

Europe's zero-carbon generation broke records in the third quarter, cutting fuel bills during the gas crisis

Lauri Myllyvirta , Hubert Thieriot and Isabella Suarez

Power generation from zero-carbon sources avoided a gas bill of €33 billion across the European Union (EU) in the first three months of the gas shortage (July-September), as well as €2.3 (£2.0) billion in Great Britain, according to new CREA analysis. The share of zero-carbon generation in the region reached an all-time high of 66% in the third quarter of the year, helping keep the lights on and cut fossil fuel import bills.

Power prices in Europe and the UK have skyrocketed in recent months as a result of rallying wholesale prices of coal, gas and carbon in tandem with power demand rebounding to pre-pandemic levels, and against a background of low fuel reserves in Europe and delays in commodity exports from producing countries. The last week of September saw these commodities trading at all-time highs — [coal delivered to Europe traded at \\$233 per tonne](#), while fossil gas [reached €92/MWh](#) and CO2 emissions priced at nearly €65 per tonne.

The price volatility in EU and UK power markets are a timely reminder that reliance on fossil imports is risky and expensive. During this time, renewables in most European countries covered a significant portion of demand, despite reports of lower generation output, shielding some part of the mix from the effects of fuel costs that would have likely required more gas.

In the EU, wind and solar capacity generated an average output of 50 GW in the July-September period, a record high, delivering 19% of all power generation (*Figure 1*). With nuclear generating an additional 77 GW (28% of power generation) and hydro another 38 GW (13%), their combined output effectively covered the equivalent of 126 large¹ coal or gas power plants running full steam, leaving 18% of power generation from gas and another 17% from coal. If this zero-carbon power had to be generated from gas, at the average of the record high prices seen over these months, it would have added approximately €26 billion to the gas import bill, with hydropower avoiding

¹ For the purposes of this analysis, this is equivalent to a 1 gigawatt (GW) fossil fuel plant.

another €7 billion². This is assuming no increase in fuel prices due to the additional demand and therefore represents a very conservative lower bound.

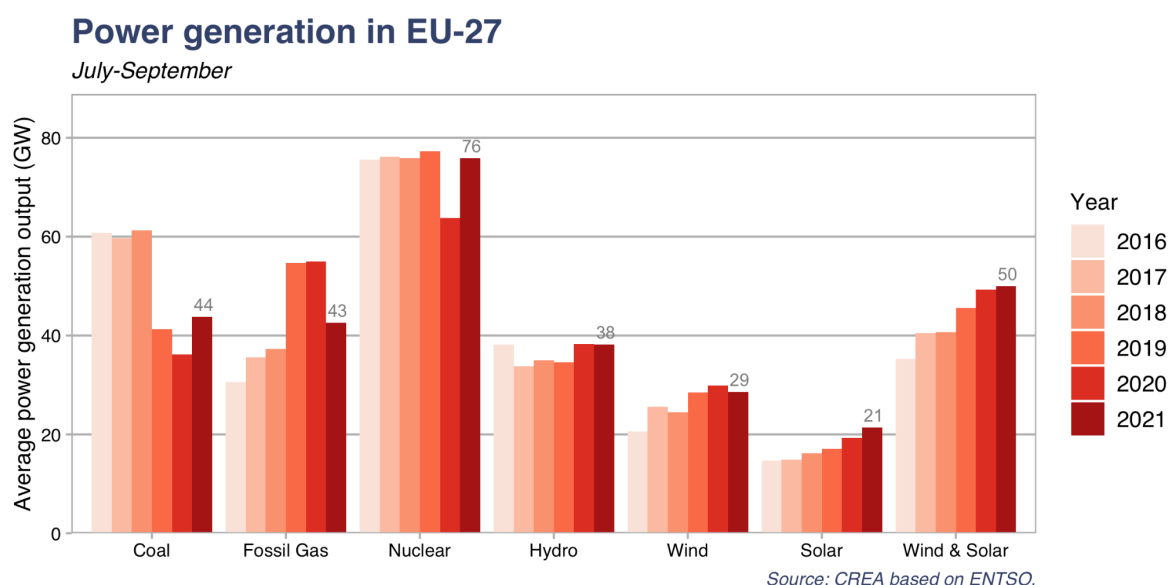


Figure 1: Combined wind & solar reached an all-time high in July-September 2021

Similarly, zero-carbon technologies in Great Britain³ accounted for half of the power generated from July to September. Wind and solar had an average output of 5.4 GW, while nuclear generated 4.6 GW over the same period. This is the total output from 10 large coal or gas power plants running full steam. If this power had to be generated from gas, at the average prices each month, the additional gas import bill would have been about €2.2 (£1.9) billion, with hydro bringing the total up to €2.3 (£2.0) billion.

² The calculation assumes average thermal efficiency of 50% for additional gas-fired generation. New combined-cycle plants can achieve efficiencies higher than this, but it is a conservative assumption for the fleet as a whole.

³ Data was obtained through BMRS which does not cover Northern Ireland.

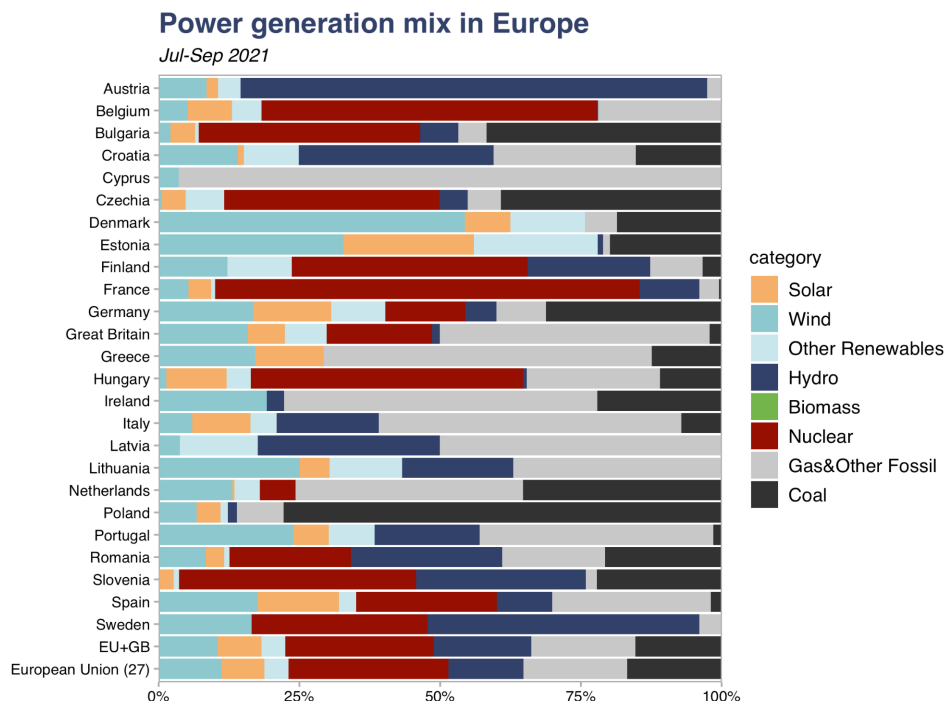


Figure 2: Renewable energy and nuclear each provided approximately 25% of electricity generation in the EU and Great Britain in the third quarter, avoiding additional spending on high-cost fossil fuels.

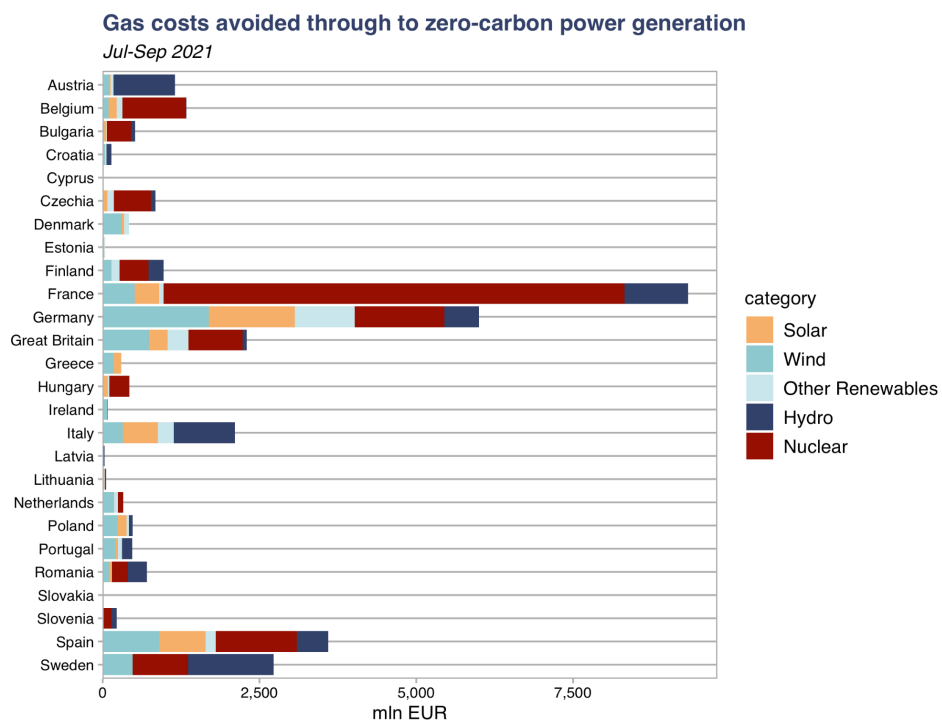


Figure 3: Renewable power generation avoided €14 billion in gas costs from July to September 2021, while nuclear power generation delivered €17 billion in savings.

Renewables aided in covering the peaks

Our analysts scrutinized renewable generation from July to September, as some commentaries around Europe's situation have gone as far as to claim that the crisis means intermittent renewables "require fossil fuel back-up" as they were unable to meet peak demand," implying that the energy transition has gone too fast, too soon.

However, our analysis of the contribution of wind and solar to meeting peak loads in July to September shows that solar and wind generation provided 28 GW worth of firm capacity in the EU. Notably, wind&solar generation during this time was higher than the average wind&solar output in 2016-20 (Figure 4). Great Britain is the notable exception to this, as wind&solar generation was 11% less than the average 2016-20 output over the same period, but wind&solar still provided 3.2 GW of firm capacity in Great Britain.

This amount of additional thermal power capacity would have needed to run at peak hours if the wind&solar capacity hadn't been in place. We quantified the contribution of wind and solar to peak loads by comparing hourly electricity demand in each country to electricity demand with wind and solar generation subtracted, and assessing how much lower the residual load was. If there were events in the data where combined output from wind and solar was zero during times of peak load, this contribution would be zero, even if they had generated at other times. The methodology is documented in the CREA report on fossil fuel overcapacity in Europe, [Ripe for Closure](#).

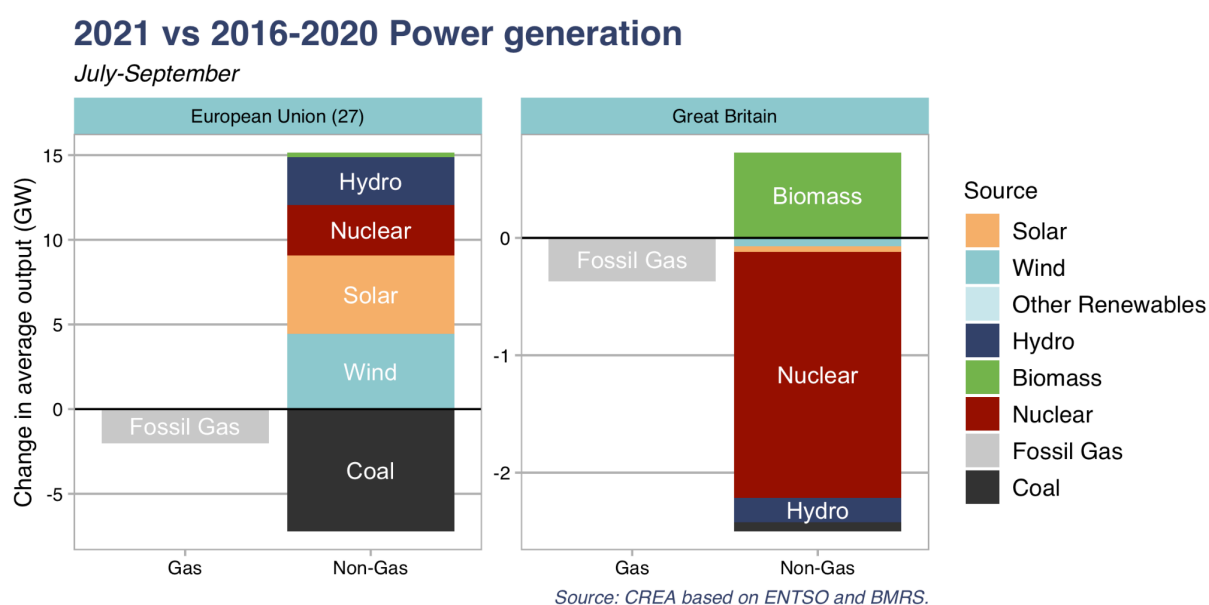


Figure 4: Renewables increased in the EU in summer 2021 compared to historical outputs

Europe has deployed a significant capacity of renewables in recent years. In 2020, [the EU and the UK generated more electricity from renewables than fossil fuels](#). In the midst of the current energy

crisis, they are doing their job in meeting peak loads in Europe during high power and gas prices. By far the biggest factor in the electricity price surge were the commodity prices of fossil fuels, which by market design sets the wholesale price for electricity. Their current price evolution signals the high risk of exposing power systems to volatile fossil fuel prices for most generation hours in a year. This underscores the need for more renewable capacity and diversity of energy sources across the continent, which could yield lower and more predictable electricity prices.

Excess Fossil Fuels

The narrative of fossil fuel as a back-up fuel is a precarious one. There are costs associated with maintaining fossil fuels plants, which are often borne by consumers. Conventional fossil fuel generators receive payments regardless of whether or not they are available to service demand, In addition fixed operating & maintenance (FOM) costs, which do not vary with generation and could be avoided with additional renewables, are incurred regardless of whether the plants are not needed to service demand.

Our recent report "[Europe — Ripe for Closure](#)" found that a combined 48.8 gigawatts (GW) of excess fossil fuel capacity in Bulgaria, Czech Republic, Germany, Italy, Netherlands, Poland, Romania, Spain, and Turkey that are not needed to keep the light on, even on the most demand intensive days.

Keeping these unneeded and underutilised fossil fuel plants in operating condition consumes €1.9 billion (\$2.1 billion) in FOM costs annually, which could otherwise be invested in zero carbon energy. With the exception of Poland and the Netherlands, the nine countries covered in this report saw zero-carbon technologies generating more than 30% of peak demand over the July and September period. In Spain and Germany, solar and wind accounted for 31% and 32% of peak capacity respectively.

About CREA

Centre for Research on Energy and Clean Air (CREA) is an independent research organisation focused on revealing the trends, causes, and health impacts, as well as the solutions to air pollution. CREA uses scientific data, research and evidence to support the efforts of governments, companies and campaigning organizations worldwide in their efforts to move towards clean energy and clean air, believing that effective research and communication are the key to successful policies, investment decisions and advocacy efforts. CREA was founded in December 2019 in Helsinki and has staff in several Asian and European countries.

Appendix: Detailed Results

The [full dataset](#) is available for download.

Table 1: Share of generation by fuel over July-September 2021

Region	Coal	Gas & Other Fossil Fuels	Hydro	Nuclear	Solar	Wind	Other Renewables
European Union (27)	16.8%	18.4%	13.4%	28.4%	7.6%	11.2%	4.4%
EU+GB	15.3%	18.5%	17.3%	26.4%	7.8%	10.5%	4.3%
Breakdown by country:							
Austria	0.0%	2.6%	82.8%	0.0%	2.0%	8.5%	4.0%
Belgium	0.0%	22.0%	0.2%	59.6%	7.9%	5.1%	5.2%
Bulgaria	41.8%	5.0%	6.8%	39.4%	4.4%	2.1%	0.6%
Croatia	15.2%	25.3%	34.6%	0.0%	1.1%	14.0%	9.8%
Cyprus	0.0%	96.5%	0.0%	0.0%	0.0%	3.5%	0.0%
Czechia	39.2%	5.9%	5.0%	38.2%	4.3%	0.5%	6.9%
Denmark	18.6%	5.7%	0.0%	0.0%	8.0%	54.4%	13.2%
Estonia	19.9%	1.2%	0.9%	0.0%	23.2%	32.8%	22.0%
Finland	3.4%	9.3%	21.8%	41.9%	0.0%	12.2%	11.4%
France	0.4%	3.5%	10.6%	75.3%	4.1%	5.3%	0.7%
Germany	31.2%	8.8%	5.5%	14.2%	13.8%	16.8%	9.6%
Greece	12.4%	58.3%	0.0%	0.0%	12.1%	17.2%	0.0%
Hungary	10.9%	23.6%	0.7%	48.3%	10.7%	1.4%	4.3%
Ireland	22.1%	55.7%	3.0%	0.0%	0.0%	19.2%	0.0%
Italy	7.2%	53.7%	18.2%	0.0%	10.3%	6.0%	4.7%
Latvia	0.0%	50.0%	32.3%	0.0%	0.0%	3.7%	13.9%
Lithuania	0.0%	37.0%	19.8%	0.0%	5.3%	25.1%	12.9%
Netherlands	35.3%	40.4%	0.0%	6.4%	0.3%	13.1%	4.5%
Poland	77.8%	8.3%	1.6%	0.0%	4.2%	6.7%	1.3%
Portugal	1.5%	41.5%	18.7%	0.0%	6.3%	23.9%	8.1%
Romania	20.7%	18.3%	26.9%	21.5%	3.3%	8.3%	1.0%
Slovenia	22.2%	2.0%	30.1%	42.1%	2.6%	0.0%	1.0%
Spain	1.9%	28.2%	9.8%	25.0%	14.5%	17.5%	3.1%
Sweden	0.0%	4.0%	48.3%	31.2%	0.0%	16.5%	0.0%
Great Britain	2.1%	47.9%	1.4%	18.7%	6.6%	15.8%	7.4%

Table 2: Gas costs avoided thanks to zero-carbon power generation in Jul-Sep 2021, mln €

Country	Hydro	Nuclear	Other Renewables	Solar	Wind
European Union (27)	6,763	14,510	2,230	3,833	5,715
EU + GB	6,829	15,365	2,563	4,127	6,448
<i>Breakdown by country:</i>					
Austria	982	0	48	24	100
Belgium	25	1,015	89	134	178
Bulgaria	65	384	6	42	21
Croatia	79	0	23	3	33
Cyprus	0	0	0	0	2
Czechia	75	590	104	64	8
Denmark	0	0	76	43	300
Estonia	0	0	10	10	15
Finland	244	463	128	0	138
France	1,131	7,348	72	392	508
Germany	551	1,427	956	1,372	1,692
Greece	0	0	0	122	174
Hungary	5	313	28	69	9
Ireland	11	0	0	0	119
Italy	1,073	0	254	557	323
Latvia	19	0	8	0	2
Lithuania	17	0	11	4	22
Netherlands	0	87	60	3	178
Poland	56	0	43	143	235
Portugal	158	0	71	34	205
Romania	306	250	11	38	97
Slovenia	89	127	3	8	0
Spain	500	1,293	161	740	898
Sweden	1,362	886	0	0	474
Great Britain	66	861	335	296	738