Weathering the winter

Europe’s power system weathered a turbulent winter with the help of reduced demand combined with record renewable generation. A coal ‘comeback’ never materialised, as EU coal power fell compared to last winter.

Published date: 27/4/23

Lead author: Dr Chris Rosslowe

Other authors: Harriet Fox, Sarah Brown

Contents

About

As Europe headed towards the end of 2022, the ongoing gas crisis combined with low nuclear and hydro output led to concerns about how countries would keep the lights on over winter. Now, looking back over the last six months, it is clear that Europe's power system successfully rode out the storm. This analysis examines power generation and changes to electricity demand across EU countries in the winter months to understand what happened over the winter, and what lessons the EU can take forward.

Highlights

>60%

The majority of member states reduced peak power demand by 5% or more over winter, as mandated by emergency EU legislation.

€12bn

Reductions in power demand across the EU this winter avoided €12 bn in electricity costs.

40%

With 40% share, renewables generated more EU electricity than fossil fuels in winter for the first time.

Executive Summary

EU power system weathered the winter

A significant decrease in electricity demand combined with record renewable electricity supply prevented the EU from returning to fossil fuels this winter.

As the EU headed into winter 2022 with fears of gas shortages and a raging cost of living crisis, there was understandable concern over how the electricity system and consumers would cope during the coldest months. Europe's power sector had already suffered a tumultuous year. Russia's invasion of Ukraine pushed the cost of gas sky high, whilst low nuclear and hydropower generation further exacerbated the energy crisis. Record solar and wind growth helped plug the generation deficit but speculation continued around the EU's 'return to coal'.

As part of an effort to tackle the energy crisis, the EU set a voluntary electricity demand reduction target for Member States over winter. Alongside this, warmer weather and high electricity prices caused demand to drop across the EU. Due to this decrease, coal and gas generation dropped sharply year-on-year for the winter period spanning October 2022 to March 2023, generating less than renewables for the first time in winter. With fossil fuel generation down, EU power sector emissions during winter were the lowest they have ever been.

Now, with Europe successfully on the other side of this winter and major supply disruptions avoided, it is clear the threatened coal comeback did not materialise. On the contrary, spring is starting in Europe with coal generation down in six of the previous seven months, historically high gas storage levels, and industry forecasts of continued renewable growth to come.

While Europe will be glad to put a difficult winter behind it, the measures taken should be learned from to inform the accelerating transition away from fossil fuels. Demand reductions that can be maintained sustainably should be, in order to reduce strain on grid infrastructure.

And demand flexibility will be a critical part of Europe's future power system: any gains made in recent months in this much-needed service should be evaluated, consolidated, and quickly built on.

01 Electricity worth €12bn saved across the EU over winter

Nearly every member state reduced electricity demand over winter, although only a handful achieved the voluntary 10% reduction target set by emergency EU legislation. Total EU electricity demand was down 6% on the five-year average, saving €12 bn worth of electricity over winter (November-March). These demand reductions contributed to security of supply, saved gas for other uses, and prevented a return of coal generation.

02 Renewables generate more power than fossil fuels over winter for first time

As fossil fuel generation dropped 12% year-on-year due to a large drop in power demand, renewables increased to overtake the share of fossil fuels in the EU electricity mix for the first time. Renewables accounted for 40% of EU generation between October and March, with fossil fuels at 37%. Coal power fell by 11% (-27 TWh) and gas by 13% (-38 TWh) compared to the previous winter.

03 Coal power fell in 15 out of 18 EU coal countries over winter

Of the 18 countries in the EU that continue to use coal for power, 15 reduced coal generation over winter 2022 compared to the same period the

previous year. The only three to increase coal generation were Italy, Finland and Hungary. 'Returning' coal units brought ran only at an average of 27% of their full capacity over winter.

04 17 EU Member States reduced peak demand by 5% or more

Emergency EU legislation in October 2022 introduced a mandatory target to reduce power consumption by 5% during peak hours. Analysis of hourly data from this winter and the previous five winters reveals that the majority of member states achieved this. These actions almost certainly lowered system adequacy risks, reduced gas consumption and limited the occurrence of even more extreme price spikes.

"Europe faced a crisis winter, with spiralling energy costs and supply concerns triggered by Russia's invasion of Ukraine. The EU got through those difficult months, but it can't rely on emergency demand cuts and mild weather for future years. To keep power supply stable, the EU needs to divorce from fossil fuels as quickly as possible."

Dr. Chris Rosslowe
Senior Energy & Climate Data Analyst,
Ember

Power generation over winter

Powering through winter

Renewables produced more EU electricity than fossil fuels this winter, as a drop in demand and record wind and solar generation led to decreased coal and gas power.

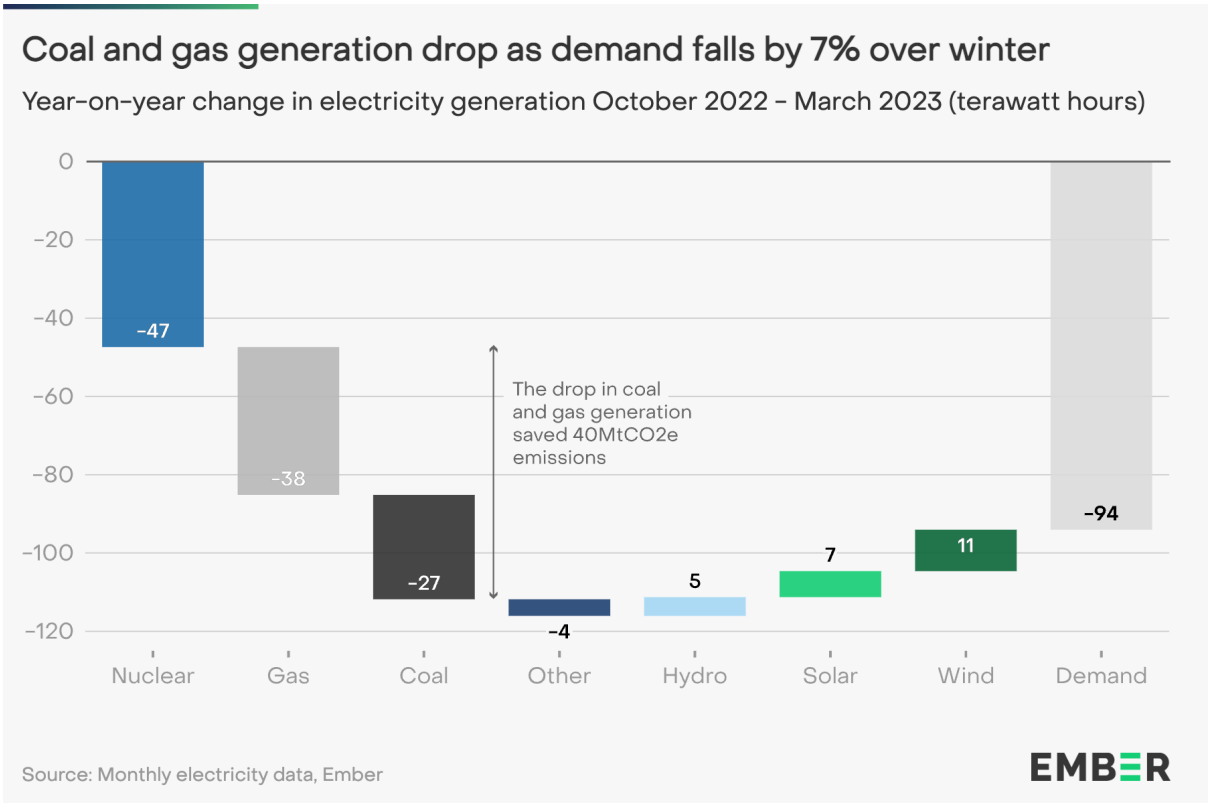
Europe entered the winter under challenging conditions. Concerns about security of supply in the power system emerged among multiple crisis conditions: sky-high gas prices, low hydro and nuclear generation and the imperative to cut ties with Russian gas.

Europe weathered the challenge with security of supply maintained, as an increasingly renewable-based power system proved its resilience. Electricity demand dropped significantly as Europe experienced its second warmest winter on record, with EU-wide voluntary electricity demand reduction targets and soaring electricity prices also pushing households and industry to cut demand. This reduction in demand, combined with record wind and solar generation, actually led to decreased coal and gas generation. As a result, renewables produced more of the EU's electricity than fossil fuels for the first time in a winter period.

Coal and gas generation wiped out by falling demand

With fossil gas prices elevated and Member States focused on reducing gas consumption, there were suggestions that the EU would have to turn back to coal power over winter 2022 (October 2022 - March 2023). In fact, the opposite occurred. Coal and gas generation both decreased compared to the previous winter, by 27 TWh (-11 %) and 38 TWh (-13 %) respectively. This drop in fossil fuel generation was mainly due to a significant fall in EU electricity demand of 94 TWh (-7%) compared to the same period the previous year.

Coal and gas generation would have dropped further if French nuclear plants had come back online as expected in January. However, the EU's nuclear generation faced continuing woes, dropping by 47 TWh compared to the previous winter period, a 13% fall. Ongoing issues with France's nuclear fleet accounted for almost two thirds of this fall.

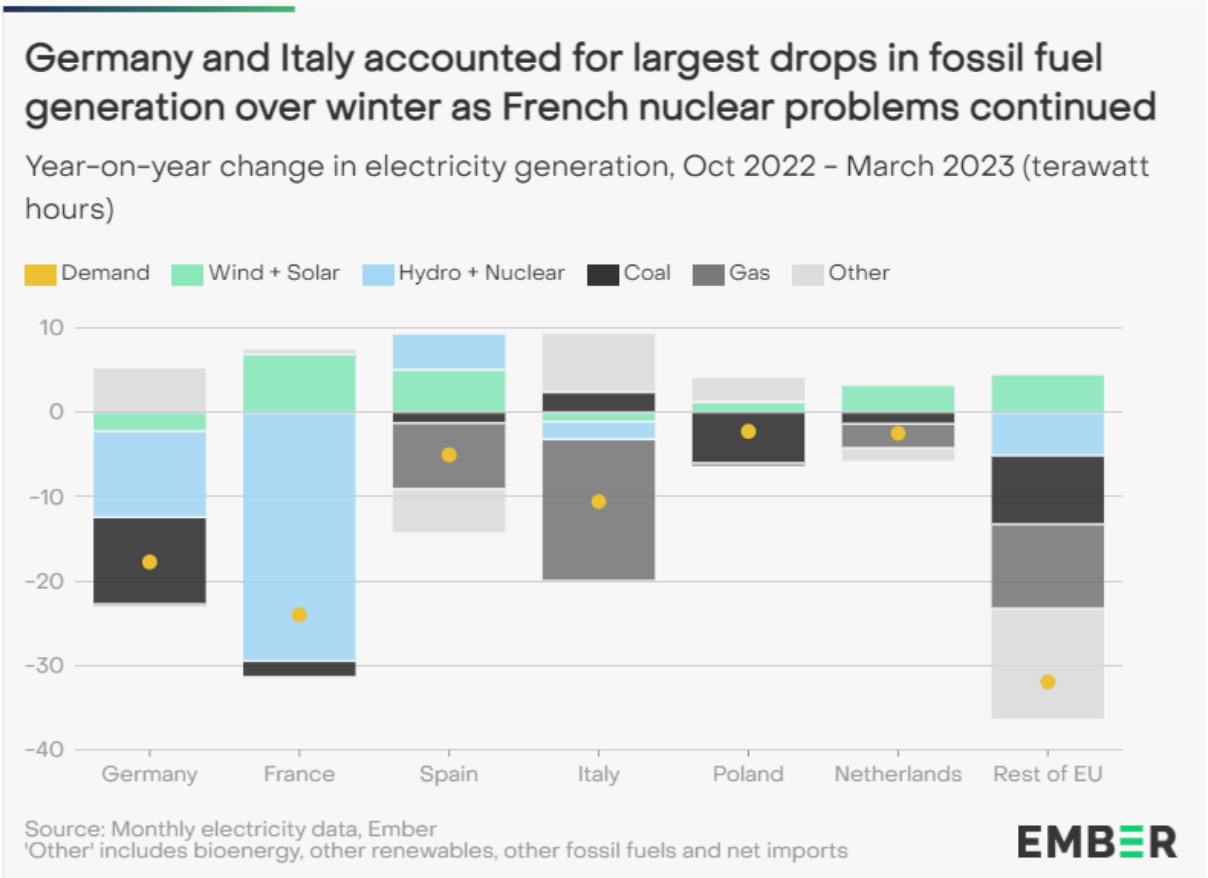


The decline in gas generation of 38 TWh (-13%) resulted in reduced gas consumption of 7 bcm this winter. This represents 16% of the total cut in winter Russian gas imports (-42 bcm) compared to the previous winter, equating to €6 billion in avoided gas costs.

This fall in gas demand for electricity generation also enabled gas to be used more efficiently in priority areas such as heating and refilling storage facilities. Consequently, the EU has come out of this winter with gas storage capacity at 56% (60 bcm), double the levels at the end of March 2022.

Wind and solar generation continued on the upward trajectory seen throughout 2022. Combined, they provided almost a quarter of the EU's electricity over the winter period, up 6% year-on-year (18 TWh).

Hydro generation remained similar to the previous winter. A 1-in-500 year drought caused output to plummet by 20% (-66 TWh) in 2022, but almost all of this drop (95%) occurred from January to September, before the start of winter. However, hydro power output this winter was still around 20% lower compared to the winters of 2019 and 2020.



Italy saw the largest absolute drop in gas generation, whilst Germany and Poland cut coal

Italy and Spain accounted for around two thirds of the reduction in gas generation across the EU compared to the previous winter. In Spain, this happened despite support for gas generation in response to the gas crisis, with subsidies introduced to reduce the input costs for gas-fired power plants.

Germany and Poland were responsible for 60% of the reduction in EU coal generation this winter, with decreases of 10 TWh and 6 TWh respectively. France experienced the largest year-on-year electricity demand decrease of any EU country in winter (-24 TWh), around 10%

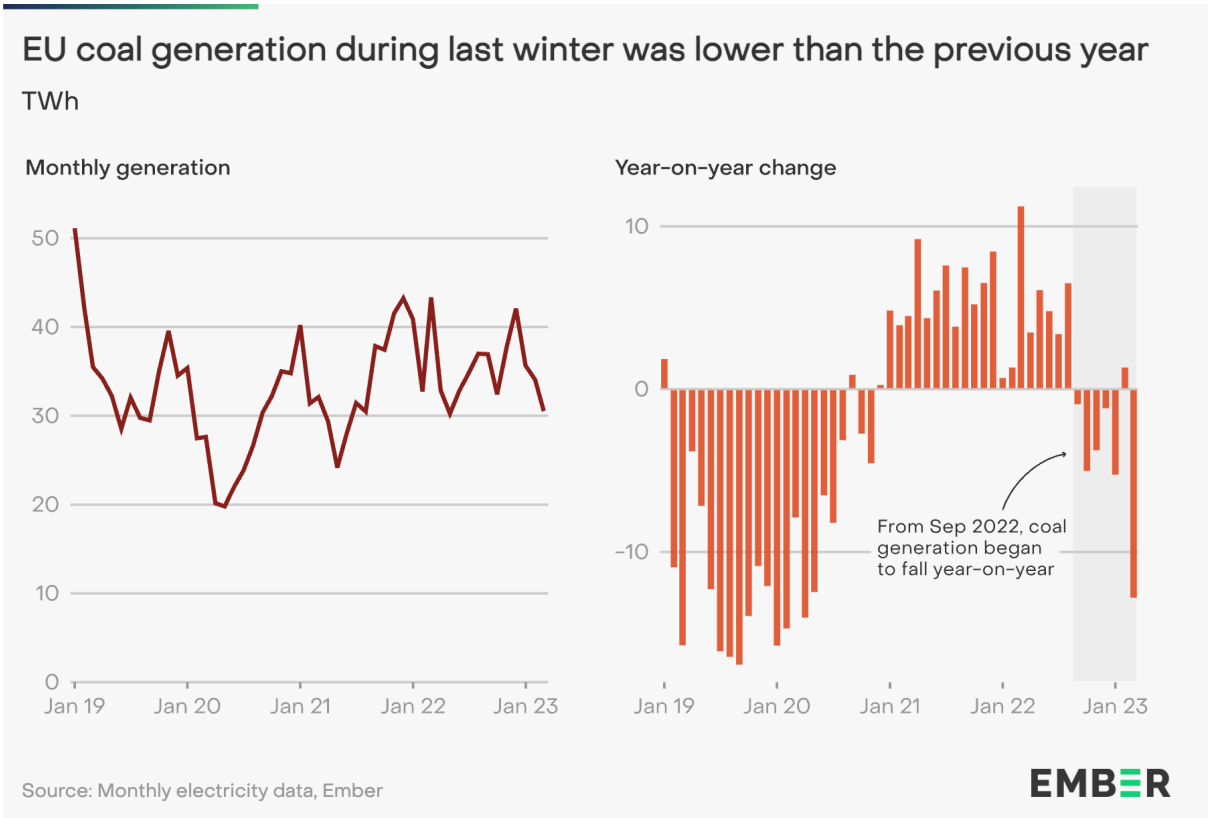
lower than the same period last year. French nuclear generation dropped even more than demand (-29 TWh), but a wind and solar increase made up the deficit (+7 TWh).

The ‘coal comeback’ that never was

Despite the fears of a possible ‘EU coal comeback’, coal generation actually fell year-on-year in six of the seven months leading up to March 2023. During winter 2022, coal generation was almost 30 TWh lower than the same period last year—a decline of 11%.

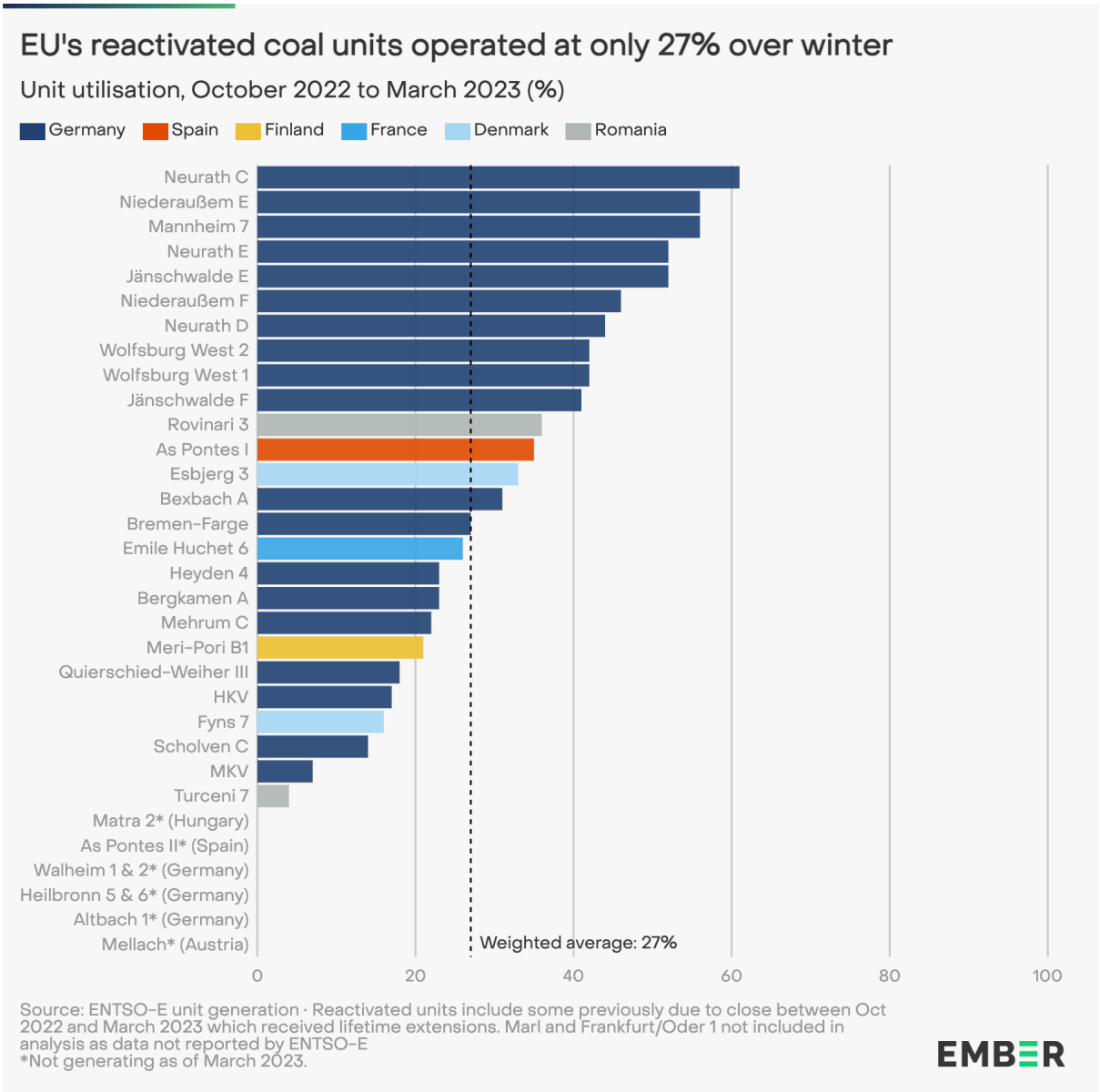
15 out of the 18 remaining coal power countries decreased coal generation over winter

Poland and Germany saw the largest year-on-year decrease in coal generation compared to the previous winter (combined they contributed to half the EU emissions from coal power plants in 2021). Coal reached a new low in the Polish electricity mix in February 2023, falling below two thirds of generation for the first time. Portugal saw the largest percentage drop in coal generation as the country phased out its only remaining coal plant in winter 2021 and brought forward a target for 80% renewable power from 2030 to 2026. The only countries to increase coal generation year-on-year in the winter period were Italy (+26%), Finland (+12%) and Hungary (+3%), which all recorded large drops in gas generation.



'Returning' coal units ran as stipulated under emergency measures

As emergency and time-limited measures, several governments created strategic reserves for selected coal units this winter, allowing plants to remain operational beyond expected closure dates or come back to the market from grid reserve. These units ran at an average of 27% of their full capacity, demonstrating that the majority were only operated in times of need, as stipulated in the plans, and not used for bulk generation. Since October 2022, these units have generated 13 TWh, around 6% of the total EU coal generation over winter. The majority of these units are in Germany, accounting for 10 GW of the 14 GW capacity.

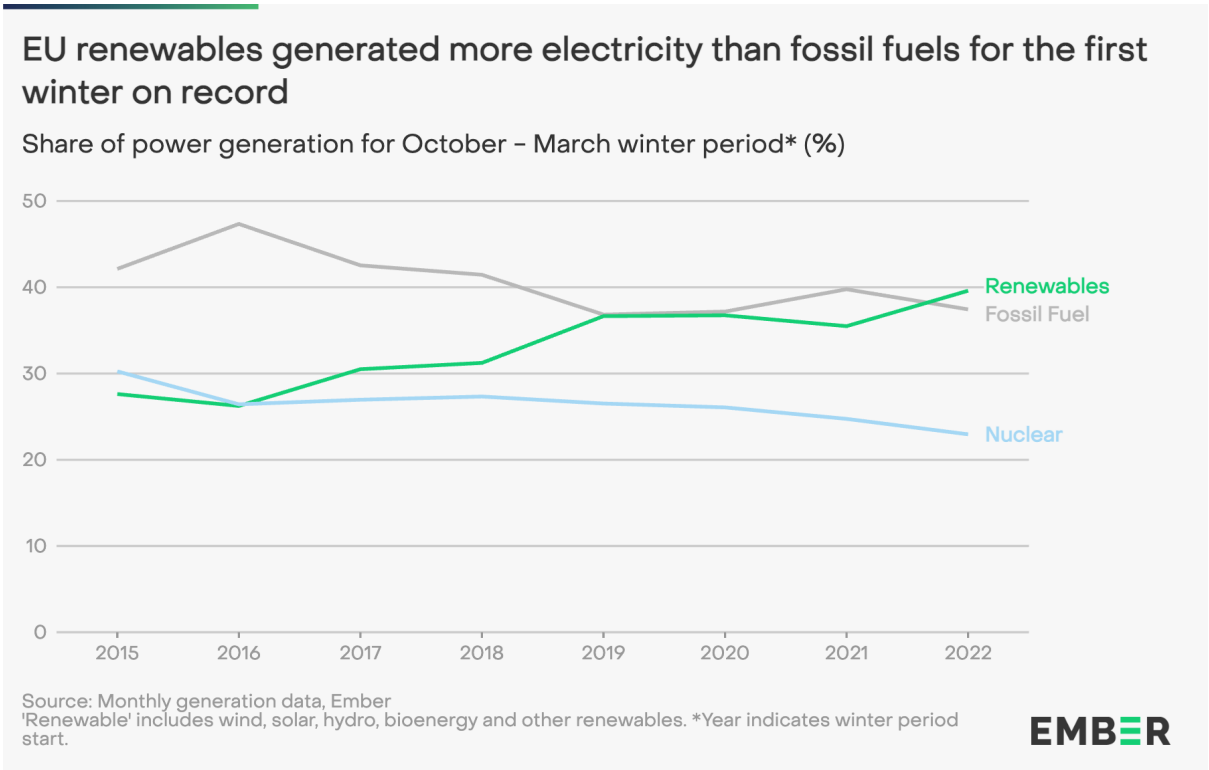


Although a select number of coal units have temporarily continued to generate or returned to the market, the overall picture confirms that countries remain committed to a coal phase-out. The German government has reiterated the importance of a 2030 coal exit, Romania moved its coal phase out forwards from 2032 to 2030 and France will phase out coal in 2023 instead of 2022 as planned. In the neighbouring UK, National Grid spent up to £420mn to keep five old coal units online over winter but ultimately only ran two, for a total of seven hours each. All UK units will be closed in line with the government's 2024 phase out date, with four already shut down by the end of March 2023.

Renewables overtake fossil fuels for the first time this winter

For the first time ever in a winter period, renewables generated a higher share (40%) of the EU's electricity than fossil fuels (37%). Fossil fuel generation dropped 12% compared to the previous winter, as a large fall in demand saw more expensive gas and coal generation pushed out of the electricity mix. Renewables, on the other hand, increased generation by 4% to 524 TWh compared to the previous winter.

Thanks to record renewable supply and low demand, winter EU power sector emissions were the lowest they have ever been, at 321 mtCO2eq. The previous low was winter 2019, which was affected by the first Covid-19 lockdowns in March 2020. The reduction in coal and gas generation led to a fall of 42 mtCO2eq compared to last winter, equivalent to total power sector emissions in Czechia in 2021.



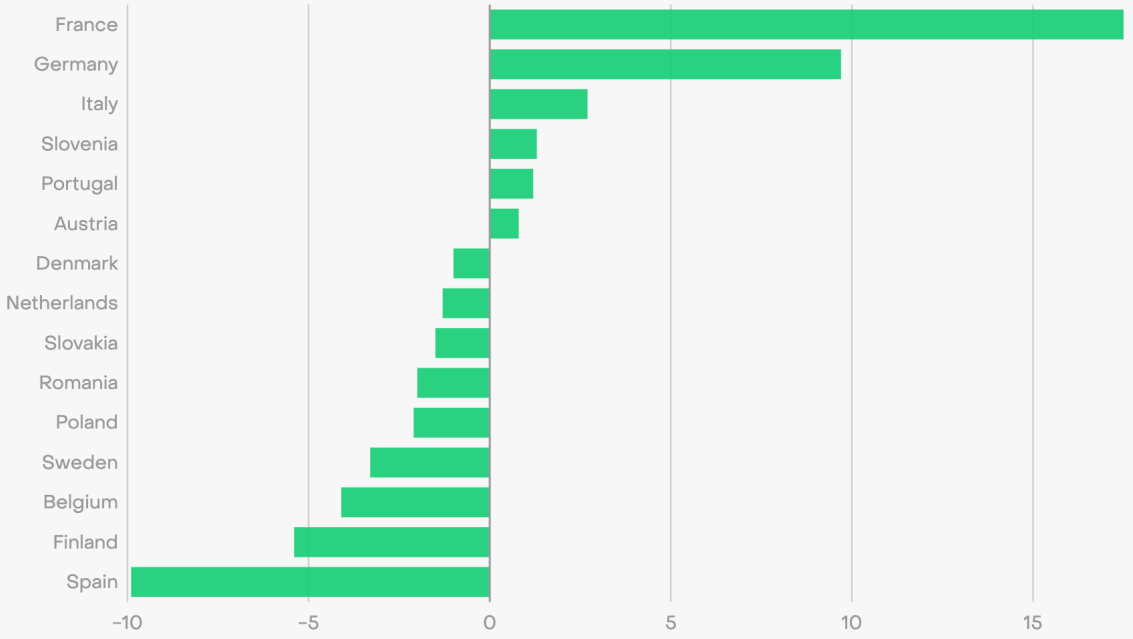
Flows reverse as interconnection plays vital role in maintaining security of supply

Changes in demand across Europe and nuclear fleet outages in France changed the landscape for electricity flows between countries this winter.

France has historically been an exporter, in the region of 10 to 25 TWh over the winter period. However, for the last two years, problems with its nuclear plants have meant France has substantially reduced power exports, and actually became a net importer over winter 2022. Germany also reduced exports by around 10 TWh this winter compared to its five year average.
With cuts in German and French exports, other countries such as Spain, Belgium and Romania became net exporters, helping neighbouring countries meet their demand. Cooperation facilitated by a well-connected and flexible grid played a critical part in ensuring security of supply over the winter, an aspect of the power system that will become even more central as the roles of solar and wind power grow.

Interconnection enabled electricity to flow where needed during winter as France became net importer

Difference in Oct 2022 - Mar 2023 net imports vs previous five-year average* (TWh)



Source: Monthly electricity data, Ember · 15 countries with largest absolute changes in net imports compared to historic average displayed.
*Same equivalent winter period

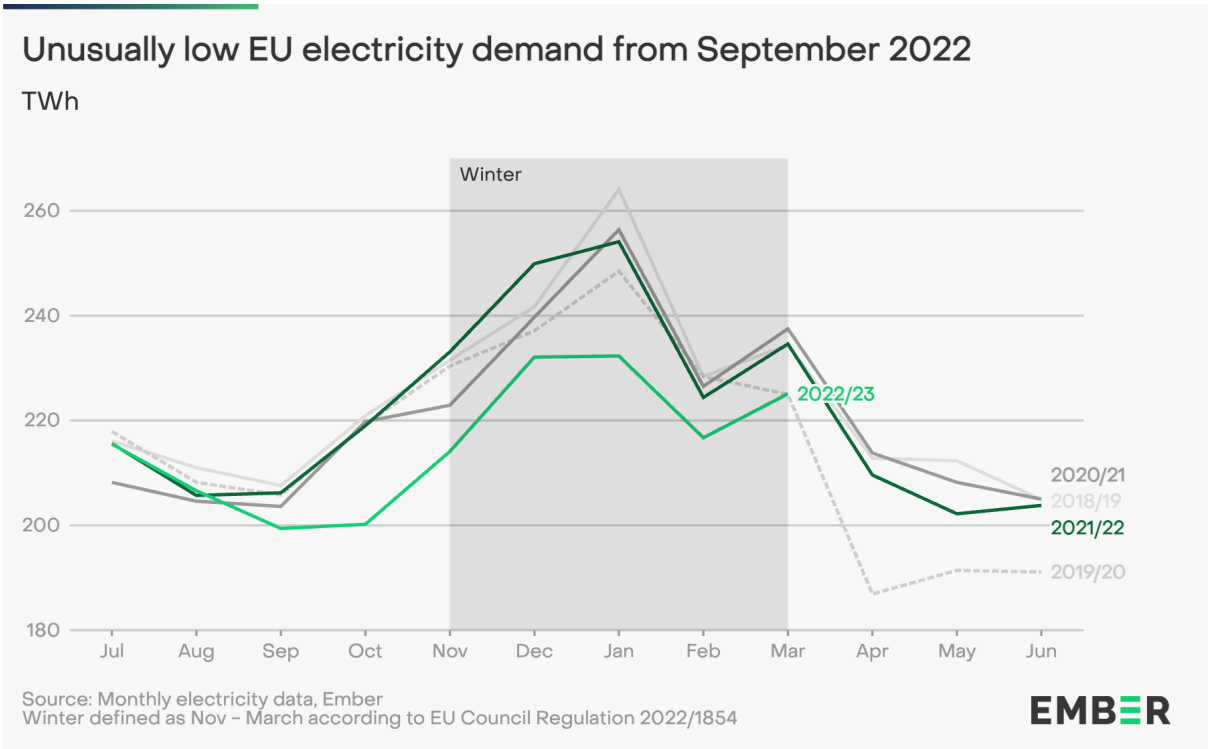
Bulk demand reductions

Widespread demand reduction

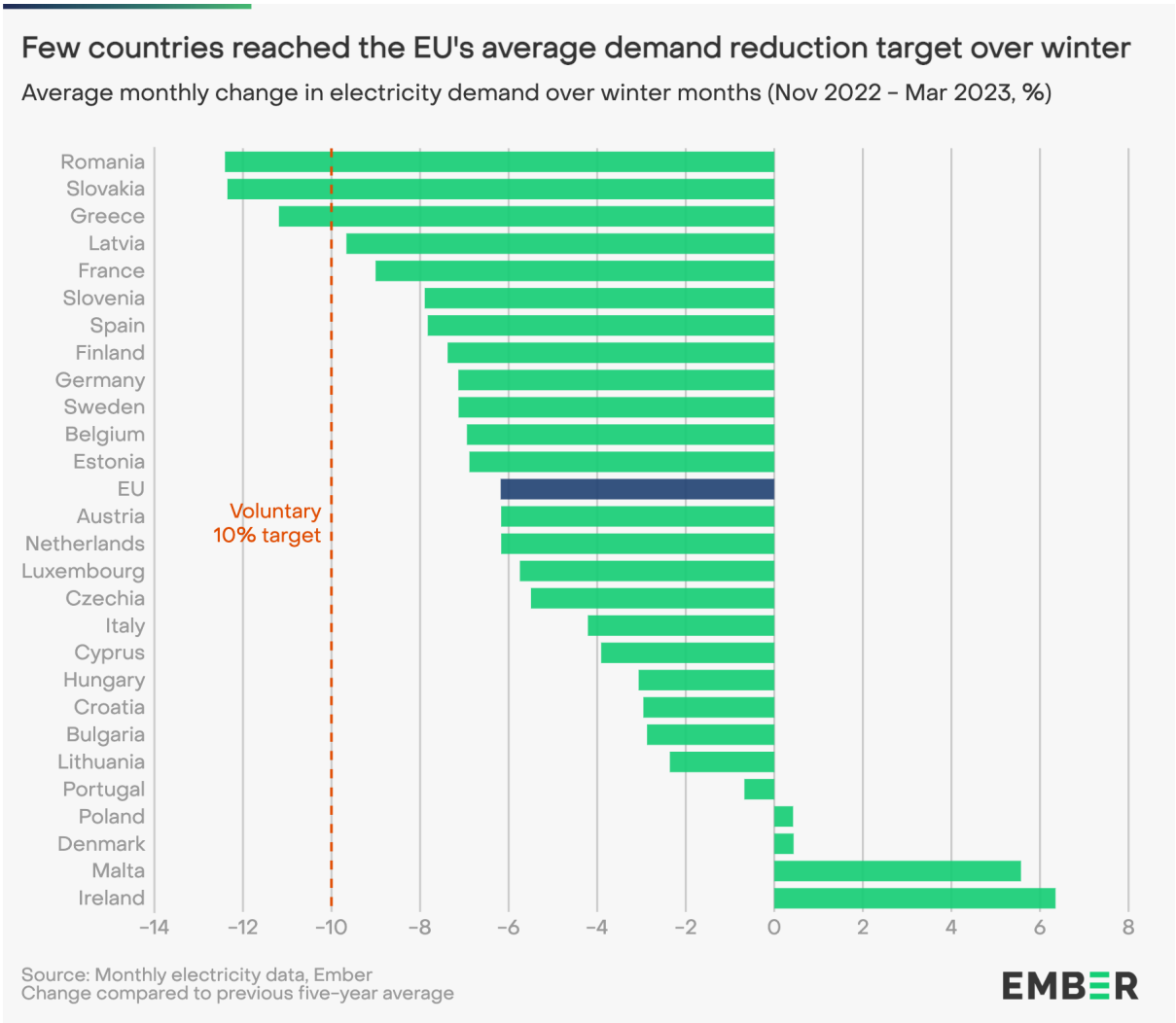
Nearly all EU Member States cut electricity consumption this winter compared to their five-year average, but only a handful achieved the voluntary target of a 10% reduction. Total EU electricity consumption was 6.2% lower than the five-year average.

A raft of emergency electricity market interventions covering the EU was introduced in October 2022 in an attempt to address abnormally high energy prices. One of the most significant measures was a voluntary target for member states to reduce electricity consumption by 10% over winter months defined as November to March. This target recognises the fact that the cheapest electricity is that which is not used. Reductions were to be measured by comparing the consumption in each month from November to March to the five-year average (referred to from now on as the reference period).

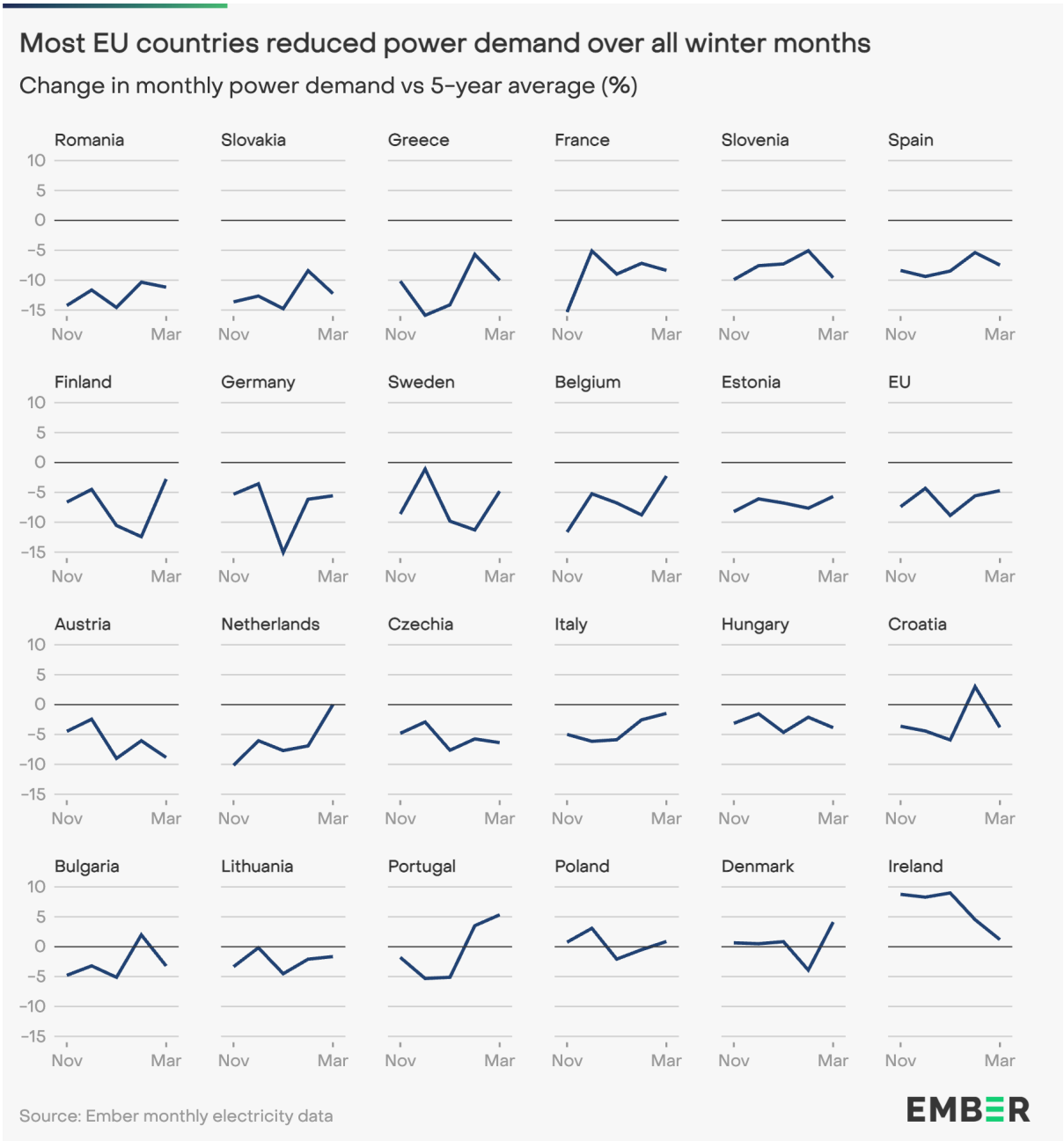
Across the EU as a whole, electricity demand has been lower than normal since September 2022. The winter started with the biggest year-on-year falls in monthly demand since the COVID-19 pandemic lockdowns in Spring 2020. The fourth quarter of 2022 saw an 8.5% decrease in demand compared to 2021. This trend continued into the first quarter of 2023, with demand 5% lower than in 2022.



Analysis of consumption over the winter period reveals that most member states (23 out of 27) reduced their monthly electricity demand. However, only three countries reached or exceeded the 10% target: Romania, Slovakia and Greece. The only countries to show an increase in electricity consumption over this period were Poland, Denmark, Malta, and Ireland.



For the EU as a whole, savings relative to the reference period were observed in all of the winter months. This can be partially explained by the fact that all months were warmer than average across Europe this winter, reducing the demand for electric heating. The strongest monthly reduction was seen in January (8.9%) and the weakest in December (4.3%) and March (4.7%). These monthly patterns correspond to temperature fluctuations in Europe, as January was the warmest month relative to historical averages (average temperature anomaly of +2.2°C), whereas December and March were the coolest (temperature anomalies of +0.9°C). However, temperature patterns alone cannot explain all observed demand reductions.



Many governments introduced energy saving measures and citizens took action, voluntary in some cases or forced in others, in response to spiralling costs and also in displays of solidarity with Ukraine.

Research published in January 2023 showed that 19 out of 27 member states had introduced measures to reduce gas and/or electricity consumption, of which 12 made them mandatory. Measures varied from public information campaigns about energy saving to restrictions on heating and lighting in public or commercial buildings. Campaigns to reduce

levels of heating in buildings (average temperatures) were widely launched in an attempt to save gas, or electricity in countries such as France and the Nordics where the heat supply is highly electrified. In the highly interconnected electricity system of Europe, moving to save electricity in one country is effectively an act of solidarity with others.

Neither Poland, Denmark nor Ireland recorded a reduction in electricity demand relative to the five-year average. While all three launched some form of energy saving programme, these either didn't succeed, or else savings were cancelled out by new forms of demand or demand stimulated by measures to reduce or cap consumer bills. The Polish government announced a price scheme capping the cost of electricity up to 90% of average usage, and a mandatory savings threshold for public administration institutions. Denmark introduced measures in the public sector including lowering the temperature in office spaces, turning off lighting in public buildings and shortening the heating season.

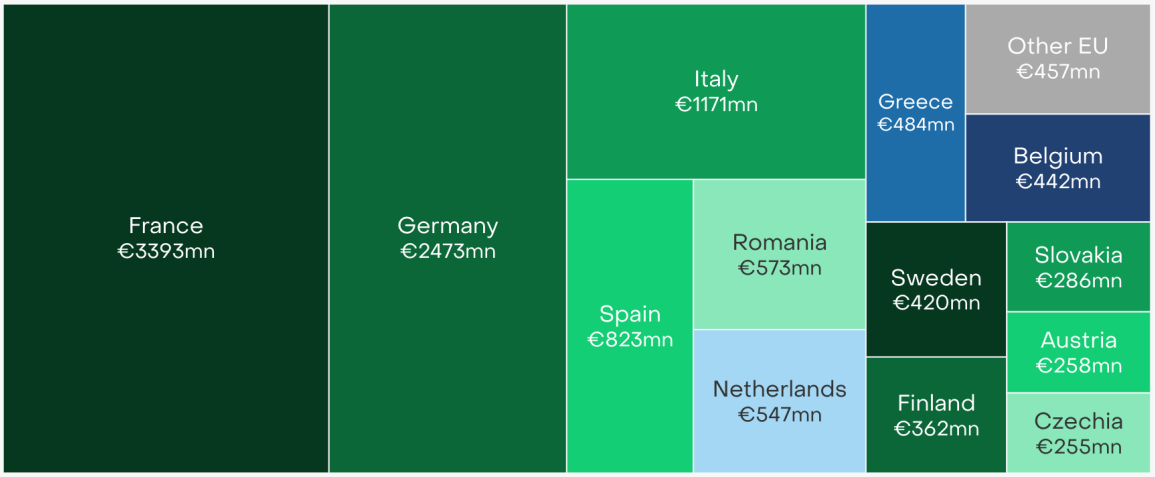
Reductions resulting from behaviour change may have been cancelled out by growing power-hungry sectors or increased demand from new electrified technologies. In Ireland, for example, electricity consumption by data centres increased by 32% from 2020 to 2021. In Poland, the heat pump market grew by 120% in 2022 alone. Heat pumps are just one example of technology shifting away from fossil fuels and towards electrification and it is widely accepted that decarbonisation will require a strong increase in electricity demand in the medium to long term. In the emergency EU legislation introducing demand saving targets it is stated that measures to reduce demand should not undermine the Union's electrification objectives.

The value of saved electricity

In total, the EU's electricity demand reductions saved electricity worth €12bn from November to March, relative to the reference period. Of all member states, France recorded the highest total savings of €3.4bn, followed by Germany with €2.5bn. However, it is to be expected that countries with the largest electricity markets saved the most in absolute terms.

Savings of €12 bn were made from electricity reductions in the EU this winter

Total value of 'saved' electricity in each member state, Nov 2022 to March 2023 (€ mn)

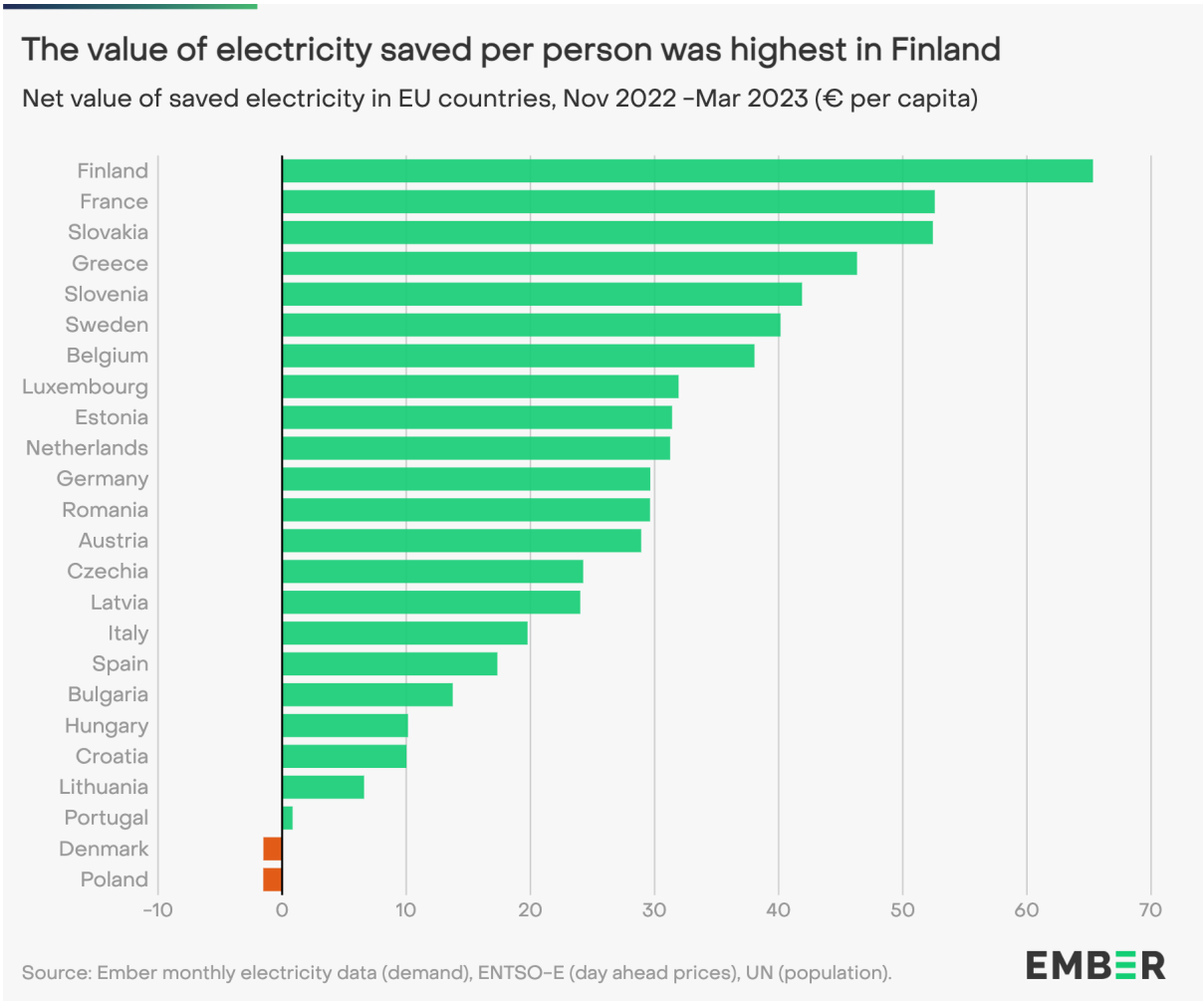


Sources: Ember monthly electricity data, ENTSO-E (day-ahead electricity prices).

The value of electricity saved per capita gives a better indication of the impact of energy saving measures. The value of electricity saved per capita is equal to €24 over the five month period, but there are significant country variations.

Savings were highest in Finland, at €65 per capita. It is not surprising that Finland tops the table of savings per capita, as it historically has the highest electricity consumption per capita in the EU. Among EU countries, Finland recorded the 8th largest relative demand reduction over winter. The main energy saving measure introduced was the 'down a degree' campaign, which, although aimed at heating in buildings, had a significant effect on electricity demand due to Finland's increasingly electrified heating sector (heat pump sales in Finland grew by 50% in 2022).

Romania, despite recording the highest relative demand reduction in the EU, only ranks 12th in value saved per capita. Romania already had the lowest electricity consumption per capita in the EU in 2022.



Are these demand reductions sustainable?

These reductions in electricity demand will have multiple contributing causes. Among the primary causes are likely to be government mandated reductions, voluntary acts of solidarity and economically motivated changes to reduce bills (demand elasticity).

From the perspective of energy system security, demand reductions are a positive outcome. However, not all reductions in consumption will be sustainable or desirable either economically or socially. Decisions taken by individuals or businesses to consume less

electricity may have come at the cost of comfort or production. Where reductions have been achieved sustainably, for example as a result of reduced wastage or smarter consumption, the gains should be consolidated.

Examining consumption patterns by sector can help to explain the origins of demand reduction, but such data is not yet available for the winter period, nor 2022 in general. However, proxies such as industrial production can provide insights. Industry consumed 44% of electricity in Germany in 2021, almost as much as buildings. German industrial production in 2022 was only 0.6% lower than 2021, and 5% down from 2019. The latest statistics for 2023 show that consecutive growth in January and February "more than compensated the significant decline in December 2022". It therefore appears unlikely that lower industrial output alone can account for electricity demand reductions of 5-15% observed across the winter months in Germany.

Peak demand reductions

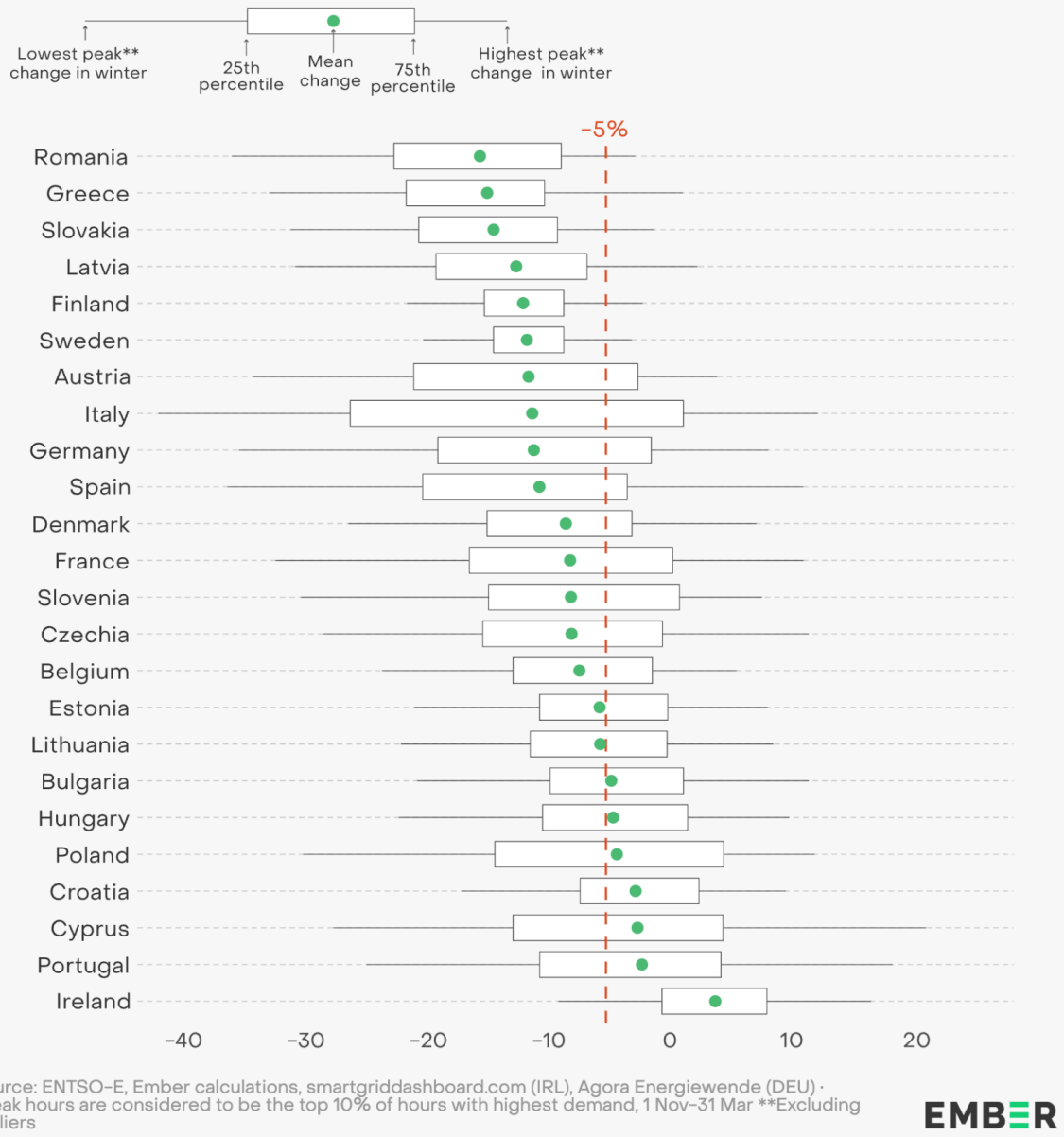
Majority of EU countries on target for peak demand reductions

The majority of member states reduced electricity demand during ‘peak hours’ by the mandatory 5% or more. All but one country for which adequate data is available (Ireland) reduced peak demand to some extent. These peak reductions almost certainly lowered system adequacy risks this winter and limited the occurrence of even more extreme price spikes.

The emergency EU regulation introduced in October 2022 included a mandatory target for all member states (except Malta and Cyprus, for whom it is voluntary) to reduce consumption of electricity during ‘peak hours’ by 5%. The focus on peak hours is justified because gas-fired power has the most significant impact on prices at these times. Therefore, according to the European Commission, reducing demand peaks would “*contribute to a reduced fuel consumption and to a smoother repartition of demand across hours, impacting hourly market prices*”. The system security benefits of such an intervention were echoed by ENTSO-E in their winter outlook, where it is stated that “*Adequacy risks decrease notably everywhere if efforts are made to reduce demand peaks*”.

The majority of EU countries reduced demand at peak times by 5% last winter

Demand change at peak hours* over the 2022–23 winter period, compared to 5 year average (%)



Source: ENTSO-E, Ember calculations, smartgriddashboard.com (IRL), Agora Energiewende (DEU) · *Peak hours are considered to be the top 10% of hours with highest demand, 1 Nov–31 Mar **Excluding outliers

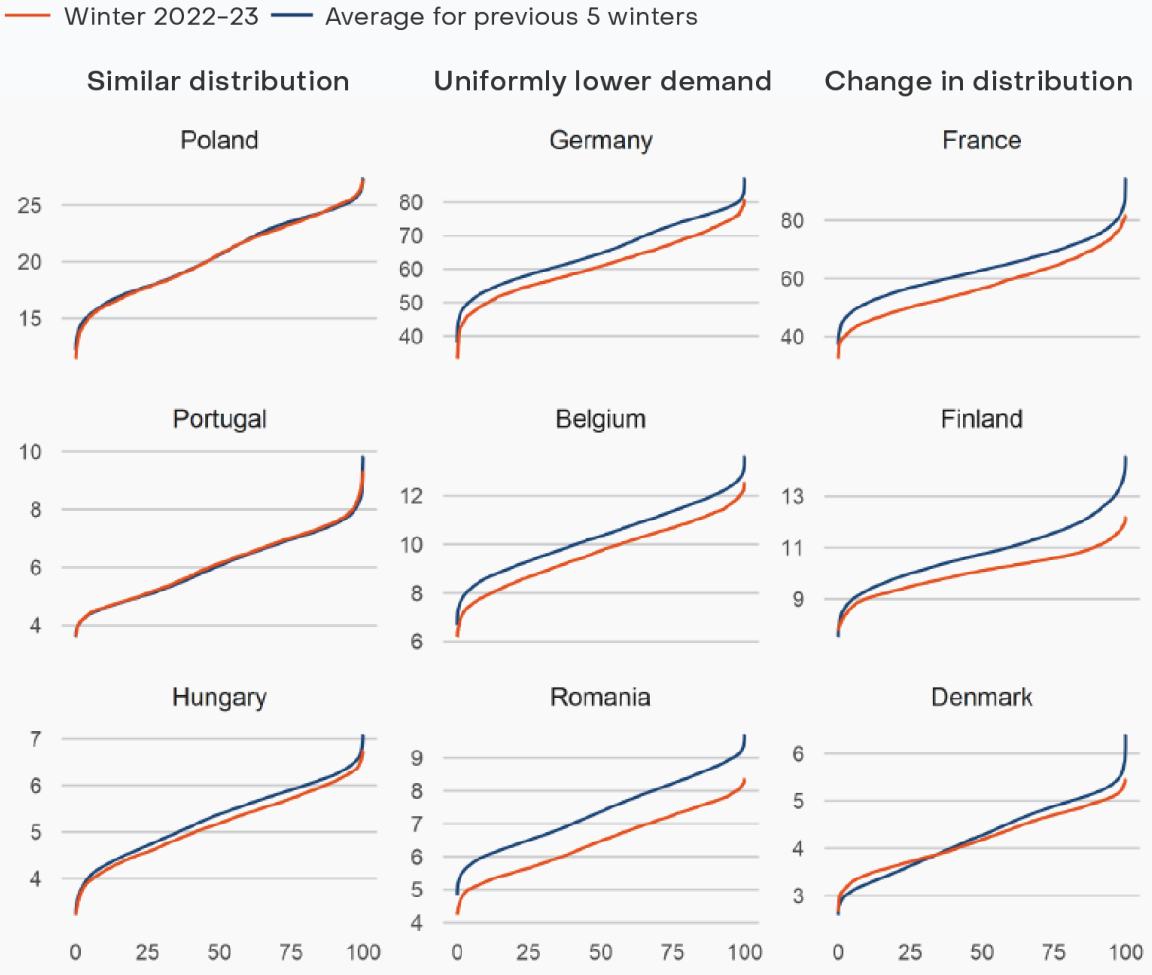
EMBER

The majority of countries reduced demand during 'peak hours' (see methodology for our definition of peak hours). Specifically, 17 countries met or exceeded the 5% target. Only one country, Ireland, recorded an increase in demand during peak hours, on average. Three member states (Netherlands, Malta, and Luxembourg) were excluded from this analysis due

to data availability or reliability concerns. The largest reduction in consumption during peak hours was observed in Romania (-15%).

Load curves reveal different reasons for EU countries' demand reductions at peak hours last winter

Share of hours (x axis, %) where load is at or below a certain power threshold (GWh, y axis)



Source: Ember calculations, ENTSO-E, Agora Energiewende (DEU)

EMBER

It is difficult to disentangle peak reductions from the overall demand reductions reported in the previous chapter. The four countries with the largest overall demand reduction also showed the largest peak reductions. Still, the results indicate that some level of targeted demand flexibility was successfully enacted in many countries this winter. Demand curves -

which display the cumulative distribution of demand over the hours of winter - give further insights.

Some countries such as Germany, Romania, and Belgium saw a uniform reduction of demand across all hours. That is, demand was lower in peak hours because demand was lower in all hours. For example, in Romania, both the median and the 95th percentile of demand reduced by 12% this winter compared to previous winters. Other countries that reduced peak demand, such as Denmark, Finland, and France, have different load curves this winter compared to previous winters. For example, median demand in Denmark reduced by 2%, but the 95th percentile reduced by 5%, suggesting a shift in consumption away from peak hours. Finland is the most extreme case, where median demand fell by 6% while the 95th percentile fell by a huge 12%.

Building on demand flexibility

Power system flexibility will need to rapidly increase to enable the integration of sufficient renewable electricity to decarbonise the power system.

The European Commission anticipates power system flexibility will need to more than double by 2030 to enable renewable targets to be reached (133% increase in GW terms on daily timescales). Flexibility from demand, such as that observed this winter, will be an essential, low-carbon source of flexibility that has the potential to reward consumers for using electricity at times of surplus and reduce power system load when supply is tight.

There is huge potential for demand flexibility, the majority of which is from households, but commercial and industrial activities can also meaningfully contribute. While data is scarce, it is claimed that at least 13 GW is active in EU markets today (i.e., the amount represented by the smartEn group). This is compared to an estimated potential of 164 GW of upward and 130 GW of downward flexibility by 2030.

This winter has shown that it is possible to reduce consumption during peak hours using demand flexibility options that are available within the existing market framework, including voluntary actions. Nevertheless, fossil gas remains the largest provider of flexibility to the European grid. To change this, the package of electricity market reforms proposed by the European Commission rightly aims to provide additional tools to support non-fossil

flexibility. Notably, the package includes an obligation for member states to assess their flexibility (and storage) needs and report on these from 2025, including in National Energy and Climate Plans (NECPs). Member States are also encouraged to introduce new support schemes in order to promote demand-side flexibility, possibly including a form of capacity payment. The package also emphasises the importance of fully implementing the existing Clean Energy Package from 2019.

In addition to the proposed actions and reforms, it is critical that the experiences of this winter are evaluated and learned from, in order to consolidate the progress made towards a more flexible and, therefore, secure European power system. A system that fully utilises demand flexibility will be cleaner due to better integration of renewables, and cheaper due to less extreme price spikes and reduced reliance on expensive fossil fuels.

Conclusion

Falling demand wipes out fossil generation and heralds a more flexible future

This winter showed that Europe's increasingly renewables-based power system can remain resilient even in a difficult energy context.

Emergency measures to reduce power demand had a demonstrable impact on security of supply in Europe this winter. With record renewable supply too, fossil fuels continued on their downward trajectory, countering claims that Europe turned back to coal in response to the gas crisis.

Power demand fell in nearly all Member States compared to the five-year average. Any demand reductions that can be maintained sustainably should be. This will accelerate the transition away from fossil fuels by reducing demands on Europe's grid infrastructure and limiting the need for future investment, which will nevertheless remain sizable.

Any improvements to demand flexibility over the winter should be evaluated, consolidated and quickly built on. The recently proposed electricity market reform presents an invitation to seriously consider demand flexibility, and introduces new tools to enhance this vital service. The energy system of tomorrow will require more flexibility to fully reap the benefits of cheap wind and solar power. Demand flexibility is one of the most cost-effective ways to deliver it.

Ultimately, the EU navigated this winter due to a combination of emergency measures, mild weather and citizen action, however, these should not be relied upon in future to protect against the risks to security of supply created by fossil fuel reliance.

Looking beyond this winter, the EU is already putting plans in place to transition away from fossil fuels permanently, with an increased renewable energy target and many more ambitious national targets already in place. Markets are also responding, with key clean technologies growing at a dizzying pace. The destination is clear: the EU is on its way to a clean power system, and that shift has gathered pace in the past year. Putting policies in

place to accelerate the delivery of a clean, renewables-based power system is the best way to ensure that the EU is never faced with a winter like this again.

Supporting Materials

Methodology

Winter definition

'Winter' in this piece refers to October of the stated year to March of the following year. 'Winter 2022' means in this case October 2022 to March 2023. Analysis of bulk and peak reduction uses the period November 2022 to March 2023 as this is the period to which the emergency EU legislation (and targets) applies.

Calculating the value of saved electricity

Electricity 'savings' (TWh) are defined as the difference between monthly demand this winter and the average demand for the same month over the last 5 years in each country. To calculate the value of this saved electricity, the TWh value per country is multiplied by the average day-ahead price over the month in that country.

Identification of peak hours

We identify peak hours in a way that matches as closely as possible to the definition set out in the emergency EU legislation. The legislation states that "*Each Member State shall identify peak hours corresponding in total to a minimum of 10% of all hours of the period between 1 December 2022 and 31 March 2023'. 'States shall reduce gross electricity consumption by 5% on average per hour', where 'peak hours' means individual hours of the day where, based on the forecasts of transmission system operators and, where applicable, nominated electricity market operators, day-ahead wholesale electricity prices are expected to be the highest, the gross electricity consumption is expected to be the highest or the gross consumption of electricity generated from sources other than renewable sources is expected to be the highest*" (p37).

As the forecasts of transmission system operators are not readily accessible, we used historical hourly data to identify the 10% of hours qualifying as peak. We were able to collect reliable hourly data for 24 member states dating back to November 2017 (hence providing a full 5 years of reference data prior to this winter). For each country, we calculated the average demand in each hour of the winter period. The 'peak hours' were identified as those hours in the top 10% for average demand over the reference period. Unlike the legislation, we included November in the reference period, to maintain a consistent definition of the winter

period for demand analysis. The impact of including November in the peak demand analysis is not significant, as only 8% of the peak hours we identified fell in November.
Across all countries most peak hours are concentrated in January (44%) and the lowest fraction are in March (3%).

Acknowledgements

With thanks to Agora Energiewende for providing high quality open data on the German power system. With thanks to the European Environmental Bureau for their research and tracking of energy saving measures in force across Europe.