The European Power Sector in 2018

Up-to-date analysis on the electricity transition

ANALYSIS

Agora Energiewende

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*RES-Share of Gross Electricity Generation

The European Power Sector in 2018

IMPRINT

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Up-to-date analysis on the electricity transition

AN ANALYSIS BY

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Preface

Dear Reader,

The power sector is playing a leading role in the decarbonisation of Europe, so it is critical to track the progress of the electricity transition as accurately and timely as possible.

For the third year in a row, Sandbag and Agora Energiewende have joined forces to update on the European electricity sector transition. Key topics include renewables growth, conventional power generation, electricity consumption, and CO_2 emissions.

We provide our best-view of 2018 electricity consumption, generation and emissions by country. This data is available to download in order to enable others to also perform up-to-date analysis.

We hope you will enjoy reading the report!

Kind regards

Patrick Graichen, Director, Agora Energiewende
Dave Jones, Electricity Analyst, Sandbag

Key findings:

1. **CO_2 emissions in the power sector fell by 5% in 2018.** Half of this was structural, from new wind, solar and biomass displacing hard coal. The other half was weather-related, as increased hydro generation reversed the temporary rise in gas in 2017. Overall EU ETS emissions, we estimate, fell by 3%, from 1754 Mt in 2017 to 1700 Mt in 2018.

2. **It's a tale of two types of coal: Europe's transition from hard coal to renewables is accelerating…** Hard coal generation fell by 9% in 2018, and is now 40% lower than in 2012. In 2018, Germany and Spain announced that coal phase-out plans were imminent. That would now put three quarters of Europe's 2018 hard coal generation under national coal phase-outs. The remaining quarter is almost all in Poland.

3. **…however, the transition from lignite – the dirtier, brown coal – to renewables proving much harder.** Lignite generation fell by only 3% in 2018. Half of Europe's lignite generation in 2018 was in Germany; the Coal Commission announcement for a 2038 phase-out includes lignite. The other half is in countries where this is not yet the case: Poland, Czech Republic, Bulgaria, Greece, Romania and Slovenia.

4. **Wind is strong, but get ready for solar!** Renewables rose to 32.3% of EU electricity production in 2018. While this year's rise was mainly due to wind growth picking up and hydro returning back to normal, solar will be the next big thing: solar additions increased by more than 60% to almost 10 GW in 2018 and could triple to 30 GW by 2022. Module prices fell by 29% in 2018. Solar outperformed during the 2018 summer heatwave, when coal, nuclear, wind and hydro all stumbled. Bold national plans for solar in 2030 were drafted in Italy, France and Spain in 2018. The EU's 2030 RES target, agreed in 2018, will result in even more.

5. **For the first time, the fuel and carbon costs alone for coal and gas plants were on a par with the full cost of wind and solar.** Coal and gas generation costs rose in 2018: coal price rose 15%, gas rose 30%, and the CO_2 price rose 170%. Consequently, electricity prices rose to 45–60 €/MWh in Europe. This is the level at which the latest wind and solar auctions cleared in Germany.

Contents

1 Introducing the latest data

1.1 What data do we use in this report?

This report produces a "best view" of electricity data to 2018. The data is available to download from our website.

2000 to 2016 data is from EUROSTAT. Note: all data used is "gross" not "net". The accompanying Excel sheet describes the mappings used for EUROSTAT.

2017 and 2018 data is our "best view" of what the EUROSTAT data will be when it is eventually published. We do this by estimating the year-on-year changes in 2017 and 2018 and add these on to the 2016 EUROSTAT data. We do this from a combination of sources. Germany is from AG-Energiebilanzen, UK is from Carbon Brief, and the rest is different ENTSO-E data checked against transmission system operator (TSO) data.

This year, we place a heavier reliance on ENTSO-E hourly data than in previous reports. This should further improve accuracy from previous years. However, that data is far from perfect so it's still an art of piecing together multiple sources. For example, the hourly ENTSO-E data misses smaller power plants (esp. gas + wind + solar), mis-classifies coal/gas (IT, NL, DE) and biomass/coal (DK, UK) and lignite/coal (ES, PL). Some gaps are massive (IE, FR, UK).

1.2 Last year's accuracy

We were very pleased with our performance again last year as we were very close to predicting the EUROSTAT actuals for 2016. In total, there is around 3000 TWh each of consumption and production so inaccuracies of 3 TWh and 11 TWh respectively against the EUROSTAT actuals are obviously quite small given the rapid transition (see Table 1).

Accuracy of last year's calculations — Table 1

TWh for EU28	Lignite	Hard Coal	Other fossil	Gas	Nuclear	Hydro	Solar	Wind	Biomass	Imports	Consumption	Production
2016 vs 2015												
Jan-18 forecast by us	-15	-77	-1	100	-18	8	3	4	6	12	20	9
Eurostat actuals	-16	-76	1	113	-17	9	3	1	3	4	24	20
Difference	**-1**	**1**	**3**	**12**	**1**	**1**	**0**	**-3**	**-3**	**-8**	**3**	**11**
2017 vs 2016												
Jan-18 forecast by us	6	-27	2	42	-9	-54	9	58	5	-8	23	31
Jan-19 forecast by us	2	-28	2	40	-9	-45	8	57	6	-8	25	32
Difference	**-3**	**-1**	**-1**	**-2**	**1**	**9**	**-1**	**-1**	**1**	**1**	**2**	**1**

Own calculations

Also, our forecast for 2017 has stayed pretty constant despite much more data becoming available. Consumption changes by only 2 TWh and production by 1 TWh. EUROSTAT are expected to publish 2017 data later in Q1-2019.

1.3 Key changes to the electricity mix in 2018

Tables 2 and 3 show the total TWh and the TWh changes in 2018, based on our best view.

- **Electricity consumption** rose slightly by 0.2% (+7 TWh), the fourth consecutive year of increases.
- **Wind generation** increased by 6% (+22 TWh). 90% of the rise in generation was in only 3 countries: Germany, UK and France.
- **Solar generation** rose by 7% (+8 TWh). This is still well-below trend: 8 TWh growth compares to 13 TWh/year average growth for 2010–2017.
- **Biomass generation** rose only 2% (+5 TWh) providing some reassurance that biomass growth has slowed - but not gone away.
- **Total wind, solar and biomass rose +35 TWh.** This is below the 53 TWh/year trend this decade mostly because of wind speed differences.
- **Hydro generation** rose by 13% (+39 TWh), recovering to normal levels vs. 2017 (when generation was at its lowest so far this century). In 2018, hydro generation was above-average in southern Europe and below-average in northern Europe.
- **Nuclear generation** was broadly unchanged at -0.3% (-2 TWh as breakdowns swapped from France to Belgium.
- **Gas generation** fell by 5% (-35 TWh) as more hydro in Spain, Italy and France reduced gas use. UK gas generation fell for the second year in a row as offshore wind is now displacing gas.
- **Hard coal generation** fell 9% (-34 TWh). This was caused by renewables growth in Germany and the UK and by the return of hydro in Italy and Spain. Hard coal generation was 40% below 2012 levels.
- **Lignite generation** fell slightly by 3% (-8 TWh) following small plant closures in Poland and Germany.
- **Overall fossil generation** fell by 6% (-81 TWh), the highest drop in 4 years, as wind and solar continued to grow, hydro stocks recovered and nuclear output stabilised.
- **CO_2 emissions** for the EU power sector fell by 5%, due largely to the fall in hard coal and gas.
- **Net electricity imports** into the EU rose by 16 TWh as the western Balkans exported more electricity to EU countries as a result of the improvement in that region's hydro situation.

All of these themes are explored in much more detail in the following chapters.

Power production 2018, by fuel by country, TWh — Table 2

TWh	Lignite	Hard Coal	Other fossil	Gas	Nuclear	Hydro	Solar	Wind	Biomass	Consumption	Imports	Production
EU28	**300**	**324**	**131**	**614**	**829**	**344**	**127**	**382**	**198**	**3276**	**26**	**3249**
Austria	0	2	4	9	0	37	2	6	5	72	9	64
Belgium	0	0	5	23	29	0	4	7	5	91	17	74
Bulgaria	19	1	0	2	16	5	1	1	0	38	-8	46
Cyprus	0	0	5	0	0	0	0	0	0	5	0	5
Czech	37	4	3	4	30	2	2	1	5	73	-14	87
Denmark	0	6	1	1	0	0	1	15	8	36	5	32
Estonia	0	0	10	0	0	0	0	1	1	10	-2	12
Finland	3	6	1	5	23	14	0	6	10	88	20	68
France	0	7	7	29	413	64	10	29	8	505	-63	568
Germany	146	83	26	84	76	17	46	112	52	595	-47	642
Greece	17	0	6	14	0	7	4	6	0	61	6	55
Hungary	5	0	0	7	16	0	0	1	2	46	14	32
Ireland	2	4	0	16	0	0	0	8	1	31	0	31
Italy	0	27	18	130	0	47	24	18	26	332	44	289
Latvia	0	0	0	3	0	2	0	0	1	8	1	7
Lithuania	0	0	1	0	0	0	0	1	1	13	10	3
Netherlands	0	34	6	55	2	0	3	9	5	121	6	114
Poland	49	80	5	11	0	2	0	13	8	175	6	169
Portugal	0	12	2	15	0	13	1	13	3	56	-3	59
Romania	16	0	1	10	11	18	2	6	0	62	-3	65
Slovakia	1	1	1	2	15	4	1	0	2	30	4	27
Slovenia	4	0	0	0	6	5	0	0	0	15	-1	16
Spain	0	38	19	57	57	33	13	52	6	284	10	274
Sweden	0	0	3	1	69	62	0	16	11	147	-17	164
United Kingdom	0	17	7	132	65	5	13	58	36	352	19	333
Luxembourg	0	0	0	0	0	0	0	0	0	7	6	1
Malta	0	0	1	0	0	0	0	0	0	2	2	1
Croatia	0	2	0	2	0	8	0	1	1	19	5	14

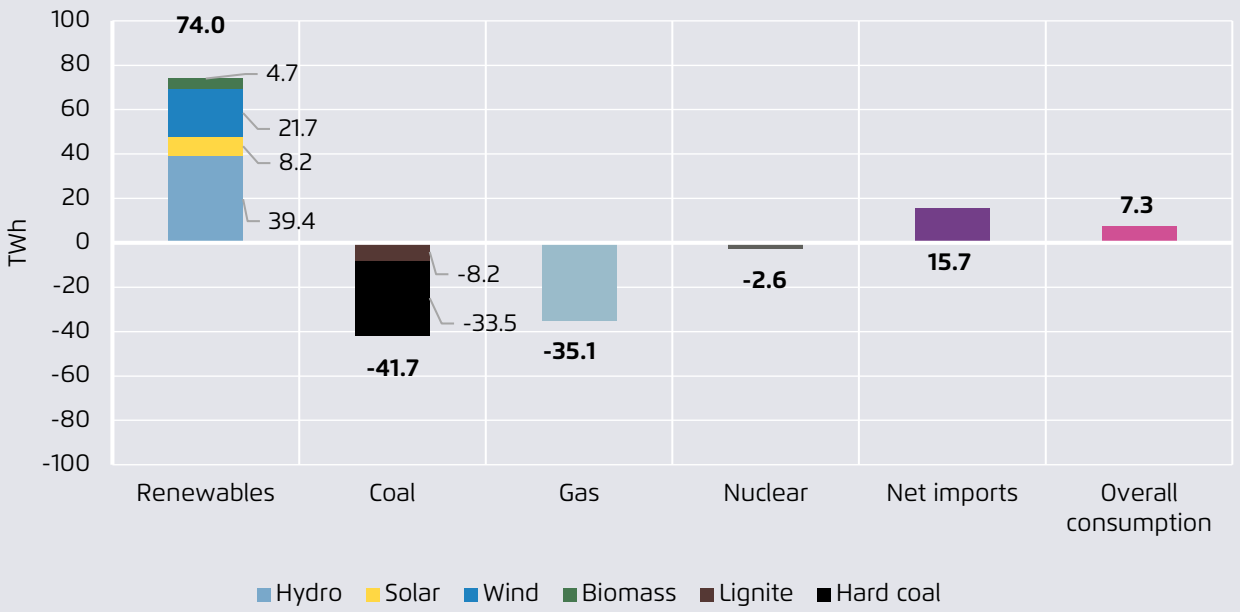
Own calculations

Changes from 2017 to 2018, by fuel by country, TWh — Table 3

TWh	Lignite	Hard Coal	Other fossil	Gas	Nuclear	Hydro	Solar	Wind	Biomass	Consumption	Imports	Production	CO_2 (Mt)
EU28	**-8**	**-33**	**-3**	**-35**	**-3**	**39**	**8**	**22**	**5**	**7**	**16**	**-8**	**-54**
%-change	**-3%**	**-9%**	**-2%**	**-5%**	**-0.3%**	**13%**	**7%**	**6%**	**2%**	**0.2%**	**150%**	**-0.3%**	**5%**
Austria	0	0	0	-2	0	-2	0	0	0	-1	3	-3	-1
Belgium	0	0	0	0	-13	0	1	1	0	0	11	-11	0
Bulgaria	-1	0	0	1	1	1	0	0	0	-1	-2	1	-1
Cyprus	0	0	0	0	0	0	0	0	0	0	0	0	0
Czech	0	-1	0	0	2	0	0	0	0	0	-1	1	0
Denmark	0	1	-1	1	0	0	0	0	-1	1	0	0	1
Estonia	0	0	-1	0	0	0	0	0	0	0	1	-1	0
Finland	1	0	0	1	0	-1	0	1	-1	1	0	2	1
France	0	-4	-1	-11	14	13	1	4	0	-6	-23	16	-8
Germany	-2	-11	0	-4	0	-3	7	8	1	0	5	-5	-13
Greece	-2	0	0	-1	0	2	0	1	0	0	0	0	-2
Hungary	0	0	0	-1	0	0	0	0	0	0	1	-1	0
Ireland	0	0	-1	1	0	0	0	1	0	1	0	1	0
Italy	0	-6	0	-8	0	10	-1	0	0	1	6	-5	-9
Latvia	0	0	0	1	0	-2	0	0	0	0	1	-1	0
Lithuania	0	0	0	0	0	0	0	0	0	1	1	0	0
Netherlands	0	0	0	-2	-1	0	1	0	0	0	3	-2	-1
Poland	-3	2	0	3	0	-1	0	-2	0	3	3	-1	0
Portugal	0	-2	0	-3	0	6	0	0	0	1	0	1	-3
Romania	-1	0	0	0	0	3	0	-1	0	1	0	1	-1
Slovakia	0	0	0	0	0	-1	0	0	0	0	1	-1	0
Slovenia	0	0	0	0	0	1	0	0	0	0	0	0	0
Spain	0	-6	0	-6	-2	14	-2	3	0	2	1	1	-8
Sweden	0	0	0	0	3	-3	0	-1	0	2	2	0	0
United Kingdom	0	-6	0	-5	-5	-1	1	8	4	2	4	-3	-7
Luxembourg	0	0	0	0	0	0	0	0	0	0	0	0	0
Malta	0	0	0	0	0	0	0	0	0	0	0	0	0
Croatia	0	0	0	-1	0	2	0	0	0	0	-1	2	0

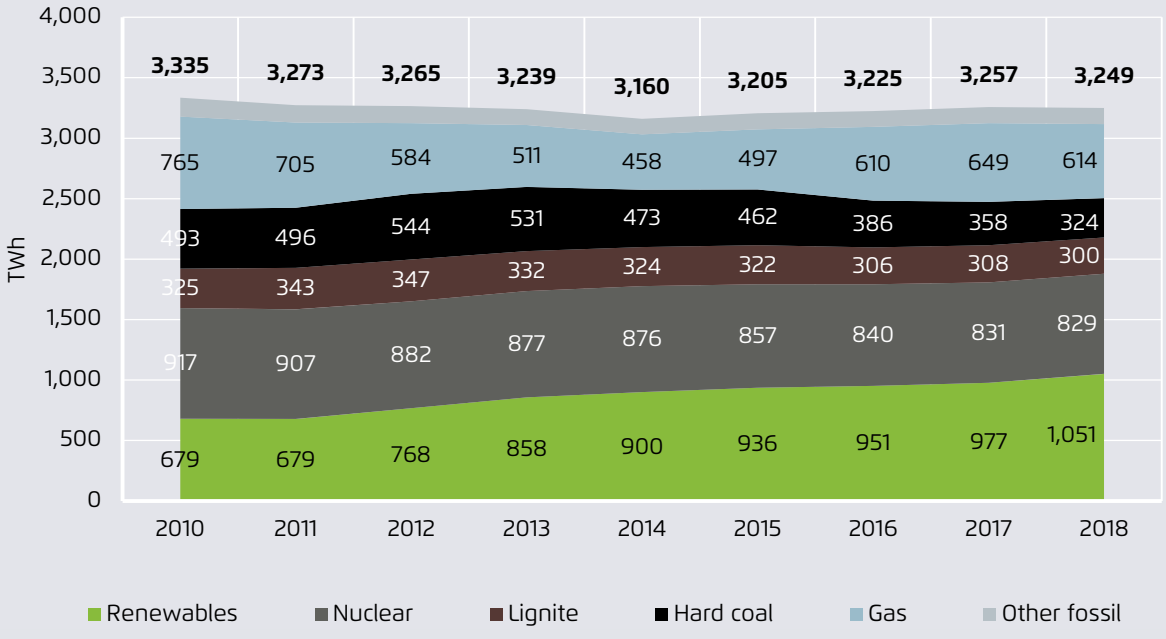
Own calculations

Changes in EU28 electricity generation from 2017 to 2018 Figure 1-1



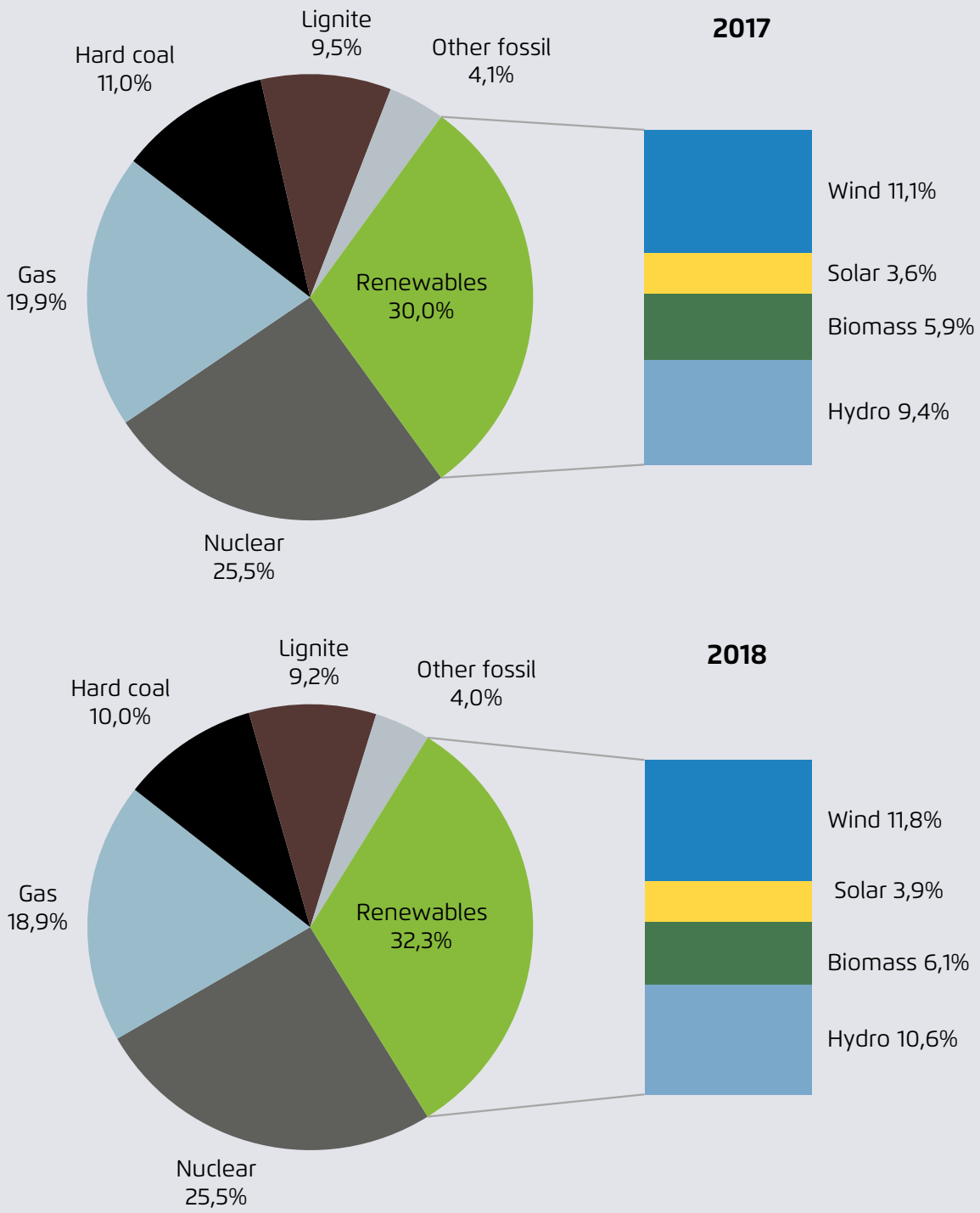
EUROSTAT data to 2016; own calculations for 2017 and 2018

EU28 electricity generation Figure 1-2



EUROSTAT data to 2016; own calculations for 2017 and 2018

Generation mix in 2017 and 2018 Figure 1-3



EUROSTAT data to 2016; own calculations for 2017 and 2018

2 Electricity consumption

Electricity consumption increased by 0.2% (7 TWh) in 2018, the fourth year in a row that overall European electricity consumption has increased albeit at a slower rate than in previous years. Electricity consumption, however, remains 2% lower than in 2010 despite a 13% rise in GDP and a 2% rise in population since then (see Figure 2-1).

Electrification of the economy is expected to increase electricity consumption. The European Commission's "Long Term Strategy 2050" released in November 2018 suggests that electricity consumption will rise 18% by 2030 (see Figure 21 here). Electrification of transport, heat and industry are seen as the main drivers. The strategy envisages that 10% of Europe's transport will be electrified by 2030 (Figure 49 here).

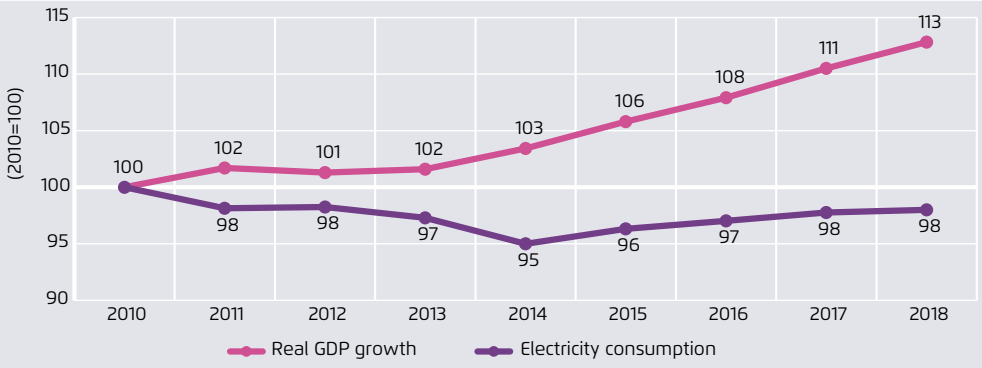
Broadly stable electricity consumption can be ascribed to the following trends in 2018:

- → Economic growth is less "industrial". While overall EU GDP rose by 2% in 2018, industrial production fell by 2% - a stark contrast from the previous 3 years when industrial production growth exceeded GDP growth. For example steel production fell by 0.5%, after rising by 4% in 2017.
- → The European electric vehicle and heat pump markets expanded in 2018 but from a small base. The step change in electrification of transport and heat is yet to come. Electric car sales were up 34% in 2018 resulting in 2.4% of new car sales being electric.

The overall weather impact on electricity use in 2018 was small. 2018 was a very warm year across the whole of Europe and 0.4 degrees warmer than 2017 (see Figure 2-2). February and March were the only two cold months, when the so-called "Beast from the East" swept windy cold air across Europe. The other ten months in 2018 were significantly above normal temperatures. Overall, the winter months were warm so the reduced heating demand offset the additional air conditioning demand in the hot summer months.

The trend in electricity consumption in 2018 followed a similar pattern to previous years – rising in eastern European countries, and stagnant elsewhere (see Figure 2-3). Poland's electricity consumption rose by 1.6% in 2018, putting it 12% above 2010 levels and, in terms of growth, second only to Lithuania. In western European countries, consumption was below 2010 levels, with the UK having reduced electricity consumption most. As said above, electrification of heat and transport is expected to raise electricity consumption everywhere in the coming decade.

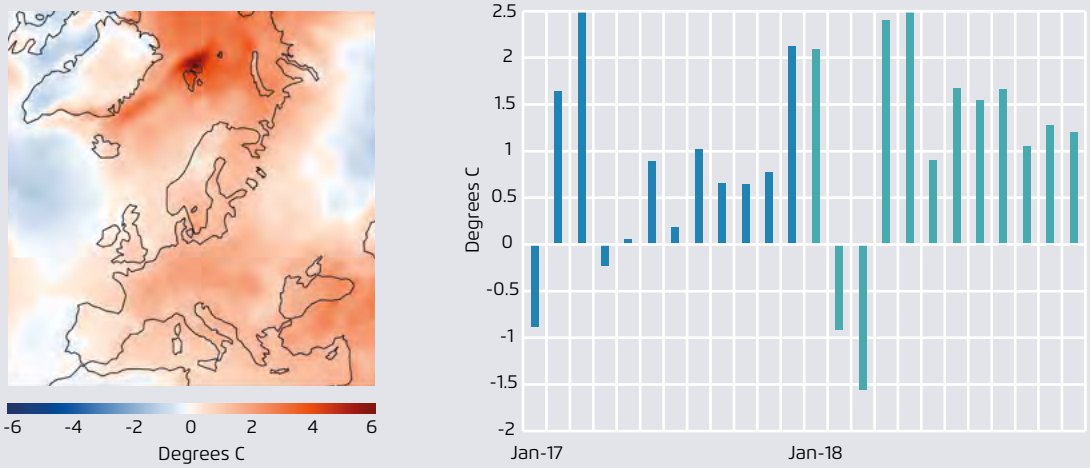
EU-28 electricity consumption, GDP (indexed) Figure 2-1



Electricity consumption from EUROSTAT data to 2016; own calculations for 2017 and 2018; GDP from EUROSTAT

Surface air temperature anomalies with respect to 1981–2010
For average Jan–Dec 2018 (left) and by month (right)

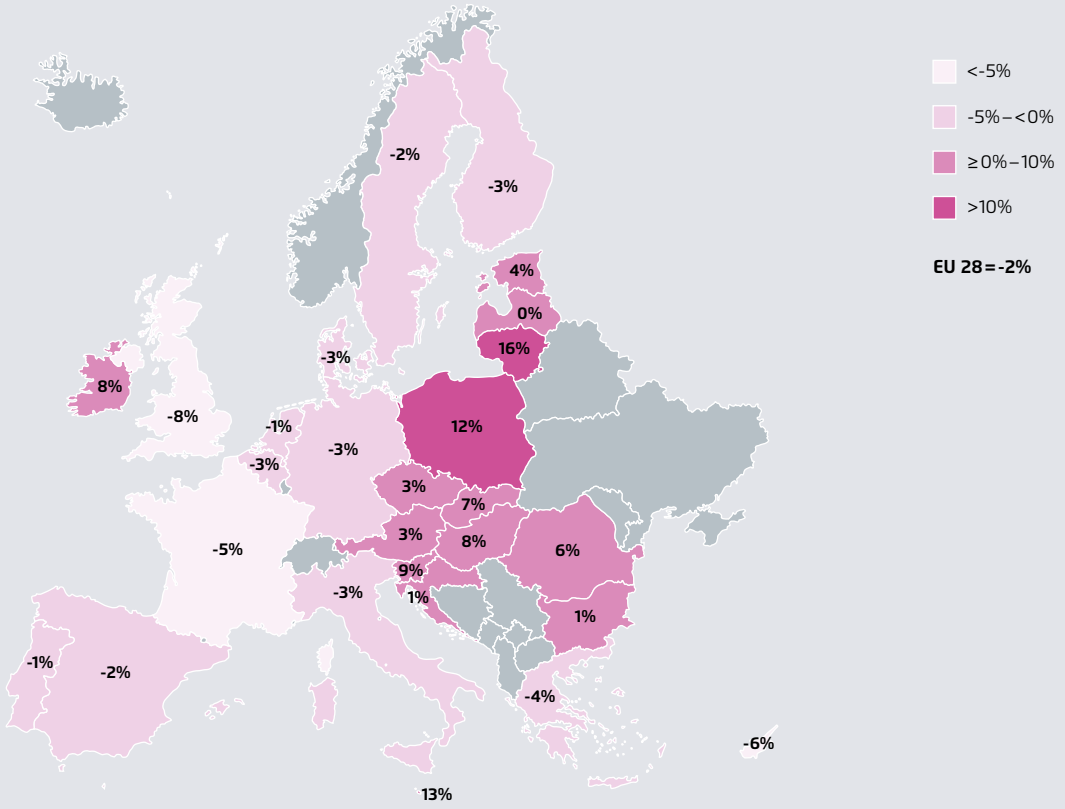
Figure 2-2



ECMWF Copernicus Climate Change Service 2018

Change in electricity consumption from 2010 to 2018

Figure 2-3



EUROSTAT data to 2016; own calculations for 2017 and 2018

3 Renewables

3.1 Renewables in 2018

In 2018, renewables generated 32.3% of Europe's electricity (see Figure 3-1). A rise of 2.3% points, from 30.0% in 2017. Of that, half was from the recovery of hydro generation and half was from the structural rise in wind, solar and biomass generation. As of 2018, wind has the largest share in the renewables mix, contributing 12% of Europe's electricity. Solar contributed 4%, less than biomass and a third of wind generation.

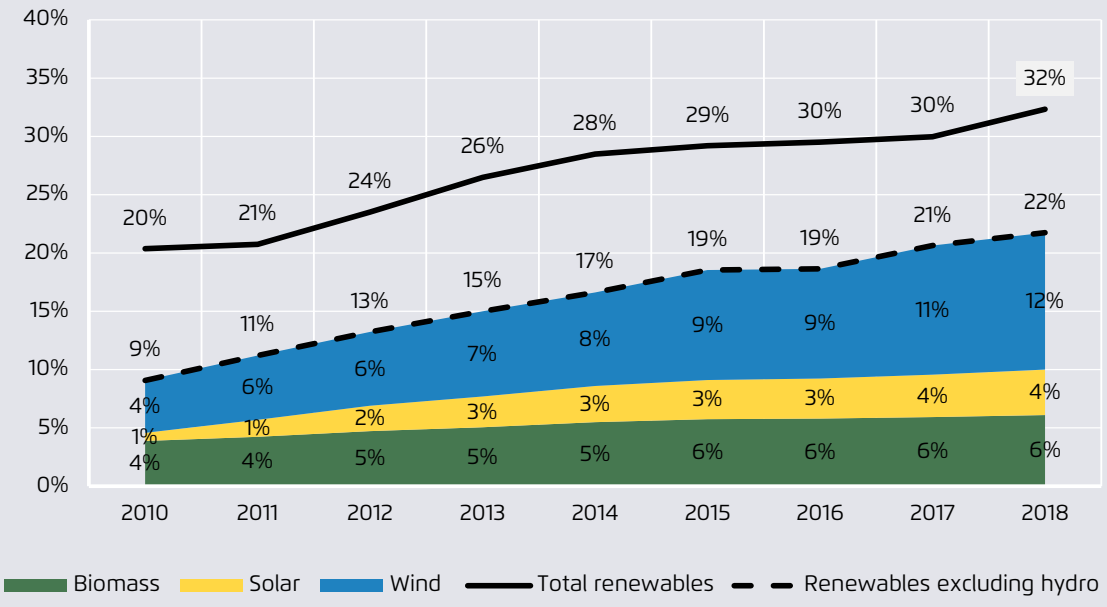
Renewable generation increased by 35 TWh in 2018 (see Figure 3-2), below the 2010–2017 average of 53 TWh per year. In part due to less windy conditions, compared to windy 2017, although increases in solar and biomass remained smaller-than-average. In the last four years, 70% of the growth in renewables has come from wind, 14% from biomass and 16% from solar.

Solar generates 4% of Europe's electricity but this is very different country to country. Italy still has the highest proportion, with 8% of its electricity from solar. Germany and Greece come in joint second at 7% (see Figure 3-3). At the other extreme, some countries have almost no solar generation: Poland, Finland, Sweden and Ireland barely register and even sunny Croatia and Portugal have <1%. German solar levels increased the most in 2018, due to the higher-than-normal sunshine across summer. In the UK, 2018 was the second sunniest on record.

3.2 Solar: the next big thing

Solar – despite currently lagging both wind and biomass – is ready to expand to become a cornerstone of Europe's power system.

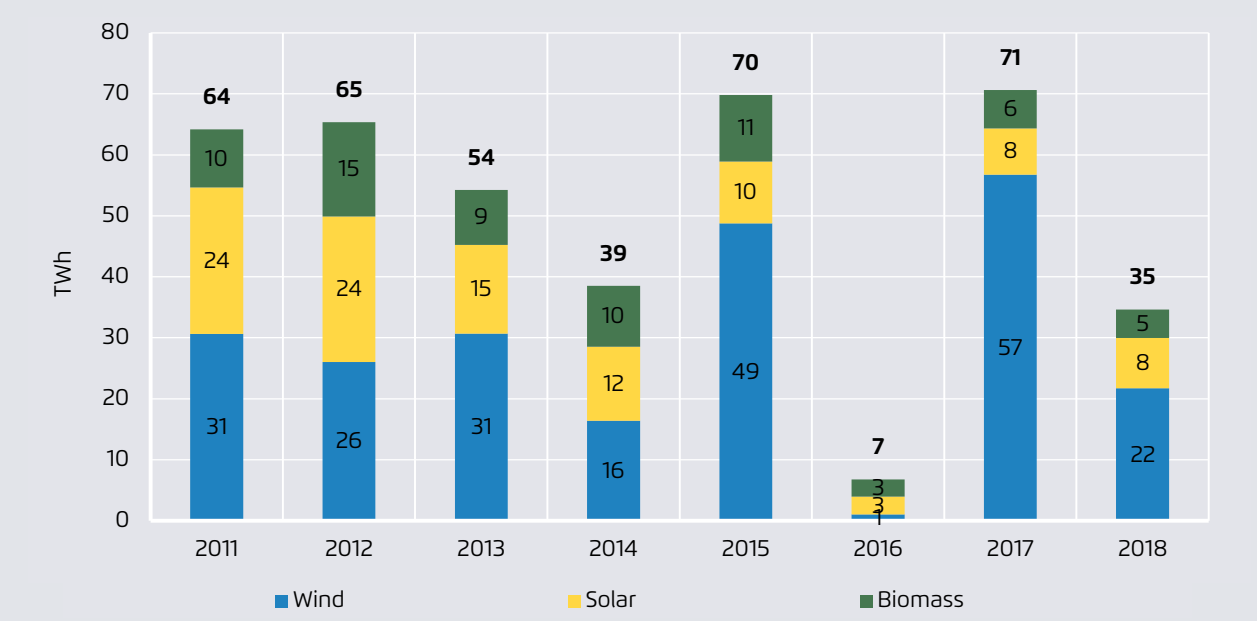
EU-28 renewables share (as percentage of gross electricity production) Figure 3-1



EUROSTAT data to 2016; own calculations for 2017 and 2018

Year-on-year changes in EU-28 renewable electricity generation

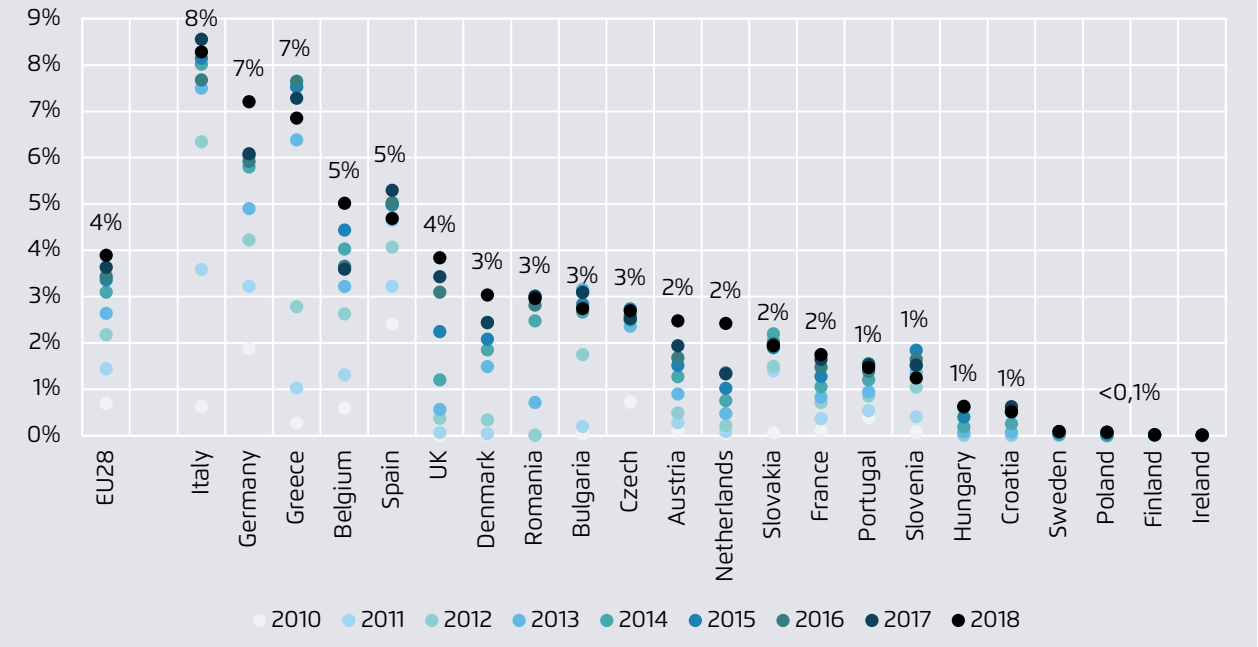
Figure 3-2



EUROSTAT data to 2016; own calculations for 2017 and 2018

Solar as percentage of national electricity production

Figure 3-3



EUROSTAT data to 2016; own calculations for 2017 and 2018

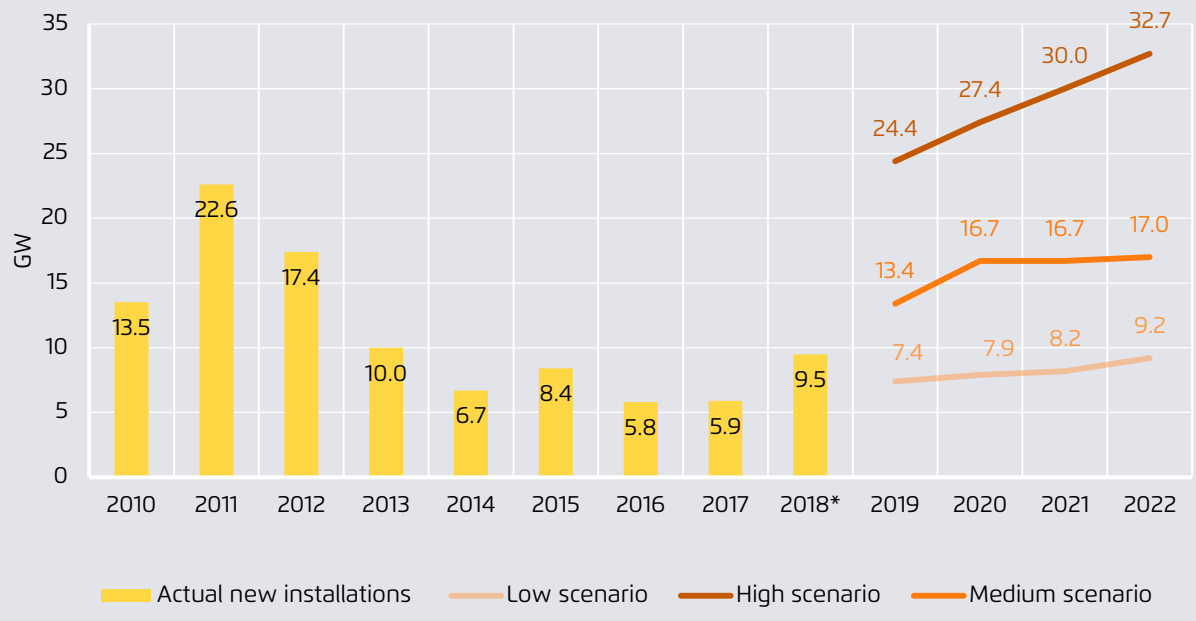
The rate solar panels were installed surged by 61% in 2018, from 5.9 GW in 2017 to 9.5 GW in 2018, SolarPower Europe estimates. This will be highest installation rate since 2013 (see Figure 3-4). SolarPower Europe said the rise "is in part thanks to the removal of the trade measures in September, which kept the price of solar at an artificially high level in Europe. By removing the duties, solar is now the cheapest form of electricity in many EU countries."

Solar installation rates could triple in 3 years to 30 GW per year, given the right policies. In June-18, SolarPower Europe updated their forecasts to 2022 (see Figure 3-4). They said "the spread between our High and Low Scenarios is very large for the next 5 years. The way solar will develop in Europe will fully depend on policy-makers in Brussels and the European countries."

Solar PV wholesale module prices saw a fall of 29% in 2018. Prices fell to 0.27 €/watt in December 2018, and follows a fall of 16% in 2017. Bloomberg New Energy Finance calculations show that global solar installations increased by 10% to 109 GW, worth $130 billion. Therefore, despite the EU's large increase in solar installations in 2018, it still accounted for less than 9% of global installations.

Solar proved its worth during the summer 2018 heatwave. Solar insolation across much of summer was significantly above average in NW Europe, where – at a time of higher electricity demand – an extended heat-wave caused shortfalls in coal, nuclear, hydro and wind generation (see Box 1).

EU-28 annual new solar PV installations — Figure 3-4



SolarPower Europe 2018; *latest forecast from SolarPower Europe

Solar outperformed during the 2018 summer heatwave, when coal, nuclear, wind and hydro all stumbled

Box 1

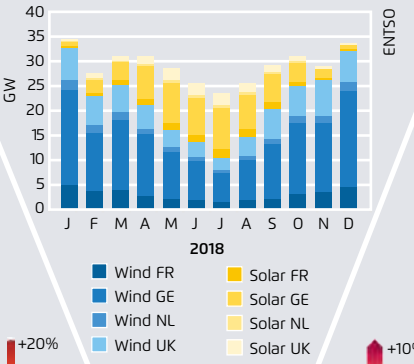
Wind

Wind generation during the heat-wave was low because the high pressure weather in July and August acted as a wall, stopping the wind from blowing in from the Atlantic to north-western Europe.

July 2018 wind speeds, anomalies to July averages for long-term average

Wind & solar

Monthly wind and solar in 2018 in France, Germany, the Netherlands and the UK

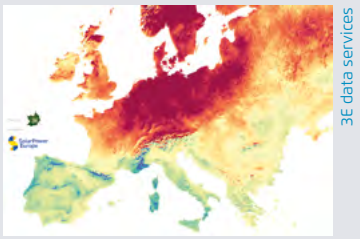


Solar replaced wind during the heatwave

Solar

The high pressure led to minimal cloud cover across NW Europe.

This meant solar was the only generation over-performing during the heatwave.



Jan–Dec 2018 solar radiation, anomalies to averages for the period 2004–2018

Nuclear

Water-cooled plants had to be shut down temporarily to protect rivers.

There were 4 complete shut-downs in France (Saint-Alban-1 1335MW, Bugey-2 & -3, 910MW, Fessenheim-2 920MW), one in Sweden (Ringhals, 900MW), plus numerous plants trimmed their output across Europe.

Demand

The heatwave led to high demand for air conditioning. Poland reached its highest ever demand in summer on June 4th of 23.2GW.

The Potsdam Institute predicted that peak demand in many European countries will shift from winter to summer, as air conditioning rises, due to higher penetration and due to climate change.

Effects of the 2018 heatwave

Hard coal

From August to November 2018, 12 plants in Germany along the Rhine alone reported supply shortage problems, because the Rhine levels was too low to import coal by barge.

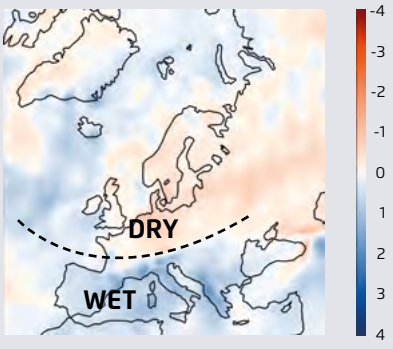
There were also problems with cooling water: Karlsruhe-7 (Germany, 505 MW) had to shut down because they were prohibited to empty their warm cooling water in the Rhine.

Hydro

Low hydro generation in northern Europe, due to below-average rainfall throughout the year:

- → Austria: lowest in eight years
- → Sweden: lowest in six years
- → Germany: lowest this century

Jan–Dec 2018 precipitation (mm/day), anomalies to averages for the period 1981–2010



ECMWF Copernicus Climate Change Service 2018

Governments drafted grandiose growth plans for solar in 2018. Governments began releasing draft "National Energy and Climate Plans" to 2030, which must be finalised by the end of 2019. Many gave explicit reference to their solar ambitions; more are expected:

- **France plans 45 GW by 2030:** France announced an aggressive expansion of wind and solar capacity to 2030, as well as slowing the rate of nuclear closures. Solar capacity in France was 8 GW in 2017.
- **Italy plans 50 GW by 2030:** Italy announced their draft National Integrated Plan for Climate and Energy 2030, which plans to increase solar capacity to 50 GW in 2030, from 19 GW in 2017.
- **Spain plans up to 77 GW by 2030:** Spain released scenarios for solar, with up to 77 GW by 2030, up from only 6 GW in 2017. Later in November, the Spanish Government went a step further and begin drafting legislation to make 100% of electricity renewable by 2050.
- **Germany committed to contract 4 GW per year of solar in 2019, 2020 and 2021.** Critically, Germany raised its target for renewable electricity in 2030 to 65%, compared to 38% in 2018.
- **Portugal** proposed a stepping stone of 80% clean electricity by 2030, on the way to 100% by 2050.

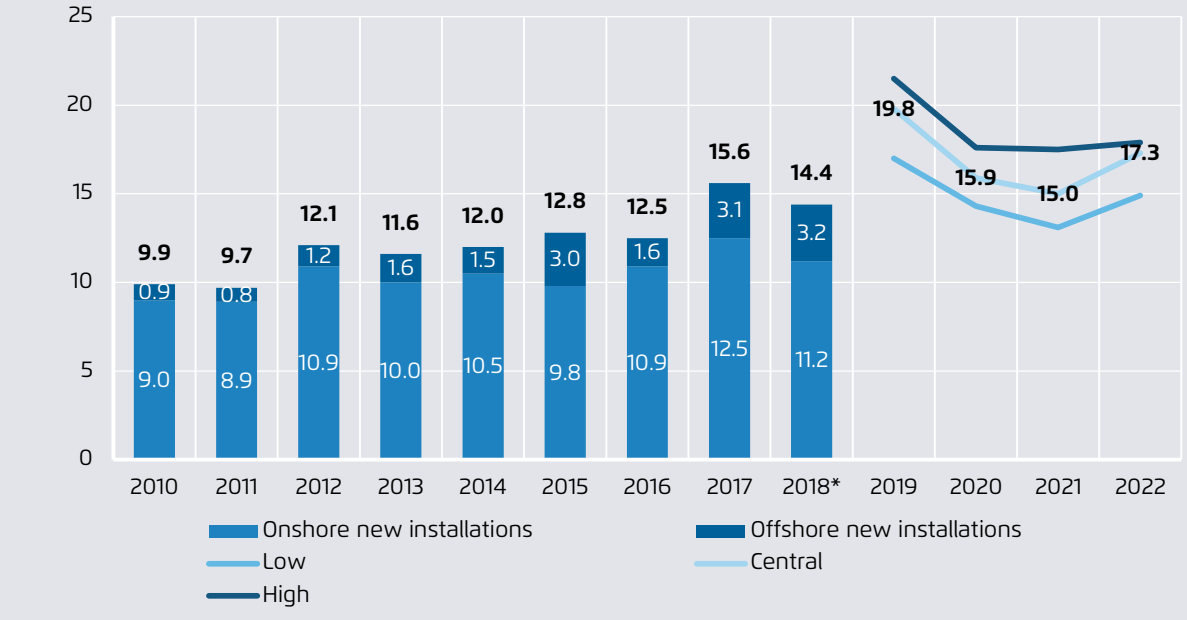
These are all promising signals that suggest solar will see a fast and substantial expansion to become a cornerstone of Europe's power system.

3.3 Wind growth

Wind generation increased by 6% (+22 TWh) in 2018. 14.4 GW of new wind capacity was installed in 2018, according to WindEurope's forecast in October 2018 (see Figure 3-5). This was down from 2017's record levels, but nonetheless represents strong growth.

However, this growth was focused only in north-west Europe. 90% of the rise in generation was in only 3 countries: Germany, UK and France. For the first half of 2018 where WindEurope have confirmed

Europe's annual new wind installations — Figure 3-5



WindEurope actuals and forecast, *WindEurope latest forecast

installation rates, they show a similar story: 71% of new capacity installed was in Germany, UK and France, and all told, 90% of new H1-2018 capacity was in NW European countries. Thirteen EU countries had zero new wind turbines installed in the first six months of 2018.

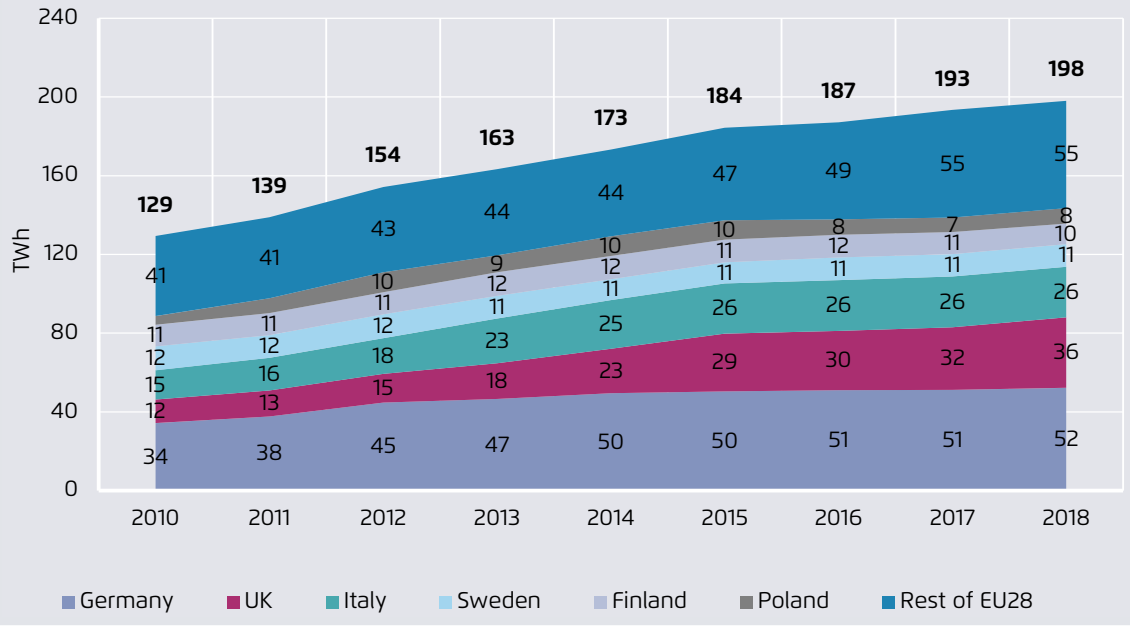
2019 is forecast to be another record year for wind, and planned new-build wind remains quite strong to 2022, albeit uneven. WindEurope released their forecast scenarios to 2022 in September 2018. They say "New installations will remain concentrated in a small number of countries, with Germany, the UK, France, Spain and the Netherlands accounting for 52% of gross capacity additions. Policy uncertainty and lack of ambition for 2030 could have a significant negative impact on the sector: visibility and regulatory certainty could increase by the end of the year, once EU countries submit their NECPs." All countries will need to step up their plans in order to reach the full potential of wind.

3.4 Biomass growth

The biomass boom is slowing, but is far from over. Biomass generation grew by only 2% in 2018. This is a similar rate to 2016 and 2017, and half the rate of the last decade (see Figure 3-6). Growth in the key countries of Germany and Italy has slowed, and biomass burn has even fallen slightly in Poland and Finland. Most of the growth came from the UK, as the Lynemouth wood pellet power plant started operations and the last biomass unit at Drax was converted from coal to biomass. There are still a few large projects under construction or looking likely to get the go ahead: UK's MGT Teesside, Denmark's Asnæs and Esbjerg coal power plant conversions, the possibility of coal conversions in the Netherlands, and as well as some smaller schemes still coming online.

Biomass does not accomplish the EU's Clean Energy for All objectives: biomass lifetime CO_2 emissions are far from zero (despite it still being zero-rated in the EU ETS), and its particulates cause pollution, hinder-

EU-28 Biomass electricity generation — Figure 3-6



EUROSTAT data to 2016; own calculations for 2017 and 2018

ing air quality. Future renewables growth must rely on wind and solar alone. This is why it is imperative to ensure wind and solar deployment accelerates to its full potential.

3.5 Hydro

A return to "normal". 2018 saw around average hydro generation for the EU as a whole. This marks a return to normal after the lowest hydro generation this century in 2017. Hydro generation rose by 13% year-on-year, or 39 TWh (see Figure 3-7).

Predictably, the rain in 2018 was not spread evenly, and – as Box 1 shows – there was a decisive split, with northern Europe quite dry, and southern Europe quite wet. This is reflected in the generation numbers, with Nordic and Germany below-average, and Spain and Italy above-average.

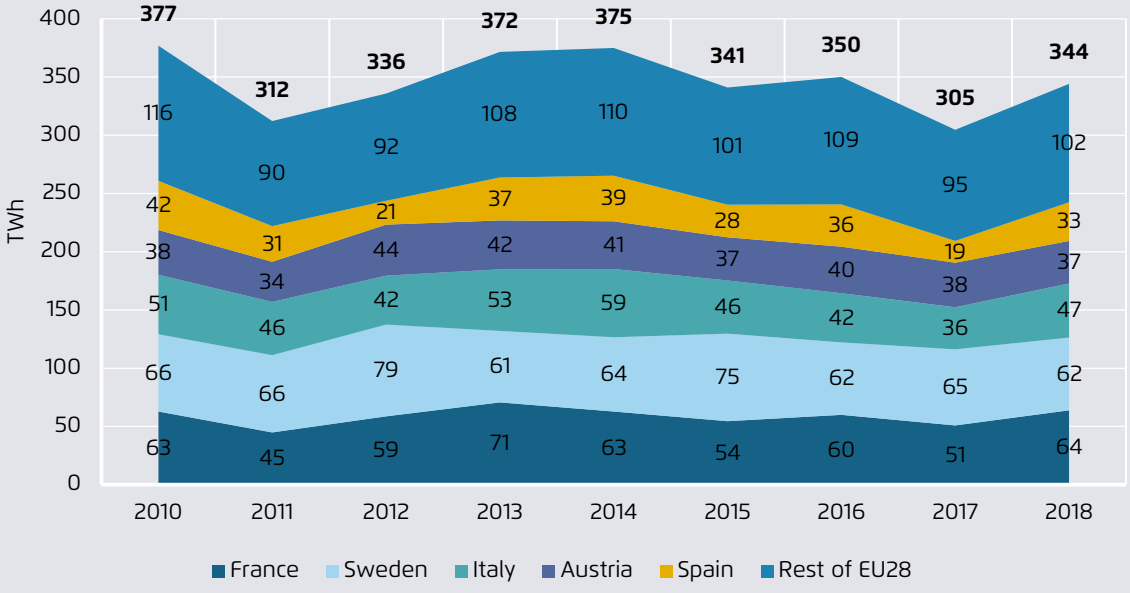
This low level of precipitation caused havoc across northern Europe during the heatwave. Not only was hydro generation lower in July, river-cooled nuclear plants also struggled and lower river levels hampered waterborne coal deliveries to power plants.

3.6 Reaching Europe's 2030 renewables targets

In November 2018, the European Commission released its 'Long Term Strategy' for decarbonising the European economy. There is only one pathway modelled to 2030. This meets Europe's 2030 Renewable Energy and Energy Efficiency targets of 32% and 32.5% respectively. The Commission also looked at various different scenario pathways to 2050, which diverge in the period after 2030 due to the different technology options.

The Commission's calculations show renewable electricity must rise to 57% by 2030, from 32% of the

EU-28 Hydro electricity generation — Figure 3-7



EUROSTAT data to 2016; own calculations for 2017 and 2018

electricity mix in 2018. Figure 3-8 shows that in the Commission's modelling, wind more than doubles from 12% in 2018 to 26% 2030, and solar almost triples from 4% to 11% (see EC page 76). Biomass implicitly almost doubles its share from 6% to 11%, assuming hydro generation stays unchanged.

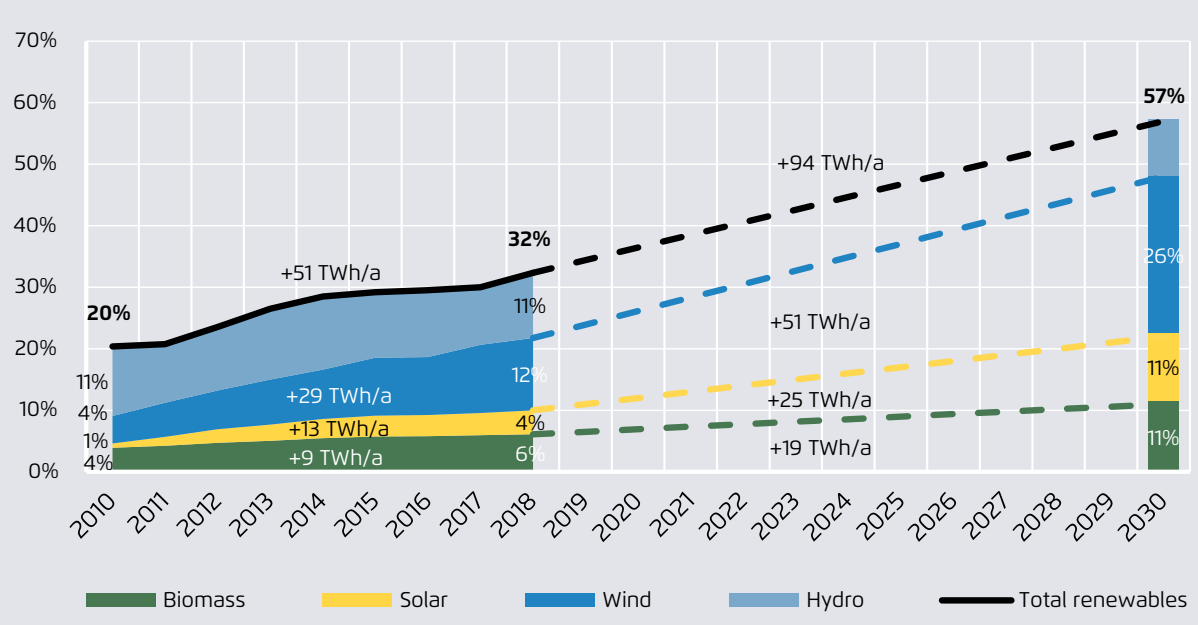
Electrification means even more renewables is needed. Electrification of transport, heat and industry means electricity consumption is forecast to rise by 18% by 2030. Therefore, renewables generation must rise by 18% by 2030 just to maintain the same 32% share as now.

All this means renewables annual deployment must rise 84% from 2010–2018 to 2018–2030. Renewables grew 51 TWh/year from 2010 to 2018. Figure 3-8 shows that to reach 57% electricity from renewables by 2030, with the extra increase in electricity demand, renewables must grow by 94 TWh/year from 2018 to 2030.

Why so much biomass? Biomass generation is implicitly forecast to double by 2030. Is this desirable, since biomass lifetime CO_2 emissions are far from zero, and particulates cause pollution? And is it realistic, given that wind and solar have largely become cheaper than biomass, and local sources of sustainable biomass are harder to find? If solar were to pick up the growth for biomass in the EC's model, it means overall **solar growth would need to more than triple from 13 TWh/year in 2010–2018 to 44 TWh/year in 2018–2030.** Whilst this is ambitious, it is certainly achievable.

In terms of capacity installed, the differences are less extreme, since wind and solar installations are more efficient than ever, delivering more energy per MW installed. The "Long Term Strategy" envisages a 2030 wind capacity of 350 GW (up from 183 GW at end-2018), and 320 GW solar (up from 117 GW at end-2018).

2030 projection of renewable electricity share in European Commission's Long Term Strategy — Figure 3-8



EUROSTAT data to 2016; own calculations for 2017 and 2018; 2030 projection from "Long Term Strategy", European Commission 2018, dashed lines show projection

4 Conventional generation

In 2018, overall conventional generation fell by almost 4% (see Figure 4-1) due to the increase in renewables. Almost all the fall was from fossil, as nuclear production was unchanged. Hard coal and gas fell in equal measure because of new wind, solar and biomass installations, and a normalisation of hydro generation. Lignite, however, only had a minor fall.

Coal generation in total fell 6% in 2018, and was 30% below 2012 levels.

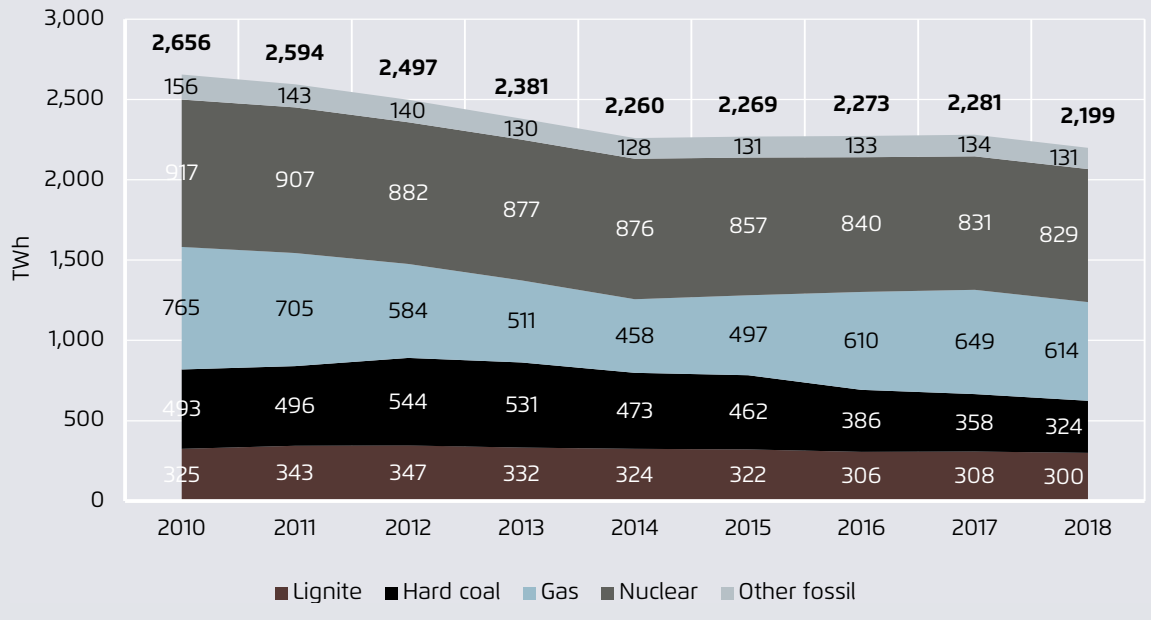
The following sections explain these developments in more detail.

4.1 Hard coal

Hard coal generation fell by 9% (34 TWh) in 2018; it is now 40% lower than in 2012 (see Figure 4-2). The 2018 fall was caused by more renewables in Germany and the UK, and the return of hydro in Italy and Spain. The proportion of electricity production from hard coal for the UK fell 40% in 2012 to 5% in 2018, and for Germany from 19% to 13% over the same period.

Three quarters of the remaining hard coal generation is under national coal phase-outs. However, this assumes Germany and Spain will carry forward their pledges to phase-out coal, which is not yet assured. Spain is still wavering, waiting to gauge the reaction from both miners and utilities of the initial announcement, and also grappling with whether to phase-out coal prior to phasing out nuclear. It also

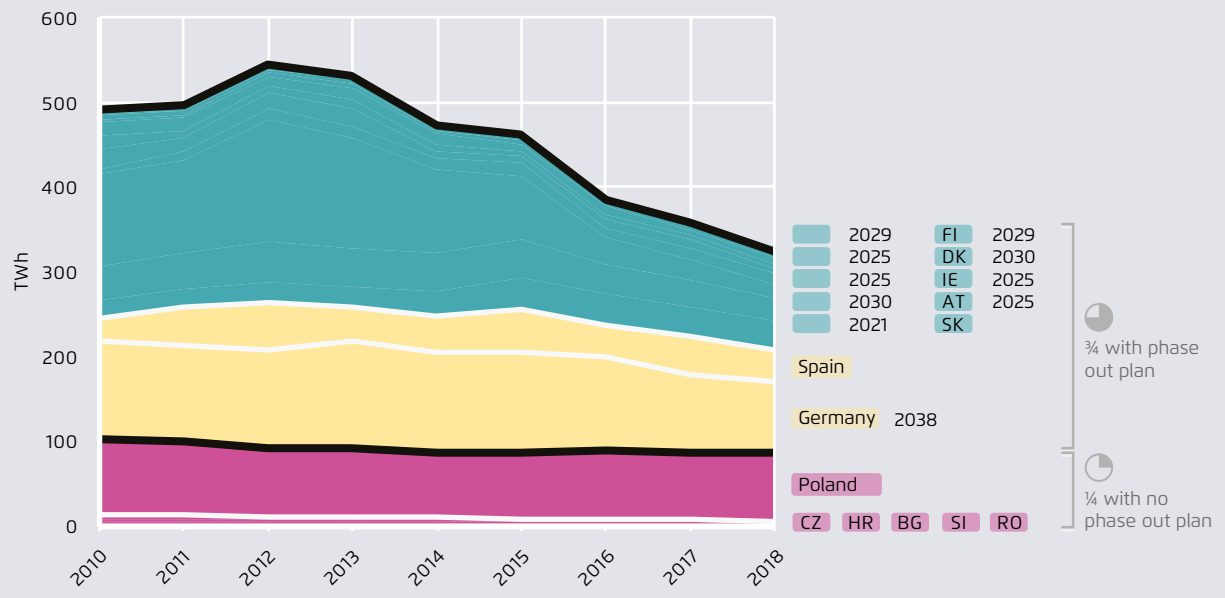
EU28 Conventional electricity generation — Figure 4-1



EUROSTAT data to 2016; own calculations for 2017 and 2018

EU-28 Hard coal electricity generation

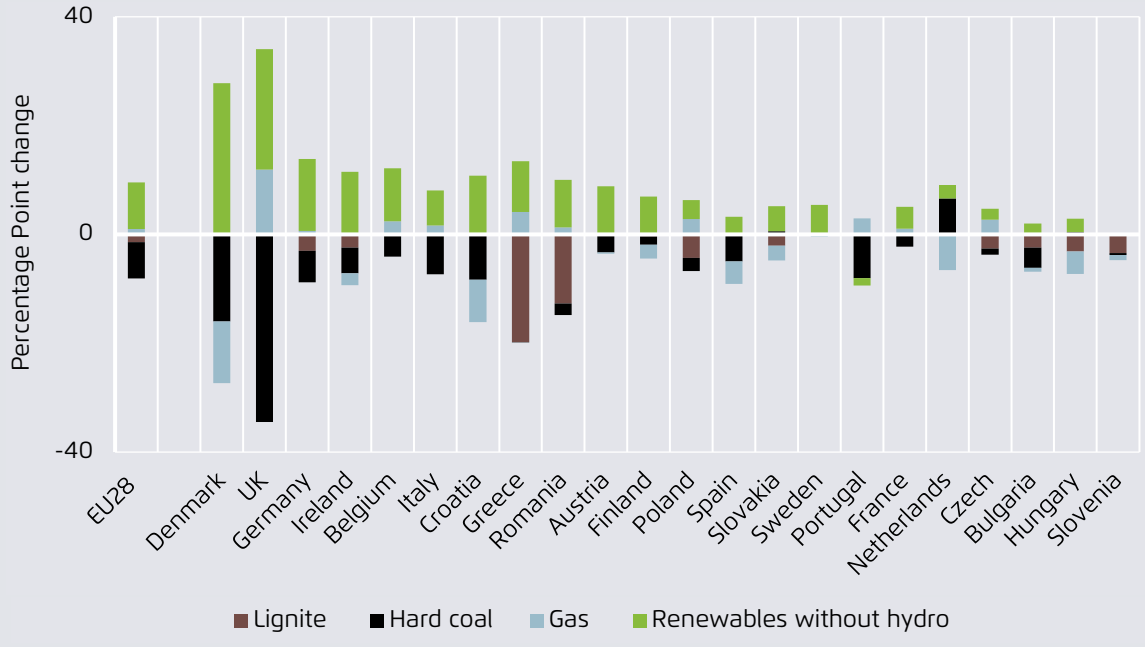
Figure 4-2



EUROSTAT data to 2016; own calculations for 2017 and 2018; phase out details from Beyond Coal 2019

Electricity mix percentage point changes, from 2012 to 2018

Figure 4-3



EUROSTAT data to 2016; own calculations for 2017 and 2018

assumes all other countries implement their pledges as promised. All are planning to phase-out hard coal by 2030 at the latest, with the exception of Germany, which announced in January 2019 to phase-out coal in the year 2038. These "phase-out countries" have been responsible for almost all of the fall in hard coal generation this decade.

The remaining quarter of hard coal is almost all in Poland, which has yet to develop a plan to phase out coal. Hard coal generation in Poland has not fallen since 2012. The current government has no plans yet to phase out coal - quite the contrary, Poland's draft energy plan released in November projects coal (hard coal and lignite) will still account for 60% of electricity generation by 2030, from 77% in 2018. Poland even broke ground on a new 1 GW coal plant, Ostrołęka C, in 2018.

Hard coal is falling because of renewables. The countries with the biggest falls in hard coal also have the biggest rises in renewables (see Figure 4-3). It shows that from 2012 to 2018, Denmark and the UK saw the biggest rise in renewables and the biggest fall in hard coal. What's more, the countries that are planning to phase-out hard coal generally have plans to rapidly expand their renewables generation. It is reassuring that Europe is phasing out coal, without creating a gas bridge for itself.

2018 saw the least amount of hard coal plants closed since 2011. Only 4 GW of hard coal plant actually closed in Europe in 2018: 3 GW in UK (Eggborough plus the final Drax conversion to biomass), 1 GW in Germany (Luenen, Duisburg-Hochfeld, Werdohl-Elverlingsen and Wuppertal-Elberfeld). However, a further 1.7 GW was announced to close in Germany by 2022, and 2 GW announced to close in Poland in 2019 and 2020.

4.2 Lignite

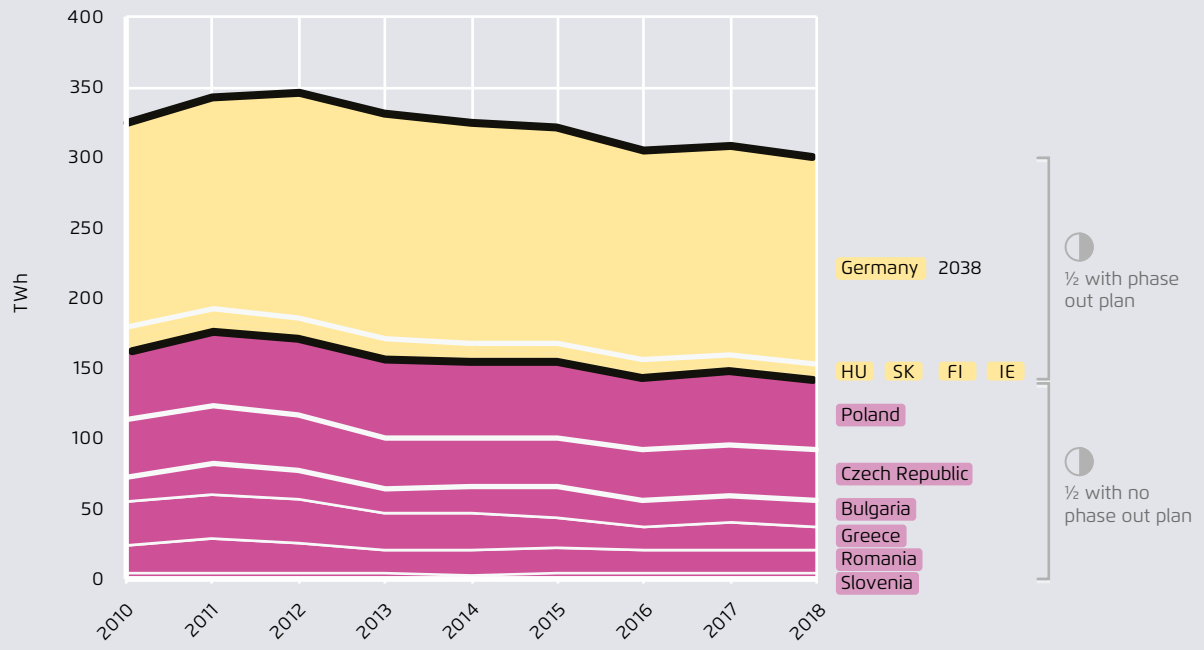
Lignite generation fell slightly by 6 TWh (-3%) in 2018 (see Figure 4-4). German lignite generation fell marginally as 1.1 GW was put into reserve, and Polish lignite generation fell by 3 TWh as Adamów closed at the end of 2017.

Half of Europe's lignite generation in 2018 was in countries where a phase-out is currently being devised. By far the largest lignite generator is Germany, and they have announced a phase-out by 2038. In 2018, Hungary and Slovakia both began to actively devise plans to phase-out lignite. In 2018, both Finland and Ireland strengthened their commitment to phase-out "coal", although neither have yet clarified dates to phase-out the burning of peat, which is included in our lignite definition.

The other half of Europe's lignite generation in 2018 was in six countries – Poland, Czech Republic, Bulgaria, Romania, Greece and Slovenia – which have yet to develop phase-out plans. Electricity generation from lignite in these countries in 2018 was barely changed from the start of the decade. Almost no lignite units have closed or plan to close in these six countries: Europe Beyond Coal report that only Poland's Adamów closed in 2017, two small units closed in Slovenia in 2018, and Poland's Bełchatów unit 1 will close in 2019.

Lignite generation is not falling because power plant operators have yet to feel the impact of the higher CO_2 price, and renewables deployment in these six countries has been very slow, and is expected to remain very slow. In 2018, SolarPower Europe and WindEurope provided central forecasts to 2022 (see Table 4). Poland is forecast to install only 0.6 GW solar and 2.1 GW wind over five years; Greece is forecast to install just 1.3 GW wind and 1.6 GW solar.

EU-28 Lignite electricity generation — Figure 4-4



EUROSTAT data to 2016; own calculations for 2017 and 2018; phase out details from Beyond Coal 2019

However, low renewables deployment in these countries is in stark contrast with the potential: A study for the European Commission mapped the solar and wind resources for each of Europe's coal regions (EU coal regions: opportunities and challenges ahead, Figure 57, 58). The analysis shows that most of these regions have good to excellent wind and solar potential. Therefore, governments of these six countries are missing out on clear opportunities, especially since their lignite plants are generally old and have a poor economic outlook; most would need investment to comply with the new air pollution limits from 2021, and the steep EU carbon price rises in 2018 will further impact profitability.

Wind and Solar forecasts for countries with no lignite phase-out — Table 4

	Wind			Solar		
	Installed end–2017	Installed end–2022	Additions 2018–2022	Installed end–2017	Installed end–2022	Additions 2018–2022
Poland	5.8	6.4	0.6	0.3	2.4	2.1
Czech Republic	0.3			2.0		
Bulgaria	0.7			1.0		
Greece	2.7	4.0	1.3	2.6	4.2	1.6
Romania	3.0	3.5	0.5	1.4		
Slovenia	0.003			0.258		

WindEurope actuals and forecast; SolarPower Europe actuals and forecast

Recognising these challenges, the European Commission chaired two workshops in 2018 of its "Coal Regions in Transition" platform. Currently, 41 regions in 12 Member States of the European Union significantly rely on economic revenues from coal mining and coal use, providing direct employment to about 185,000 people across the EU. The platform that was launched in December 2017 to allow for a dialogue and sharing of experience between governments and stakeholders of "high carbon" regions and to assist those regions to modernize and prepare for the structural and economic change that will come with phasing out coal.

4.3 Gas

Gas generation fell by 5% in 2018. Hence, the 9% fall in hard coal generation in 2018 was due to renewables, not an increased reliance on gas. In fact, in each of the four main countries where hard coal generation fell in 2018 – Germany, UK, Spain Italy – gas generation also fell.

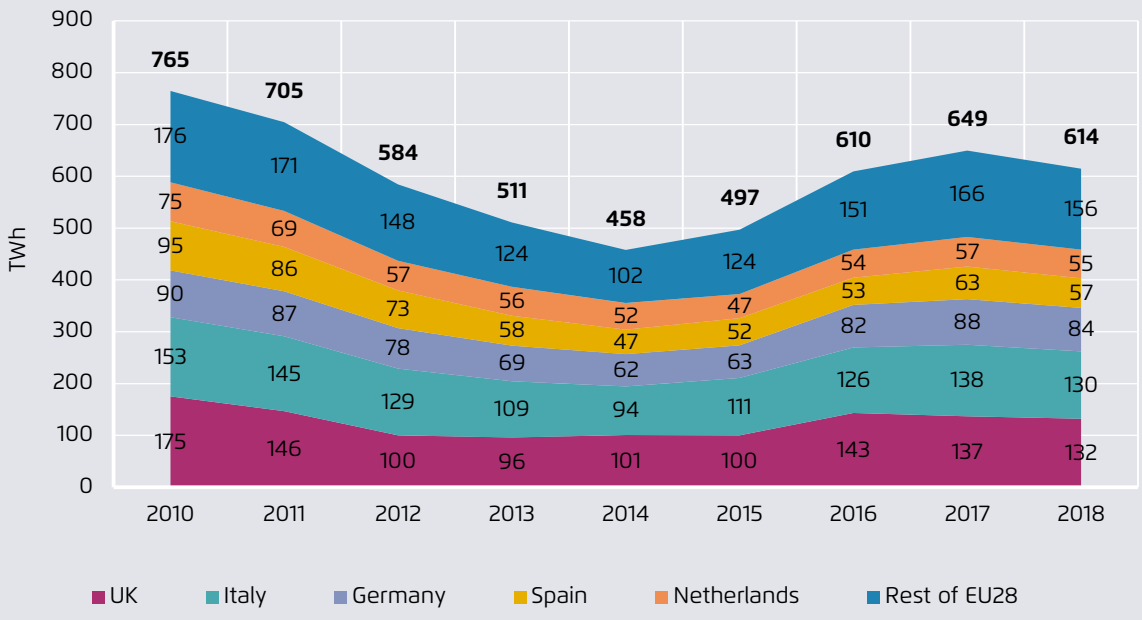
Gas generation fell by 5% (35 TWh) in 2018 (see Figure 4-5). This reverses the gains in 2017, which were driven by the record low hydro generation of that year. In particularly, France, Italy and Spain saw large falls in gas burn with the return of wetter weather in 2018.

UK gas generation fell for the second year in a row, as new renewables start to displace more gas now that UK coal generation is already so low. Sandbag's 2018 report, "Coal to Clean", highlighted how gas will structurally fall into the future, as offshore wind rises faster than the forecast falls in coal generation.

Coal-to-gas switching was negligible in 2018 as gas prices were too high relative to coal (see next chapter).

In 2018, only one gas plant was commissioned in the EU: Płock in Poland, which is 0.6 GW. This compares to 21 GW of CCGT commissioned in the US in 2018. Only 5 GW has been commissioned in the EU since 2016, and less than 3 GW is currently under construction (see Table 5).

EU-28 Gas electricity generation — Figure 4-5



EUROSTAT data to 2016; own calculations for 2017 and 2018

EU-28 Gas power plants currently under construction — Table 5

Country	Name	Company	MW	Build date
Germany	Lichterfelde, Berlin	Vattenfall	300	Q1-2019
Germany	Marzahn, Berlin	Vattenfall	260	Q1-2020
Germany	Kiel, Schleswig-Holstein	Stadtwerke Kiel	190	Q1-2019
Poland	Zeran, Mazowieckie		450	Q4-2020
Poland	Stalowa Wola, Podkarpackie	Tauron	450	Q4-2019
United Kingdom	King's Lynn, Norfolk	Centrica	370	2020
United Kingdom	Keadby 2, Scunthorpe, N Lincs	SSE	840	2023

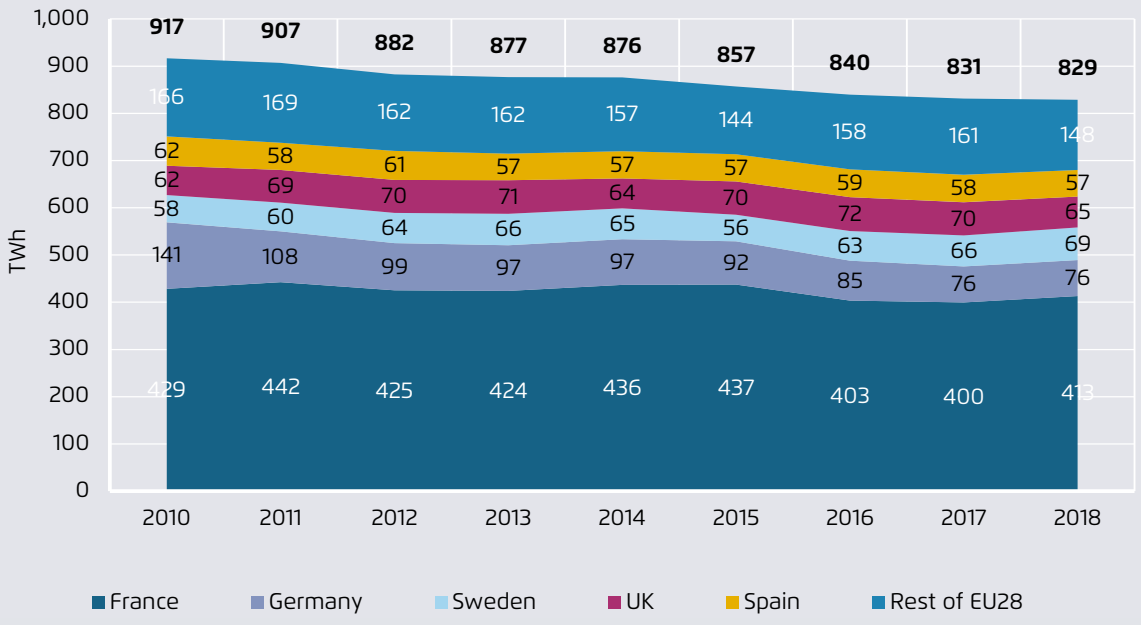
Platts Power Plant Tracker, December 2018

4.4 Nuclear availability

If it's not one country, it's another …

Nuclear generation was almost unchanged in 2018 (down 2 TWh). A rise in French and Swedish availability coincided with another large downturn in Belgian availability (see Figure 4-6). Germany closed Gundremmingen B at the end of 2017 as part of its nuclear phase out strategy, but this was offset by improved availability of the other German nuclear power plants in 2018. The next German nuclear closure will be at the end of 2019.

EU-28 Nuclear electricity generation — Figure 4-6



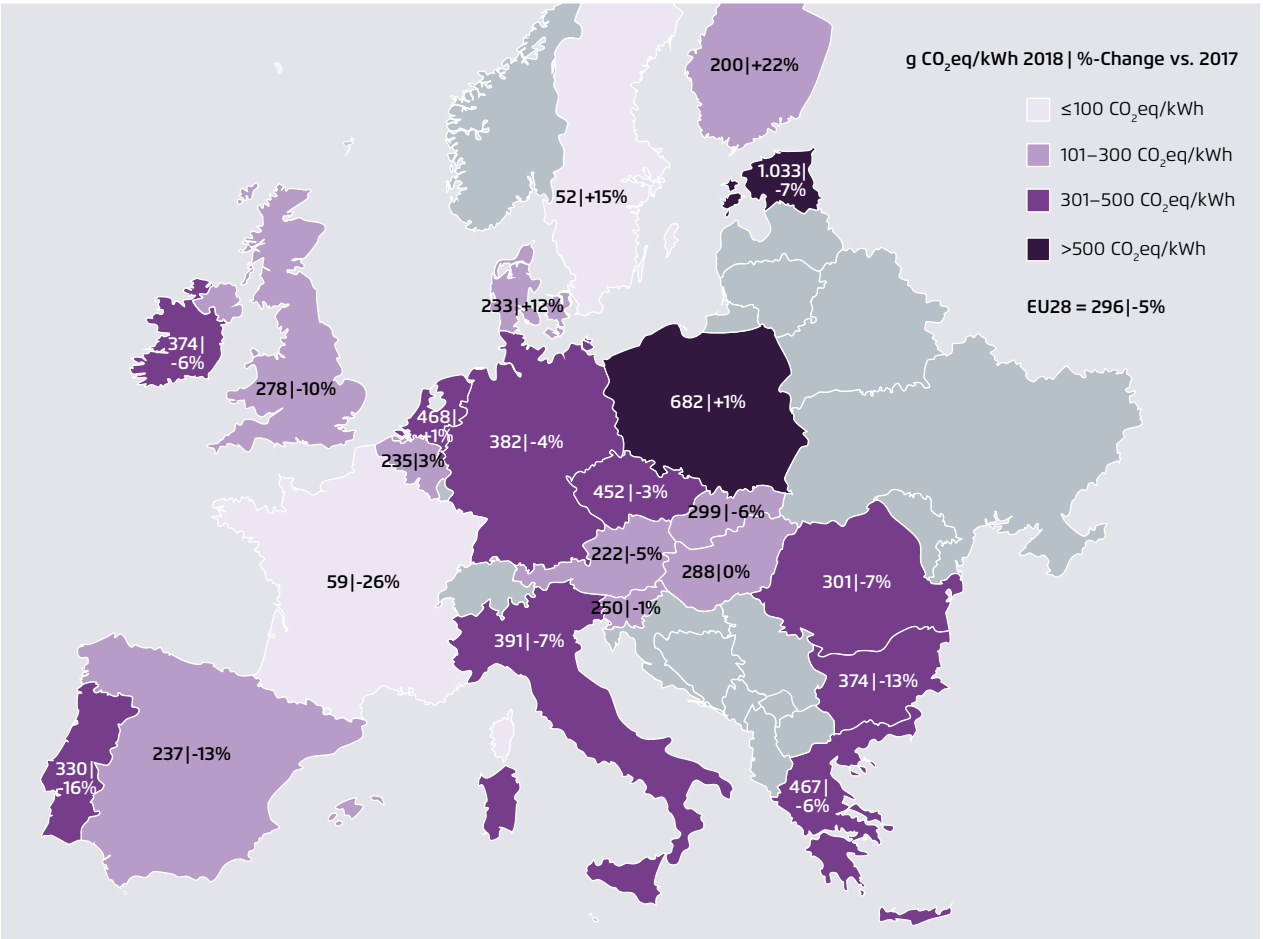
EUROSTAT data to 2016; own calculations for 2017 and 2018

5 CO_2 Emissions

CO_2 emissions in the power sector fell by 5% in 2018. *Half of this was structural – a result of new wind, solar and biomass displacing hard coal. The other half was seasonal as hydro generation returned to normal, undoing the very temporary rise in gas in 2017. In context that emissions actually rose slightly in 2017, the 5% fall in 2018 is quite unimpressive. Industrial emissions are likely unchanged. We forecast overall EU ETS emissions will fall by 3%, from 1754 Mt CO_2 in 2017 to 1700 Mt CO_2 in 2018.*

Power sector emissions fell by 5% (53 million tonnes) in 2018 to 985 million tonnes. Correspondingly, the carbon intensity of the EU's electricity also fell by 5% (since electricity consumption is almost unchanged). The overriding reason was more wind turbines were built, and a return to normal hydro, meant that hard coal and gas generation both fell. Carbon intensity fell from 311g CO_2/KWh to 296g, based on calculations from www.ElectricityMap.org, who track real-time carbon-intensity (see Figure 5-1).

CO_2-intensity of of electricity consumption — Figure 5-1



Our aggregation of www.ElectricityMap.org data. They use lifetime carbon intensity figures from 2014 IPCC report by fuel (e.g. 450 g CO_2/KWh gas, 820 g coal - no distinction of lignite or hard coal, 11 g for wind), and generation mostly from ENTSO-E. Carbon intensity of imports/exports are calculated according to generation mix in the giving/receiving country in that hour.

Estonia and Poland have by far the most polluting electricity systems. They both have only 14% of their electricity from renewables, and most of the rest of the generation is from oil shale and coal respectively. There were big fluctuations in 2018, mostly due to hydro: Nordic countries increased, as they had less hydro availability and relied on more fossil generation; France, Spain and Portugal fell where more hydro generation reduced hard coal and gas.

We estimate overall EU ETS stationary emissions in 2018 will fall by 3.1% to 1700 million tonnes. This is because of a 5% fall in power sector emissions, largely driven by a fall in hard coal generation (see Figure 5-2). Industrial emissions are likely to be unchanged: whilst overall EU GDP rose by 2% in 2018, industrial production fell by 2% - a stark contrast from the previous 3 years. Steel production fell 0.5% in 2018, after rising 4% in 2017. The fall of 3.1% is slightly better than the average of -2.4% per year which the EU ETS has seen since its beginning in 2005. **In context that emissions actually rose slightly in 2017, the 5% fall in 2018 is quite unimpressive.**

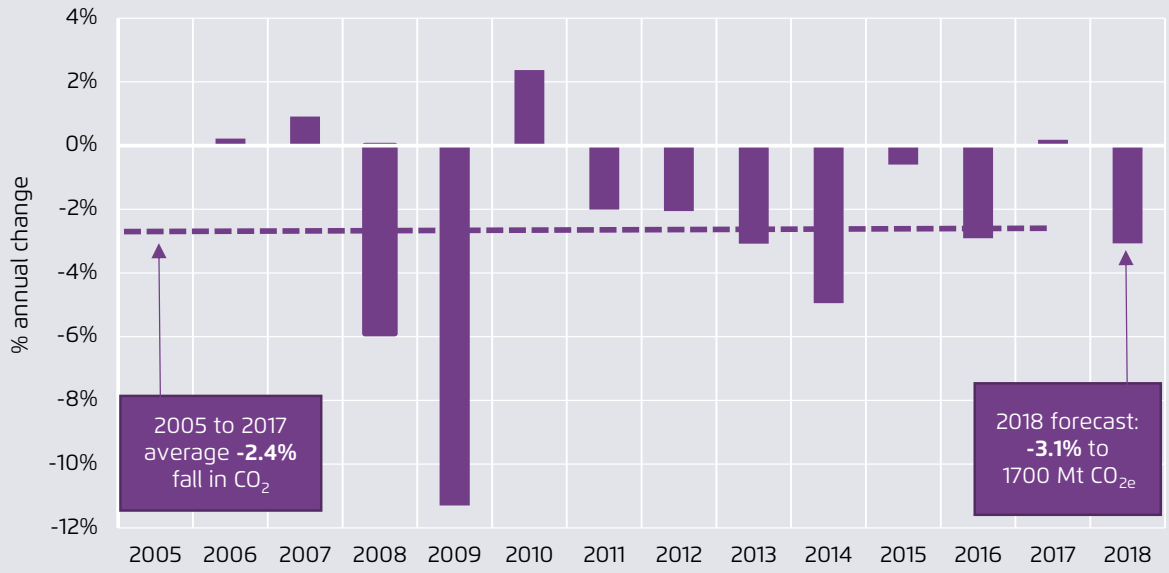
Power sector emissions are down 5% in 2018, and down 21% since 2012. Hard coal power plants have contributed most of this fall - they are down 41% since 2012. Lignite emissions are only down 13% in those six years (see Figure 5-3). **Lignite emissions still made up 20% of EU ETS emissions in 2018.** Coal power plants (lignite and hard coal summed) made up 37% of EU ETS emissions in 2018.

We forecast industrial emissions will be unchanged in 2018, and the same level as in 2012. As power sector emissions fall, this means industrial emissions make up a larger proportion of the EU ETS emissions: 42% in 2018.

EU-ETS emissions fell by 3%, faster than the 2% fall in the cap, and are now 10% below the cap. This large difference between demand and supply of carbon

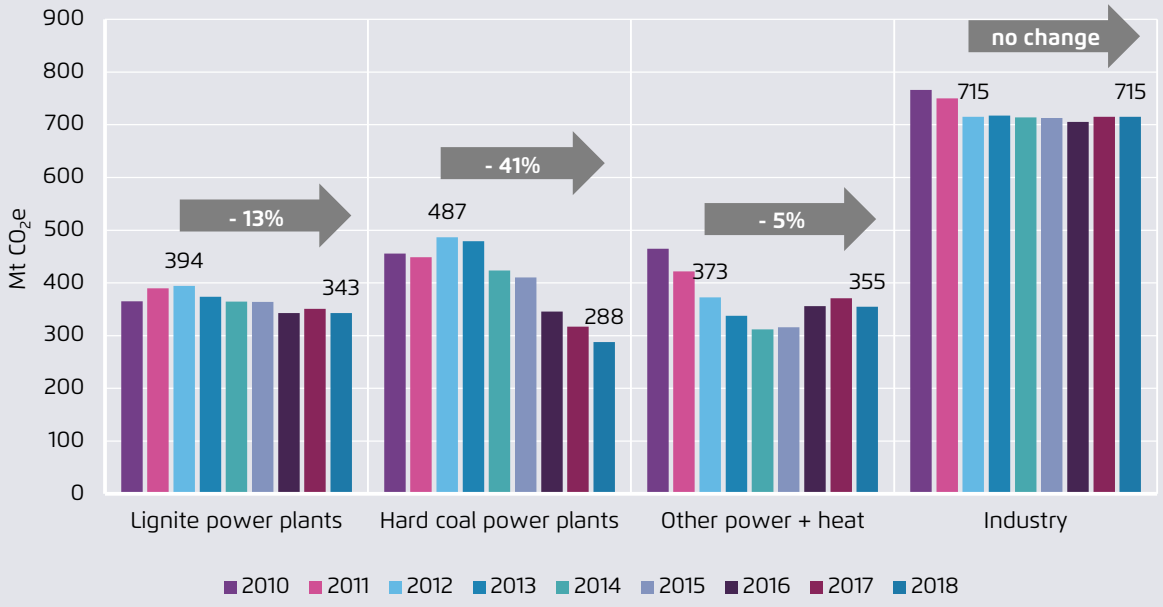
EU-ETS Emissions, annual change

Figure 5-2



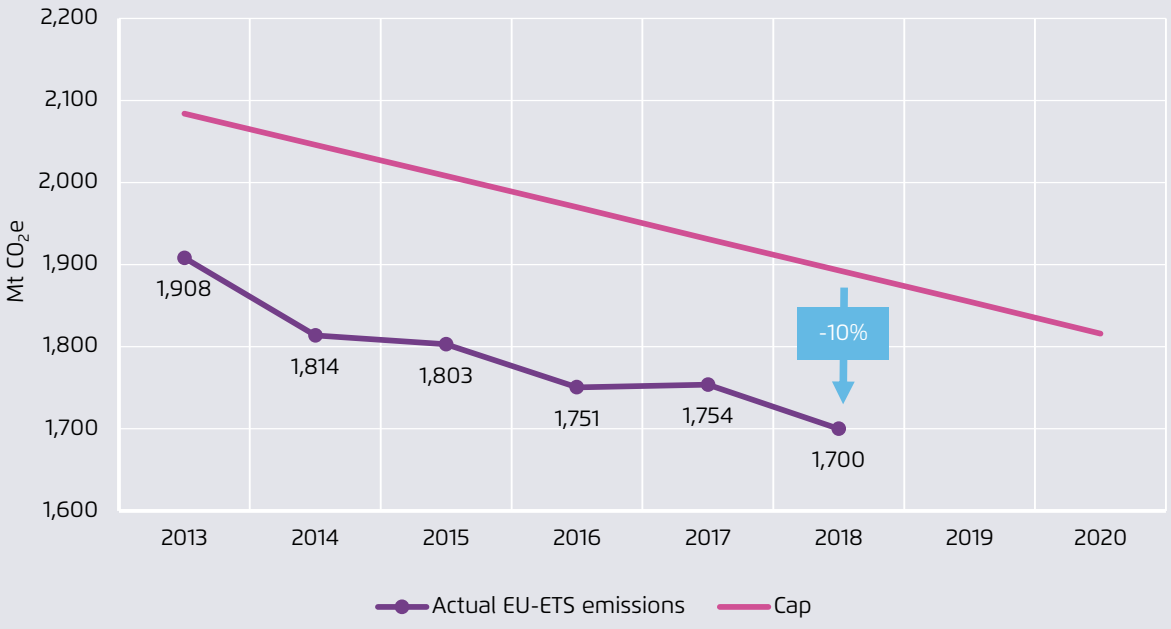
EEA data to 2017 scope-adjusted; own calculations for 2018

EU ETS emissions split by sector and changes 2018 vs. 2012 Figure 5-3



EUTL data to 2017, based on Sandbag classifications; own calculations for 2018

EU ETS emissions and cap Figure 5-4



Sandbag 2019

permits is still causing a dangerous imbalance in the market (see Figure 5-4). The market stability reserve (MSR) which will come into action in 2019 will reduce the oversupply of certificates and, as of 2023, delete surplus certificates, and should keep carbon prices supported.

However, such a heavy need for this single policy puts the ETS at risk of falling prices in the future if the MSR does not function as effectively as expected. This would leave especially the industry sector without a constant and credible decarbonisation signal. Redefining the cap to a Paris-compliant to 2030 remains therefore essential to ensure stability of the EU's ETS.

6 Prices and interconnection

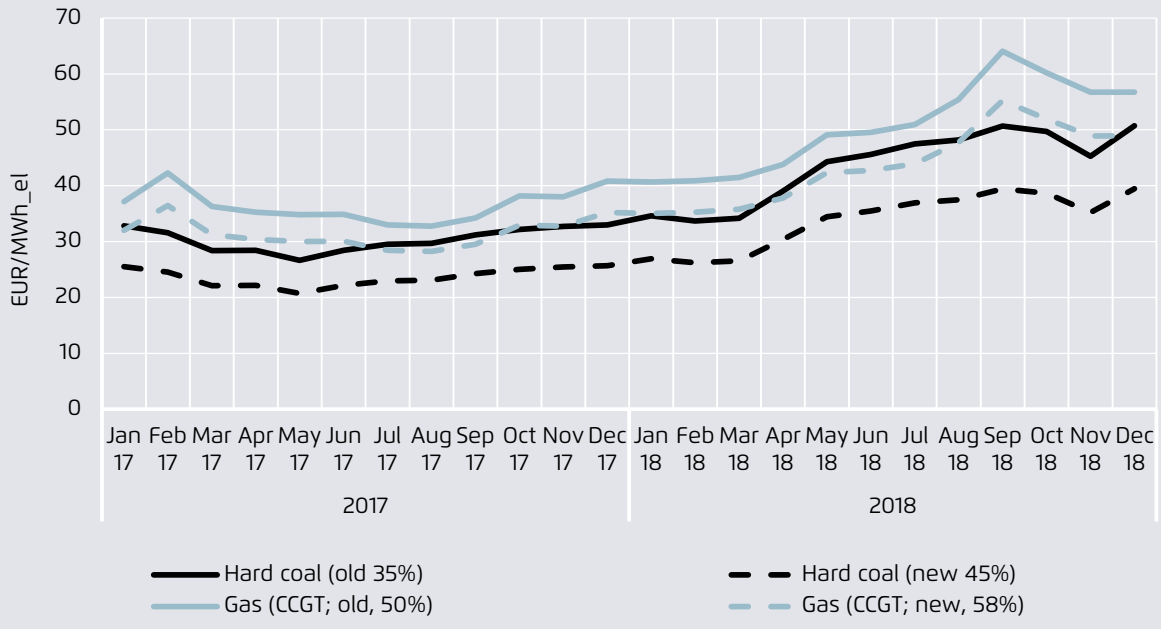
Electricity prices have risen on higher coal, gas and carbon prices. *The out-turn prices for 2018 vs 2017 rose by 15% for coal (in Euro currency), 30% for gas price, and 170% for CO_2 permits. Coal-gas switching though remained unchanged, despite the higher carbon price. For the first time, coal and gas power plant short-term costs are now on a par with wind and solar auction prices.*

The out-turn prices for coal, gas and CO_2 permits all rose in 2018. The out-turn prices for 2018 vs 2017 rose by 15% for coal (in Euro currency), 30% for gas price, and 170% for CO_2 permits.

Coal-gas switching in 2018 was as low in 2018 as in 2017. Throughout 2018, as carbon price rose, gas price rose faster than coal price, keeping relative coal and gas prices similar (see Figure 6-1). Carbon, coal and gas prices have moved in a way so that much of the last 2 years, inefficient coal is about the same price level as efficient gas.

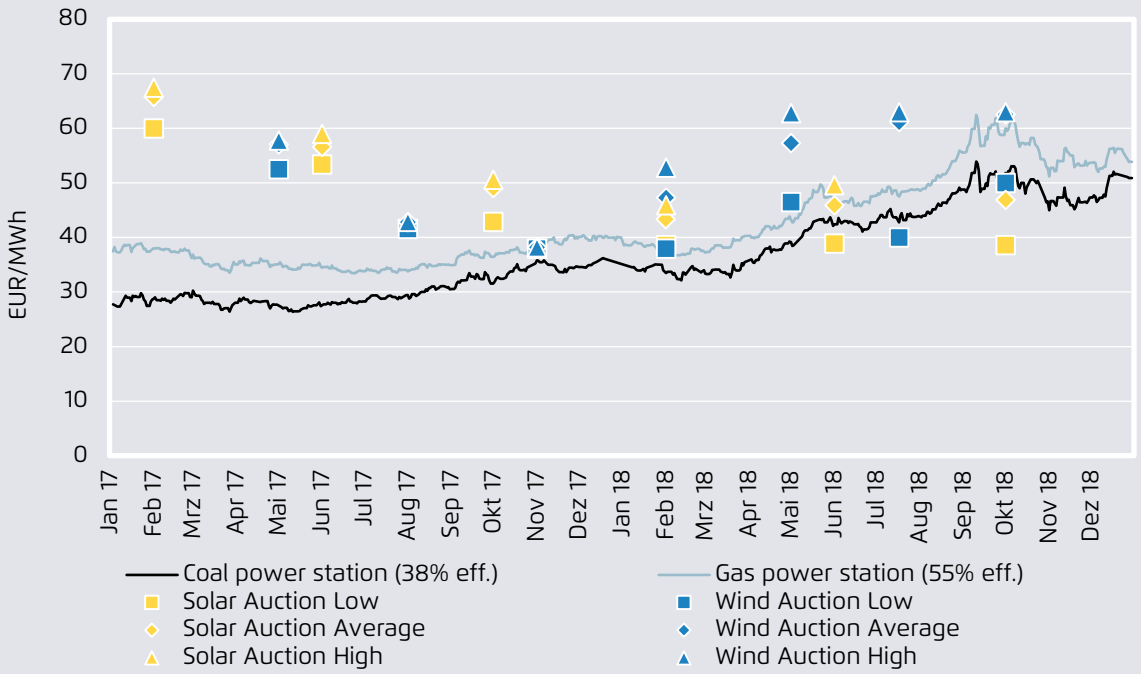
The wind and solar auctions in Germany are lower even than short-run costs for coal and gas power plants. At the end of 2018, both the short-term costs of coal and gas were above 50 €/MWh (methodology here). By comparison, the German solar auctions in October cleared at a median price of 47 €/MWh (see Figure 6-2). The median cost of onshore wind rose in 2018, and sat a little above short-run coal and gas prices at 63 €/MWh in the October auction, although the cheapest project did clear at below coal and gas costs, at 50 €/MWh.

Coal and gas plant running costs (average day-ahead price) Figure 6-1



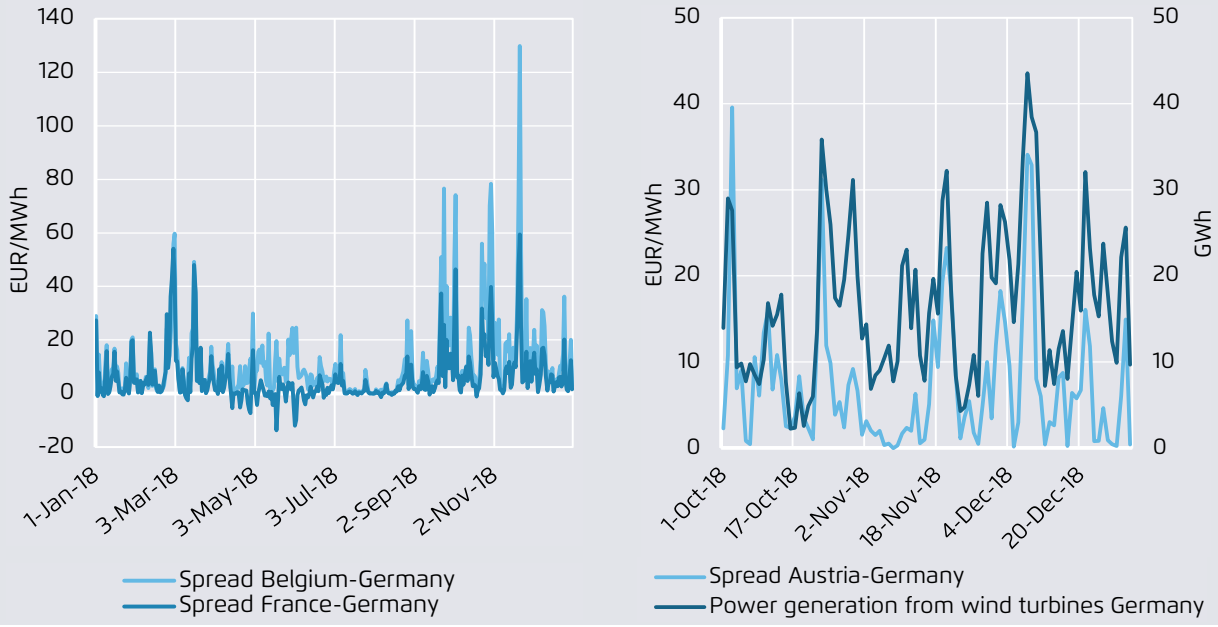
World Bank 2019; Bundesbank 2019; UBA 2015; DEhSt 2019; own calculations

Coal and gas plant running costs (year-ahead price) vs German renewables auctions Figure 6-2



Bloomberg 2017/18, Bundesnetzagentur 2017/18; Sandbag calculations

Price spread for day-ahead electricity (left)
Price spread for day-ahead electricity after AT-DE grid split, vs German wind (right) Figure 6-3

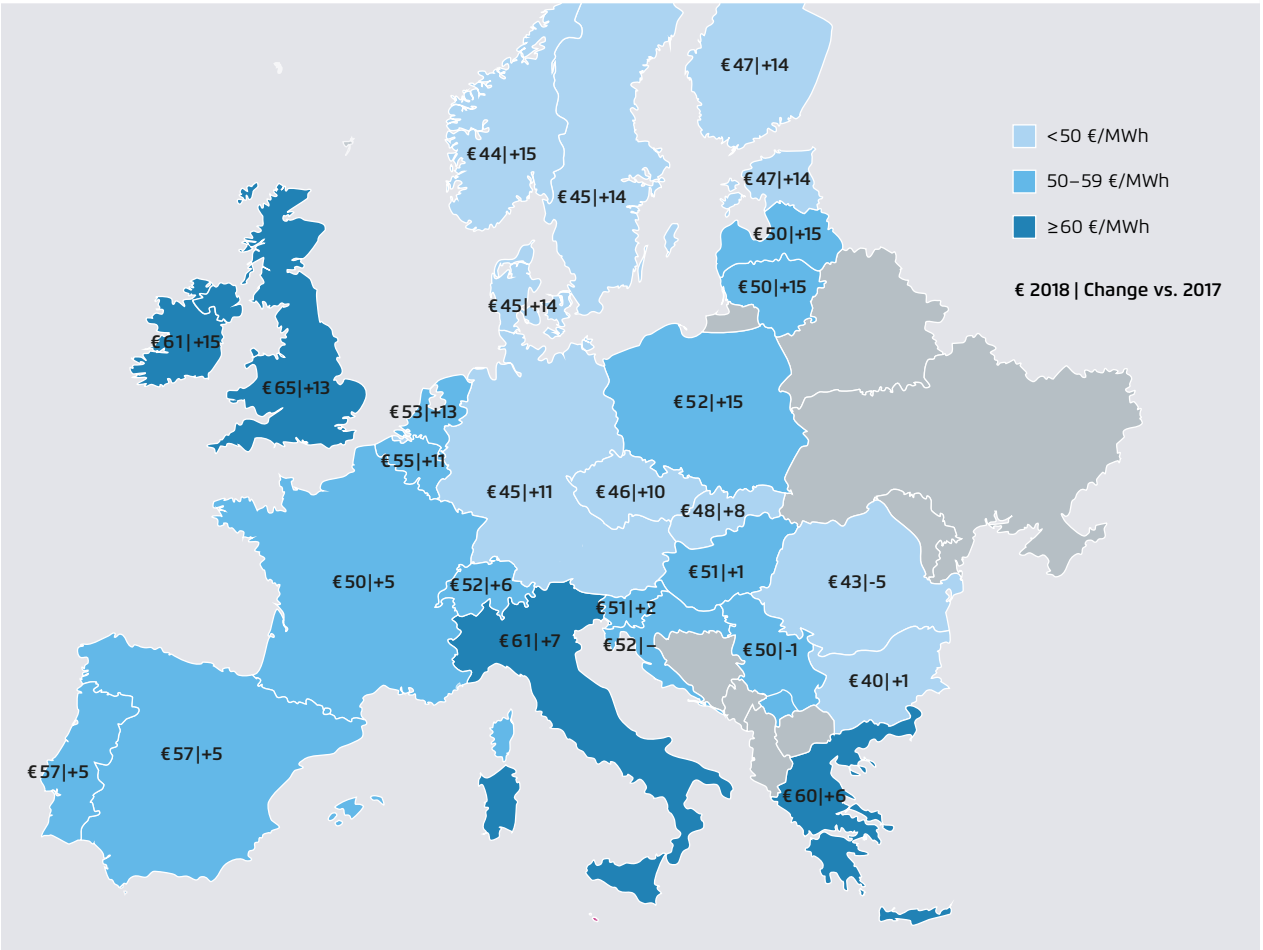


ENTSO-E

The rise in coal, gas and carbon prices pushed up the out-turn power prices in almost every EU country by in 2018 (see Figure 6-4). The Nordic and Baltic regions, which were hit by very low hydro levels, had large increases of about 14 €/MWh. Germany and Poland whose power systems are characterized by a high coal share, also unsurprised suffered by the higher coal and carbon prices. But also Italy, Ireland and the UK, where gas power plants are setting the wholesale electricity prices, saw large increases of more than 10 €/MWh.

There were two noteworthy power prices incidents happening in 2018: price spikes in Belgium in Q4-2018, and the split of the German-Austrian price zone from 1-October, leading to significantly higher prices in Austria. Belgium nuclear outages caused prices spikes from the end of September, with daily Belgium wholesale prices often out-turning 50 €/MWh+ above German prices (see Figure 6-3, left). Also 1-October 2018 saw the decoupling of the German and Austrian price zones. In Q4-2018, Austrian power prices were on average 7.5 €/MWh higher than German ones. As Figure 6-3 (right) shows - perhaps unsurprisingly - the price difference between Austria and Germany was higher when German wind generation was high.

Average day-ahead wholesale electricity prices — Figure 6-4



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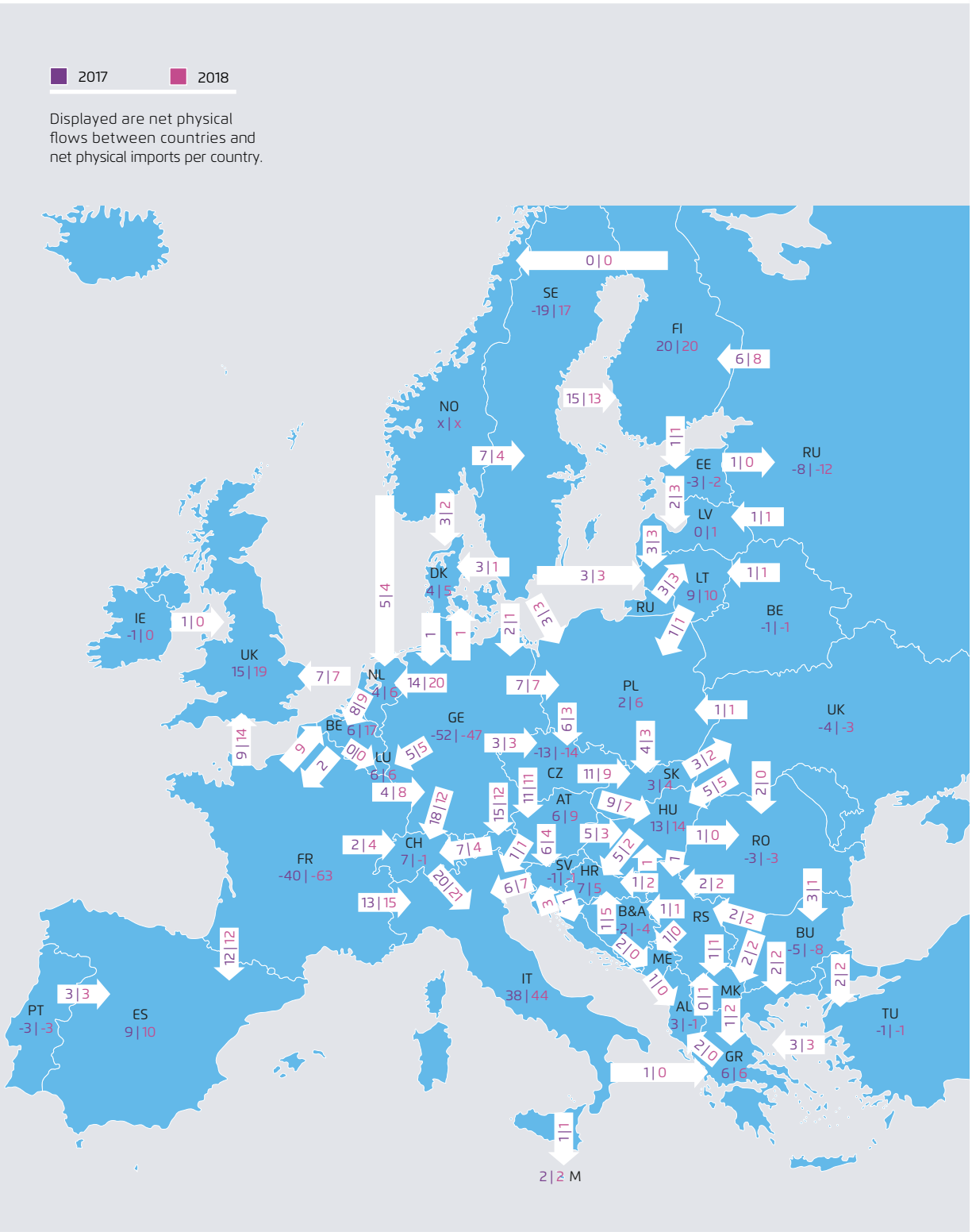
Security of supply problems to the European electricity grid in 2018 were reassuringly minor. Here are the seasonal summaries by the European grid operator, ENTSO-E:

- → *ENTSO-E's Winter 2017/2018 review: Last winter was mild and windy without any adequacy issues. Frequency deviation was experienced due to power imbalances in Serbia, Macedonia, Montenegro (SMM block) and specifically Kosovo . ENTSO-E calls for a political resolution of the dispute that caused the deviations so as to ensure a long-lasting solution to the problem. This will remain a focus area for the association in the course of 2018.*
- → *ENTSO-E's Summer 2018 review: Summer was marked by temperatures much higher than average, especially in Northern and Eastern Europe. This led to some local electricity supply disruptions in Czech Republic, Croatia and Greece.*

The changes in electricity flows across Europe in 2018 mostly relate to changes in Europe's hydro and nuclear generation (see Figure 6-5). There was more inflow into the EU from the western Balkans and Switzerland due to better hydro power conditions in these countries. France's exports massively expanded as its nuclear and hydro improved, helping make up Belgium's shortfall from its nuclear outages.

Physical electricity flows, TWh

Figure 6-5



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7 Policy

2018 saw the almost full finalisation of a frantic legislative discussion to set out the EU laws for achieving the 2030 greenhouse gas and energy targets. ***The important news is: The European Union institutions are able to deliver on a topic that ranks high on the list of concerns of citizens throughout Europe, despite more widely held EU-scepticism.***

Before summer 2018, the European Parliament and Member States hammered out their political agreement on two key European laws:

1. **National plans.** A new governance mechanism (Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action) obliges Member States to plan ahead for their respective energy transitions: Concrete plans for 2030 are complemented by more strategic plans up to 2050. The 2030 plans must be integrative in approach and quantify the planned national contributions for achieving the EU's 2030 targets on renewable energy and on energy efficiency.
2. **2030 RES/EE targets:** As regards the latter, the Union legislator eventually set 2030 targets for renewables and for energy efficiency well above the fairly unambitious targets proposed by the European Commission in 2016: by 2030, energy efficiency shall be improved by 32.5 percent compared to a 2007 baseline (Directive (EU) 2018/2002 amending Directive 2012/27/EU on energy efficiency) and the share of renewable energy in gross final energy consumption shall stand at 32 percent (Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources). The latter translates into around 57 percent renewable electricity in the European power system by 2030.

Whether the power system is ready for the cost-effective integration of rising shares of renewable electricity will depend on the effective implementation of a second set of European laws on electricity market design that were politically agreed just before Christmas 2018.

Overall, there are two important messages:

First, the new EU targets for energy efficiency and on renewables mean that the current EU climate target to reduce greenhouse gas emissions domestically by at least 40 percent by 2030 ***could be increased to above 45 percent*** greenhouse gas emission reductions without further measures.

Second, although each Member State approaches the energy transition from a different starting point, meeting the ***2030 targets requires all countries in Europe to develop their energy system in the same direction*** over the next decade: Increasing the efficiency of energy use and replacing climate-polluting fossil energy sources with clean energy sources, predominantly with wind and solar PV.

7.1 Energy consumption

The reformed EU Energy Efficiency Directive effectively continues the existing system. Its centre-piece is the annual energy savings obligation in Article 7 that will be the main regulatory driver for increasing energy efficiency in Europe. The final agreement sought to ensure a real energy savings rate of at least 0.8 percent per year after 2020. This is, however, not enough for reaching the EU's 2030 efficiency target. Much thus depends on how robust Member States address the issue of energy efficiency in their new integrated energy and climate plans for 2030. Member States were obliged to submit drafts of those plans by the end of 2018; these are now evaluated by the European Commission and will be finalised over the course of 2019.

7.2 Renewable Energy

The revised EU Renewable Energy Directive creates a more stable planning and investment perspective for project developers and investors. It sets out clear time-frames for permitting of new renewable capacity as well as a fast-track, streamlined permitting procedure for re-powering; an obligation on Member States to give at least three year ahead visibility of the planned dates, volumes and budgets for tendering renewable energy capacity; it includes a clear statement against retroactive changes to commitments made in support of renewable energy projects (e.g., for market premium payments) as well as strengthened provisions on connecting to the grid. The rights for *prosumers* to self-generate and self-consume renewable power and to feed surplus generation into the grid as well as new rights for *renewable energy communities* are now explicit, and have the potential to help kick-start solar PV across Europe from bottom-up.

The practical value of these partially new, partially strengthened obligations on national authorities rests, however, on the planned national contribution of each Member State to the achievement of the binding EU renewable energy target for 2030. The mechanics for ensuring that all Member States contribute at least a minimum share to the EU renewables target are set out in the new integrative EU governance framework for climate and energy. They include tools for filling eventual gaps from un-ambitious national planning as well as tools for filling delivery gaps that may emerge on the way.

Overall, the measures for target delivery are more robust and credible than many expected at the beginning of the legislative process.

The main EU laws that will determine how the European power system will cope with a progressively rising share of renewable electricity from 32 percent today to 57 percent in 2030 are found in the new Electricity Market Regulation and the new Electricity Market Directive that were politically agreed between the European Parliament and the Council before Christmas 2018. Here, much will depend on effective national implementation. The planned strengthening of short term and of balancing markets will enable market participation of intermittent renewable electricity producers, whereas the removal of privileges such as priority dispatch or new rules on renewables curtailment add new risks that could increase investment costs.

7.3 Conventional generation

Air pollution: Compliance with air pollution standards for large combustion plants under the EU Industrial Emissions Directive is a challenge, particularly in Eastern Europe (see above). Specific air pollution standards are set out in technical documents that detail best available technologies for reducing emissions of different pollutants. By mid-2021, public authorities must update operating permits and oblige plant operators to adhere to these standards. Derogations to these are only possible if there is a clear economic benefit relative to the increased health impacts.

Capacity mechanisms: Limitations on the legality of so called "capacity payments" to coal-fired generators are of principled importance, i.e. the ability of governments to subsidise coal assets for their availability not for the kilowatt hours produced, thereby opening a revenue stream that could be used to build new coal or upgrade old plants. The topic was highly contentious when the EU legislator reached a political agreement on the new Electricity Market Regulation before Christmas. Capacity payments - past and future – amount to a 58 billion Euro bonanza, according by Greenpeace research – hence the controversy.

The result: no capacity payments are allowed for new plants from January 2020 and existing plants from July 2025. The only two main derogations: ultra-peaking coal plants (<4% utilisation), and the grandfathering of capacity contracts signed prior to 2019.

A grandfathering clause for capacity commitments tendered prior to the entry into force of the Regulation could effectively shield Poland's new capacity market from these new EU laws. Poland's capacity market was formally approved by the European Commission on 21 December 2018 (See Commission Decision SA.46100 on the Planned Polish capacity mechanism), three days after the political agreement on the Electricity Market Regulation.

Following the successful legal challenge against the UK's Capacity Mechanism, it will be interesting to see whether a market participant will challenge the Commission's approval of the Polish capacity market by the 14 March 2019 deadline. As regards the UK capacity market, the European Court of Justice found that the Commission had insufficiently assessed whether there was an actual need for such a far reaching and costly intervention and also criticised that the scheme's design favoured fossil fuel generation at the expense of alternative technologies such as demand response.

Coal phase-out: Leaving aside the specific issue of the future of coal in Poland, though, the political headline message is that EU climate and energy laws for 2030 will accelerate the phasing down of coal in Europe. It is therefore important that the European Commission has indicated that its "Coal Regions in Transition" platform launched at the end of 2017 will be continued over the next years and underpinned with significant financing from the next European budget that runs from 2021–2027.

8 Outlook

New wind and solar records: WindEurope are forecasting a bumper year for wind installations in 2019 - over 25% higher than the previous record set in 2017. Solar will continue its climb, with some big announcements expected in the NECPs. Renewables should become more than a third of Europe's power mix.

Coal generation to fall below gas first time ever? In 2019, it is likely that total coal generation will fall below gas generation for first time in Europe's history, as renewables growth continues to erode coal generation. Also, hard coal generation is likely to fall below dirtier lignite generation, putting even more of a focus on phasing out lignite. It's possible that coal-to-gas switching could put a further dent in hard coal generation, due to the rise in the carbon price: Platts forecast less than 1 GW of switching at current gas prices, but 10 GW of switching if gas prices fall in line with their bearish gas forecast.

Nuclear to stay constant in 2019: Currently, we do not see any major changes for nuclear in 2019 – there are no closures expected, and the launch of Finland's Olkiluoto 3 reactor has been postponed again; it is now due to begin production in 2020, 11 years behind schedule. In Belgium, nuclear woes continue: at the time of writing, two out of 7 nuclear power plants are not operating and Engie fears it might have to do without three nuclear reactors in winter 2019–2020.

The phase out of coal will continue. Germany will decide on the future of coal, the same is expected in Spain. The decisions in these two key coal countries in Europe could have a significant impact on those countries that still rely on coal – depending on the outcome. In the Netherlands, the government will make a decision on how to implement its Climate agreement. At the same time, Poland is currently consulting on its options for future energy policy and might take important decisions to increase its renewables share by 2030 considerably.

As part of the new EU's governance on climate and energy, all Member States must finalise their National Energy and Climate plans (NECPs) by year-end. These will give more detail on the nature and speed of the planned transition from fossil-fuelled to renewable electricity in each of the EU's member states, from 2021 to 2030. Through the consultation process, the NECPs provide an excellent opportunity for the European commission and civil society to call out Europe's laggards and push for greater ambition through 2019.

Brexit: At this point in time, it is highly unclear how the situation in the UK will play out. With regards to energy and climate policy, we however do not expect major changes due to UK leaving the European Union, even in the event of a hard Brexit. Electricity trades with countries outside of the EU are common standard as the examples Norway and Switzerland demonstrate, and the UK government has already announced it would impose a carbon tax on power production of at least the EU ETS price in the event of a hard Brexit. As more interconnectors between the continent and the UK are currently being built, we expect a deepened integration of the power markets in the coming years, regardless of the result of the Brexit debate.

European elections: On May 26–29, all over Europe the elections for the European Parliament will take place. As a consequence, the new European Commission will enter into office in autumn 2019, coming up with a new climate and energy agenda for the next five years. To keep on moving on the path of a European energy transition, a lot needs to be done. For example, one of the first tasks will be to revise the EU gas directive - where a push towards green hydrogen and synthetic, wind and solar based fuels will be needed in order to make gas infrastructures compatible with long-term climate action objectives.

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