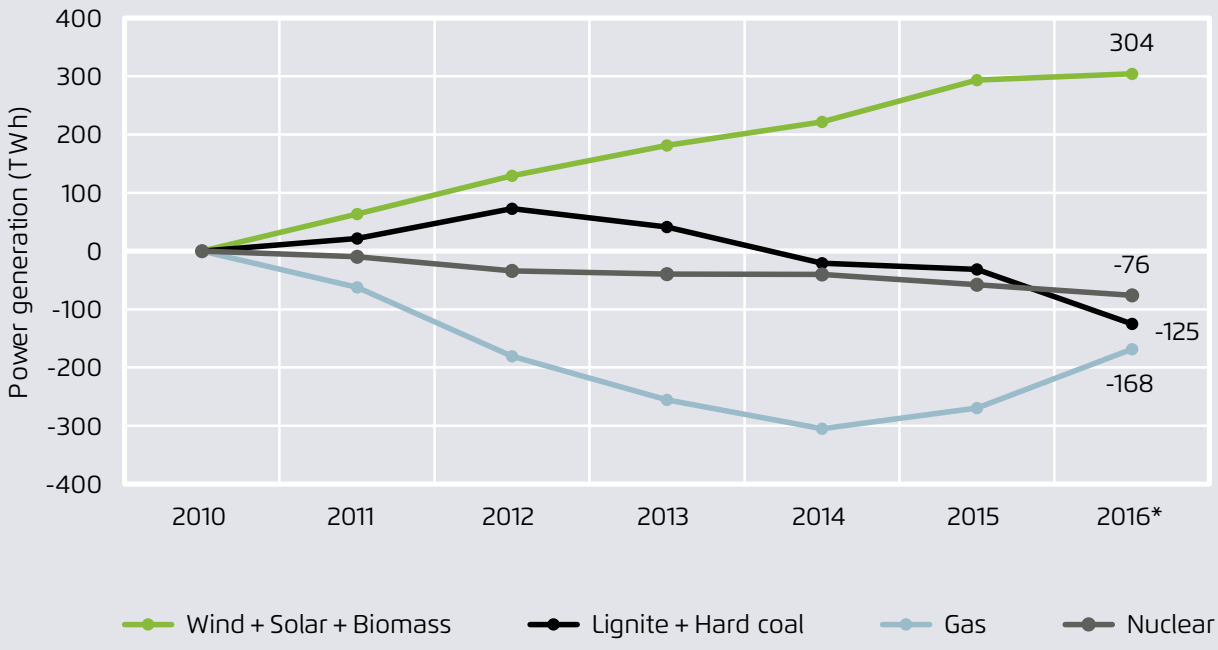
gas generation was still 168 Terawatt hours below that in 2010. In addition, even after the 12 percent fall in coal generation in 2016, coal has still suffered less from renewables than gas generation – having fallen 125 Terawatt hours since 2010, compared to 168 Terawatt hours for gas. It is clear that the opportunity exists for a further shift from coal to gas generation without needing to build any new power stations or upstream infrastructure.

Figure 19 shows where the coal-gas changes happened. Half of the coal-gas switch happened in the UK, which was due to coal plant closures and the increase in carbon price support. Spanish coal fell early in 2016 as hydro levels returned to normal; French gas generation increased aggressively in late 2016 because of widespread nuclear outages. Germany and Netherlands had a temporary coal-gas switch because gas became cheaper than coal in August, September and October 2016. Greek gas generation took market share from lignite because of a lower gas price and the removal of a tax on gas in June. Italy saw a big change too.

We can split this coal-gas-switch roughly into four reasons, which by coincidence are about evenly split:

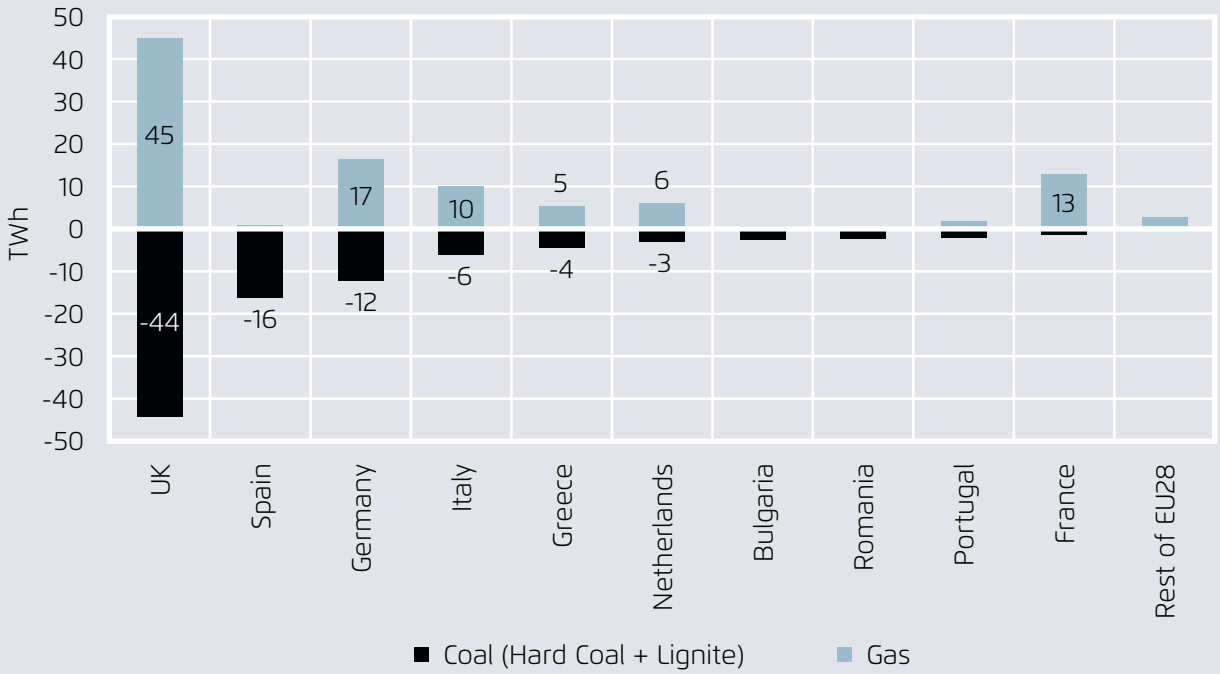
- → a quarter is from closures of 8 Gigawatt of old coal plants, mostly in the UK.
- → a quarter is from permanent coal-gas switching from the UK's carbon price support
- → a quarter is from temporary coal-gas switching outside the UK because of low gas prices
- → a quarter is from factors related to one-off changes in nuclear and hydro generation 2016.

Change of electricity production since 2010 — Figure 18




Own calculations; *preliminary

Changes in power generation of gas and coal from 2015 to 2016 Figure 19




Own calculations; *preliminary

## 4.1 Coal closures

There was 8 Gigawatt of coal plant that closed in 2016.

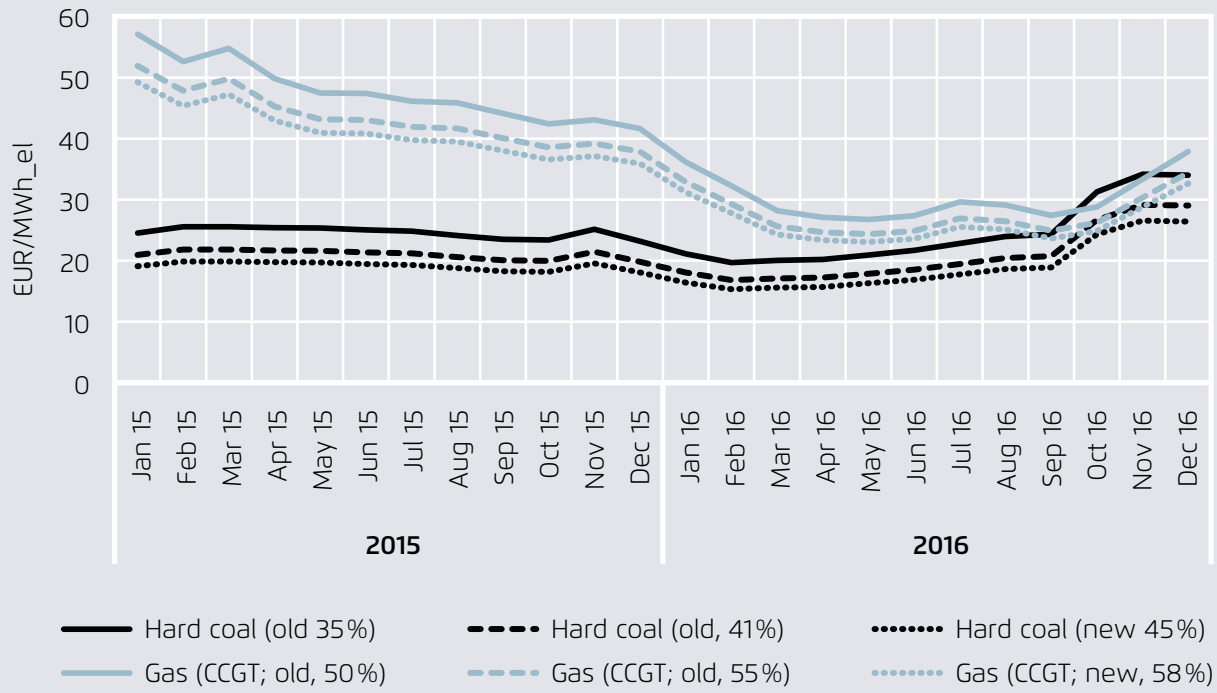
- → 4.9 Gigawatt in UK: Longannet, Ferrybridge and Rugeley, mostly in March 2016. In addition, Drax unit 3 converted to biomass.
- → 1.6 Gigawatt in Netherlands: Amer 8, Borssele 12 and Gelderland closed end 2015.
- → 0.6 Gigawatt in Italy: Vado Ligure units 3 and 4 closed.
- → 0.6 Gigawatt in Belgium: Langerlo closed.
- → 0.6 Gigawatt in Germany: 392 Megawatt of lignite moved into the reserve (Buschhaus), and 284 Mega—watt of hard coal closed.
- → 0.2 Gigawatt in Poland: Two Tauron 110 MW units closed (Lagisza B5 and Siersza B5)

## 4.2 UK's carbon price support

In April 2015, the UK's carbon price support doubled to 18 pound/tonne of $CO_2$, on top of the EU-ETS price, which means the power price must pay around 30 Euros/tonne for , compared to the EU-ETS price of around 5 Euros/tonne. This 30 Euros/tonne is sufficient to cause near-permanent switching of the merit order; in the UK, gas price needs to be at a high level before coal can compete with gas.

Although the price change was in April 2015, the impact was mostly felt in 2016, because coal power plants in 2015 had planned high levels of coal burn, and due to high coal deliveries and coal stocks that they could not unwind, they had to generate in 2015, despite the negative economics. This effect did not last to 2016, leading to a significant reduction in power production of coal.

Marginal costs of standard-type power plants 2015 and 2016 Figure 20




Worldbank 2017; Bundesbank 2017, UBA 2015, DEhSt 2017, own calculations

## 4.3 Temporary coal-gas switching

Coal and gas prices were very volatile during 2016. Gas price fell very rapidly in Q1-2016, bringing the costs of coal-gas generation close throughout all of 2016, compared to 2015 when gas generation held a significant premium to coal throughout the year – see figure 20.

From April 2016, the coal-gas prices came close for the rest of the year, leading to some coal-gas switching. However, the biggest price advantage, which led to the biggest switching was in August, September and October.

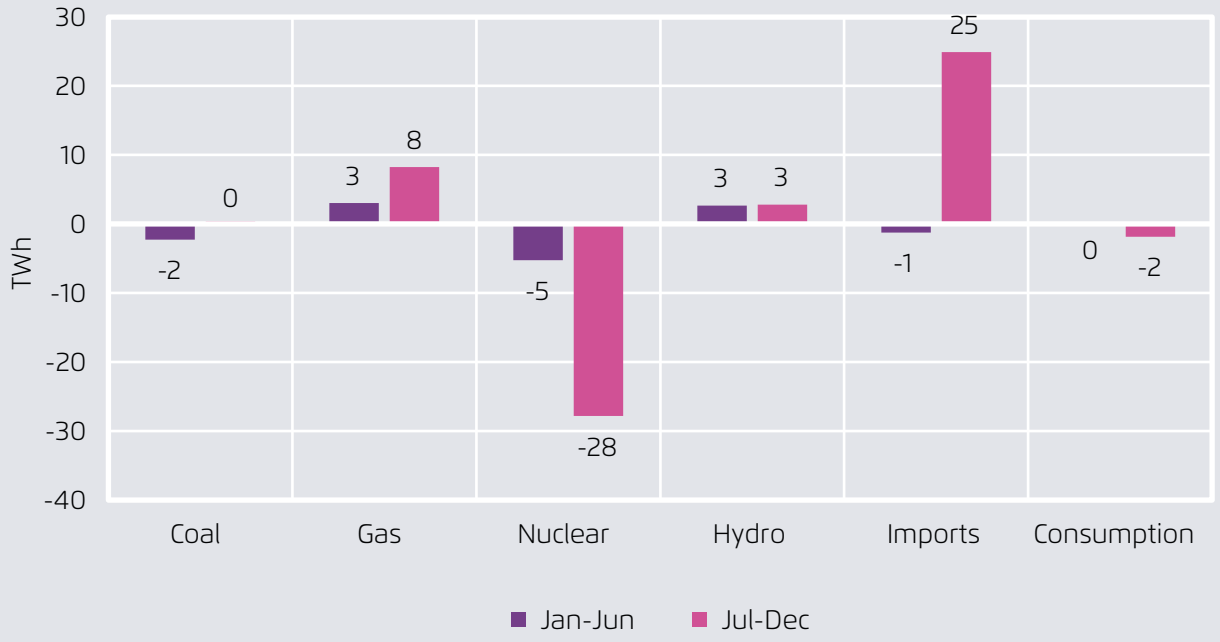
## 4.4 Changes to nuclear generation

The biggest changes happened in French nuclear generation, which fell by 33 Terawatt hours due to significant outages. This happened from July through to December – see figure 21. One-third of the nuclear shortfall was made up from increased French gas generation, and two-thirds resulted in less exports to Belgium, UK and Germany. [8]

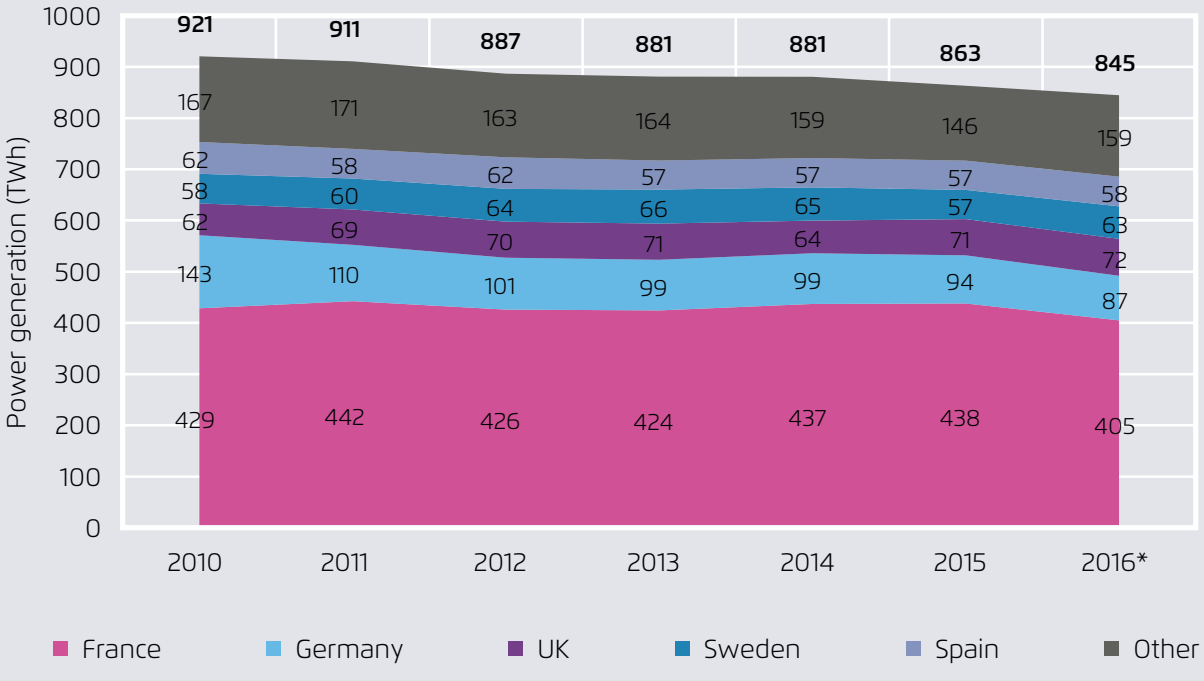
There were other changes in nuclear generation, see figure 22. Both Belgium nuclear reactors came back online, increasing Belgium nuclear generation by 17 Terawatt hours. German nuclear generation fell in H1-2016, resulting from Grafenrheinfeld's closure in Q3-2015. Sweden had a rather average year in 2016 after a poor year in 2015.

8 The next chapter analyses the change in electricity flows in 2016.

Changes in French power production 2016 Figure 21




Nuclear production 2010–2016: European total and top five countries Figure 22




Own calculations; *preliminary

# 5 Electricity interconnectors helped to keep grid secure

There were some interesting changes in electricity flows in 2016; however, most were just one-off changes. France exported less electricity to Germany, Belgium and the UK because of its nuclear outages. German set another record for electricity exports, because of the French nuclear problems and a dry Nordic year (although there were substantially less exports to Netherlands because of return of the Belgium nuclear reactors).[9]

There was a severe increase in electricity prices in some countries in Q4-2016, because of the French nuclear problems and because of the UK coal plant closures, as there was limited capacity left in these countries – see figure 24. ENTSO-E communicated in their Winter Outlook that there was sufficient capacity in neighbouring countries to avoid a security of supply incident.

However, that did not stop the market seeing large price increases. Power prices rose up in France and UK, but also in Italy, Spain, Belgium, Portugal and Switzerland – see figure 25. This created a large division across Europe, with Germany, Poland and the Nordic region seeing much lower prices.

9 A note on data: we have assumed there is seven Terawatt hours flowing between Italy and Austria which are not reported in ENTSO-E. Otherwise, the ENTSO-E flows would be substantially different from national data, which would make no sense.

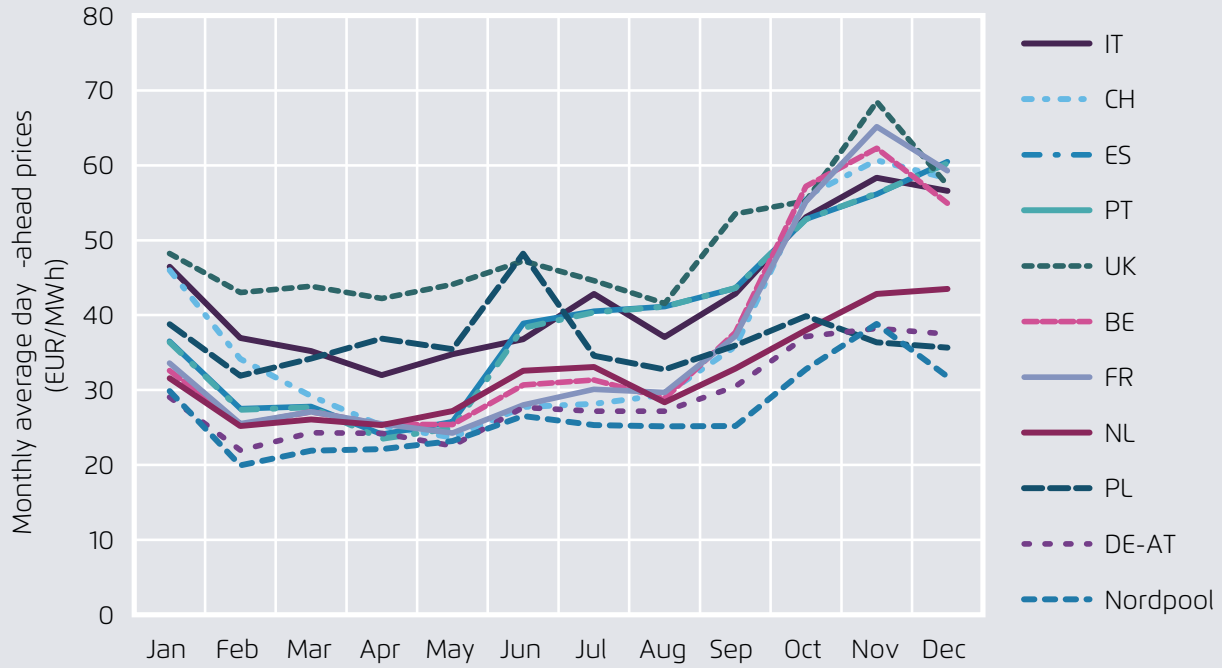
Physical electricity flows in TWh

Figure 23


ENTSO-E 2017

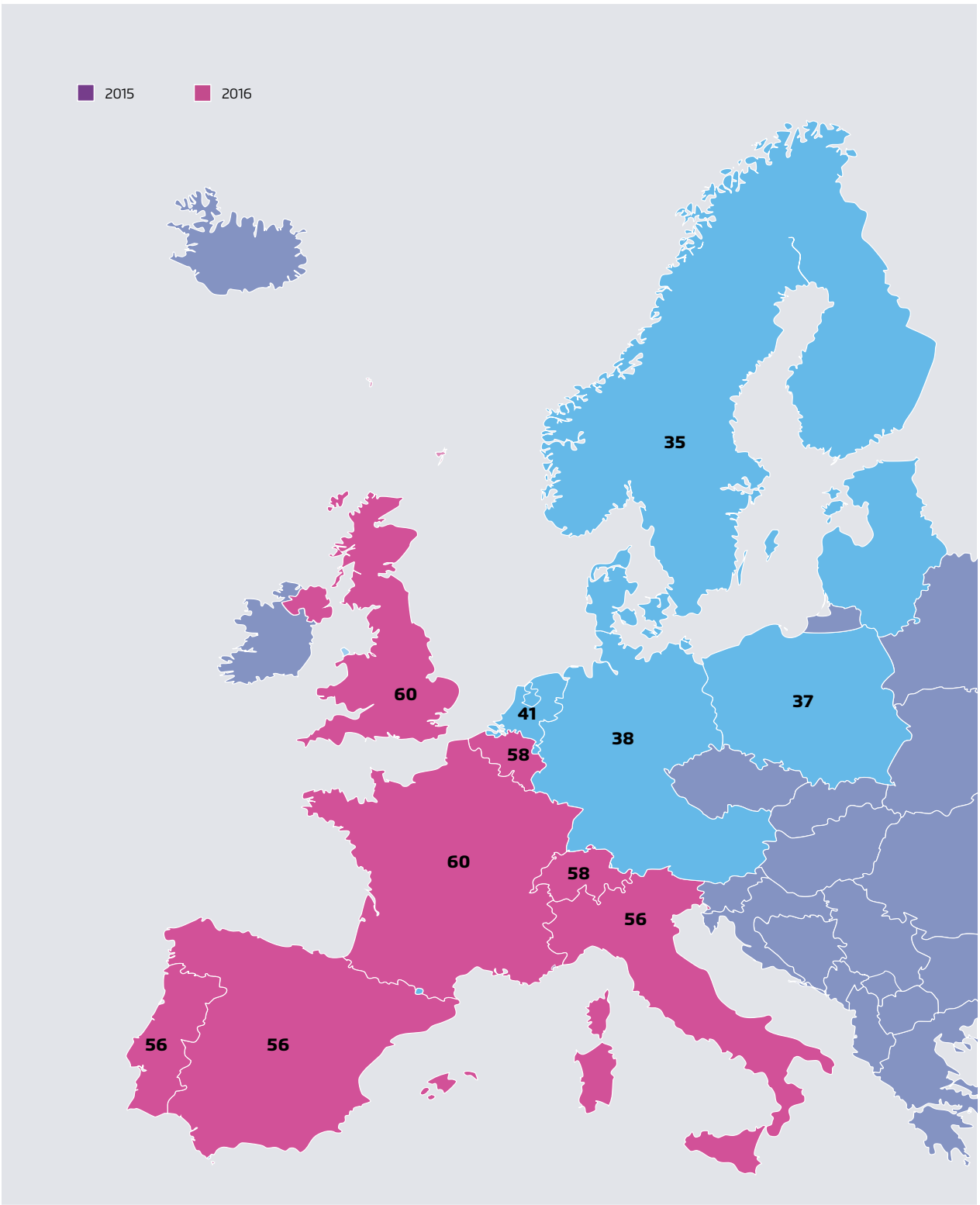
Day-ahead prices in selected European countries

Figure 24




EEX 2017, EPEX 2017, APX 2017, OMEL 2017, GME 2017, PGE 2017, Nordpool 2017

Average day-ahead power prices in Europe in Q4 2016 Figure 25




EEX 2017, EPEX 2017, APX 2017, OMEL 2017, GME 2017, PGE 2017, Nordpool 2017

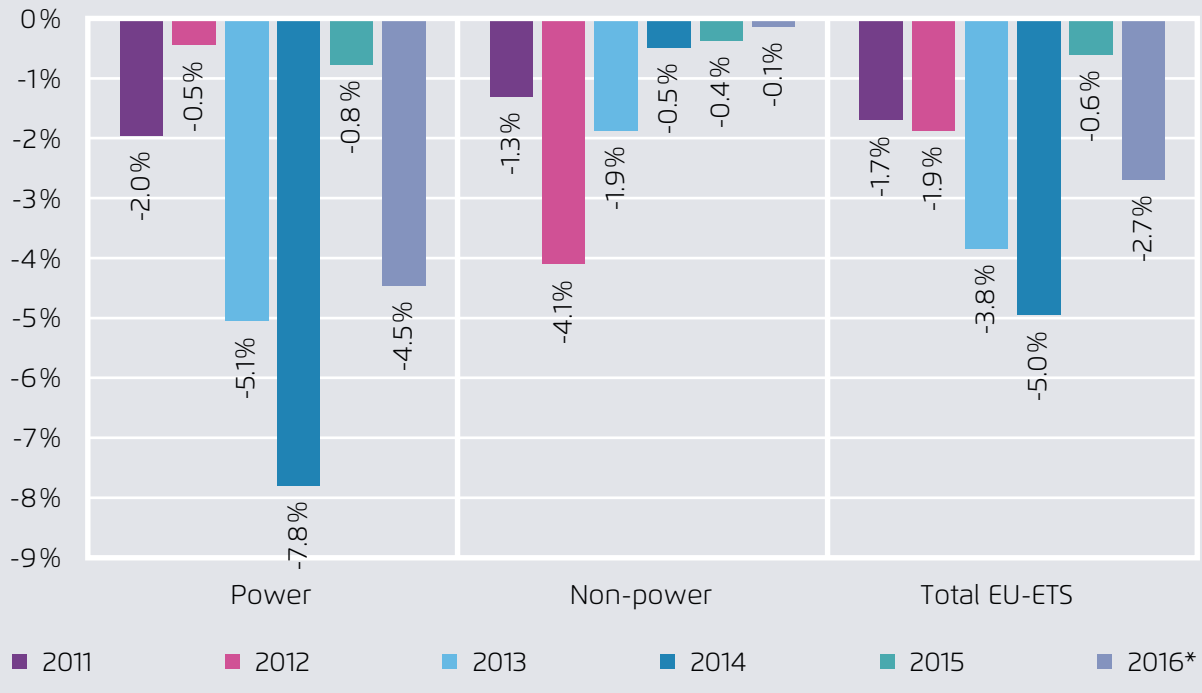
# 6 Power sector $CO_2$ emissions fell by 4.5 percent in 2016

**We estimate last year's power sector emissions have fallen by 4.5 percent – down 48 million tonnes from 1066 million tonnes in 2015 to 1018 million tonnes in 2016.** The reasons for this is the large coal-gas switch discussed earlier in this document. For non-power ETS emissions, Sandbag forecast a slight fall of 1 million tonnes – this assumes that industry continues to show little structural abatement, and that the massive 30 percent fall in UK steel production is offset by rises in cement production reported in Germany and Greece.

**This means our forecast for total 2016 EU emissions covered by the emissions trading scheme is to fall by 2.7 percent from 1803 million tonnes to 1754 million tonnes.** This is significantly above our forecast in summer 2016 of 1718 million tonnes; not all the emissions reductions we forecasted happened because of the significant French nuclear outages and a low Q4 wind speeds, which both resulted in significantly more fossil generation than we anticipated.

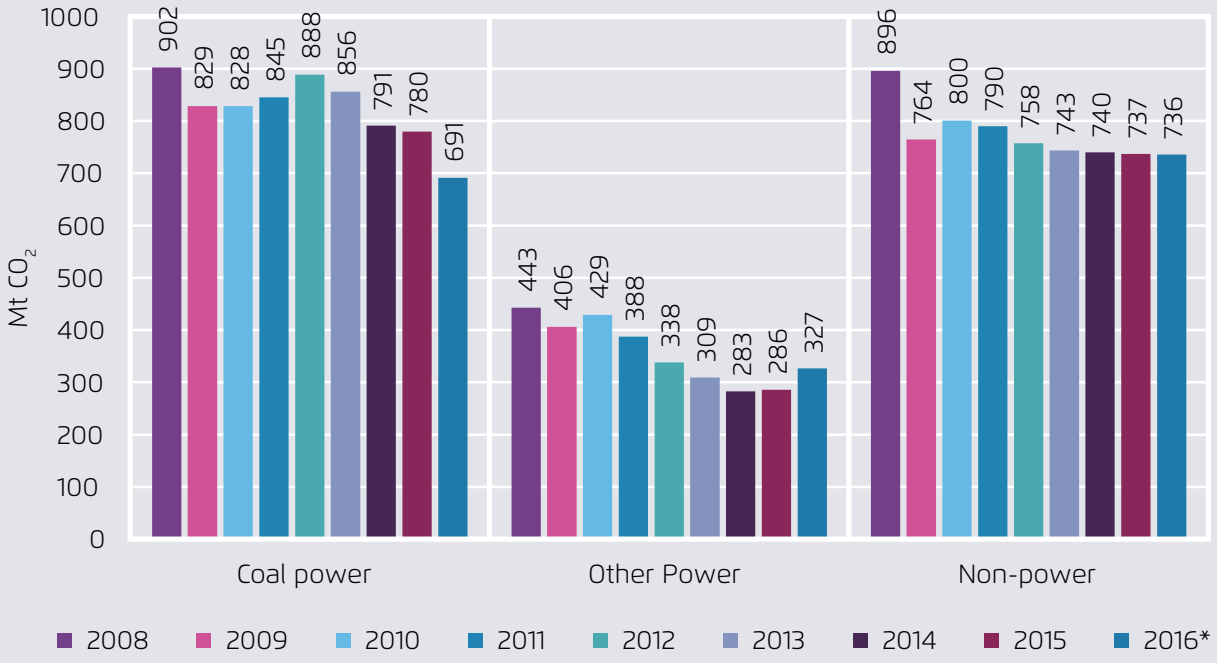
This would mean that in the last four years, ETS emissions have fallen at an average of 3.0 percent per year – see figure 26 – but with a big difference between the power sector and non-power sector. The power sector fell by 4.5 percent per year, and the non-power sector fell by 0.7 percent per year.

Changes of EU ETS emissions (stationary sources) 2011–2016 Figure 26

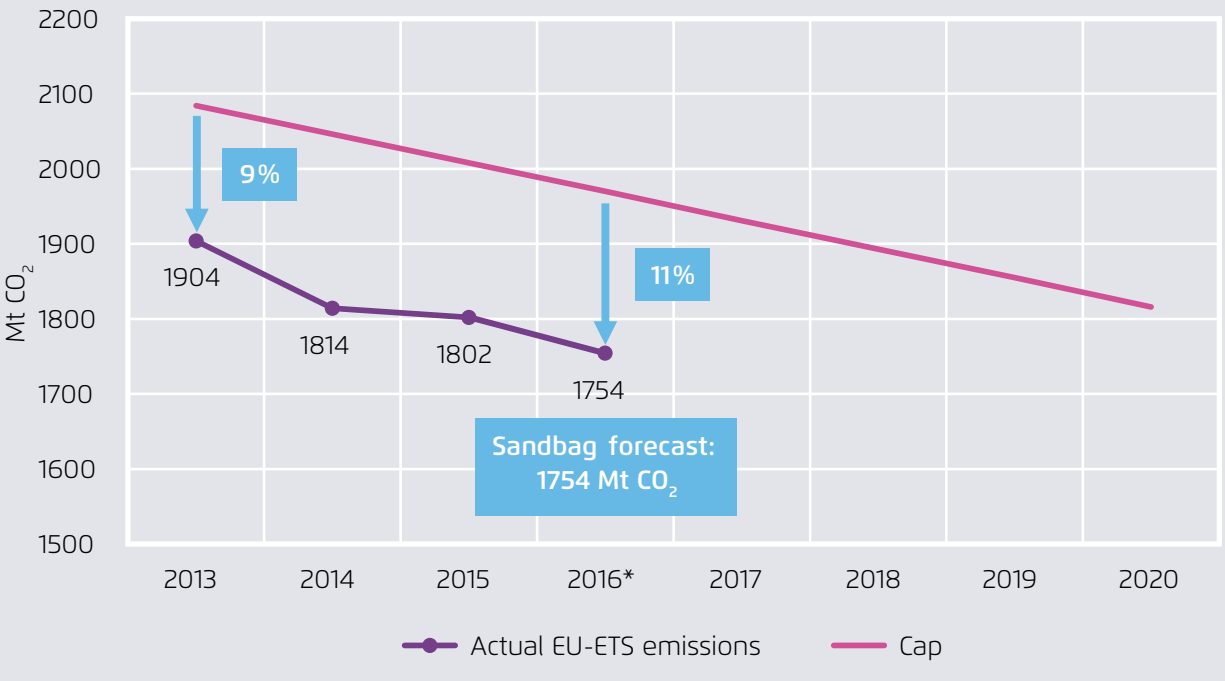



Own calculations; *preliminary

ETS emissions from coal, other power and non-power sectors 2008–2016 Figure 27




ETS cap 2013–2020 and actual emissions 2013–2016 Figure 28




Own calculations; *preliminary

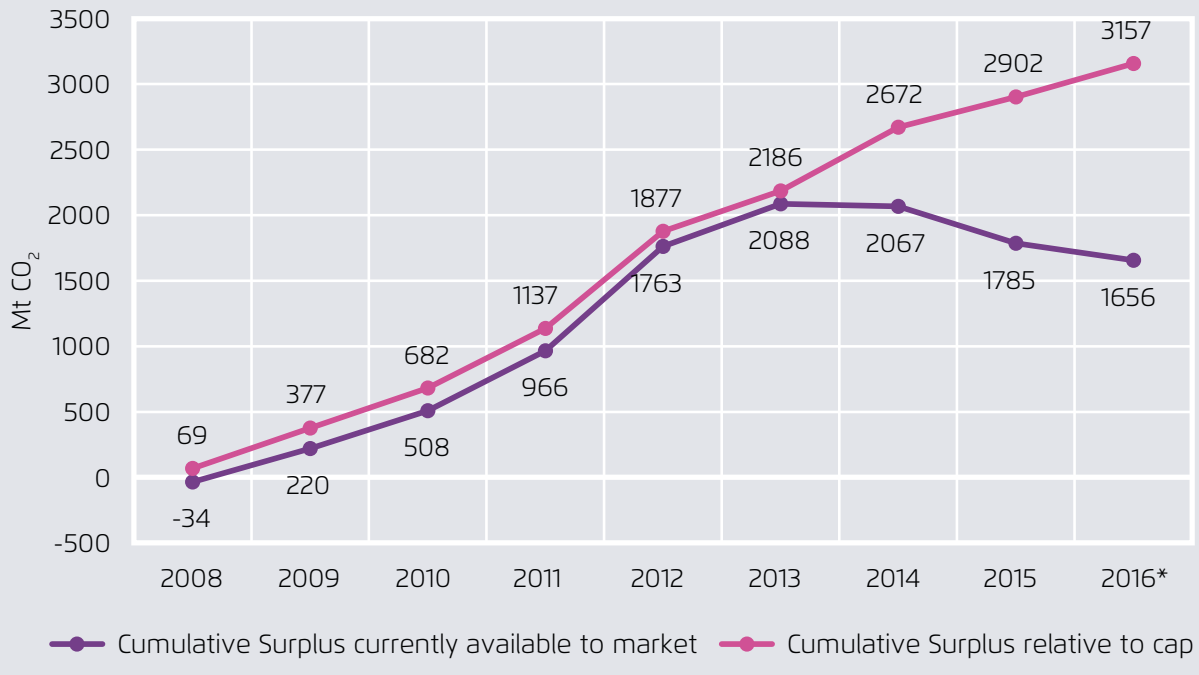
The fall in EU-ETS emissions has been accelerating specifically because of the rapid fall in coal power emissions – see figure 27. Despite these falls, coal power emissions will still be 40 percent of all EU-ETS emissions in 2016. Therefore, to understand the EU-ETS, one must understand coal generation. However, also, 2016 will be the first year ever that coal power emissions will have fallen below non-power sector emissions, with non-power emissions expecting to have fallen just 1 percent in three years.

This means emissions are falling faster than the cap – see figure 28. In 2013, emissions were 9 percent below the cap, creating a structural surplus. By 2016, emissions were 11 percent below the cap. This means the structural surplus will have increased by around 255 million tonnes in 2016 alone.

The EU ETS surplus in the market shrunk in 2016, from about 1.8 billion tonnes to 1.7 billion tonnes. This is because not all supply is coming to market, because of back-loading of certificates into the market stability reserve, partial cessations and not issuing all new entrant reserve. However, as long as there is no rule that would permanently cancel surplus certificates from the market stability reserve, these certificates currently held back will one day enter the market.

Therefore, the structural surplus in the EU ETS is getting bigger every year; the cap is just so much higher than actual emissions. In 2016, this surplus has increased to above 3 billion tonnes for the first time – see figure 29.

ETS surplus 2008–2016 Figure 29




Own calculations; *preliminary

# 7 Outlook

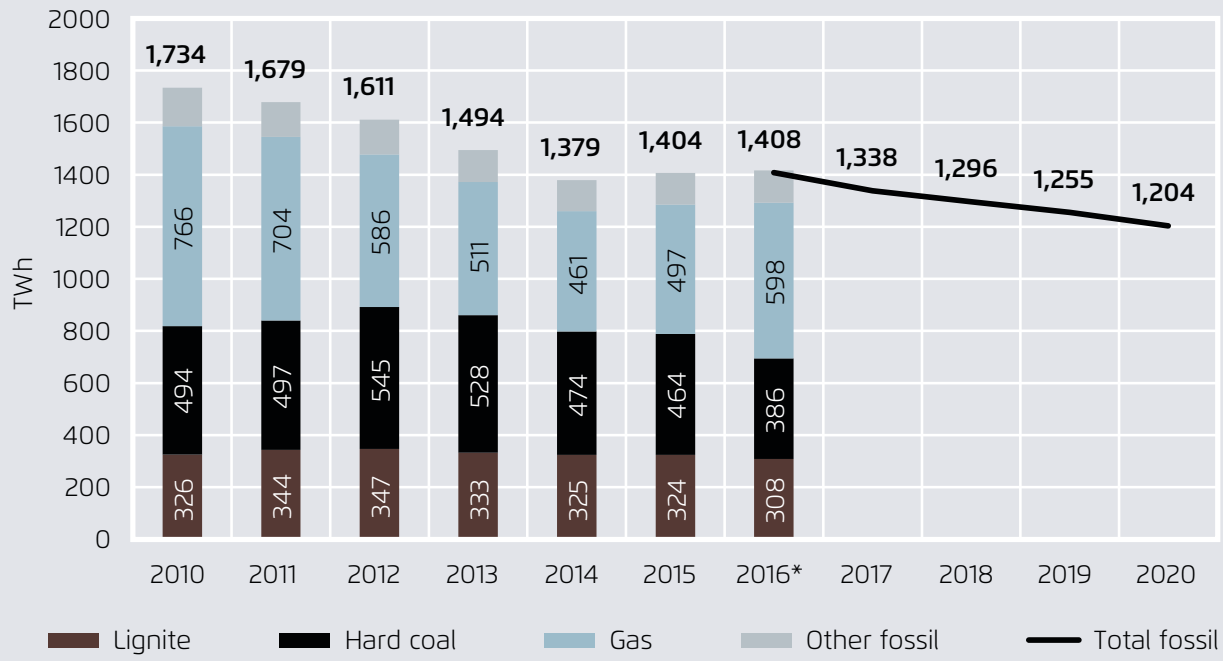
The outlook on consumption is for continued stagnation, until there is a big successful push on energy efficiency to ensure that economic growth increases efficiency investments. The European Commission is forecasting EU GDP growth of 1.5 percent in 2017 and 1.7 percent in 2018, with growth higher in eastern European countries[10] – if this is not met by additional efforts in efficiency and clean power production in those countries, this could mean rising emissions in power production in Eastern Europe.

The outlook on renewables is mixed – in 2017, we would expect the level of installations to be at least as high as in 2016 as EU Member States seek to achieve their respective 2020 renewable energy targets. Price falls, especially in solar and offshore wind, give confidence of continued renewables build. The average 2011 to 2016 renewables generation growth was 51 Terawatt hours per year; it seems reasonable to assume this going forward. However, post 2020, no reliable EU renewables framework exists nor is proposed to ensure that the EU's 2030 renewables target is met, which could drive new investments in clean power throughout Europe. The more we approach 2020, the more the future of renewables in Europe becomes uncertain.

The outlook for fossil generation is bleak. Fossil generation should fall by at least 70 Terawatt hours in

10 See EC's Autumn Forecast http://ec.europa.eu/economy_finance/eu/forecasts/2016_autumn_forecast_en.htm

Fossil power production 2010-2016 and projected total fossil production 2017-2020 Figure 30




Own calculations; *preliminary

2017, due to a return to normalised French nuclear generation, a return to normalised wind and solar conditions and new renewables. Then it will continue to fall to 2020, with the continued addition of more renewable capacity. The less predictable factor is whether the fall in fossil generation will be coal or gas. This would be most driven by two factors: closures of old coal plants, and the coal-gas switching price.

Coal power plants amounting to 7 Gigawatt have announced to close in 2017-2020, representing less than 5 percent of the European coal fleet. In Germany, some 2.5 Gigawatt of hard coal will come offline in 2017 and 2.4 Gigawatt of lignite will further go into reserve by October 2019 (of which 0.6 Gigawatt in 2017). In the Netherlands, one Gigawatt at Maasvlakte 1+2 must close, covering very small units in Poland, Romania, Spain, Croatia and Italy. Closing 5 percent of the coal fleet over the next four years will do little to change overall emissions. However, more coal plants will likely announce to close, given the vast over-capacity in many countries still.

On the coal-gas-price-switch, two factors could lead to gas power plants becoming cheaper than coal:

- First, global LNG oversupply could lead to gas prices to crash again, as new Australian gas in 2017 floods the market, which caused the coal-gas switching in 2016. However, although this may happen, it is hard to see this as permanent, especially with the costs of coal extraction so low and the coal market once again returning to oversupply.
- Second, a higher carbon price. It is clear from the UK that a 30 Euro/tonne carbon price would lead to a near-complete hard coal-gas switching. However, even if the ETS reforms voted by the European Parliament's environment committee in December 2016 were adopted by the Parliament and the Council, it is unlikely that this would raise the carbon price by much. The reason is the structural oversupply, as described in the chapter above.

Regarding European energy policy, 2017 will see the beginning of the legislative procedure on the "Clean Energy for All Europeans"-package of proposals and possibly finalization of further reforms of the EU ETS and the effort-sharing decision. Thus, energy policy is back on the agenda in Europe 2017 – covering the whole range of policies from energy efficiency, renewables, power market design and climate policy instruments.

Absent much more drastic reforms, the enormous and ever-growing emissions surplus in the ETS suggests prices for emissions allowances will not have a significant effect on power market investments at least until 2030. If the ETS does not push coal out of the market, we expect more national initiatives to accelerate the shut-down of coal-fired generators – or more member states to adopt a carbon price support mechanism like the UK. The issue of "just transition" that also addresses the socio-economic challenges of a coal phase-out, particularly in regions with mining activities, is thus likely to gain momentum in the clean-energy-package negotiations.

Furthermore, we expect the issue of the future of renewables to be one of the key fields of debate in 2017. Given that the stunningly low prices seen for wind and solar in 2016 were far below the levels expected by the European Commission when proposing the 2030 climate and energy targets, there is a case to revisit both the EU's 2030 renewables target and the mechanisms proposed in the renewables directive. There is certainly a need for stable and robust regulation coupled with smart financing tools to guarantee low risk premiums, so that Europe can reap the full potential of energy efficiency and renewables, also beyond 2020.

# 8 Annex

## 8.1 Data

This report is mostly focused around the changes in generation by country in 2016 versus 2015. Table 1 shows the Terawatt hours changes, which form the basis of the report; the methodology is outlined in the section below.

Terawatt hour changes by fuel type by country in 2016 versus 2015 — Table 1

| | Lignite | Hard Coal | Other fossil | Gas | Nuclear | Hydro | Solar | Wind | Biomass etc | Imports | Consump-tion | $CO_2$ (Mt) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EU28** | **-15.8** | **-77.8** | **1.4** | **101.4** | **-18.5** | **6.3** | **4.0** | **3.9** | **2.7** | **6.2** | **13.6** | **-48** |
| Austria | 0 | -1 | 0 | 0 | 0 | 3 | 0 | 1 | 0 | -1 | 2 | -1 |
| Belgium | 0 | -2 | 0 | -1 | 17 | 0 | 0 | 0 | 0 | -14 | 0 | - |
| Bulgaria | -2 | -1 | 0 | 1 | 1 | -2 | 0 | 0 | 0 | 3 | 0 | -2 |
| Cyprus | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Czech Republic | 1 | 0 | 0 | 1 | -3 | 0 | 0 | 0 | 0 | 2 | 0 | 2 |
| Denmark | 0 | 2 | 0 | -1 | 0 | 0 | 0 | -1 | 2 | 0 | 2 | 1 |
| Estonia | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | 0 | 0 |
| Finland | 0 | 2 | 0 | -1 | 0 | -1 | 0 | 1 | 0 | 2 | 2 | 1 |
| France | 0 | -1 | 0 | 13 | -33 | 3 | 1 | 0 | 1 | 22 | 5 | 4 |
| Germany | -5 | -8 | 0 | 17 | -7 | 3 | 0 | 1 | 1 | -4 | -2 | -5 |
| Greece | -4 | 0 | 0 | 5 | 0 | -1 | 0 | 0 | 0 | -1 | 0 | -5 |
| Hungary | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | -2 | 0 | 0 |
| Ireland | | 0 | | 2 | 0 | 0 | 0 | 0 | 0 | -1 | 1 | 1 |
| Italy | 0 | -6 | -2 | 10 | 0 | -4 | 0 | 2 | 0 | -5 | -5 | -1 |
| Latvia | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lithuania | 0 | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| Netherlands | 0 | -3 | | 6 | -1 | 0 | 1 | 1 | -1 | -2 | 2 | 0 |
| Poland | -2 | 1 | 0 | 1 | 0 | 0 | 0 | 2 | -1 | 0 | 1 | -1 |
| Portugal | 0 | -2 | 0 | 2 | 0 | 7 | 0 | 1 | 0 | -7 | 0 | -1 |
| Romania | -2 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 1 | -2 |
| Slovakia | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Slovenia | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | 0 | 0 |
| Spain | -2 | -14 | 0 | 1 | 1 | 8 | 0 | 1 | 0 | 7 | 2 | -14 |
| Sweden | 0 | 0 | 1 | 0 | 6 | -12 | 0 | -1 | 0 | 8 | 2 | 0 |
| United Kingdom | 0 | -44 | 0 | 45 | 1 | -1 | 2 | -1 | 1 | -3 | 1 | -22 |

Blue cells are using mostly ENTSO-E data; pink cells are using mostly national system operator data

## 8.2 Methodology

When working with recent European power data, various obstacles occur. This applies mostly to generation data, but also export data are not always complete. Annual Eurostat data for generation is in most cases available until 2014.

We then add on the generation differences for 2015 and 2016. We primarily get these from ENTSO-E monthly aggregated data. However, ENTSO-E did not start reporting all relevant data until mid-January 2015, and changed their methodology in 2016, whilst they also had their website offline for most of 2016. The ENTSO-E aggregated data is lagged, and for many countries the data is only available to August 2016. Therefore, we also supplement and cross-check this data with national governments and national energy institutions, and also with some ENTSO-E hourly data from the transparency platform.

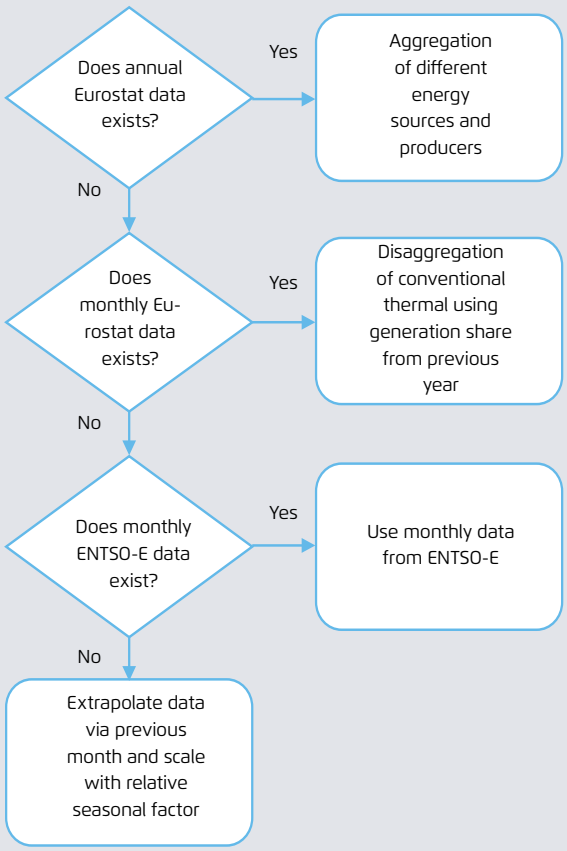
We welcome insights to better, more reliable, more recent data and to the used methodology for the EU.

If not indicated otherwise, all figures in this report are gross values. Gross consumption is calculated as follows:

Gross consumption = gross production – exports + imports – grid losses – pump storage losses

Eurostat reports annual data in a very detailed fashion. We aggregated the various energy sources according to the following table 2.

Flow chart: Calculation of annual electricity generation

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Classification of fuel type — Table 2

| Energy sources as used in this report | Detailed energy carriers used in EUROSTAT |
|---|---|
| Lignite | Lignite, peat, patent fuels and BKB (Braunkohlebrikett) |
| Hard Coal | Hard coal, blast furnace gas, coke oven gas |
| Oil | Bitumen, crude oil, diesel, naphtha, kerosene, residual fuel oil |
| Gas | LPG, natural gas liquids, gas work gas and other recovered gases |
| Other | Industrial waste, non-renewable municipal waste, shale oil, oil sands, gas coke, coal tar, coke oven coke, coking coal, petroleum coke |
| Biomass | Gaseous, liquid and solid energy carriers plus the renewable share of waste, if reported separately |
| Other renewables | Geothermal plus tide, wave and ocean |
| Hydropower | Should include run-of-river and storage, but no pumped storage for our purpose. However, hydropower from annual EUROSTAT data includes generation from pumped storage. Therefore, hydropower is calculated from hydropower as reported by EUROSTAT minus pumped storage. Generation from pumped storage does not include energy from natural inflow; natural inflow is included in stored water. |
| Solar | Photovoltaic and solar thermal |

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**Agora Energiewende**
Anna-Louisa-Karsch-Straße 2 | 10178 Berlin
P +49. (0)30. 284 49 01-00
F +49. (0)30. 284 49 01-29
www.agora-energiewende.de
info@agora-energiewende.de

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