LSEG Power Research

Analyst Update

Climate Change Impact on European Power

December 2024

Summary

Following our previous report on Climate Change Observations and Projections on the European Continent, we now take a look at the impacts of Climate Change in the European Power sector. For each power price area we look at our forecasts for demand, wind and solar power production across 32 weather years, and summarize the results in the table below in change per decade as a percentage of the average of weather years.

	Consumption									Wind									Solar								
	2025	DJF	Q1	MAM	Q2	JJA	Q3	SON	Q4	2025	DJF	Q1	MAM	Q2	JJA	Q3	SON	Q4	2025	DJF	Q1	MAM	Q2	JJA	Q3	SON	Q4
DEU	0	0	0	0	0	0.2	0	-0.2	-0.3	-2	0	-2	-2	-2	-4.9	-4	-3	-1	1.9	-1	2	2.8	2.3	1.8	2	2	0
FRA	0	-1	0	0	0	0.5	0	-0.9	-1	-1	-1	-2	-2	-5.2	-2	-2	-3	-1	1.2	-1	0	-1	-1	1.4	1.8	2.2	-1
BEL	0	0	0	0	0	0	0	-0.3	-0.5	-2	-1	0	-4	-5.1	-3	-3	-2	0	2.1	-1	2	3.6	3.2	2	2	2	0
NLD	0	0	0	0	0	0.2	0	0	-0.2	-1	-1	-1	-3	-4.0	-3	-2	-1	1	1.8	-1	2	3.2	2.6	1	2	2	0
GBR	0	-1	0	0	0	0	0	-0.6	-0.8	-1	-1	-1	-4.6	-4.7	-1	0	-1	-1	1	0	2	2.3	1	0	0	-1	-1
IRL	0	0	0	0	0	0	0	0	0	-2	0	-2	-5.2	-5.3	-2	-1	-1	0	0	2.3	3.0	-1	1	0	-1	-1	0
PRT	0	0	0	0	0	0	0	0	0	0	1	3	0	3	2	3	2	0	0	0	-1	-1	0	1	1.2	-1	-1
ESP	0	0	0	0	0	1.2	1.1	0	0	0	2	4	0	3.5	-1	-1	-2	-1	0	-1	-1	-1	0	1	1	-1	-1
ITA	0.4	-0.5	0	0	0.6	2.0	1.8	0	-0.5	0	2	4.5	1	-1	-1	-1	-4	-4	0	0	-1	0	1	1	1	-1	-1
CHE	0	0	0	0	0	0	0	-0.4	0	n/a									1.3	0	2	2	1	1	1	2	2
AUT	-0.4	-0.7	-1	-0.4	0	0.2	0	-0.6	-0.8	-2	-2	0	-1	-1	-4	-5.8	-4	-1	1	0	2.9	1	0	1	0	1	2
CZE	-0.5	-1	-1	-0.5	-0.3	0	0	-0.7	-1.1	-3.9	-2	-3	-2	-2	-7.2	-9.0	-6.3	-3.5	1.6	-1	2	2	2.0	2.1	2	1	0
POL	-0.2	0	0	0	0	0.3	0	-0.3	-0.6	-2	0	-3	-1	0	-5.0	-4.4	-3	0	1.9	0	2	2.2	2.3	2.0	2	2	0
DK1	0	0	0	0	0	0	0	-0.4	-0.5	0	0	-2	-1	-1	0	1	0	2	1	-1	2	2.8	2.1	0	0	0	-2
DK2	-0.5	-0.7	-1	0	-0.3	0	0	-0.7	-0.9	0	1	-2	-1	-1	-3	0	1	1	1	-1	2	2.7	2.7	0	0	0	-2
SE4	-1.0	-1	-1	-1	-0.6	-0.3	-0.3	-1.6	-1.8	0	0	-3	-1	0	-1	1	1	2	1	2	3.9	3.0	2.1	0	-1	0	-1
SE3	-0.7	-1	-1	-1	-0.6	0	0	-1.3	-1	0	-2	-2	-1	-1	1	2	3	2	1	0	3	1.9	2	0	-1	-1	-1
SE2	0	0	0	0	0	0	0	-0.8	-1	0	-3	0	4	2	0	1	0	-1	0	-2	2	-1	1	1	0	-3.0	-3
SE1	-0.4	0	0	0	-0.3	0	0	-0.7	-1	0	-4	0	6	3	1	2	0	-3									
NO1	-1.5	-1	-1	-1.5	-1.5	-0.9	-0.9	-2.4	-2	-1	0	0	0	-1	0	2	4	2									
NO2	-0.8	0	-1	-0.8	-0.9	-0.6	-0.5	-1.3	-1	0	2	2	2	1	2	2	0	2					n/a				
NO5	-0.8	0	-1	-0.8	-0.8	-0.7	0	-1.4	-1.3	n/a																	
NO3	-0.6	0	0	0	0	-0.4	0	-1.1	-1.1	-1	0	-1	2	1	0	2	3	2									
NO4	-0.5	0	0	-1	0	0	-0.5	-1.1	-0.9	-1	-4.0	-2	-1	-1	-1	-1	-1	-3									
FIN	-0.5	-1	0	0	-0.3	0	0	-1.0	-1.0	-1	-3	-1	1	0	0	0	-1	-2	0	-3.0	2	2	2	0	-1	-2.7	-2
EST	-0.5	-1	-1	0	0	0	0	-1.0	-1.1	0	-2	-2	2	1	2	1	1	1	0	-2	-1	2.6	2.4	0	-1	-2	-2
LVA	0	0	0	0	0	0.4	0	-0.5	-0.7	-1	-3	-4	2	2	-1	0	0	1	n/a								
LTU	0	0	0	0	0	0.3	0	-0.5	-0.8	-1	-1	-4	1	1	-4	-2	-1	-1	1.2	-1	3.3	2.9	2.3	0	0	-1	-1
Total	0	-1	0	0	0	0.4	0.3	-0.5	-0.7	-1	0	0	-1	-2.6	-2	-2	-1	0	1.2	0	-1	1.6	1.5	1.1	1.2	-1	-1

The results show a trend of the impact of the weather developments over the past 32 years in the power sector. Greyed out cells in the table above correspond to trends with p-values higher than 5%, which are not considered statistically significant. No conclusions will be taken from these. Regions marked as “n/a” are not modelled.

Note that these are **not real observations of demand, wind and solar** power from the past, but are "replayed” **weather years** where the same hourly weather as observed in each year from 1991 to 2022 is fed through our models to forecast the power demand, wind and solar outputs at the current levels of demand, wind and solar installed capacities.

Starting with **consumption**, total European demand does show a marginally negative trend, but the p-value is too high to conclude that this trend is significant. Instead, we observe a statistically significant decrease in the yearly values in the Nordic region and Central Eastern Europe of between 0.2% and 1.5% per decade. Italy is the only country where yearly demand increases, at 0.4% per decade. Looking at seasonality, we see lower statistical significance in winter/Q1 in general, but we are still able to conclude that contrary to the annual trend, ITA sees decreased consumption during the winter (-0.5%), along with AUT (-0.7%) and DK2 (-0.7%). It is in summer that most of the demand increase in Italy is observed (2%), but also ESP (1%), DEU (0.2%), FRA (0.5%), NLD (0.2%), LVA (0.4%) and LTU (0.3%) see increased demand in this season. Total demand on the continent also increases 0.4% in summer as a result. However, not all countries see an increase in demand in this season, as most of the Norwegian price areas and SE4 have a decreasing trend due to less heating needed during the summer in these countries. Lastly, it is in the fall that most countries observe statistically significant decrease in consumption ranging from 0.2% in DEU to 2.4% in NO1.

Moving on to **wind power**, there is generally much lower statistical significance, meaning that although the European wind trend is negative at 1% per decade, the p-value is too high to conclude that this trend is significant. Yearly wind power production decrease is only statistically significant in CZE, at 3.9% per decade. Turning into the seasons, it is observed that wind power production in winter decreases 4% per decade in NO4 but increases 4.5% per decade in ITA during Q1. Spring sees a decrease in wind power production in GBR and IRL of 4.6% and 5.2% per decade, respectively. Similar values for Q2 in these price areas, but Q2 also sees statistically significant trends in FRA (-5.2% per decade), BEL (-5.1% per decade), NLD (-4% per decade), and ESP (-3.5% per decade). Total European wind power production drops by 2.6% per decade in this quarter. In summer, DEU, POL and CZE experience a lower wind power production of 4.9%, 5.0% and 7.2% per decade, respectively. It is, however, in Q3 that the highest decrease is observed, at -9% per decade in CZE, followed by AUT (-5.8%) and POL (-4.4%). Fall/Q4 only shows statistical significance in CZE, at -6.3 / -3.5% per decade.

Lastly, total yearly European **solar power** production increases by 1.2% per decade, along with DEU (1.9%), FRA (1.2%), BEL (2.1%), NLD (1.8%), ITA (1.3%), CZE (1.6%), POL (1.9%), and LTU (1.2%). In winter, only IRL is showing better solar power production conditions, with an increase of 2.3% per decade, while FIN shows a decrease of -3% per decade. IRL shows an even higher trend in Q1 at 3% per decade, while AUT shows 2.9%, SE4 3.9%, and LTU 3.3%. It is in spring/Q2 that most conclusions can be taken, with total European production increasing by 1.6 / 1.5% per decade, DEU displaying an increase of 2.8 / 2.3% per decade, BEL 3.6 / 3.2%, NLD 3.2 / 2.6%, GBR 2.3 / -%, CZE - / 2.0%, POL 2.2 / 2.3 %, DK1 2.8 / 2.1 %, DK2 2.7 / 2.7%, SE4 3.0 / 2.1%, SE3 1.9 / -%, EST 2.6 / 2.4%, LTU 2.9 / 2.3 %. DEU also increases its solar power production in summer (by 1.8% per decade), along with France (1.4 and 1.8 % in Q3), CZE (2.1%) and POL (2.0%). PRT sees increased solar production in Q3 (1.2% per decade). Lastly, in the fall it is FRA that shows an increase of 2.2% per decade, while SE2 and FIN decrease 3.0 and 2.7 % per decade, respectively.

In this report the **occurrence of extreme weekly events** is also studied. For consumption, there is a clear increase in the number of weeks of high consumption in summer for Continental Europe, and an opposite trend for Finland, Sweden and Norway. For wind, there is a decrease in the number of weeks of low wind in winter for Europe and DEU. Lastly, for solar there is a clear increase in the number of weeks of high solar power production.

The **R-squared** was chosen not to be displayed in this report, as this is a metric of how much of the variation in the dependent variable that is explained by the independent variable. Given that climate trends are much weaker than weather variability, the R-squared is rather low and not very meaningful. Instead, we choose to present **p-values**, which is a measure of statistical significance of the observed trend. Here we assume that p-values lower than 5% indicate strong evidence against the null hypothesis that the trend is zero, suggesting that the predictor variable (weather years) has a significant effect on the dependent variable.