REFINITIV COMMODITIES RESEARCH

POWER

Flexible capacity needs in 2030 under increasing renewable energy additions in Central-Western Europe

Likelihood assessment for tight supply situations in France, Germany and Belgium

January 2022

Introduction

With our inhouse forward model for the CWE countries (DEU, FRA, Benelux, AUT) and Great Britain we have a powerful tool to simulate the electricity dispatching and expected price outcome based on **real-observed weather from past years, "re-played" in future years.**
In our previous report we assessed **how tight the French, German and Belgian markets can get** in Q1-2022 if renewable production is very low and consumption is very high at the same time. We saw that for Q1-22 France was most likely to see tight hours with a supply gap, which in the most extreme cases would be very high and pose a serious challenge. The German system saw moderate risk of tight and expensive hours, though in the present winter there are enough non-market resources to cover even for the worst case identified by our model. For the Belgian market we saw that the very tight situations would be much more severe than for the German/French examples, but the likelihood for those was a lot smaller in comparison.
In this report, we want to have a look at how the occurrence of tight situations will develop towards 2030 by looking at the years 2022 – 2026 – 2030.

Our Approach

Since the conventional power stack is undergoing major changes in our countries of scope, the simulation of a certain weather year will lead to different tightness & price volatility situations from one year to the next. We simulate each weather year repeatedly for the years 2022-30. The wind/solar generation will increase in accordance with our capacity growth assumption, which reflects the current governmental targets in the respective countries.[1] While this will lead to less tightness over the years, increasing consumption will tighten the market going towards 2030.

The weather scenarios are built on the weather data of the full years 1991 to 2015[2]. Twenty-Five to Thirty years is a commonly accepted period length for determining a “weather normal”, that is, a measure of the average expected weather for a certain time of the year. We suggest that within 25 years of weather data a wide - though not exhaustive - range of

[1] The new German government’s announcement of targeting zero coal by 2030 and raising the renewable capacity targets is not considered in our assumptions yet, i.e. it will only be once the targets pass the parliamentary vote and become binding
[2] We plan to add the weather years 2016-21 to our modelling framework in early 2022

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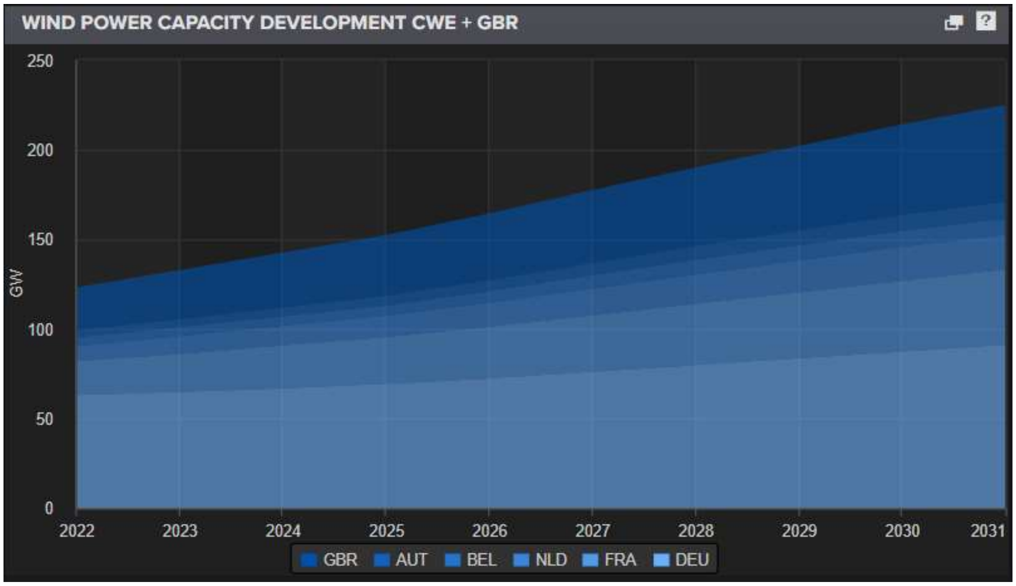
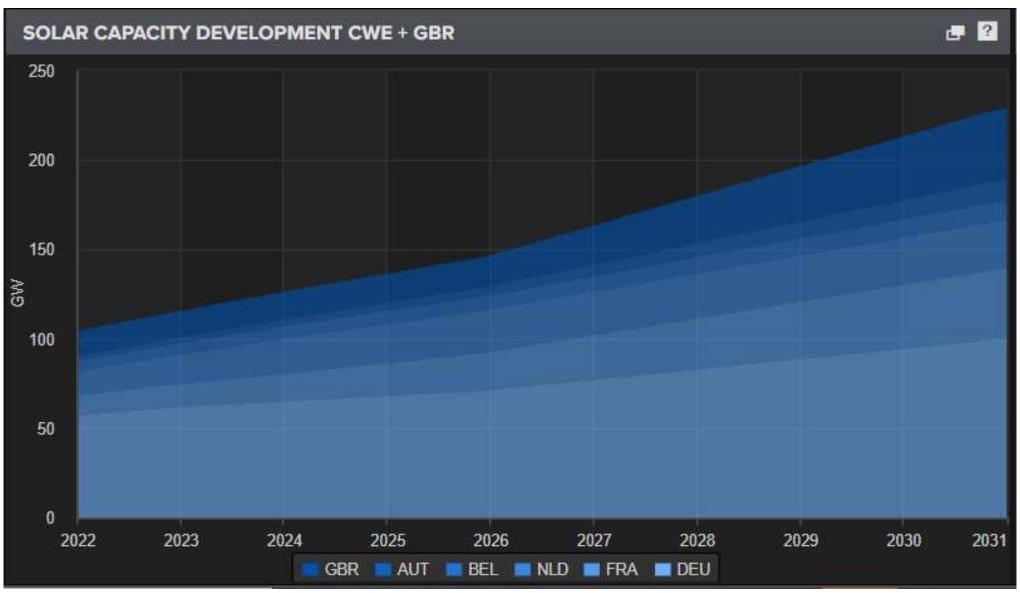
possible constellations of temperature, wind speed and solar radiation can be observed. We want to use the entirety of this data set to explore possible extremes of very high residual demand[3] which cannot fully be met by available conventional capacity and imports.

Our capacity growth assumptions for wind and solar are shown below:





In our model, we include the power capacity that is known to be available in the future for dispatch to cover the residual demand. We also consider the known future outages as published in REMIT messages and make additional assumptions on unplanned outages based on historical availability rates. We also consider cross-border flows and new interconnectors that will be completed within this decade, according to the current plan for the future European grid.[4]

The moment when all the dispatchable capacity is maxed out by the system, the algorithm proceeds to the next step of "demand shedding", in which a certain part of demand is force-shut by the TSO. We do not suggest that we will see demand

[3] Residual demand = hourly consumption deducted by solar and wind generation

[4] https://tyndp.entsoe.eu/

shedding in the narrow sense, but that in the hours in which the model turns to demand shedding the TSOs would have to turn towards the supply slack or a future capacity reserve that is not represented in our model, i.e. “non-market” resources in ENTSO-E terminology. In the case of Germany, for extreme market tightness situations there are currently several GW of (cold) reserve capacity of decommissioned coal plants available and some flexibility offering from the industry, both also referred to as “non-market resources”.

For this analysis, we want to assess how frequently the ceiling could be hit, i.e. a generation gap can occur, and how much excess demand for generation there could possibly be in those hours. This is, inversely, a measure for the need for additional capacity and/or flexibility in the system.

Tight weather situations in 2022 – 2026 – 2030

Growing power demand and the phaseout of nuclear and coal capacity will naturally lead to further tightening in Europe, while the massive planned renewable capacity additions and more interconnectors all over Europe should have the contrary effect.

Given that by end of 2021 we expect close to 4 GW of nuclear and 2 GW of coal/lignite to be phased out in Germany, it is interesting to see if under these new conditions we can already expect very tight hours in 2022. The following overview shows the evaluation for **Germany** in 2022 – 2026 – 2030:

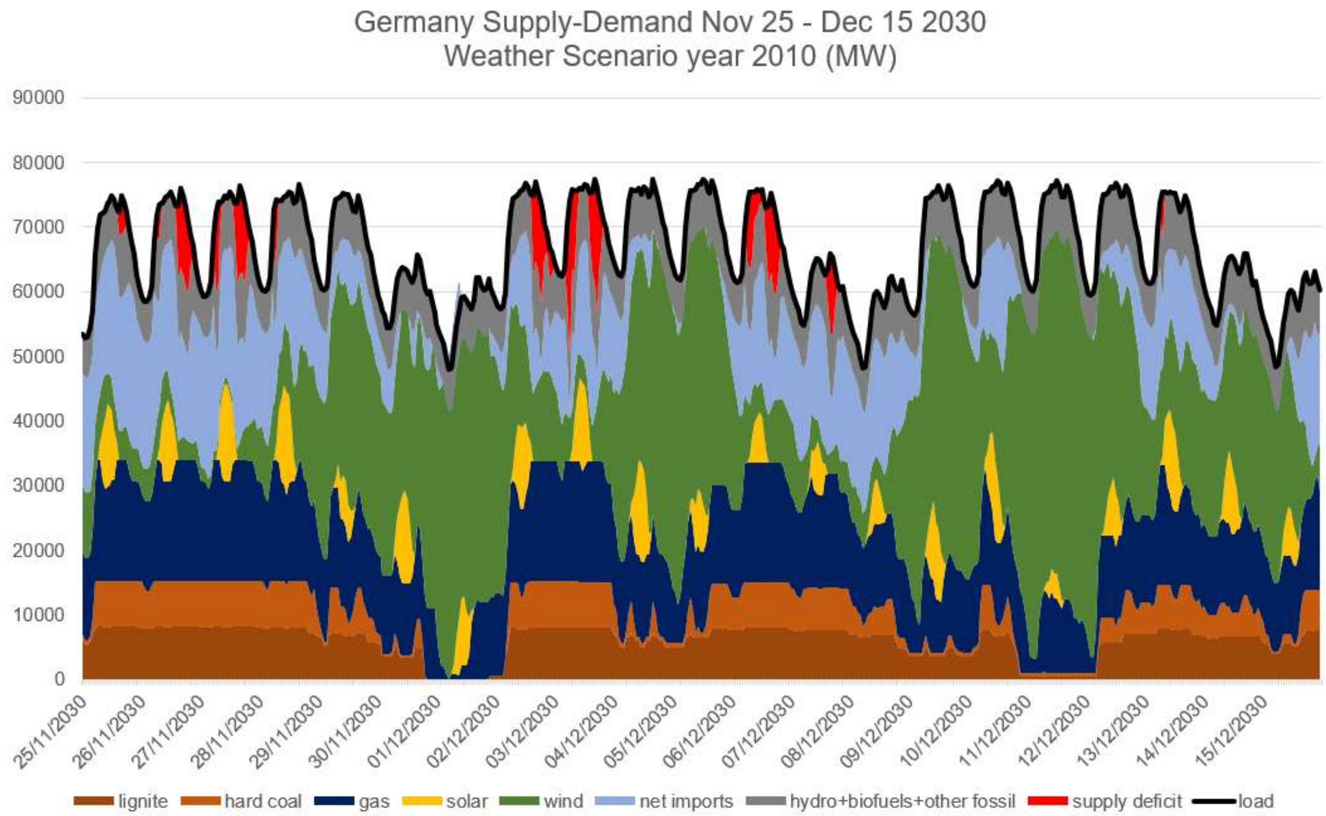
Germany Cal-2022	Amount of hours	share of hours	max flex need (MW)
1991	32	0.4%	3,085
1992	11	0.1%	1,619
1993	11	0.1%	2,529
1994	1	0.0%	582
1995	13	0.1%	2,584
1996	18	0.2%	3,367
1997	13	0.1%	1,368
1998	27	0.3%	3,552
1999	4	0.0%	2,518
2000	3	0.0%	1,419
2001	12	0.1%	2,602
2002	0	0.0%	-
2003	0	0.0%	-
2004	20	0.2%	2,598
2005	6	0.1%	2,547
2006	18	0.2%	1,456
2007	16	0.2%	4,592
2008	11	0.1%	5,867
2009	18	0.2%	4,010
2010	**48**	**0.5%**	**7,007**
2011	4	0.0%	1,445
2012	19	0.2%	2,597
2013	6	0.1%	1,500
2014	0	0.0%	-
2015	5	0.1%	1,404
max 1991-2015	**48**	**0.5%**	**7,007**
ave 1991-2015	**12.6**	**0.1%**	**2,410**

Germany Cal-2026	# hours	share of hours	max flex need (MW)
1991	31	0.4%	7,914
1992	0	0.0%	-
1993	14	0.2%	7,868
1994	0	0.0%	-
1995	21	0.2%	7,947
1996	27	0.3%	7,925
1997	18	0.2%	7,880
1998	**43**	**0.5%**	**14,498**
1999	0	0.0%	-
2000	0	0.0%	-
2001	16	0.2%	7,947
2002	4	0.0%	3,609
2003	0	0.0%	-
2004	10	0.1%	6,687
2005	2	0.0%	2,184
2006	6	0.1%	6,786
2007	0	0.0%	-
2008	5	0.1%	4,204
2009	11	0.1%	7,076
2010	**46**	**0.5%**	**15,965**
2011	0	0.0%	-
2012	20	0.2%	6,819
2013	2	0.0%	862
2014	0	0.0%	-
2015	2	0.0%	2,896
max 1991-2015	**46**	**0.5%**	**15,965**
ave 1991-2015	**11.1**	**0.1%**	**4,763**

Germany Cal-2030	# hours	share of hours	max flex need (MW)
1991	109	1.2%	15,452
1992	75	0.9%	17,444
1993	91	1.0%	17,884
1994	46	0.5%	10,166
1995	116	1.3%	12,489
1996	**138**	**1.6%**	16,092
1997	87	1.0%	16,003
1998	114	1.3%	**21,014**
1999	35	0.4%	**22,493**
2000	36	0.4%	13,150
2001	98	1.1%	12,275
2002	53	0.6%	12,006
2003	61	0.7%	12,007
2004	108	1.2%	17,859
2005	50	0.6%	14,408
2006	43	0.5%	12,275
2007	52	0.6%	12,276
2008	67	0.8%	12,274
2009	79	0.9%	17,732
2010	**153**	**1.7%**	**23,937**
2011	56	0.6%	12,024
2012	117	1.3%	14,892
2013	73	0.8%	12,047
2014	46	0.5%	12,264
2015	28	0.3%	9,629
max 1991-2015	**153**	**1.7%**	**23,937**
ave 1991-2015	**77.2**	**0.9%**	**14,804**

- For **2022** the maximum share of tight hours is only 0.5%, yet the generation gap reaches 7 GW in one hour (early December). Overall, there are very few situations in which the generation gap can reach more than 5 GW.
- Interestingly, **in 2026** the maximum and average percentage of tight hours is nearly the same as in 2022 at 0.5%/0.1%, yet the maximum flexibility need in the tightness case is much higher at nearly 16 GW: The frequency does not increase but we can expect tight hours to be **more extreme** in that year. The system needs to be ready to cover up to 16 GW of residual demand with decommissioned coal plants and/or flexible assets.
- However, in **2030 we already have a quite strong need for additional capacity** to buffer residual demand spikes: the average share of tight hours increases nine-fold and the projected available capacity in 2030 cannot directly meet demand in 0.9% of all hours. **Ramp-ups of up to 24 GW** will have to be met in single hours, particularly if the weather behaves as in 1998/1999/2010.

In order to see how a gap of 24 GW can occur, we can have a look at two weeks in 2030 under the 2010 weather scenario:



We can see that on Nov 27th, 2030, wind speed drops so low that there is less than 1 GW of wind production. Only a few days later wind generation spikes up to 62 GW – the capacity is nearly 91 GW at that time, but near-zero wind will still be possible in 2030!

The remaining 15 GW of hard coal and lignite run baseload during the weekdays and available gas-fired capacity of 18 GW is ramped up fully. It is worth noting that the current German government is considering a complete phaseout of the remaining hard coal & lignite capacity by 2030. This would mean that another 15 GW would theoretically be missing in 2031 and require alternative flexible generation of the same size.

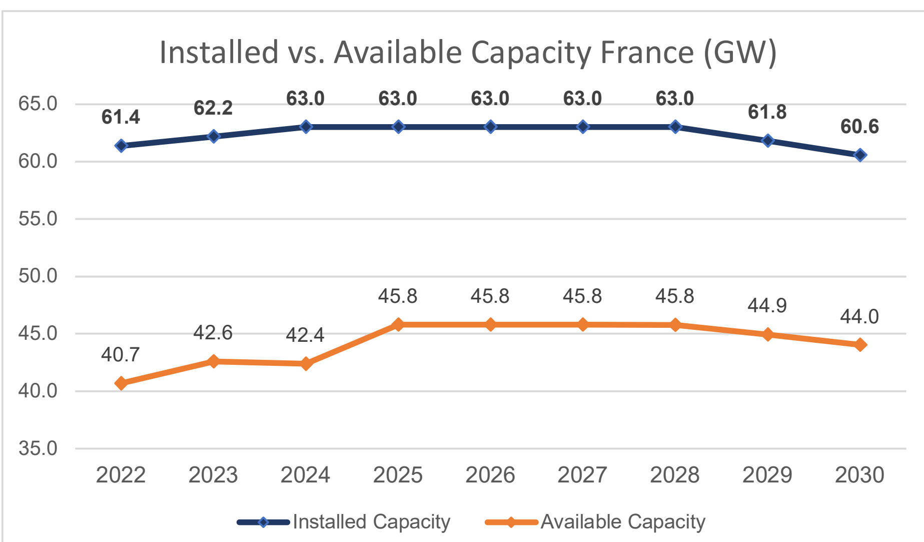
Interestingly, in **France**, we see a quite different development:

France Cal-2022	# hours	share of hours	max flex need (MW)
1991	22	0.3%	5,628
1992	2	0.0%	666
1993	22	0.3%	**14,285**
1994	0	0.0%	-
1995	5	0.1%	5,441
1996	0	0.0%	-
1997	22	0.3%	3,215
1998	19	0.2%	8,551
1999	2	0.0%	3,180
2000	3	0.0%	3,524
2001	9	0.1%	3,669
2002	0	0.0%	-
2003	13	0.1%	6,139
2004	1	0.0%	181
2005	14	0.2%	5,607
2006	7	0.1%	7,365
2007	0	0.0%	-
2008	0	0.0%	-
2009	18	0.2%	5,557
2010	**84**	**1.0%**	**11,173**
2011	4	0.0%	1,017
2012	**133**	**1.5%**	**11,146**
2013	9	0.1%	1,650
2014	0	0.0%	-
2015	0	0.0%	-
max 1991-2015	**133**	**1.5%**	**14,285**
ave 1991-2015	**15.6**	**0.2%**	**3,920**

France Cal-2026	# hours	share of hours	max flex need (MW)
1991	0	0.0%	-
1992	0	0.0%	-
1993	0	0.0%	-
1994	0	0.0%	-
1995	0	0.0%	-
1996	1	0.0%	1,799
1997	0	0.0%	-
1998	**3**	**0.0%**	**4,577**
1999	0	0.0%	-
2000	0	0.0%	-
2001	0	0.0%	-
2002	0	0.0%	-
2003	0	0.0%	-
2004	0	0.0%	-
2005	0	0.0%	-
2006	0	0.0%	-
2007	0	0.0%	-
2008	0	0.0%	-
2009	0	0.0%	-
2010	0	0.0%	-
2011	0	0.0%	-
2012	0	0.0%	-
2013	0	0.0%	-
2014	0	0.0%	-
2015	0	0.0%	-
max 1991-2015	**3**	**0.0%**	**4,577**
ave 1991-2015	**0.2**	**0.0%**	**255**

France Cal-2030	# hours	share of hours	max flex need (MW)
1991	2	0.0%	4,020
1992	0	0.0%	-
1993	**4**	**0.2%**	**9,850**
1994	0	0.0%	-
1995	1	0.0%	1,049
1996	**4**	**0.2%**	**9,698**
1997	**4**	**0.2%**	1,339
1998	3	0.1%	**6,225**
1999	1	0.0%	7,821
2000	1	0.0%	2,983
2001	1	0.0%	1,132
2002	0	0.0%	-
2003	0	0.0%	-
2004	3	0.1%	505
2005	0	0.0%	-
2006	0	0.0%	-
2007	1	0.0%	246
2008	0	0.0%	-
2009	2	0.1%	1,151
2010	**4**	**0.2%**	3,747
2011	0	0.0%	-
2012	3	0.1%	3,524
2013	0	0.0%	-
2014	0	0.0%	-
2015	0	0.0%	-
max 1991-2015	**4**	**0.2%**	**9,850**
ave 1991-2015	**1.4**	**0.1%**	**2,132**

- **2022 is the tightest year:** the average occurrence is twice as high as in Germany with 0.2% and the tightest hours are twice as high in GW, with a maximum at 14 GW.
- Yet, there is **almost no occurrence of tight hours in 2026**, even in very cold weather years. By then, there will be a higher nuclear capacity (with the addition of Flammanville 3) and overall higher supply of renewable energy. Short-term demand spikes are covered by flexible hydro supply and net imports.[5]
- By **2030, the market grows somewhat tighter** compared to 2026, but not nearly as tight as in 2022. The baseload capacity of France remains rather stable, and the higher share of flexible hydro reservoir resources contributes to minimizing supply squeezes.



[5] This is under normal hydrological conditions, i.e. we did not look at weather scenarios for the hydro situation, which would be a possible extension to this model

It is important to note that our nuclear availability assumptions are the highest in 2025-28: We expect the start of Flamanville 3 (1650 MW) in mid-2023 and apply historical availability rates on the installed capacity for the long-term forecast.

Considering this, we wanted to look at how the situation changes if the nuclear availability in France was 3 GW lower at 42.8 GW vs. the original 45.8 in our model: Even with this reduced nuclear availability we see a quite low-risk situation: In 18 weather years there is no tightness situation at all:

France Cal-2026 -3 GW nuclear	# hours	share of hours	max flex need (MW)
1991	1	0.0%	375
1992	0	0.0%	-
1993	1	0.0%	286
1994	0	0.0%	-
1995	0	0.0%	-
1996	1	0.0%	4,800
1997	2	0.0%	1,466
1998	**8**	**0.1%**	**7,577**
1999	0	0.0%	-
2000	0	0.0%	-
2001	0	0.0%	-
2002	0	0.0%	-
2003	0	0.0%	-
2004	0	0.0%	-
2005	0	0.0%	-
2006	0	0.0%	-
2007	0	0.0%	-
2008	0	0.0%	-
2009	0	0.0%	-
2010	5	0.1%	1,231
2011	0	0.0%	-
2012	6	0.1%	2,131
2013	0	0.0%	-
2014	0	0.0%	-
2015	0	0.0%	-
max 1991-2015	**8**	**0.1%**	**4,577**
ave 1991-2015	**1.0**	**0.0%**	**255**

The **Belgian** nuclear phaseout is set to be completed by end of 2025, therefore we are interested in seeing how market balance will look like in the year after that:

Belgium Cal-2022	# hours	share of hours	max flex need (MW)
1991	**18**	**0.2%**	**4,955**
1992	4	0.0%	1,798
1993	10	0.1%	4,053
1994	0	0.0%	-
1995	2	0.0%	1,005
1996	8	0.1%	2,492
1997	5	0.1%	2,468
1998	6	0.1%	2,825
1999	2	0.0%	1,409
2000	0	0.0%	-
2001	6	0.1%	3,648
2002	0	0.0%	-
2003	0	0.0%	-
2004	9	0.1%	4,204
2005	0	0.0%	-
2006	8	0.1%	3,295
2007	6	0.1%	4,669
2008	1	0.0%	**5,705**
2009	7	0.1%	4,880
2010	**28**	**0.3%**	**6,560**
2011	0	0.0%	-
2012	9	0.1%	3,919
2013	1	0.0%	399
2014	0	0.0%	-
2015	0	0.0%	-
max 1991-2015	**28**	**0.3%**	**6,560**
ave 1991-2015	**5.2**	**0.1%**	**2,331**

Belgium Cal-2026	# hours	share of hours	max flex need (MW)
1991	4	0.0%	1,653
1992	0	0.0%	-
1993	1	0.0%	664
1994	0	0.0%	-
1995	1	0.0%	274
1996	**5**	**0.1%**	**5,913**
1997	**6**	**0.1%**	4,163
1998	**6**	**0.1%**	3,259
1999	0	0.0%	-
2000	0	0.0%	-
2001	2	0.0%	2,218
2002	0	0.0%	-
2003	0	0.0%	-
2004	0	0.0%	-
2005	0	0.0%	-
2006	2	0.0%	1,836
2007	0	0.0%	-
2008	0	0.0%	-
2009	0	0.0%	-
2010	**6**	**0.1%**	**6,259**
2011	0	0.0%	-
2012	**5**	**0.1%**	**5,377**
2013	0	0.0%	-
2014	0	0.0%	-
2015	0	0.0%	-
max 1991-2015	**6**	**0.1%**	**6,259**
ave 1991-2015	**1.5**	**0.0%**	**1,265**

Belgium Cal-2030	# hours	share of hours	max flex need (MW)
1991	14	0.2%	4,877
1992	1	0.0%	2,238
1993	13	0.1%	5,396
1994	0	0.0%	-
1995	10	0.1%	5,157
1996	**21**	0.2%	4,673
1997	11	0.1%	**6,505**
1998	15	0.2%	4,707
1999	1	0.0%	3,007
2000	0	0.0%	-
2001	9	0.1%	3,148
2002	2	0.0%	2,522
2003	1	0.0%	440
2004	18	0.2%	**5,892**
2005	1	0.0%	1,022
2006	3	0.0%	4,274
2007	4	0.0%	2,237
2008	2	0.0%	3,163
2009	8	0.1%	5,162
2010	**31**	**0.4%**	**5,876**
2011	4	0.0%	3,106
2012	13	0.1%	**5,732**
2013	1	0.0%	221
2014	2	0.0%	1,997
2015	0	0.0%	-
max 1991-2015	**31**	**0.4%**	**6,505**
ave 1991-2015	**7.4**	**0.1%**	**3,254**

- In **2022 there are a few weather years** with tight scenarios. It is interesting to see those hours are nevertheless usually very tight, i.e., of the dimension of 5-6.5 GW, which is about half of the load.
- We realize that in **2026, the year after the Belgian nuclear phaseout is concluded**, the occurrence of tight hours is still very low and just a few hours per year for all the weather years. While the last nuclear capacity is shut down by end of 2025, we expect nearly 1.9 GW of gas capacity to fill the gap here[6]. There is also quite strong reliance on French imports.

[6] We schedule the commissioning of Vilvoorde 3 (800 MW), Amercoer 3 (330 MW) and Awirs 6 (800 MW) by Jan-2026.

- The **occurrence increases again by 2030,** just as in the French case, which also reflects the sustained dependency of Belgium on French imports. The degree of the supply gap is high when compared to the overall load in the country, but not much higher than in 2022.

For all three countries, the occurrence of such tight hours is **limited to the winter months**, i.e. mainly during the months of November to March. The maxima are usually observed in the first half of December and in late January/ early February.

Conclusions & Outlook

This report aimed to highlight the likelihood and magnitude of tight situations in the German, French & Belgian electricity systems on an hourly level. The underlying data is presented in our Refinitiv Energy Transition content.

The results should give a feel for the future supply risks we are facing under the current market design and the current expectations for moderate electricity demand growth, the currently known interconnectors and conventional capacity planned to be (de-) commissioned and expected renewable energy capacity growth. Another way of taking the results is as **measure for the need for backup generation capacity or flexible generation.**

In **France**, with the given flexibility from hydro generation and under a moderate nuclear availability scenario, the market should not face tightness, at least not systematically.

In the **Belgian** case we could identify very stressed system scenarios, but the simulated supply gap situations have a very small likelihood for the next years.

In the **German** case, we see a different picture: The supply stack will lose a quite large part of its baseload supply, which is to be replaced by massive renewable newbuild and stronger imports. Yet, without the presence of flexible generation capacity the system could face serious supply gaps in a non-negligible number of hours by 2030. Reversely, our results show that a generation backup capacity of 24 GW will be needed to secure the German system. This would most realistically be either today's "non-market" resources, mainly the decommissioned coal plants, batteries and electrolysers, or additional CCGT plants.