
The European Power Sector in 2019

Up-to-Date Analysis on the Electricity Transition

ANALYSIS



34.6*

*Share of Renewables in Gross Electricity Generation

The European Power Sector in 2019

PUBLICATION DETAILS

ANALYSIS

The European Power Sector in 2019:
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 fourth year in a row, Sandbag and Agora Energiewende have joined forces to provide a current snapshot on the European electricity sector transition. Key topics addressed in this report include renewables growth, conventional power generation, electricity consumption and CO₂ emissions.

We provide our best assessment of 2019 electricity consumption, generation and emissions by country.

This data is available for download in order to enable others to perform up-to-date analysis.

We hope you enjoy reading this report!

Yours sincerely,

Patrick Graichen
Executive Director of Agora Energiewende

Dave Jones
Electricity Analyst, Sandbag

Key findings

1

Coal generation collapsed by 24% in the EU in 2019. Hard coal generation dropped by 32%, while lignite decreased by 16%. This development is driven by CO₂ price increases and deployment of renewables. Gas replaced around half of the coal, solar and wind the other half. The decline of coal will continue: Greece and Hungary both made commitments in 2019 to phase out coal, bringing the total of member states phasing out coal to 15. Only Poland, Romania, Bulgaria and Slovenia are yet to start.

2

The fall in coal means CO₂ emissions in Europe's power sector fell by a record 120 Mt, or 12% in 2019. This is likely to be the largest ever fall. EU Emissions Trading Scheme (EU ETS) stationary emissions, including heavy industry, fell by 7.6% in 2019, implying that industrial emissions are likely to have decreased by only 1%. Nevertheless, overall emissions covered by the EU ETS are falling much faster than the cap; showing the central role of a further strengthening of the EU ETS to accelerate climate action in Europe.

3

Renewables rose to a new record supplying 35% of EU electricity. For the first time, wind and solar combined provided more electricity than coal, contributing 18% of EU electricity in 2019. This is more than a doubling of market share since 2013. The increase in wind and solar generation was strongest in western Europe, while Poland and Greece have started to engage. The rest of eastern Europe is significantly lagging behind. The economic opportunities of low-cost renewables became increasingly visible. 2019 saw record low auction prices for offshore wind (UK) and solar (Portugal) - below wholesale prices - and the largest wholesale price decreases in countries where wind and solar expanded most.

4

Europe's energy transition is taking off. The European Green Deal has put the fight against the climate crisis at the very core of all EU policy work over the next five years: EU heads of state have endorsed Europe to become the first greenhouse gas neutral continent by 2050, and the EU commission is putting forward proposals to raise Europe's 2030 greenhouse gas reduction target to -50% or -55% below 1990 levels. This implies power sector emissions will keep falling, even if electricity demand increases as transport, heating industry continue to electrify.

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1 Introducing the latest data

1.1 What data do we use in this report?

This report provides a “best view” of electricity data up to 2019. The presented data is also available for download at our website

The 2000 to 2017 data is from EUROSTAT. Note: all data used is “gross”, not “net”. The accompanying Excel sheet describes the mappings used for EUROSTAT.

The 2018 and 2019 data represents our best estimate of what the EUROSTAT data will be when it is eventually published. We do this by estimating the year-on-year changes in 2018 and 2019 and adding these to the 2017 EUROSTAT data. We do this by drawing on a combination of sources. Data on Germany is from [AG-Energiebilanzen](#), data on the UK is from [Carbon Brief](#), and data on the rest of the EU is based on ENTSO-E checked against transmission system operator (TSO) data.

Like last year, we place a heavier reliance on ENTSO-E hourly data than in previous reports. This

should further improve accuracy from previous years. However, ENTSO-E 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) as well as biomass/coal (DK, UK) and lignite/coal (ES, PL). Some gaps are rather large (IE, FR, UK).

1.2 Last year’s accuracy

We were once again very pleased with our performance last year as we were very close to predicting the EUROSTAT actuals for 2017. In total, there is around 3300 TWh of consumption and production so inaccuracies of 1 TWh and 2 TWh, respectively, against the EUROSTAT actuals are obviously very small given the rapid transition (see Table 1).

Also, our forecast for 2018 has stayed relatively constant despite much more data becoming available. Consumption has changed by only 6 TWh and pro-

Last year’s calculation accuracy

Table 1

| TWh for EU28 | Lignite | Hard Coal | Other fossil | Gas | Nuclear | Hydro | Solar | Wind | Biomass | Imports | Consumption | Production |
|-----------------------|-----------|-----------|--------------|-----------|-----------|-----------|-----------|-----------|-----------|----------|-------------|------------|
| 2017 vs 2016 | | | | | | | | | | | | |
| Jan-19 forecast by us | 2 | -28 | 2 | 40 | -9 | -45 | 8 | 57 | 6 | -8 | 25 | 32 |
| Eurostat actuals | 2 | -30 | -2 | 52 | -10 | -50 | 8 | 60 | 4 | -8 | 26 | 34 |
| Difference | 0 | -2 | -4 | 12 | -1 | -4 | 0 | 3 | -2 | 0 | 1 | 2 |
| 2018 vs. 2017 | | | | | | | | | | | | |
| Jan-19 forecast by us | -8 | -33 | -3 | -35 | -3 | 39 | 8 | 22 | 5 | 16 | 7 | -8 |
| Jan-20 forecast by us | -9 | -38 | -2 | -37 | -3 | 44 | 8 | 16 | 6 | 17 | 1 | -16 |
| Difference | -1 | -5 | 1 | -2 | -1 | 4 | -1 | -5 | 2 | 2 | -6 | -8 |

Authors’ calculations

duction by 8 TWh. EUROSTAT are expected to publish 2018 data later in Q1 2020.

1.3 Key changes to the electricity mix in 2019

Tables 2 and 3 show the total TWh and the TWh changes in 2019, based on our best estimation.

- **Electricity consumption** Electricity consumption decreased by 1.7% (-56TWh), bringing demand back to 2015 levels. Almost every country recorded a fall, helped by the milder winter months. Germany saw the biggest fall, of 3.3%.
- **Wind generation** increased by 14% (+54 TWh). 73% of the rise occurred in just 5 countries: Germany, the UK, France, Sweden and Spain. In 15 countries, wind generation did not change from 2018.
- **Solar generation** rose by 7% (+9.5 TWh). The Netherlands (+3 TWh) and Spain (+2 TWh) accounted for 54% of the EU-wide increase in solar generation.
- **Biomass generation** rose only 1% (+1.4 TWh), confirming a slowdown in biomass growth.
- **Total wind, solar and biomass rose +65 TWh.** This was largely triggered by strong growth of wind in a few countries, but also by good wind availability in these countries in 2019.
- **Hydro generation** decreased by 6% (-21.5 TWh), reaching the third lowest level in this century. In 2019, hydro generation decreased throughout Europe in 13 countries and stayed unchanged in 8 countries.
- **Nuclear generation** decreased slightly by 1% (-6 TWh), with a 3 and 14% decrease in France and the UK, respectively, and a 48% increase in Belgium (as several Belgium reactors were brought online after long unavailabilities).
- **Gas generation** rose by 12% (+73.5 TWh) as increasing CO₂ prices in the EU ETS boosted the competitiveness of gas in relation to coal generation. Spanish gas power accounted for 37% (+27 TWh) of the EU-wide increase in gas generation, followed by the Netherlands (+12 TWh), Italy and Germany (+9 TWh each), and France (+8 TWh). Together, these five countries were responsible for 88% of the increase in EU gas power generation.
- **Hard coal generation** fell 32% (-101 TWh). This was caused by renewables growth and rising CO₂ prices (leading to increased gas generation). Hard coal generation decreased by 26 TWh in Germany, 24 TWh in Spain, 10 TWh in the Netherlands and the UK, and 9 TWh in Italy. Together, these five countries contributed 79% to the EU hard coal generation decrease.
- **Lignite generation** fell by 16% (-49 TWh), 32 TWh of which occurred in Germany and 7 TWh in Poland. Market economics (cheap RES generation, rising CO₂ prices) have thus started to strongly affect lignite generation.
- **Overall fossil generation** fell by 6% (-82 TWh), next to 2018 the largest drop in the last five years, as wind and solar continued to grow while demand fell.
- **CO₂ emissions** in the power sector fell by 12% due to the fall in hard coal and lignite generation.
- **Net electricity imports** into the EU decreased by 11 TWh, with a resulting net import of 16 TWh. Austria's net imports decreased by 7 TWh due to higher wind and hydro generation, and Belgium's net imports decreased by 19 TWh (due to nuclear reactors being brought online after some time and making the country a net exporter for the first time since 2009). Swedish net exports rose by 9 TWh (due to increasing hydro and wind generation, as in Austria). Dutch net imports decreased by 7 TWh due to increased gas and solar generation, leading to an even balance of trade for electricity.

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

Power production in 2019, by fuel and country, TWh

Table 2

| TWh | Lignite | Hard Coal | Other fossil | Gas | Nuclear | Hydro | Solar | Wind | Biomass | Consumption | Imports | Production |
|----------------|------------|------------|--------------|------------|------------|------------|------------|------------|------------|-------------|-----------|-------------|
| EU 28 | 252 | 218 | 117 | 699 | 821 | 348 | 137 | 432 | 199 | 3239 | 16 | 3222 |
| Austria | 0 | 2 | 3 | 11 | 0 | 44 | 1 | 8 | 4 | 76 | 2 | 73 |
| Belgium | 0 | 0 | 4 | 24 | 43 | 1 | 4 | 9 | 5 | 89 | -2 | 92 |
| Bulgaria | 18 | 0 | 0 | 3 | 17 | 3 | 1 | 1 | 0 | 38 | -6 | 45 |
| Croatia | 0 | 1 | 0 | 3 | 0 | 6 | 0 | 1 | 1 | 19 | 7 | 12 |
| Cyprus | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 5 |
| Czech | 35 | 1 | 2 | 6 | 30 | 3 | 2 | 1 | 5 | 74 | -13 | 86 |
| Denmark | 0 | 5 | 0 | 0 | 0 | 0 | 1 | 16 | 9 | 37 | 6 | 31 |
| Estonia | 0 | 1 | 6 | 0 | 0 | 0 | 0 | 1 | 1 | 10 | 2 | 8 |
| Finland | 3 | 5 | 1 | 4 | 24 | 12 | 0 | 6 | 13 | 87 | 20 | 68 |
| France | 0 | 4 | 11 | 38 | 399 | 63 | 12 | 35 | 7 | 509 | -61 | 570 |
| Germany | 114 | 57 | 26 | 91 | 75 | 19 | 47 | 126 | 51 | 569 | -37 | 605 |
| Greece | 13 | 0 | 5 | 18 | 0 | 5 | 4 | 7 | 0 | 62 | 10 | 52 |
| Hungary | 4 | 0 | 0 | 9 | 16 | 0 | 0 | 1 | 2 | 46 | 13 | 33 |
| Ireland | 2 | 2 | 0 | 16 | 0 | 1 | 0 | 8 | 1 | 30 | 0 | 30 |
| Italy | 0 | 18 | 15 | 138 | 0 | 45 | 24 | 20 | 27 | 330 | 41 | 289 |
| Latvia | 0 | 0 | 0 | 3 | 0 | 2 | 0 | 0 | 1 | 7 | 1 | 7 |
| Lithuania | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 2 | 1 | 13 | 8 | 4 |
| Luxembourg | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 8 | 6 | 2 |
| Malta | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 2 |
| Netherlands | 0 | 17 | 6 | 74 | 3 | 0 | 6 | 11 | 4 | 121 | 0 | 121 |
| Poland | 43 | 77 | 3 | 14 | 0 | 3 | 0 | 15 | 7 | 172 | 10 | 161 |
| Portugal | 0 | 6 | 1 | 17 | 0 | 11 | 1 | 14 | 3 | 57 | 3 | 54 |
| Romania | 13 | 0 | 1 | 9 | 11 | 16 | 2 | 7 | 1 | 61 | 1 | 60 |
| Slovakia | 1 | 1 | 1 | 2 | 15 | 5 | 1 | 0 | 2 | 29 | 2 | 28 |
| Slovenia | 4 | 0 | 0 | 1 | 6 | 5 | 0 | 0 | 0 | 16 | 0 | 16 |
| Spain | 0 | 13 | 17 | 85 | 58 | 26 | 15 | 55 | 6 | 282 | 7 | 275 |
| Sweden | 0 | 0 | 3 | 0 | 67 | 66 | 0 | 22 | 12 | 143 | -26 | 171 |
| United Kingdom | 0 | 7 | 6 | 130 | 56 | 9 | 13 | 65 | 36 | 344 | 22 | 322 |

Authors' calculations

Changes from 2018 to 2019, by fuel and country, TWh

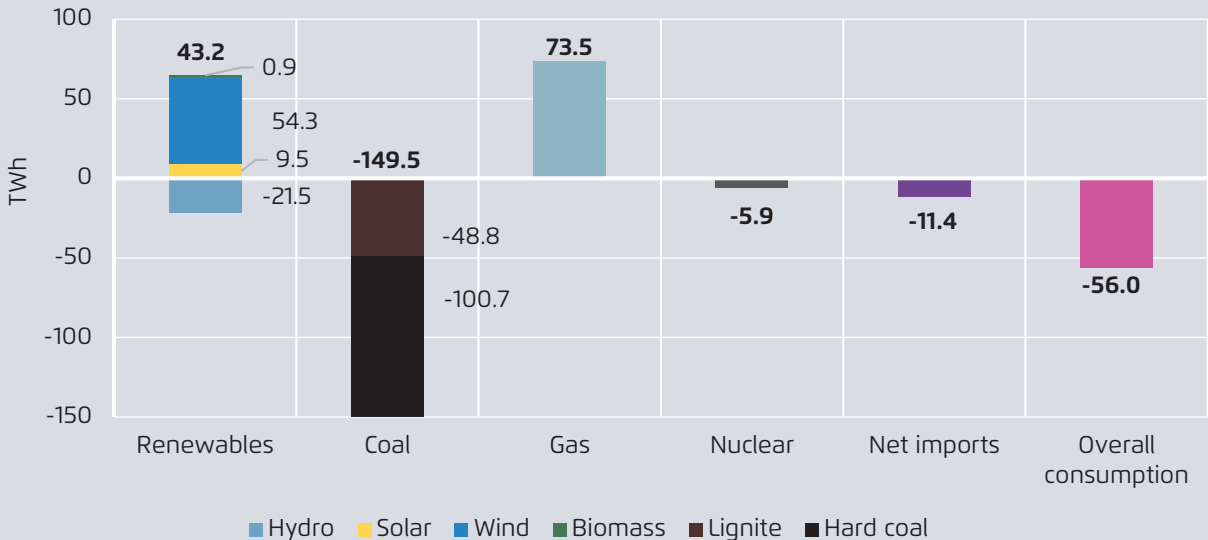
Table 3

| | TWh | Lignite | Hard Coal | Other fossil | Gas | Nuclear | Hydro | Solar | Wind | Biomass | Imports | Consumption | Production | CO2 (Mt) |
|-----------------|-----|--------------|---------------|--------------|--------------|-------------|--------------|-------------|--------------|-------------|--------------|--------------|--------------|---------------|
| EU 28 | | -48.8 | -100.7 | -5.7 | +73.5 | -5.9 | -21.5 | +9.5 | +54.3 | +0.9 | -11.4 | -56.0 | -44.5 | -120.4 |
| %-change | | -16% | -32% | -5% | 12% | -1% | -6% | 7% | 14% | 0% | -41% | -2% | -1% | -12% |
| Austria | | 0 | 0 | 0 | +2 | 0 | +3 | 0 | +2 | 0 | -7 | -1 | +5 | 0 |
| Belgium | | 0 | 0 | 0 | +1 | +14 | 0 | 0 | +2 | 0 | -19 | -3 | +17 | +1 |
| Bulgaria | | -1 | 0 | 0 | 0 | 0 | -2 | 0 | 0 | 0 | +1 | -1 | -2 | -1 |
| Croatia | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cyprus | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Czech | | -2 | -2 | 0 | +2 | 0 | 0 | 0 | 0 | 0 | +1 | -1 | -1 | -3 |
| Denmark | | 0 | -3 | 0 | 0 | 0 | 0 | 0 | +2 | 0 | +1 | 0 | -1 | -2 |
| Estonia | | 0 | 0 | -4 | 0 | 0 | 0 | 0 | 0 | 0 | +4 | 0 | -4 | -4 |
| Finland | | 0 | -1 | -1 | 0 | +1 | -1 | 0 | 0 | 0 | 0 | -2 | -3 | -2 |
| France | | 0 | -5 | 0 | +8 | -14 | -6 | +2 | +6 | -1 | +2 | -8 | -10 | -1 |
| Germany | | -32 | -26 | 0 | +9 | -1 | +1 | +1 | +16 | 0 | +12 | -20 | -32 | -55 |
| Greece | | -5 | 0 | 0 | +1 | 0 | 0 | 0 | +1 | 0 | +3 | 0 | -2 | -5 |
| Hungary | | 0 | 0 | 0 | +1 | +1 | 0 | 0 | 0 | 0 | -2 | 0 | +2 | 0 |
| Ireland | | 0 | -2 | 0 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | -1 | -2 |
| Italy | | 0 | -9 | 0 | +9 | 0 | -5 | +1 | +3 | +2 | -3 | -3 | 0 | -5 |
| Latvia | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lithuania | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 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 |
| Netherlands | | 0 | -10 | 0 | +12 | 0 | 0 | +3 | 0 | 0 | -7 | -2 | +5 | -4 |
| Poland | | -7 | -4 | 0 | +1 | 0 | 0 | 0 | +2 | 0 | +5 | -2 | -7 | -10 |
| Portugal | | 0 | -6 | 0 | +2 | 0 | -3 | 0 | 1 | 0 | +6 | -1 | -6 | -5 |
| Romania | | -2 | 0 | 0 | -1 | 0 | -2 | 0 | 0 | 0 | +4 | -1 | -5 | -3 |
| Slovakia | | 0 | 0 | 0 | 0 | +1 | +1 | 0 | 0 | 0 | -2 | -1 | +1 | 0 |
| Slovenia | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Spain | | 0 | -24 | 0 | +27 | +2 | -11 | +2 | +4 | 0 | -5 | -4 | 0 | -11 |
| Sweden | | 0 | 0 | +1 | 0 | -1 | +3 | 0 | +5 | 0 | -9 | -2 | +8 | 0 |
| United Kingdom | | 0 | -10 | 0 | +1 | -9 | +1 | 0 | +8 | +2 | +3 | -5 | -8 | -9 |

Authors' calculations

Changes in EU 28 electricity generation from 2018 to 2019

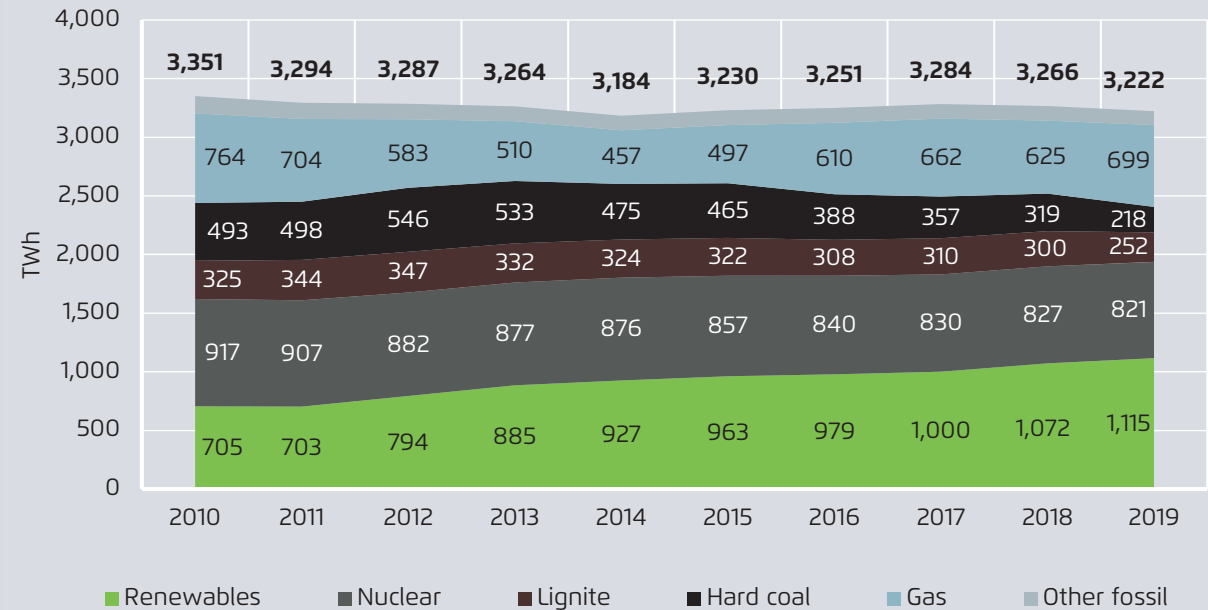
Figure 1-1



EUROSTAT data to 2017; Authors' calculations for 2018 and 2019

EU 28 electricity generation

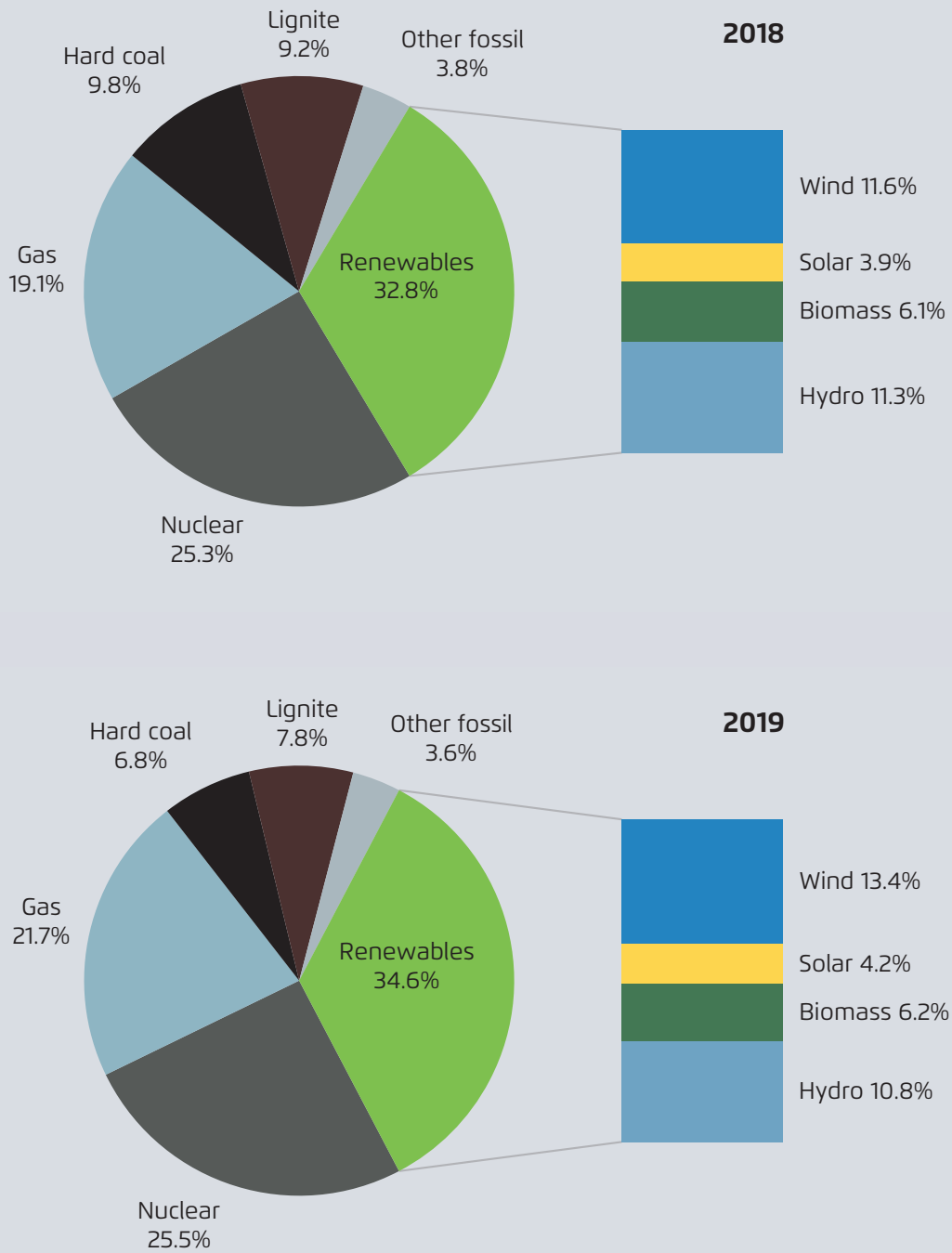
Figure 1-2



EUROSTAT data to 2017; Authors' calculations for 2018 and 2019

Generation mix in 2018 and 2019

Figure 1-3



EUROSTAT data to 2017; Authors' calculations for 2018 and 2019

2 Electricity consumption

Electricity consumption decreased by 2% (-56 TWh), bringing demand back to 2015 levels, while GDP grew by 1.4% in 2019. EU electricity consumption remains 4% lower than in 2010 despite a 14% rise in GDP and a 2% rise in population since then (see Figure 2-1).

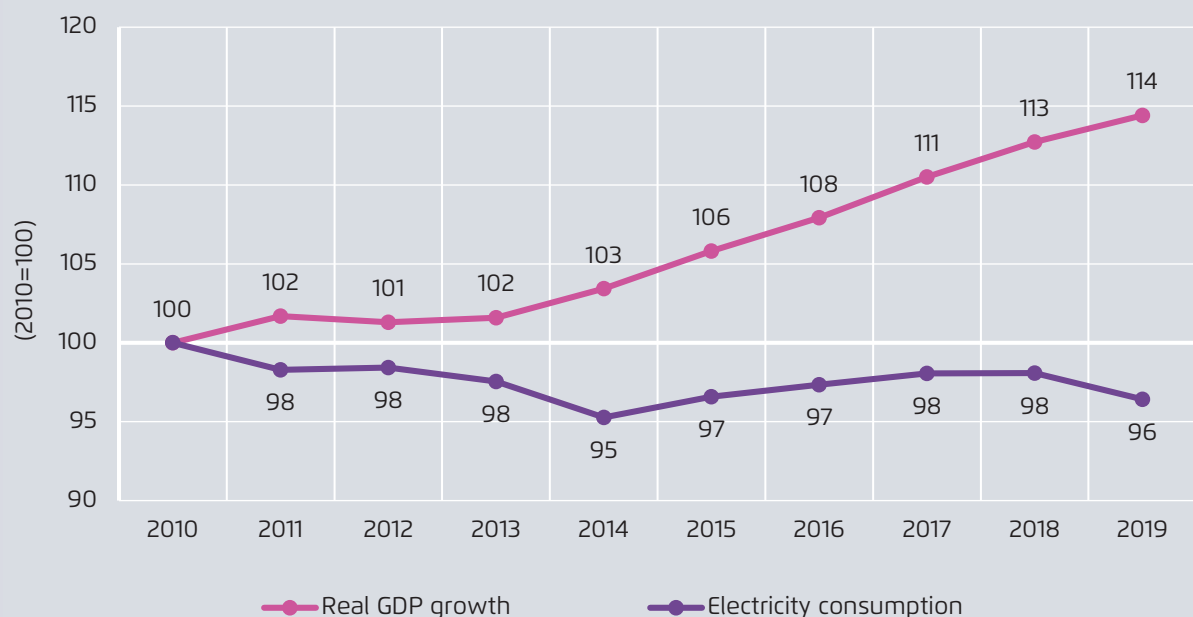
From 2018 to 2019 electricity demand has been falling both in western Europe and eastern Europe. The overall regional trends are, however, still significant when considering the last decade (see Figure 2-2). In Hungary, Ireland and Malta, demand did not change from 2018 to 2019. Power demand increased slightly in Cyprus and Greece by 2 and 1%, respectively. It decreased between 1 and 3% in the remaining 22 EU countries. Poland's electricity consumption in 2019 was 11% above 2010 levels and, in terms of growth, third only to Lithuania (+14%) and Malta (+19%).

Compared to 2010 levels, the UK reduced electricity consumption most (-10%), followed by Luxembourg (-8%) and Germany (-7%).

The July 2019 heatwave, which sent temperatures above 40°C in Northern Europe, strongly increased power demand for air conditioning. However, very warm winter months in early and late 2019 lowered power consumption, more than compensating for summer power demand surges. For example, December 2019 was the warmest December on record in Europe. September to November was the fourth hottest autumn of the last forty years, while 2019 was the hottest year on record in Europe. Overall, the reduced heating demand in the warm winter months continues to offset additional air conditioning demand in the hot summer months.

EU 28 electricity consumption, GDP (indexed)

Figure 2-1



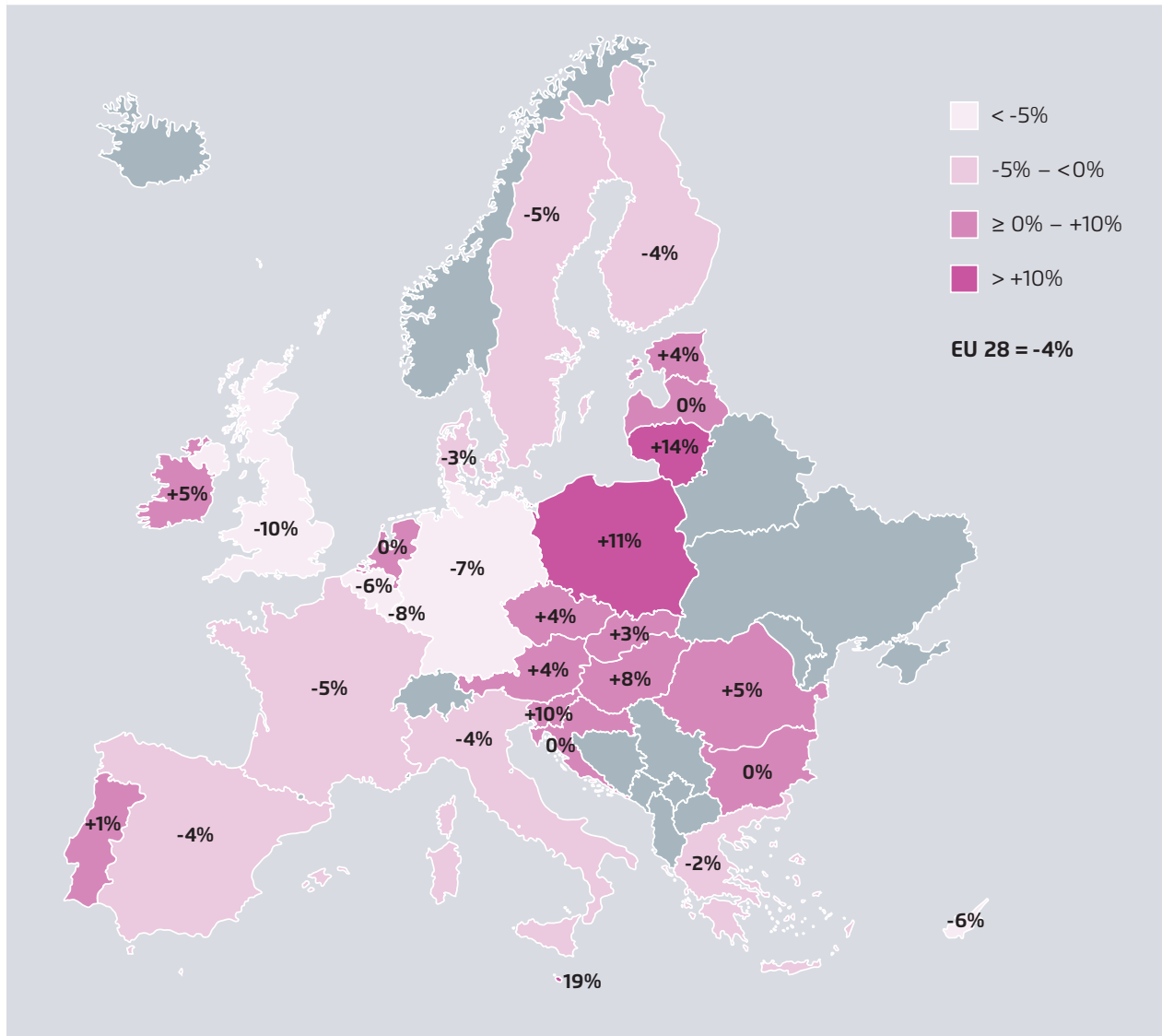
Electricity consumption from EUROSTAT data to 2017; Authors' calculations for 2018 and 2019; GDP from EUROSTAT

Electricity consumption is being impacted by the shift away from industrial production as a source of GDP growth. While overall EU GDP rose, industrial production fell in 2018 and 2019, especially in the steel sector. The European electric vehicle and heat pump markets expanded in 2019. Electric car sales were up almost 50%, resulting in 4% of new car sales being electric.

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

Change in electricity consumption from 2010 to 2019

Figure 2-2



EUROSTAT data to 2017; Authors' calculations for 2018 and 2019

3 Renewables

3.1 Renewables in 2019

In 2019, renewables generated 34.6% of Europe's electricity (see Figure 3-1). This represents a rise of 1.8 percentage points, up from 32.8% in 2018. Growth in wind and solar more than offset the decrease in hydro generation. Wind, solar and biomass generated 24% of power in the EU. These renewables covered 47% of power demand in Denmark, 30% in Germany, 28% in Ireland, 26% in Portugal, 25% in Spain and 23% in UK (although the EU average is 18%). In the category of renewables, wind has a RES share of 39%, followed by hydro (32%) and biomass (18%). Solar contributed 12% to EU-wide RES generation.

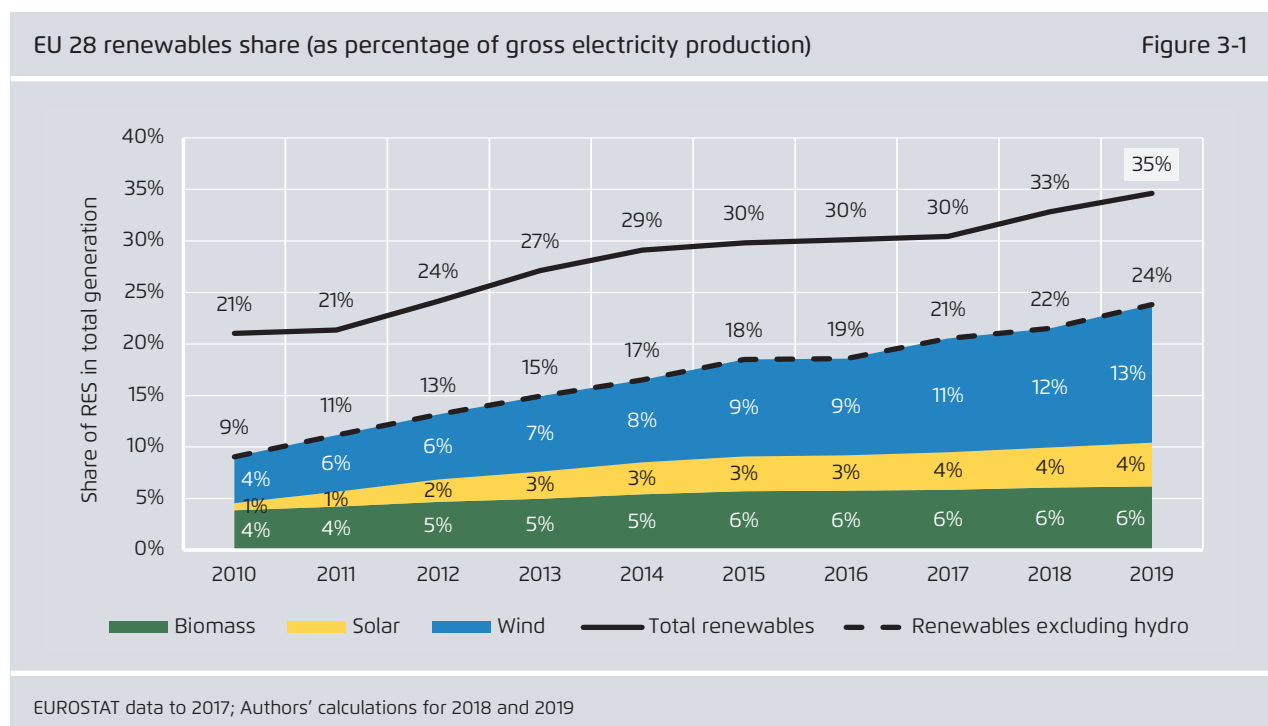
Renewable generation (excl. hydro) increased by 65 TWh in 2019 (see Figure 3-2), exceeding the 2010–2018 average of 50 TWh per year. This high level of RES production was mainly attributable to an increase in wind generation. Since 2015, 84% of the growth in

total renewables generation has come from wind, 18% from solar and 10% from biomass.

3.2 Solar

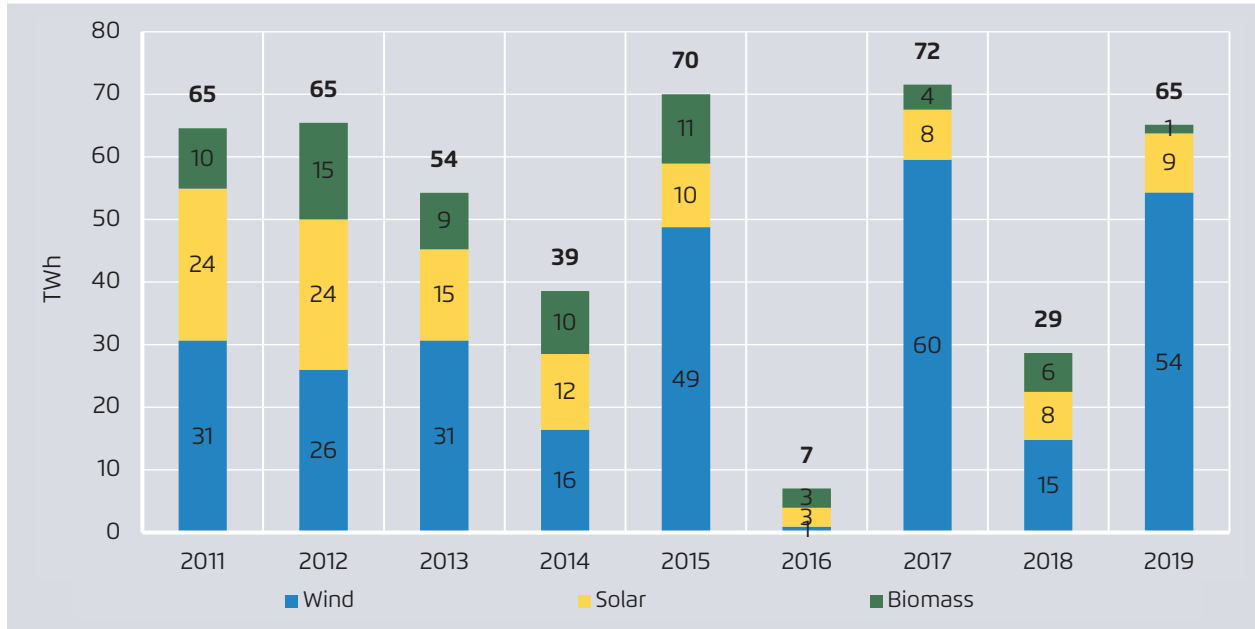
Solar generates 4% of Europe's electricity, but this rate varies significantly from country to country.

Malta has the highest proportion, producing 9% of its electricity from solar. Germany, Greece and Italy all compete for second place at 8% (see Figure 3-3). At the other extreme, some countries have almost no solar generation: Poland, Finland, Estonia, Latvia, Sweden and Ireland barely register and even sunny Croatia and Slovenia have only 1%. Dutch solar generation increased the most in 2019 (+ 3 TWh), followed by Spain (+ 2.1 TWh) and France (+ 1.7 TWh). These three countries contributed 54% to the EU-wide increase in solar generation (see Figure 3-4).



Year-on-year changes in EU 28 electricity generation by wind, solar and biomass

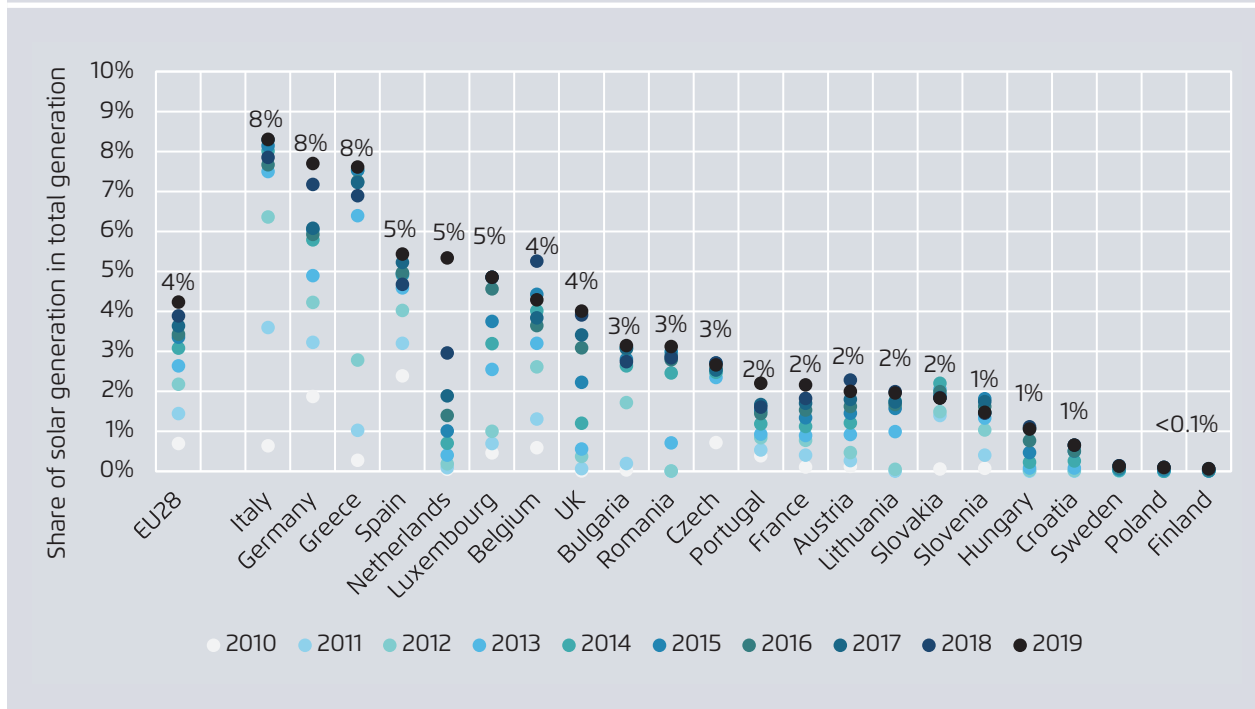
Figure 3-2



EUROSTAT data to 2017; Authors' calculations for 2018 and 2019

Solar as percentage of national electricity production

Figure 3-3



EUROSTAT data to 2017; Authors' calculations for 2018 and 2019

Growth in solar surged by 104% in 2019, from 8.2 GW in 2018 to 16.7 GW in 2019, SolarPower Europe [estimates](#). This will be the highest installation rate since 2010 (see Figure 3-5). SolarPower Europe said “the key to solar’s growth in the EU and beyond is its competitiveness. Solar power is often cheaper than any other power generation source today, and its attractiveness is only increasing as the cost reduction curve continues at a much faster pace than for any other technology.”

Spain was the largest solar market in Europe in 2019. It [installed](#) 4.7 GW of solar PV, followed by Germany (+4 GW) and the Netherlands (+2.5 GW). France installed 1 GW and Poland came in fifth with 0.8 GW. Together these five countries installed 78% of the EU’s new solar capacity.

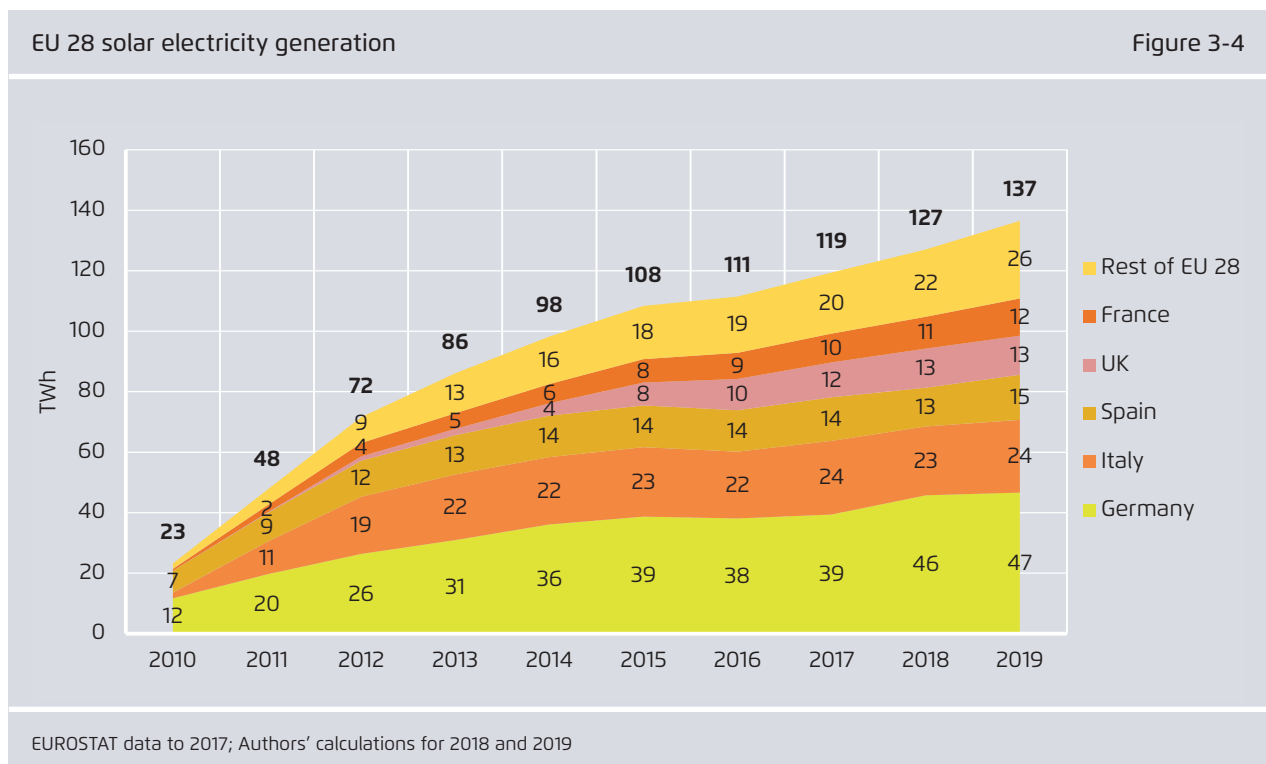
Solar installation rates could almost triple in 3 years to 41.4 GW per year, given the right policies. In the above mentioned publication, SolarPower Europe updated their forecast to 2023, predicting annual

capacity expansion of 26.8 GW under its Medium Scenario and 41.4 GW under its High Scenario (see Figure 3-5).

Solar PV wholesale module prices fell to €0.26/watt by April 2019, spurring [global](#) solar capacity expansion of 114 GW in 2019. Therefore, despite the EU’s large increase in solar installations in 2019, it still accounted for less than 15% of global installations.

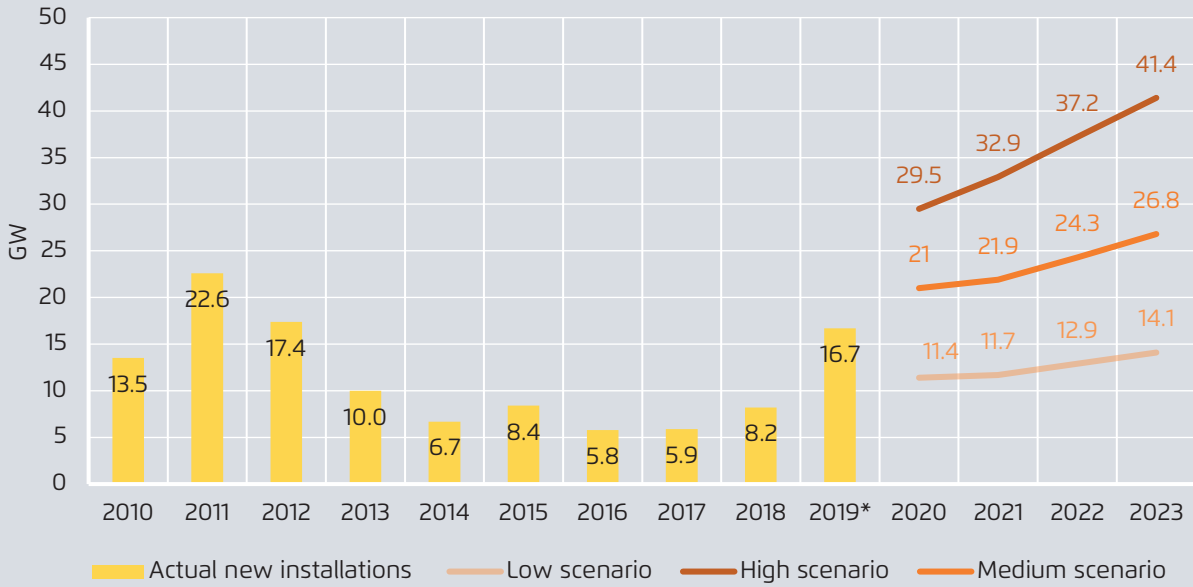
Solar is becoming cheaper. An [auction](#) in Portugal showed a record-low auction price of just €14.8/MWh.

Solar proved its worth during the summer 2019 heatwave. Solar insolation across much of the summer was above average in Europe, encouraging very high PV feed-in and depressing generation from coal, nuclear, hydro and wind, despite higher electricity demand.



EU 28 annual new solar PV installations

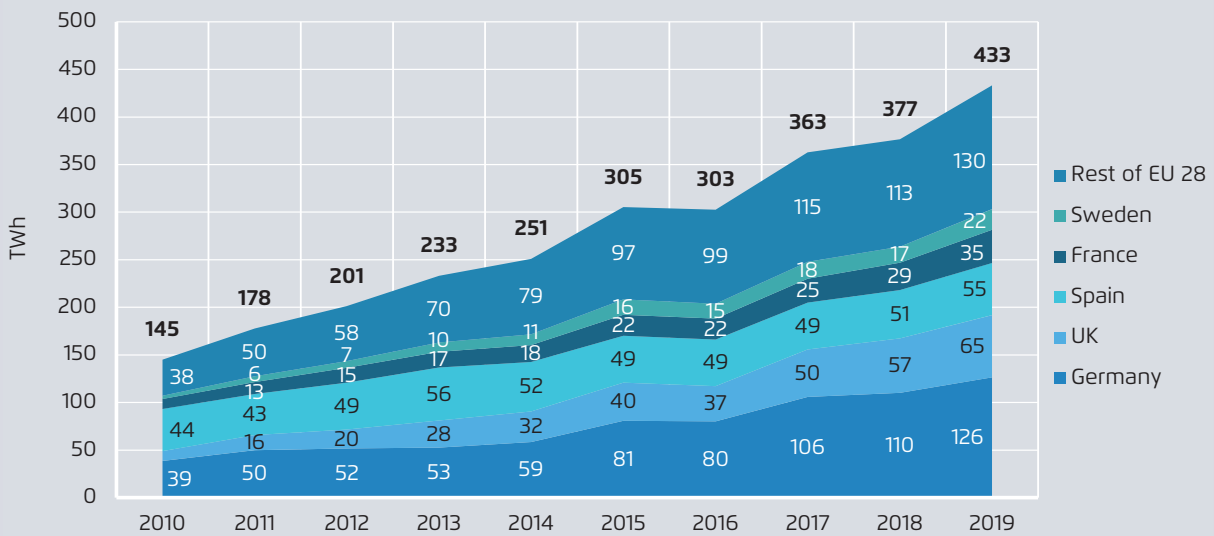
Figure 3-5



SolarPower Europe 2019; *latest forecast from SolarPower Europe

EU 28 wind electricity generation

Figure 3-6



EUROSTAT data to 2017; Authors' calculations for 2018 and 2019

3.3 Wind

Wind generation increased by 14% (+54 TWh) in 2019 (see Figure 3-6). Almost 14 GW of new wind capacity was installed in 2019, according to WindEurope's [forecast](#) in October 2019 (see Figure 3-7). This was slightly less than 2017's record levels, but nonetheless represents very strong growth. More than three quarters of new installations were onshore wind.

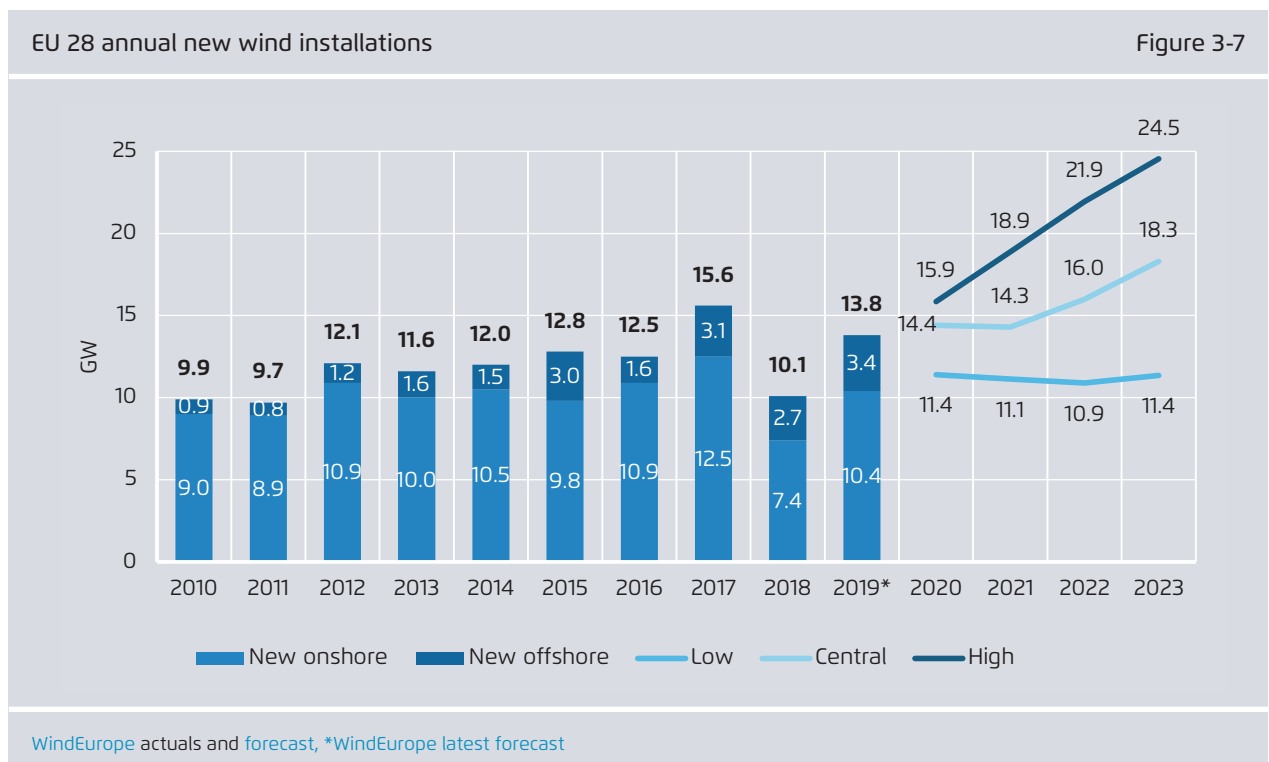
However, this growth was focused in seven countries. 65% of the rise in generation capacity took place in Germany, France, Spain, the UK, Sweden, the Netherlands and Italy.

2019 was, next to 2017, a record year for wind, and planned new-build wind should remain strong up to 2023, albeit geographically uneven. Poland held the largest onshore wind auction ever in the EU with a total volume of 2.2 GW, garnering an average bid of €49/MWh. WindEurope released their [forecast](#) sce-

narios to 2023 in October 2019. In its Central Scenario, an average annual expansion for onshore wind of 12.2 GW is foreseen by 2023. Germany, followed by Spain, France and Sweden, are the expected market leaders. By the end of 2023, an average of 3.7 GW of offshore wind is expected to come online annually, according to the industry's forecast. They state "2022 could be another record year, followed by an even stronger 2023. However, uncertainty towards the end of the 5-year period is quite high, particularly in onshore, and we could witness a stagnation of installations if national authorities do not tackle spatial planning and permitting issues in an efficient and comprehensive manner."

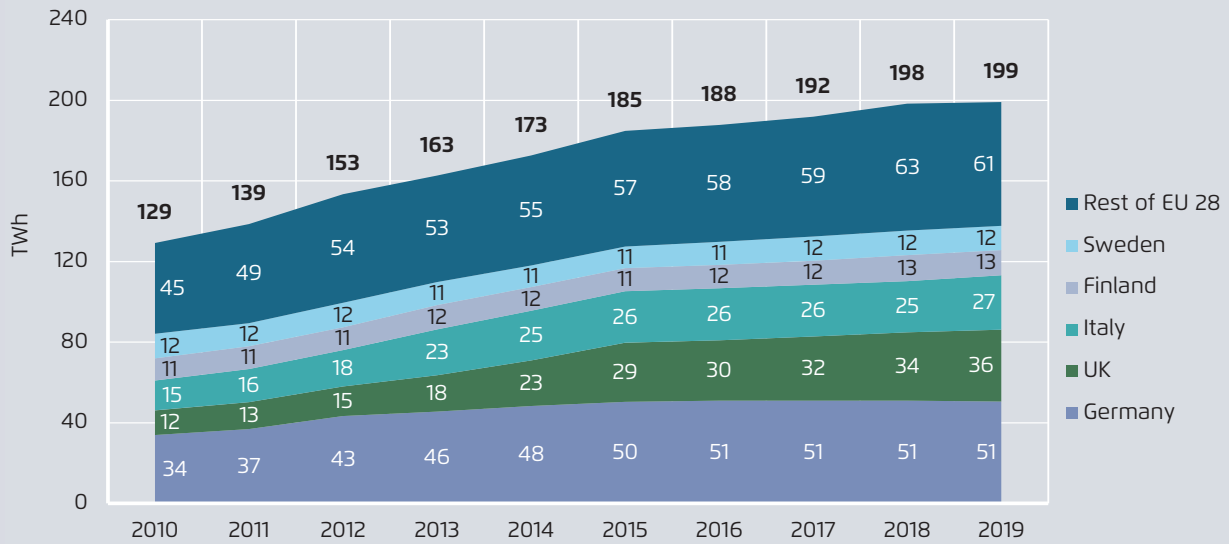
3.4 Biomass

The biomass boom continues to slow. Biomass generation grew by only 1% in 2019. This is one fifth of the the growth rate from 2010-2018 (see Figure 3-8). Growth in the key countries of Germany and Italy



EU 28 biomass electricity generation

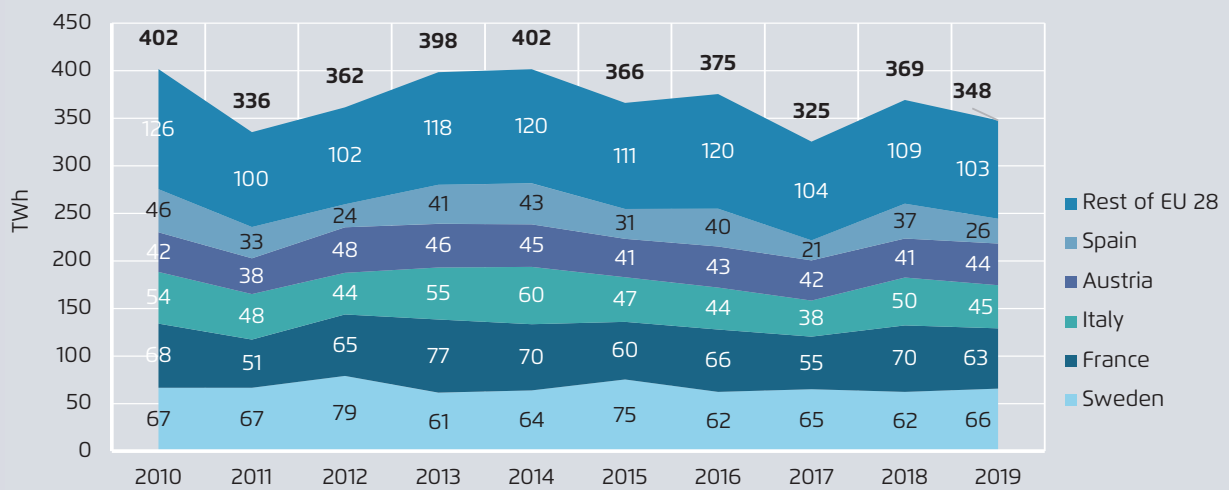
Figure 3-8



EUROSTAT data to 2017; Authors' calculations for 2018 and 2019

EU 28 hydro electricity generation

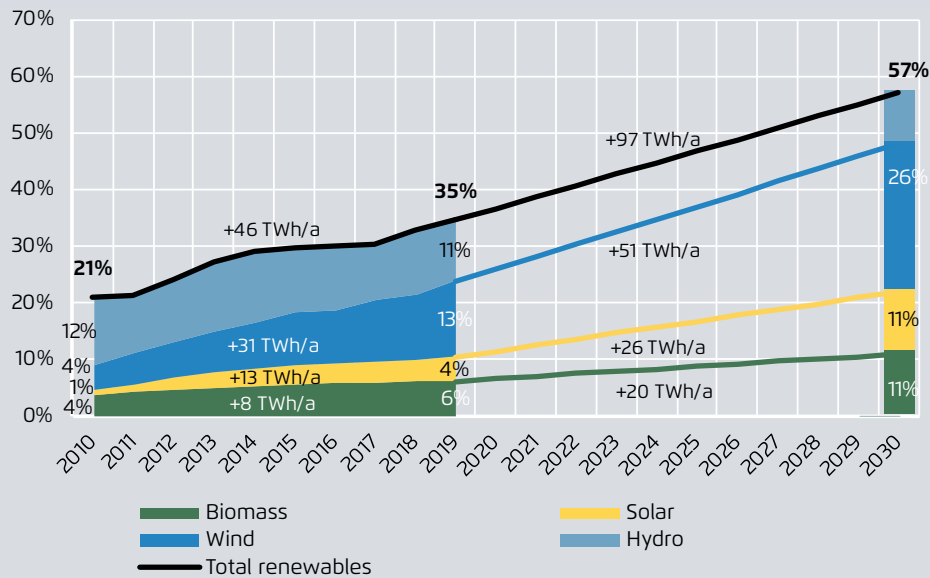
Figure 3-9



EUROSTAT data to 2017; Authors' calculations for 2018 and 2019

2030 projection of renewable electricity share in European Commission's Long Term Strategy

Figure 3-10



EUROSTAT data to 2017; Authors' calculations for 2018 and 2019; 2030 projection from "Long Term Strategy", European Commission 2018, dashed lines show projection

has either stopped or strongly slowed, and biomass consumption has fallen slightly in eleven EU countries. More than 50% of EU biomass generation came from Germany, UK and Italy, while most of the growth from 2018 to 2019 came from the UK and Italy. There are still a few large projects under construction or on the verge of approval, including the UK's MGT Tees-side, Denmark's biomass plant Amager Unit 4 built on the site of a former coal power plant, the possibility of further coal conversions in the Netherlands, and some smaller conversion projects.

Biomass does not fulfil the EU's "Clean Energy for All" objectives: biomass lifetime CO₂ emissions are far from zero (despite it still being zero-rated in the EU ETS), and its particulates cause pollution, impairing air quality. Future renewables growth must rely on wind and solar. This is why it is imperative to ensure wind and solar deployment accelerates to its full potential.

3.5 Hydro

The downward trend in hydro generation that has been underway since 2014 continued in 2019 as Spain, Italy and France had a drier year. Hydro generation decreased 6% year-on-year, or by 21 TWh, continuing the onward decline in hydro power (see Figure 3-9).

Precipitation in 2019 deviated from the norm in a geographically uneven manner. This is reflected in the generation numbers, with Austria and Sweden generating more hydro, and France, Spain, Italy and Portugal significantly less hydro than the year before. Almost 70% of EU hydro generation stemmed from Sweden, France, Italy, Austria and Spain.

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

3.6 Reaching Europe’s 2030 renewables targets

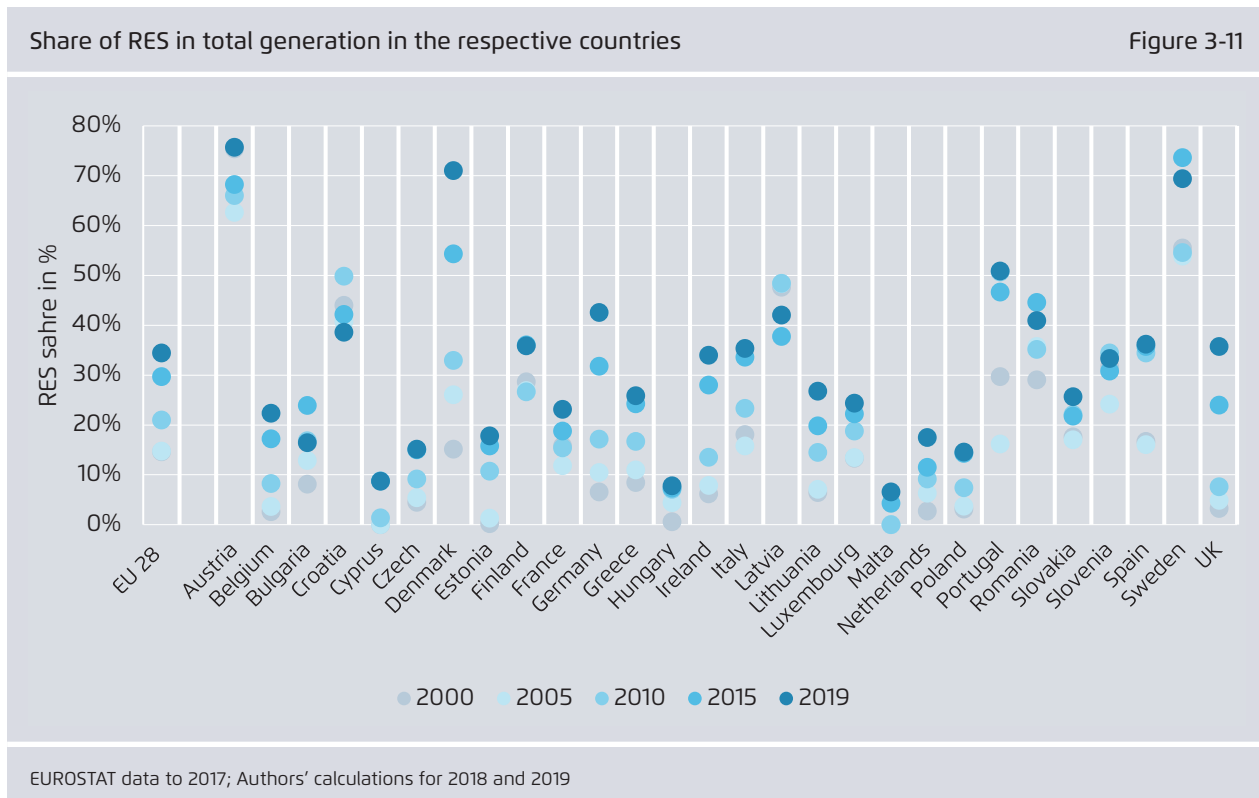
In November 2018, the European Commission released its “Long Term Strategy” for decarbonising the European economy. There is only one pathway modelled to 2030. This pathway meets Europe’s 2030 Renewable Energy and Energy Efficiency targets of 32% and 32.5%, respectively. The Commission also looked at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

The Commission’s calculations show renewable electricity must rise to 57% of the electricity mix by 2030, up from 35% in 2019. Figure 3-10 shows that in the Commission’s modelling, wind more than doubles from 13% in 2019 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 are needed. The electrification of transport, heat and industry means electricity consumption is forecast to rise 18% by 2030. Therefore, renewables generation must rise by 18% by 2030 just to maintain today’s 35% share.

This means that annual renewables deployment must double from its 2010-2019 average in 2019-2030. Renewables grew 46 TWh/year from 2010 to 2019. Figure 3-10 shows that to reach a 57% share of electricity from renewables by 2030, given the extra increase in electricity demand, renewables must grow by 97 TWh/year from 2019 to 2030. Looking at historic growth rates in EU member states, only a few countries, including Denmark, Portugal, Germany, Ireland and the UK, have seen sufficiently robust growth to meet the EU 2030 target (see Figure 3-11).

In 2019, solar and wind growth has picked up in many member states (see Figure 3-12), being strong-



est in western Europe, while Poland and Greece have started to engage. The rest of eastern Europe is significantly lagging behind.

Wind and solar growth rates indicate that the economic opportunities of low-cost renewables become increasingly visible. 2019 saw record low auction prices for offshore wind (UK) and solar (Portugal) - below wholesale prices - and the largest wholesale

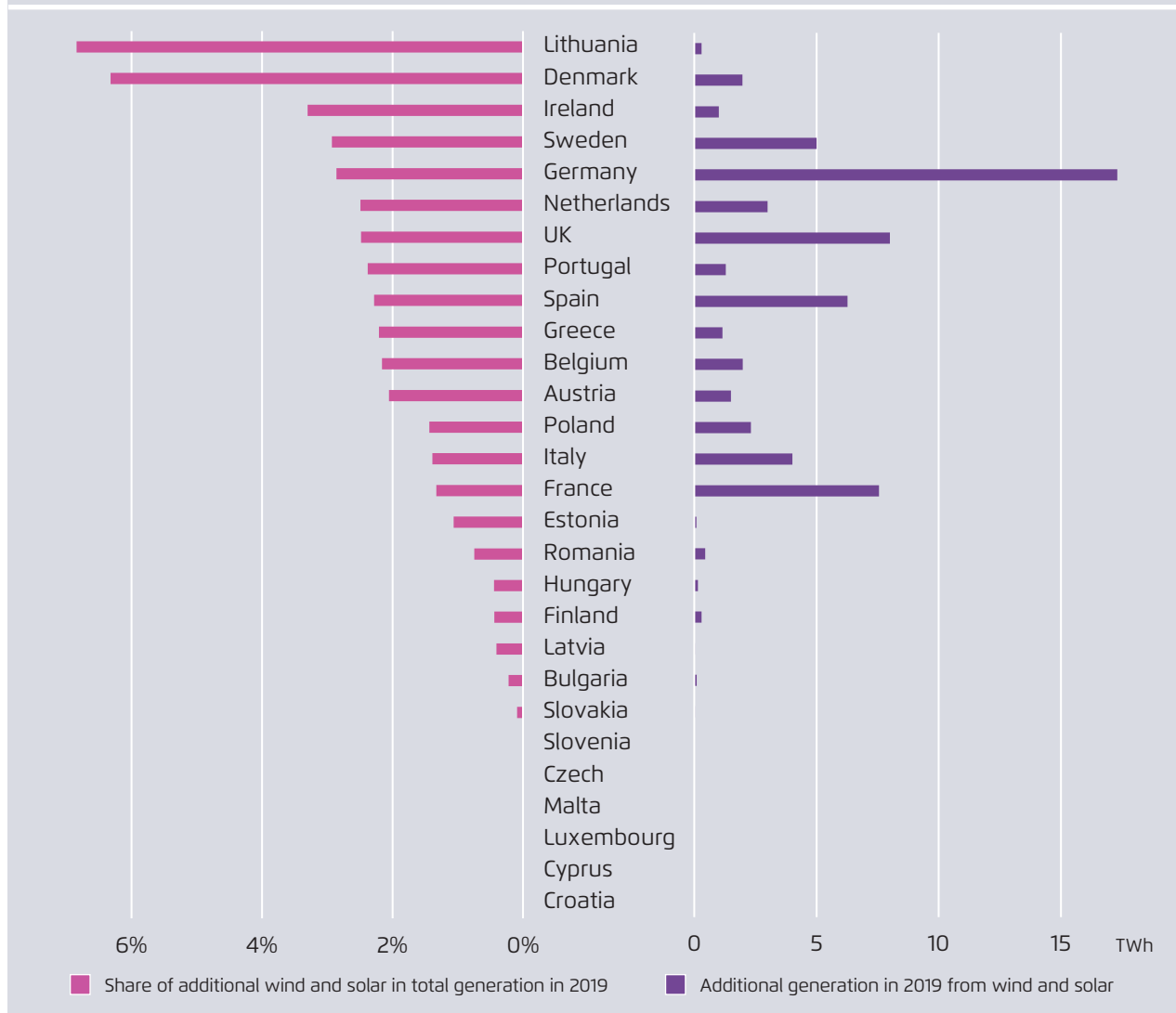
price decreases in countries where wind and solar expanded most (compare Figure 3-12 and Figure 6-4).

Why so much biomass in the EU's 2030 scenario?

Biomass generation is implicitly forecast to double by 2030 in the Commission's 2030 scenario. Is this desirable, since lifetime biomass emissions are far from zero, and particulates cause pollution? And is this expansion realistic, given that wind and solar

Additional generation in 2019 from wind and solar (right) and share of additional wind and solar in total generation (left)

Figure 3-12



EUROSTAT data to 2017; Authors' calculations for 2018 and 2019

have largely become cheaper than biomass, and local sources of sustainable biomass are harder to find? If solar were to replace biomass growth in the EC's model, overall **solar growth would need to more than triple from 12 TWh/year in 2010–2019 to 44 TWh/year in 2019–2030**. Whilst ambitious, this is certainly achievable.

In terms of installed capacity, the differences are less extreme, since wind and solar installations are more efficient than ever, delivering more energy per MW installed. The European Commission's "Long Term Strategy" envisages a 2030 wind capacity of 350 GW (up from 200 GW at end-2019), and 320 GW solar (up from 134 GW at end-2019).

4 Conventional generation

In 2019, overall conventional generation fell by 4% (see Figure 4-1) due to the increase in renewables and decrease in demand. Hard coal and lignite were responsible for nearly all of this decline.

From 2012 to 2019, lignite and hard coal generation dropped by 424 TWh in the EU, while gas generation increased by 116 TWh and renewables (excl. hydro) increased by 335 TWh. As of 2017, generation from wind, solar and biomass exceeded generation from hard coal and lignite. In 2019, wind, solar and biomass generated 768 TWh, while hard coal and lignite generated 470 TWh (see Figure 4-2).

Coal generation in total fell 24% (- 150 TWh) in 2019, and was 47% below 2012 levels. Six countries in the EU are now coal-free and fourteen have pledged to become coal-free by 2030 or earlier. Germany has

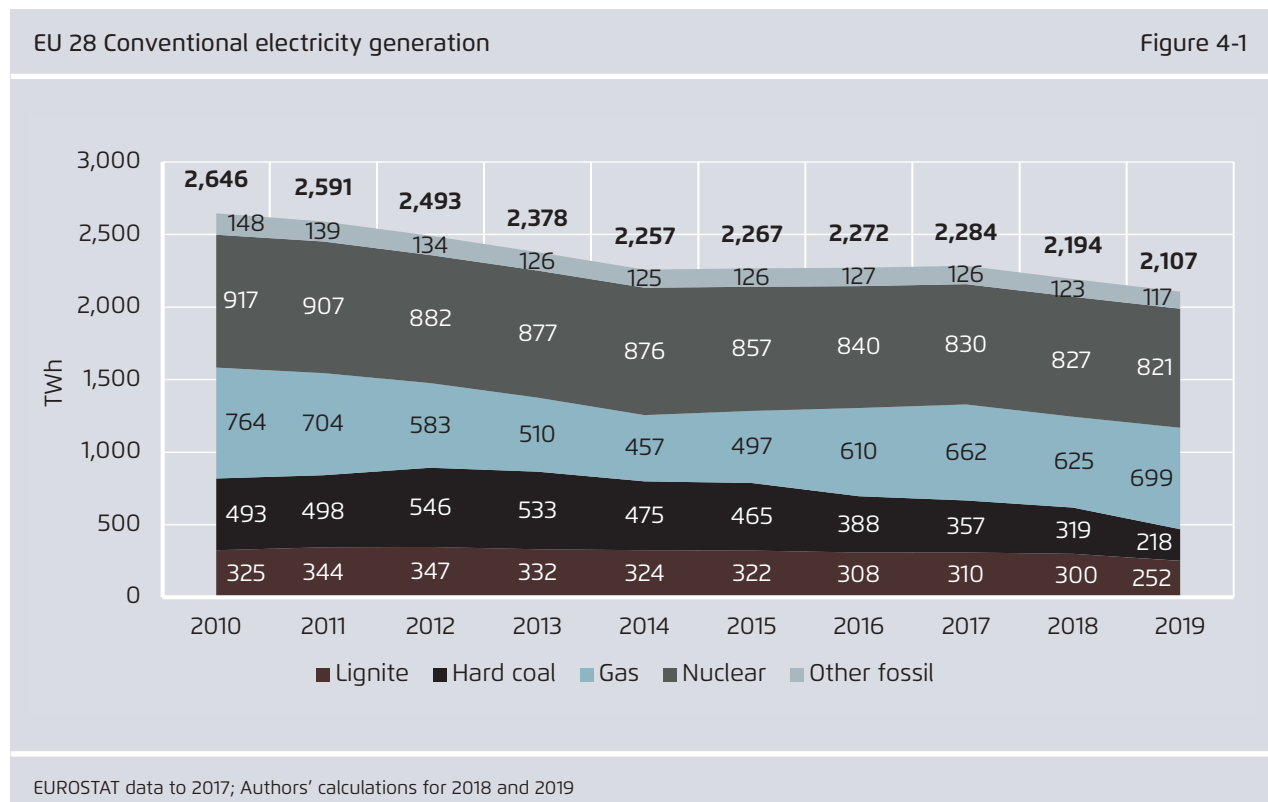
pledged to become coal-free by 2038 at the latest. Coal phase-out discussions are ongoing in the Czech Republic and Spain. Bulgaria, Croatia, Poland, Slovenia and Romania have no national coal phase-out debate as of yet (see Figure 4-6).

The following sections explain these developments in more detail.

4.1 Hard coal

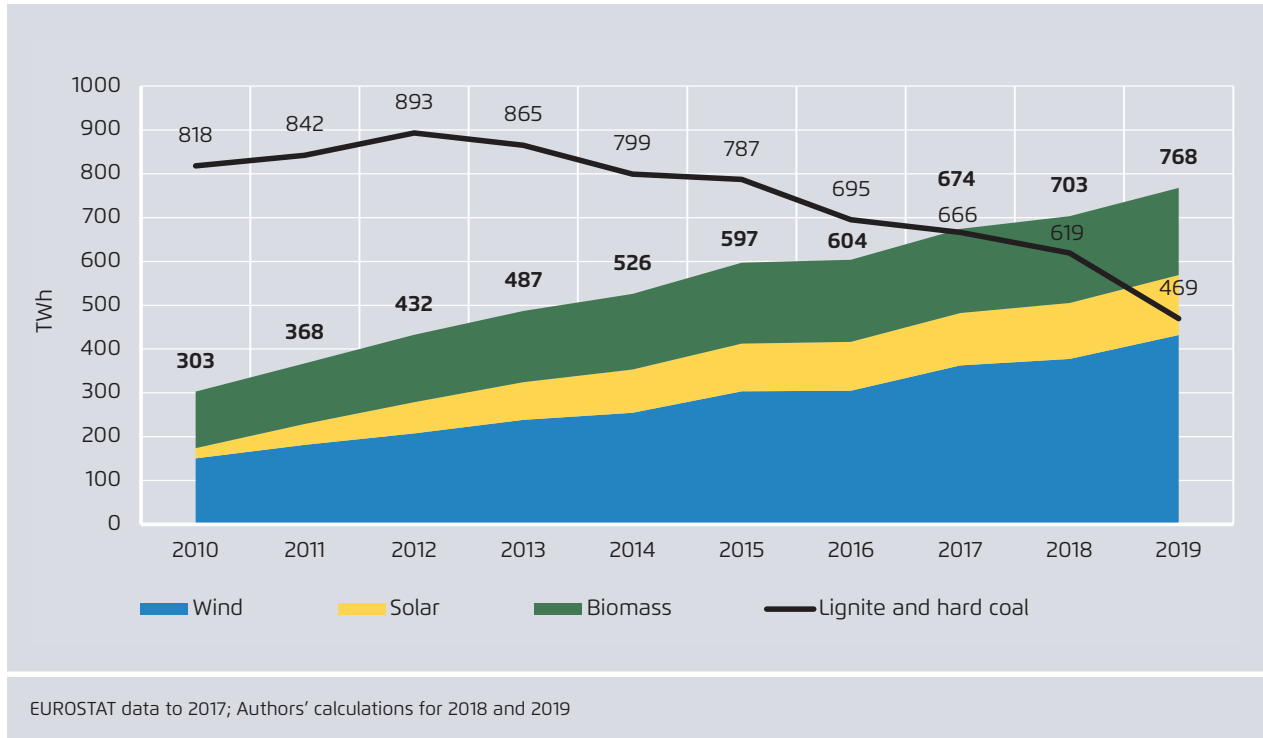
Hard coal generation fell by 32% (101 TWh) in 2019; it is now 60% lower than in 2012 (see Figure 4-3).

The 2019 fall was caused by more renewables, lower demand and the worsening economics of hard coal plants due to CO₂ price increases in the EU ETS. The biggest generation drops occurred in Germany and



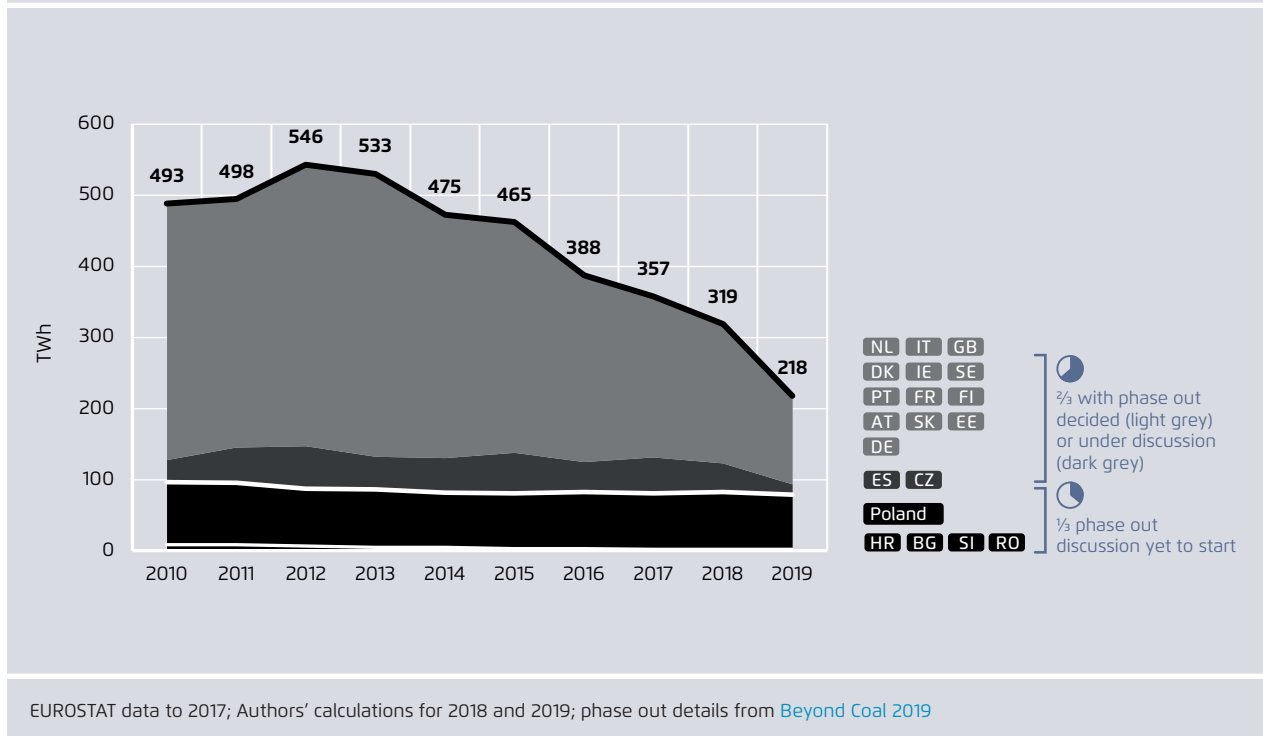
EU 28 generation from hard coal and lignite combined as well as wind, solar and biomass

Figure 4-2



EU 28 hard coal electricity generation

Figure 4-3



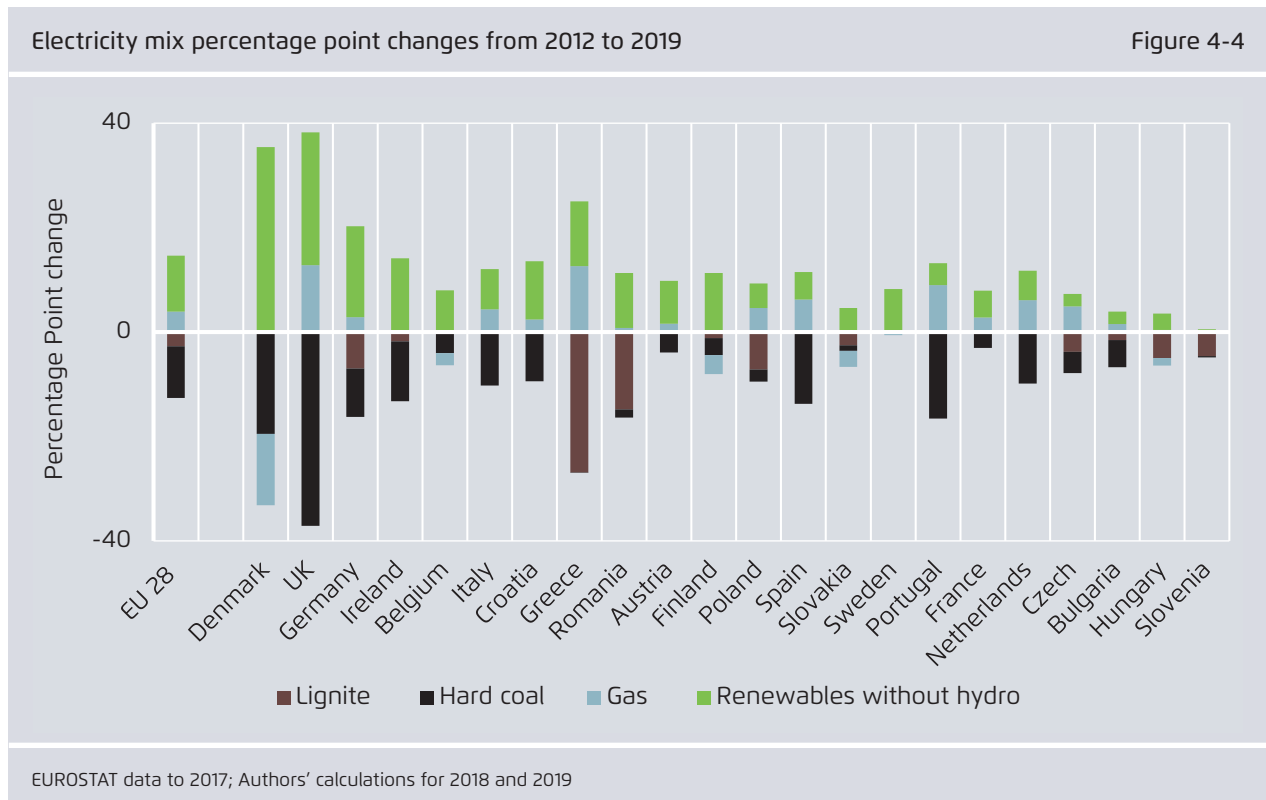
Spain (each experienced a -25 TWh decline), followed by UK, the Netherlands and Italy (-10 TWh each). The smallest relative reduction in hard coal generation happened in Poland (-4%), due to the lack of alternative generation options in the Polish energy mix. At the same time, net Polish imports doubled in 2019, because of the strongly deteriorating economics of hard coal in ever-more integrated power markets.

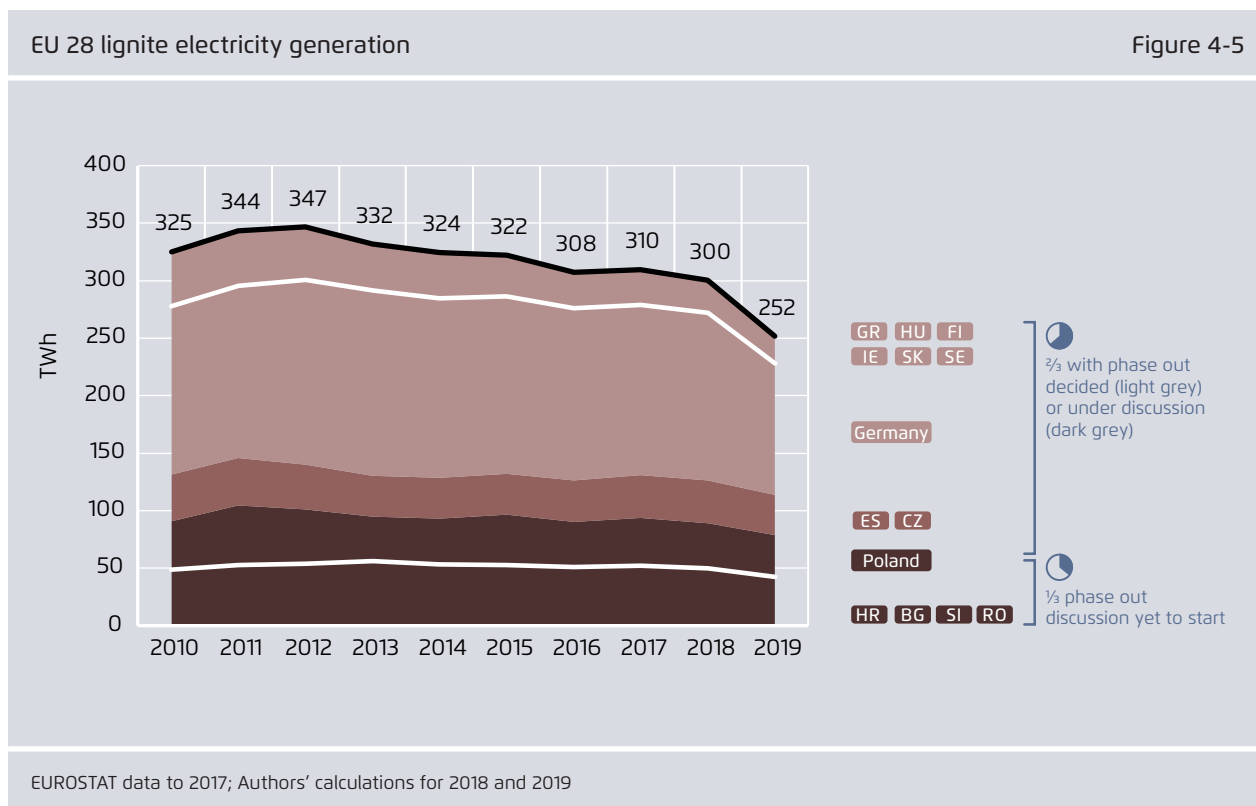
64% of the remaining hard coal generation is slated for shutdown under national coal phase-out plans. In all nations with such intentions, phase out is foreseen by 2030 at the latest, with the exception of Germany, which plans to phase out coal by 2038. These “phase-out countries” have been responsible for almost all of the fall in hard coal generation this decade (see Figure 4-3).

The remaining 36% of hard coal is almost all in Poland, which has yet to develop legislation to phase out coal. Hard coal generation in Poland has fallen

12% since 2010. The current government has no plans yet to phase out coal. Poland’s [draft](#) National Energy and Climate Plan, submitted to the EU Commission in December 2019, projects hard coal and lignite will still account for 56% of electricity generation by 2030, down from 75% in 2019.

Hard coal is falling because of renewables and market economics. The countries with the largest declines in hard coal also have the biggest increases in renewables (see Figure 4-4). From 2012 to 2019, the UK and Germany decreased their total coal generation by 136 and 106 TWh, respectively, while their renewables generation (excl. hydro) increased by 78 and 102 TWh, respectively. Gas generation increased comparably little by 30 TWh in the UK and 15 TWh in Germany. In Greece, lignite generation dropped by 18.5 TWh from 2012 to 2019, while renewables generation increased by 5.6 TWh and gas generation increased by 4.7 TWh.





Rising CO₂ prices in the EU ETS have strongly affected the economics of coal plants and have caused generation from existing gas plants to displace that of existing coal plants. Roughly half of the hard coal and lignite decrease in 2019 was caused by increased renewables generation (excl. hydro, +65 TWh) and the remaining half by fuel switching from coal to gas (the latter +74 TWh).

4.2 Lignite

Lignite generation fell by 49 TWh (-16%) in 2019 (see Figure 4-5). Lignite generation in Germany fell by 22%. Greek lignite fell by 26%, Polish lignite by 14%, and Romanian lignite by 13%. Lignite generation started to fall in 2019 because power plant operators have started to feel the impact of higher CO₂ prices.

70% of Europe's lignite generation in 2019 was in countries where a phase-out is currently being devised. By far the largest lignite generator is Ger-

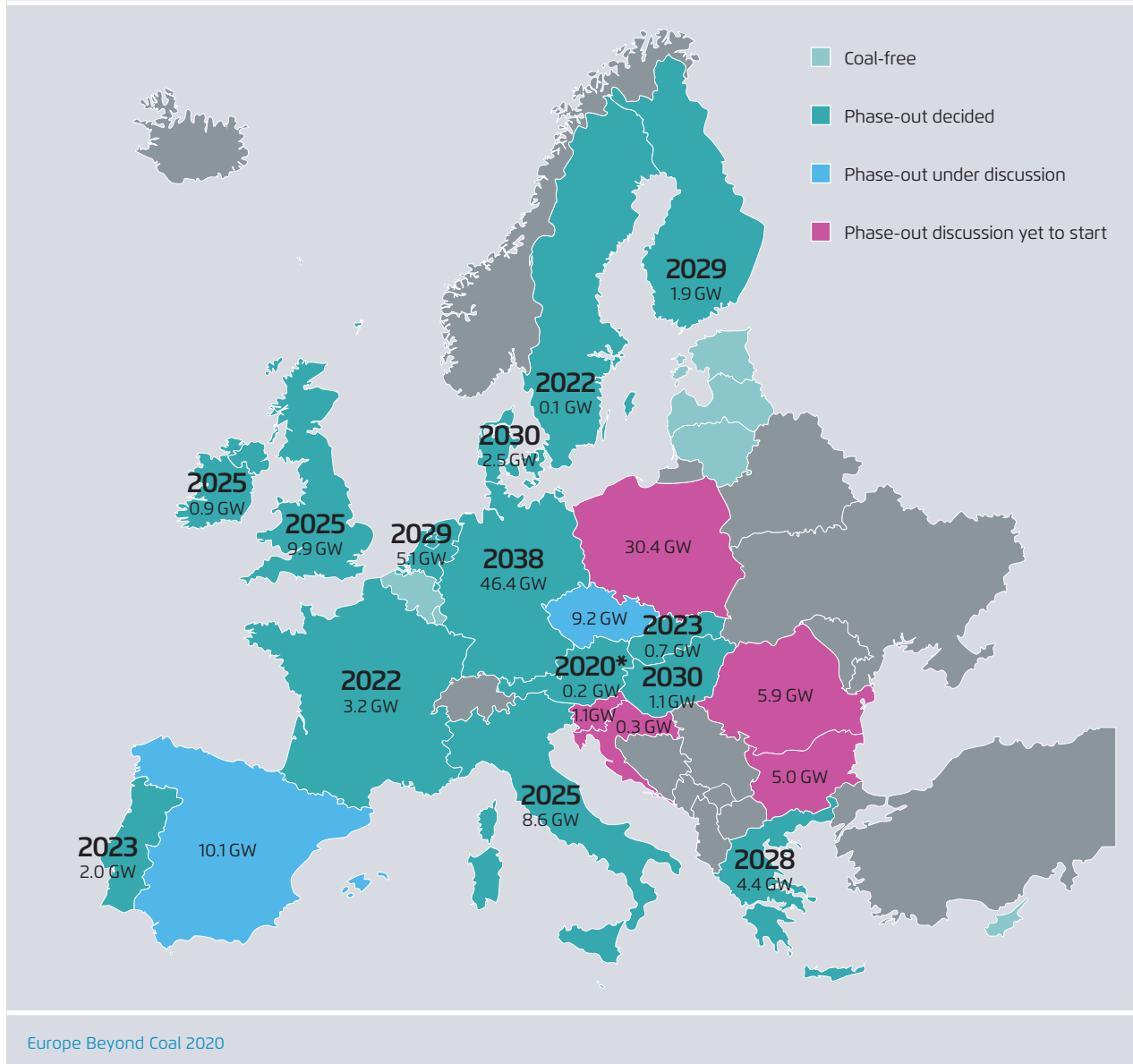
many, which has announced a phase-out by 2035-2038. In September 2019, Greece announced it would phase out its lignite by 2028 latest. In August 2019, the Czech Republic's Coal Commission met for the first time.

30% of Europe's lignite generation in 2019 was in four countries – Poland, Bulgaria, Romania and Slovenia – which have yet to develop phase-out plans. Electricity generation from lignite in these countries in 2019 was 15% below 2010 levels.

Rather low renewables deployment in these four countries stands in sharp contrast to their 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 study shows that most of these regions have good to excellent wind and solar potential. The governments of these countries are thus missing out on clear opportunities, especially since their lignite plants are generally old and have

Coal phase-out dates and remaining coal capacities

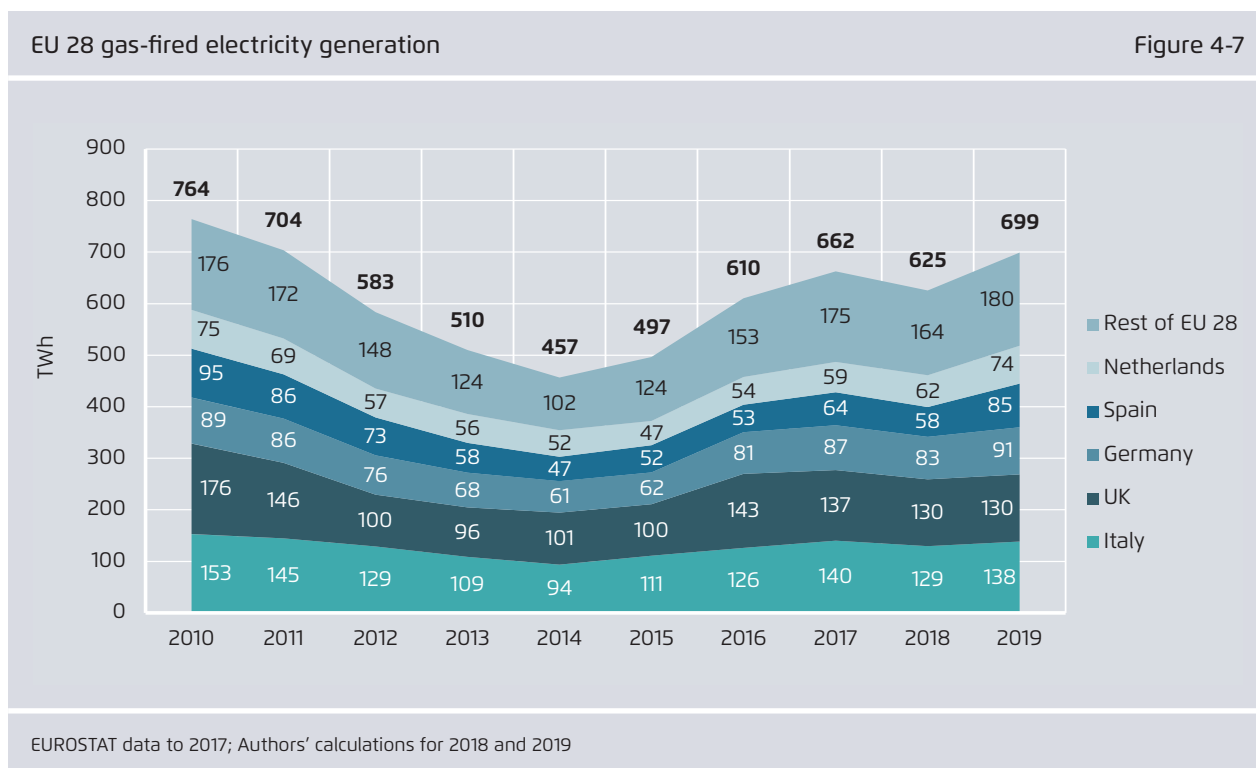
Figure 4-6



a poor economic outlook; most would need investment to comply with the new air pollution limits that go into effect in 2021, and the anticipated robust increase in EU carbon prices will further impact profitability.

Recognising these challenges, the European Commission launched its “Coal Regions in Transition” platform in 2017. Currently, 41 regions in 12 Member States of the European Union rely significantly on the economic

prosperity created by coal mining and use; indeed, the sector provides direct employment to some 237,000 people across the EU. The platform aims to enable dialogue and the sharing of experience between governments and stakeholders in “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. In 2019, a secretariat was established to manage activities and provide technical assistance to coal regions. Dedicated financial support of up to



100 billion Euros will be provided through the proposed European Just Transition Mechanism.

4.3 Gas

Gas generation increased by 12% (73 TWh) in 2019 (see Figure 4-7). Spain (+ 27 TWh), the Netherlands (+ 12 TWh), Italy and Germany (+ 9 TWh each), and France (+ 8 TWh) saw the largest increases. Together, these five countries generated almost 75% of gas power in the EU. Only in Romania did gas generation decrease in 2019.

Gas generation in 2019 was 8% below the 2010 record level (which was the highest amount of gas generation in the EU over the last 20 years).

Fuel switching from coal to gas took place extensively and was triggered by rising prices for CO₂ emission allowances in the EU ETS (see the next chapter). Wind, solar and biomass increased their generation by 65 TWh, such that roughly **half of the reduction**

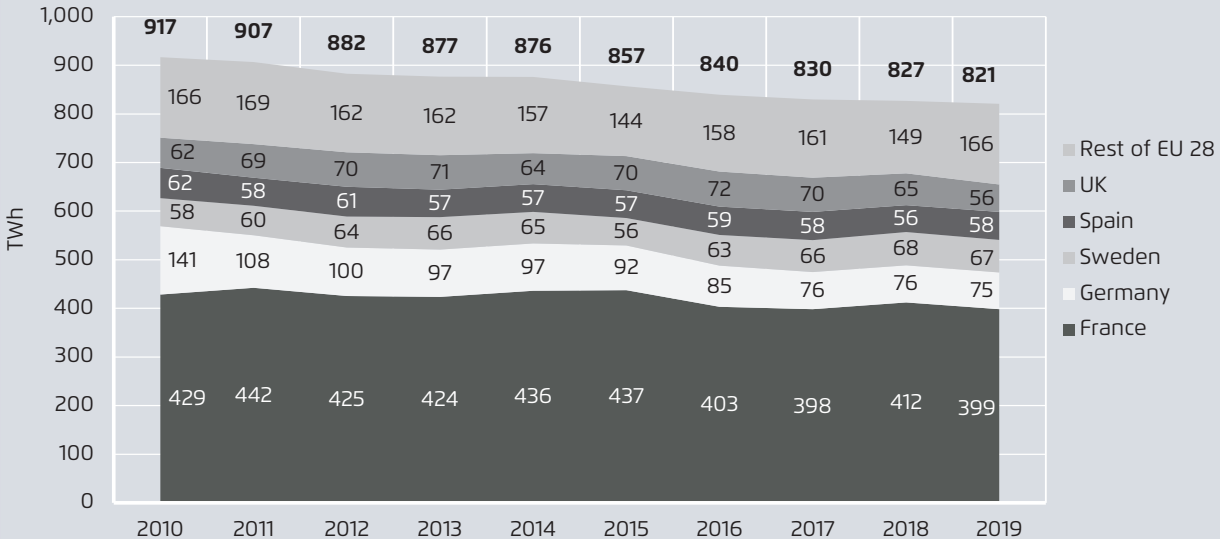
in lignite and hard coal generation was offset by renewables and the other half by gas.

4.4 Nuclear

Nuclear generation decreased slightly in 2019 (down 1%, or 6 TWh). A decrease in French, UK and Swedish availability coincided with a large increase in Belgian availability (see Figure 4-8), as several large Belgium reactors were brought online after long unavailabilities. At the end of 2019, the German nuclear plant in Philippsburg closed for good.

EU 28 nuclear electricity generation

Figure 4-8



EUROSTAT data to 2017; Authors' calculations for 2018 and 2019

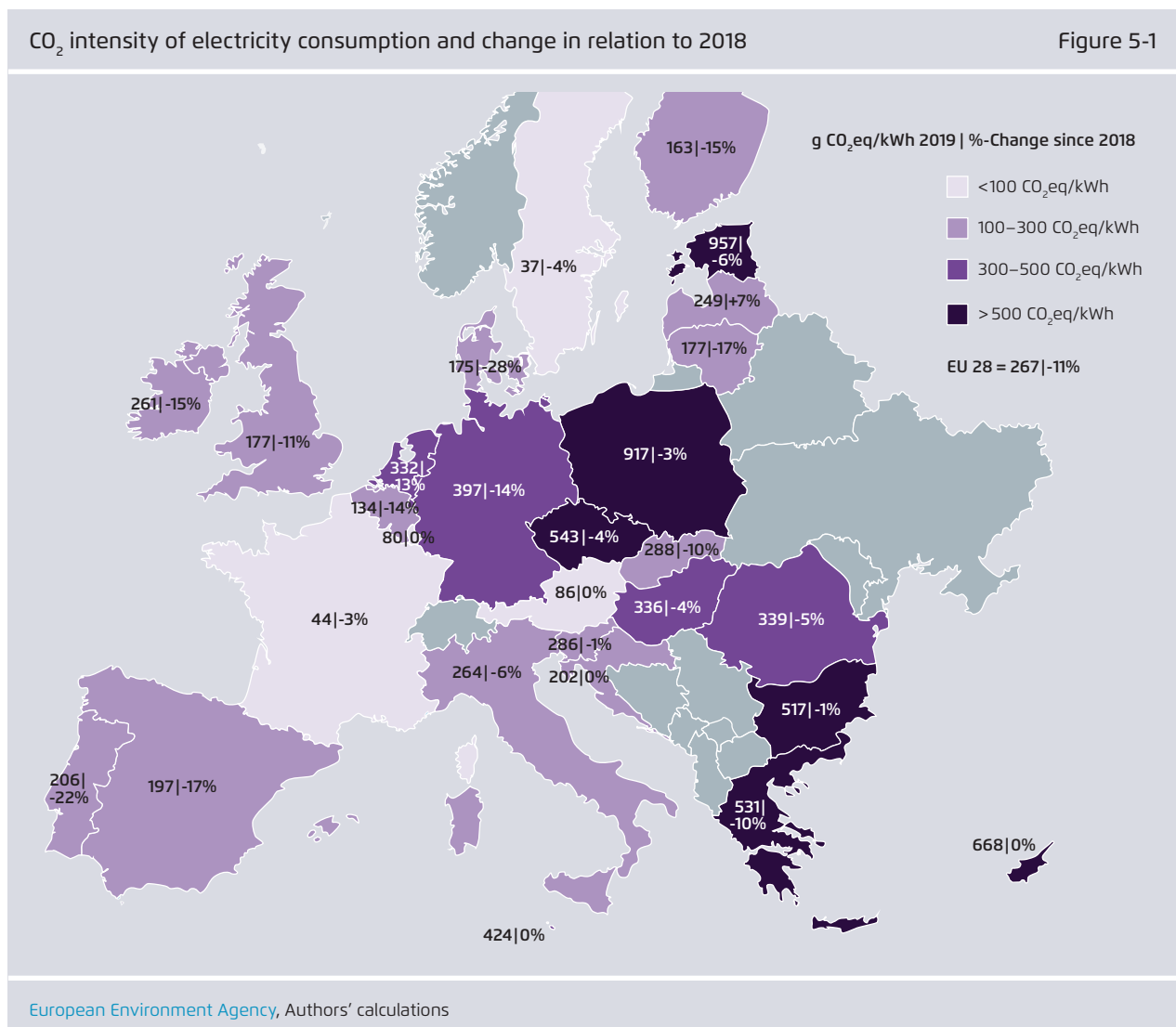
5 CO₂ emissions

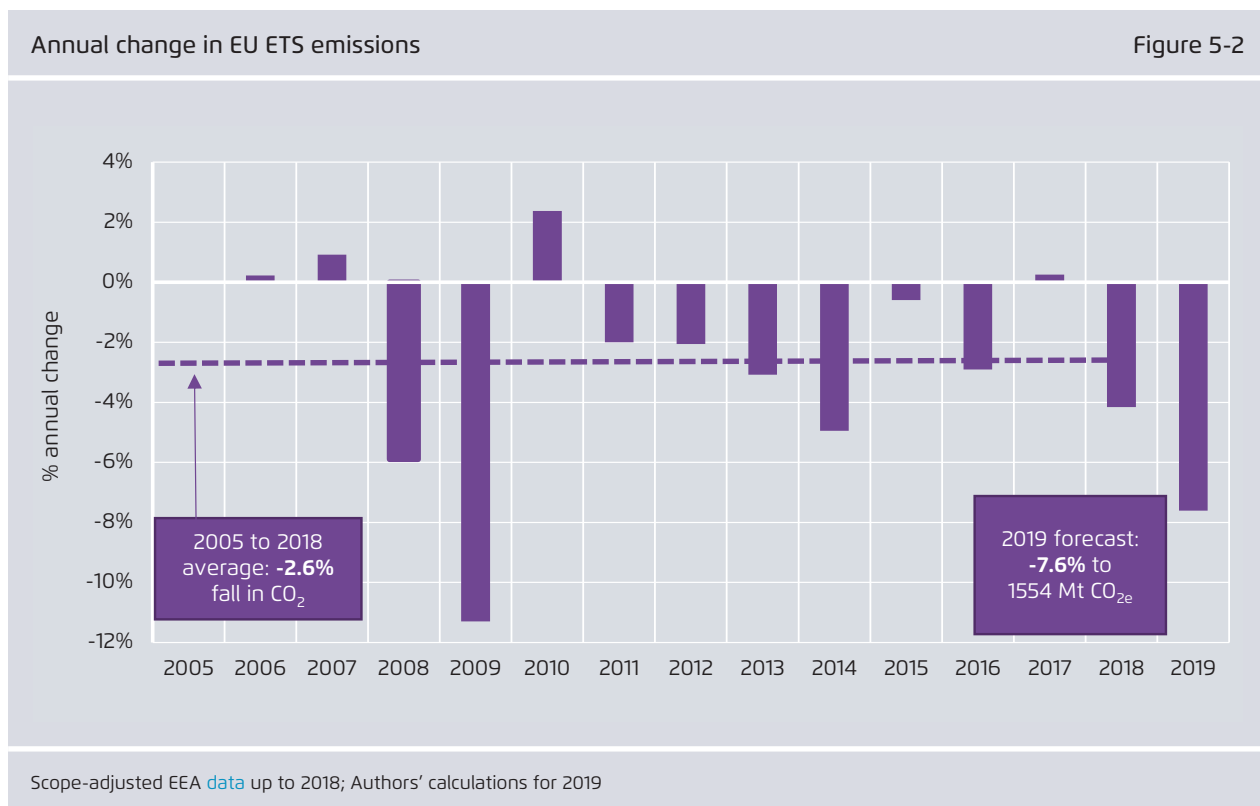
CO₂ emissions in the power sector fell by 12%, or 120 million tons, in 2019. Half of this decline was a result of new wind and solar displacing coal and the other half was a result of gas displacing coal (through rising CO₂ prices in the EU ETS).

We forecast that overall EU ETS emissions has fallen fall by 8%, from 1682 Mt CO₂ in 2018 to 1554 Mt CO₂ in 2019. In addition to a 12% fall in power sector emissions (see Figure 5-2), industrial emissions are likely

to have decreased by 1%: whilst overall EU GDP rose by 1.4% in 2019, industrial production fell by 0.6%. Steel production fell 5% in 2019. **Considering that emissions in the EU ETS have fallen by 2.6% on average since 2005, an 8% fall in 2019 is quite impressive; 2009 was the only year to see a larger drop.**

Power sector emissions declined 12% in 2019, and have fallen by 32% since 2012. Hard coal power plants have made the greatest contribution to this





fall - their generation has declined 59% since 2012. Lignite emissions have declined 29% during the same period (see Figure 5-3). **Lignite emissions still made up 18% of EU ETS emissions in 2019.** Coal power plants (lignite and hard coal summed) made up 31% of EU ETS emissions in 2019.

We forecast industrial emissions will be down 1% in 2019, thus falling to the same level witnessed in 2016. As power sector emissions fall, industrial emissions make up a larger proportion of EU ETS emissions, rising to 45% in 2019.

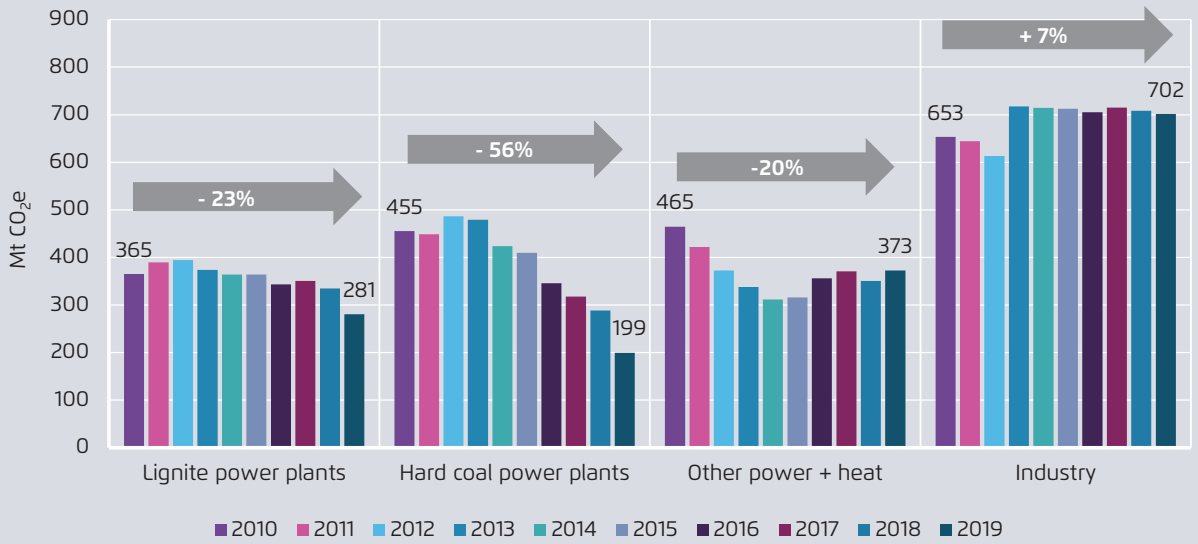
EU ETS emissions fell by 8%, faster than the 2% fall in the cap, and are now 16% below the cap. This large difference between the demand and supply of carbon permits is still causing a dangerous imbalance in the market (see Figure 5-4). The market stability reserve (MSR), which came into effect in 2019, will reduce the oversupply of certificates (until 2023, 24% of the surplus will be absorbed by the MSR) and, beginning in

2023, delete surplus certificates. This should, in principle, keep prices elevated.

However, such a **heavy need for the MSR as single stabilisation policy puts the ETS at risk.** Note specifically that beginning in 2024, the annual absorption rate of surplus certificates is reduced to 12%. If the amount of surplus certificates increases further due to the announced national coal phase-out policies, this puts the ETS at risk of falling prices in the future. This would leave the ETS sectors without a constant and credible decarbonisation signal. **Redefining the cap, through a higher linear reduction factor and/or rebasing the cap,** thus remains essential to ensure the stability of the EU's ETS.

EU ETS emissions split by sector and changes, 2019 vs. 2012

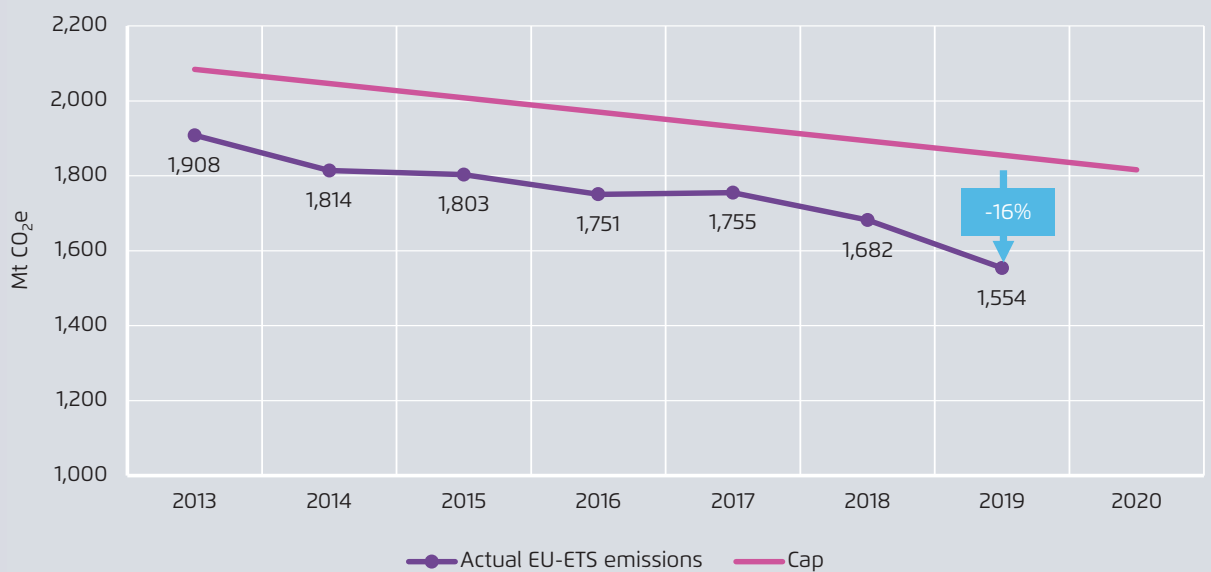
Figure 5-3



Scope-adjusted EEA data up to 2018; Authors' calculations for 2019

EU ETS emissions and cap

Figure 5-4



Authors' calculations

6 Prices and interconnection

In 2019, the out-turn prices for coal and gas fell, while they increased for CO₂ prices. From 2018 to 2019, year-over-year out-turn prices (denominated in euros) fell by 21% for coal and 34% for natural gas, while rising 58% for CO₂ permits.

Substitution of coal with natural gas as a fuel source was pronounced in 2019. Coal-gas switching was predominantly driven by the higher carbon price. Throughout 2019, the short-run generation costs (SRMC) of gas plants (old inefficient & new efficient alike) were below that of old inefficient hard coal plants. For most of the year, the generation costs of new gas plants were even below that of new coal plants (see Figure 6-1).

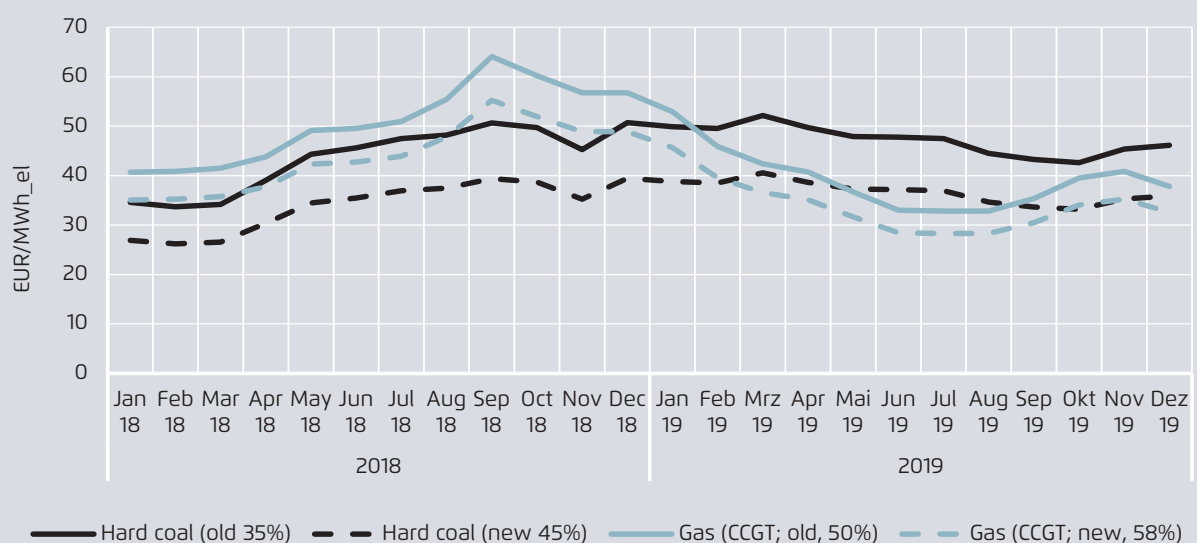
The combination of rising carbon prices, falling gas and coal prices and increased renewables generation

pushed down the out-turn power prices in almost every EU country in 2019 (see Figure 6-2). On average, day ahead prices in the EU fell by 5.3 EUR/MWh year-on-year. Belgium wholesale prices decreased by 16 EUR/MWh on average, due to nuclear plants coming back online after long downtimes. UK power prices decreased by 16 EUR/MWh as wind generation increased by 14% year-on-year. Countries whose power systems are characterized by a high coal share were affected by the higher carbon prices, resulting in a 17 EUR/MWh average price increase in Bulgaria and a 1.3 EUR/MWh in Poland.

Security of supply problems to the European electricity grid in 2019 were reassuringly minor. The UK experienced a major power failure caused in part by a lightning strike, leaving 1.1 million electricity customers without power for between 15 and 50 min-

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

Figure 6-1



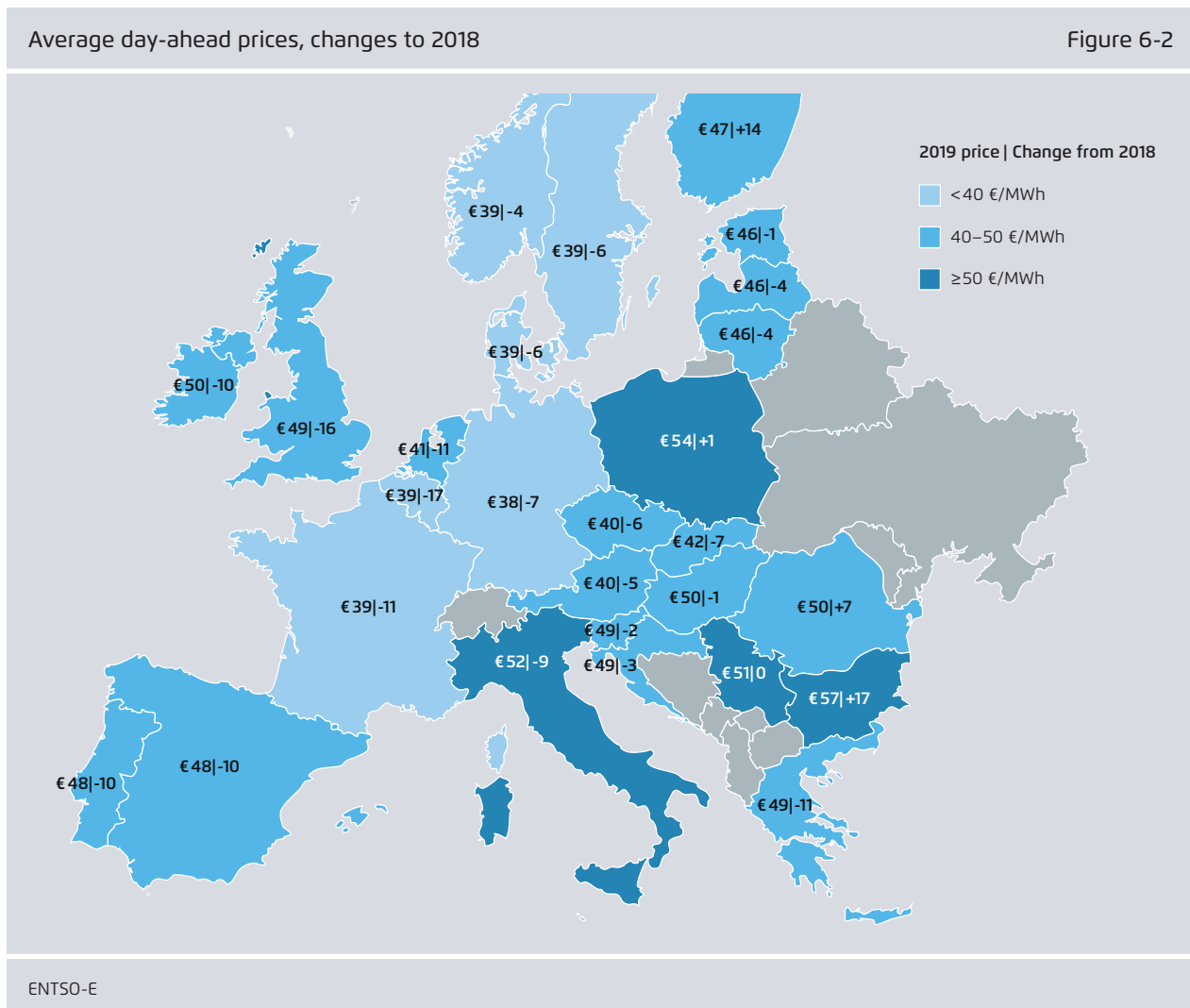
World Bank 2019; Bundesbank 2019; UBA 2015; DEhSt 2019; Authors' calculations

utes. Besides that, here are the seasonal summaries by the European grid operator, ENTSO-E:

→ ENTSO-E's Winter 2018/2019 [review](#): Last winter was generally mild, with above average temperatures throughout most of the season. The mild winter has helped ease adequacy conditions throughout Europe, but some storms still had impacts on the electricity system. Coal supply to the power plants via the Rhine river was impeded. The main reason for this was low water levels in the Rhine river and limited capability to deliver coal by railroads. Coal stocks in power plants recovered during Christmas and the New Year holiday period, when

water levels rose and electricity demand decreased due to holidays. Energy balance issues in Kosovo, which operates within the Serbian control area, are persisting and creating frequency deviations. However, Continental Europe TSOs are taking action to maintain deviations within limits.

→ ENTSO-E's Summer 2019 [review](#): Last summer was distinguished by above-average temperatures. No significant events were recorded in summer 2019. Some heatwaves were recorded, but with no impact on electricity supply security. A lower-than-average precipitation was recorded in Austria and France. Hydro levels were near average by the end of the summer season in most regions,



except Italy, where reservoir levels settled slightly above historical minimum levels.

The changes in electricity flows across Europe in 2019 mostly relate to changes in Europe's hydro and nuclear generation and the effects of coal-to-gas switching. Net electricity imports into the EU decreased by 11 TWh, with a resulting net import of 16 TWh. There was less inflow into the EU from the western Balkans and Switzerland due to lower hydro power availability in these countries.

Polish net imports doubled in 2019 to 10 TWh, because of the strongly deteriorating economics of hard coal in increasingly integrated power markets. Similarly, Greek net imports rose by 3 TWh to compensate for the drop in uncompetitive lignite generation.

Germany's net exports decreased by 12 TWh as higher electricity generation from renewables abroad reduced foreign electricity purchases. Likewise, coal-fired power generation got significantly more expensive, reducing the competitiveness of German coal-fired power generation compared to gas-fired power generation in neighbouring countries. Austria's net imports decreased by 7 TWh due to higher wind and hydro generation, Belgium's net imports decreased by 19 TWh (due to nuclear reactors being brought online after some time and making the country a net exporter for the first time since 2009). Swedish net exports rose by 9 TWh (thanks to increased hydro and wind generation, as in Austria). Dutch net imports decreased by 7 TWh due to increased gas and solar generation, leading to an even balance of trade over the year.

7 Policy

Throughout 2019, polls showed rising public awareness for the looming climate crisis, including a notable uptick in concern in Eastern Europe and in corporate boardrooms. An ever-greater number of cities, regions and countries in Europe have declared a state of climate emergency. While often symbolic in nature, such declarations underscore the sense of urgency surrounding the need to rapidly and drastically cut greenhouse gas emissions.

Thanks to high voter turn-out, the European elections in May 2019 led to a robust pro-European majority of conservative, liberal, social-democrat and green MEPs who are in favour of stronger EU climate action by the incoming European Commission.

New Commission President Ursula von der Leyen made accelerated action to reduce greenhouse gas emissions the centrepiece of her mandate, and got to a strong political start: on 12 December 2019 EU heads of state and government unanimously endorsed the objective of EU greenhouse gas neutrality by 2050. This goal entails accelerated climate action in the 2020-2030 decade and hence a further enhancement of the current climate and energy targets for 2030.

7.1 National energy and climate plans

The EU started into 2019 with newly adopted EU targets on energy efficiency and on renewable energies. 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.

Setting targets is well and good. But are Member States actually walking the talk? An important early indicator is the national energy and climate plans (NECPs) for 2030 that Member States must develop under the new [Regulation \(EU\) 2018/1999 on the Governance of the Energy Union and Climate Action](#).

The NECPs must be integrative in their approach and quantify the planned national contributions for achieving the EU's 2030 targets on renewable energy and on energy efficiency. The importance of the NECPs can hardly be overstated: they should offer a robust base for judging whether individual EU countries and the EU as a whole are on track to meeting their climate and energy targets; they should enable governments to identify priority infrastructure needed for the energy transition; and they should provide strong investment signals to project developers and private investors.

Member States were obliged to submit draft NECPs by the end of 2018. In June 2019, the European Commission published its comments on each of the national drafts as well as an analysis of the 28 draft NECPs as a whole. On renewable energies, the Commission found that national renewables deployment would fall short of the EU's 2030 ambition on renewables by about 1.5%. As regards energy efficiency, the aggregate assessment of the draft NECPs showed that planned national efforts would fall up to 5% short of reaching the EU's 2030 efficiency target to improve final energy consumption by 32.5% by 2030 compared to a 2007 baseline.

An assessment by WindEurope found that most plans contained too little detail to enable a project developer or investor to make an informed judgement on whether or not to engage in a country. An [analysis](#) by Agora Energiewende and partners on draft NECPs from South-East Europe showed lacking ambition regarding renewables and energy efficiency in addi-

tion to a reliance on inconsistent approaches (for example in the area of carbon pricing).

Member States were obliged to submit their final NECP by the end of 2019 while taking into account the respective recommendations by the European Commission. At the end of January 2020, some Member States, including Germany and Poland, still had to submit final NECPs. The Commission will decide by June 2020 if its recommendations have been taken into account and whether additional measures are necessary.

7.2 Charting the way to a climate-neutral Europe: the European Green Deal

The new European Commission led by Ursula von der Leyen has made embarking on a path to EU greenhouse gas neutrality by 2050 a central element of its work programme. Under the rubric of a "European Green Deal", the Commission has been advocating measures to reduce greenhouse gas emissions while simultaneously promoting social justice and economic competitiveness.

On 11 December 2019 the Commission published a Communication on the European Green Deal and a roadmap with key actions to deliver its objectives. The actions cut across the entire economic spectrum, and announce specific actions to accelerate EU emission reductions in the 2020-2030 decade. In addition to an industrial strategy, the roadmap also sets forth measures for greening the EU's industrial policy, protecting nature and adapting to climate change. The most notable feature of the European Green Deal, however, is that it puts the fight against the looming climate crisis at the heart of future economic policy-making and seeks to leverage public and private financing to meet the additional investment need, which has been estimated at 260 billion euros annually over the next decade.

With this focus, the European Green Deal can build on the experience of an increasing group of EU Member States that have put in place a national commitment to achieve long-term greenhouse gas neutrality, and which are now adopting legislation to achieve this objective.

The target year for greenhouse gas neutrality varies by country, with Finland targeting 2035, Austria targeting 2040, Sweden targeting 2045, and Denmark, Germany, France and Spain all targeting 2050.

Underpinning a long-term goal of greenhouse gas neutrality with concrete measures requires tangible preparations for the phasing out of fossil fuel use across the economy and for investing in clean alternatives. The Spanish government recently estimated that fully meeting its 2020-2030 climate targets would require investments of approximately 235 billion euros. The German Coal Commission recommended investing some 40 billion euros in German regions currently dependent on coal in order to ensure a social equitable and smooth phase-out of this fossil fuel.

These examples show that robust planning, dialogue with stakeholders in regions and sectors affected by the transition, and solid financing and investment strategies are generally viewed as important elements of a successful transition from polluting to clean energy systems.

8 Outlook

8.1 EU 27

New wind and solar records. WindEurope are forecasting another dynamic year for wind installations, with 17.9 GW of anticipated new capacity in 2020. Meanwhile, SolarPower Europe expects 21 GW of new solar in 2020. Renewables should thus account for more than 35% of Europe's power mix, although this will depend on hydro availability.

Coal generation will be eclipsed by natural gas generation for the third year in a row. The gap between gas generation and total coal generation will likely widen in 2020 due to a combination of coal phase-out policies and market forces (including a robust CO₂ price outlook).

Nuclear generation will continue to fall in 2020.

By the end of 2019 the German nuclear power plant Philippsburg was shut down, and the French Fessenheim plant is expected to close in summer 2020. The launch of Finland's Olkiluoto 3 reactor has been postponed to March 2021.

The phase out of coal will continue. Germany will implement its coal phase-out law, and the first closures will take place in 2020. Spain and the Czech Republic are expected to finalise their coal phase-out discussions. According to its draft NECP, Poland plans to increase its renewables share to 23% and decrease its coal share to 56% by 2030, with several gigawatt of renewables projects already in the pipeline for 2020/2021.

European climate action is accelerating. The Paris Agreement obliges its parties to make increased contributions to combatting dangerous climate change every five years. The UNFCCC COP26 in November 2020 in Glasgow is the first "ratcheting up" meeting. The focus will be on national contributions to reducing global greenhouse gas emissions up to 2030. In

December 2019, EU heads of state and government invited the Commission to update the EU's nationally determined contribution for 2030 in good time before COP26. The Commission has indicated that it will seek to increase the EU's 2030 climate target **from the current goal of -40% emissions up to -50% or -55% below 1990 levels.**

European Green Deal. Achieving a -50% or -55% emissions reduction by 2030 will require a deep and rapid transformation of the entire European economy. In the power sector this will necessitate the phasing out of coal in the years towards 2030 and a further acceleration in the deployment of renewable energy. The [roadmap](#) set forth by the European Green Deal contains important provisions in this regard, including an investment plan with a dedicated Just Transition Mechanism; a European Climate Law enshrining the 2050 climate neutrality objective; an EU industrial strategy sketching out the European framework that will enable industry to invest in zero and ultra-low carbon technologies at a large scale; as well as a comprehensive plan for augmenting the EU's 2030 climate target. 2020 will mark an important preparatory year. 2021-2023 will see a comprehensive updating of European laws and policies in order to accelerate European climate action. With regard to the power sector, some elements are particularly noteworthy:

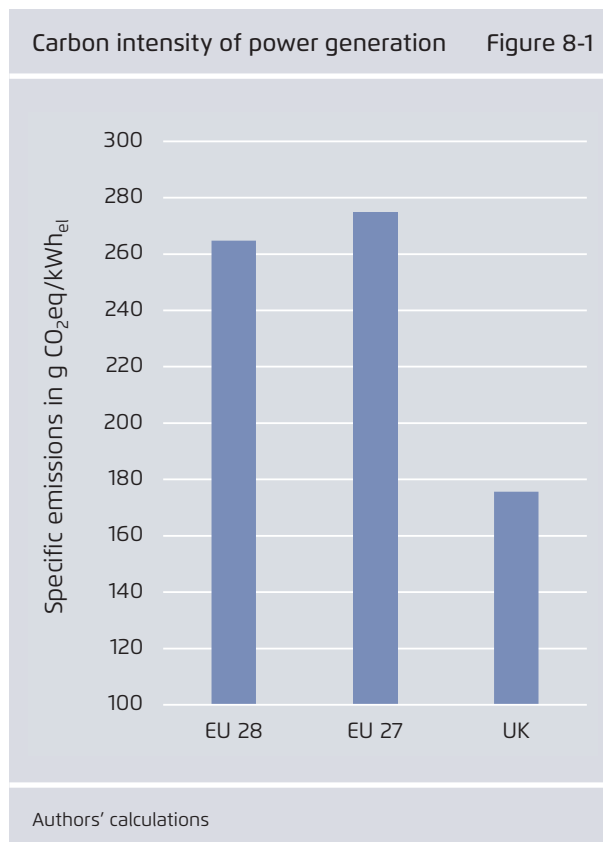
→ **Mainstreaming.** The European Commission seems committed to ensuring its core economic policies are consistent with the EU climate neutrality objective. This includes harmonisation of policies related to state aid and public procurement, as well as the need to ensure transparency about the carbon risks faced by listed companies and investments that qualify as green and sustainable in the next multi-year European budget and the lending of the European Investment Bank. The latter will end support for fossil fuel investments by 2021.

- **Green hydrogen.** Hydrogen produced on the basis of renewable electricity is increasingly regarded as a critical enabler of deep decarbonisation in industry, heavy transport and aviation. The EU and Member States will have to revisit their plans for developing renewable energies, in particular offshore wind, in light of the expected increase in demand for green hydrogen.
- **Carbon pricing.** The Commission has announced that it will push for a stronger role of carbon pricing to reduce greenhouse gas emissions. It will propose an extension of the EU Emissions Trading System to international aviation and shipping, and possibly to other sector such as transport or buildings. These measures will accelerate decarbonisation in the power sector. The Commission additionally announced that it will propose a Carbon Border Adjustment mechanism to reduce the risk of carbon leakage. Any such mechanism needs to closely interact with the EU Emissions Trading System, and may, for example, require a review of the current system of free allocation of emission allowances.

8.2 Brexit

On 31 January 2020, the United Kingdom left the EU based on Article 50 of the Treaty on the European Union. The UK has a significantly less CO₂ intense power mix than the EU average. One immediate result of separately accounting for the UK's emissions after Brexit is that the average CO₂ intensity of the new EU 27 power mix will increase from 265 to 275 gCO₂/kWh.

According to recent data from the European Environment Agency, 2018 greenhouse gas emission levels of the EU 27 are not 23.2% but rather 20.6% below 1990 emission levels due to Brexit. Brexit will thus also influence the starting point for political debates on increasing the EU's 2030 climate target to -50% or possibly to -55%. We estimate that the EU 27 would have to reduce emissions by an additional two to



three percentage points to achieve the same targets due to the impact of Brexit.

The concrete impact of Brexit on the future EU climate and energy framework will, however, depend on the future relationship between the EU 27 and the UK. Negotiations on this relationship are only starting now and are on the EU-side fundamentally driven by concerns on how to achieve a level playing field and continued alignment of climate and energy policies. For the energy transition in the power sector two aspects seem particularly relevant:

Emissions trading. In January 2019, the EU temporarily suspended the free allocation of emissions allowances to the UK, auctioning, and the exchange of international credits. This was done based on concerns that in the event of a hard Brexit, UK companies would not anymore be under the EU Emissions Trad-

ing System and could flood the EU's carbon market with unused permits, driving down prices.

Looking into the future, the UK will need to decide whether it wishes to continue to participate in the EU carbon market by linking its own emissions trading system to the European system, like Switzerland started doing in January 2020.

Internal electricity market. UK industry has a keen interest in continued access to relatively cheaper electricity from the continent. Currently, 4 GW of interconnector capacity is installed between the UK and the continent and plans are to further expand to 8 GW.

In all likelihood, the UK will no longer fully participate in the EU internal electricity market under the new EU-UK relationship. This means that significant benefits from EU electricity market integration would be lost, including in particular algorithm-based implicit trading that uses the existing power infrastructure – including interconnectors – more efficiently than previous “explicit” trading practices.

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