NCC Annual Report 2021

For Elia Users Group 31.03.2021

Joachim Van Erps – National Control Center

EAS alert states EAS emergency states

2021

jan

08/01: System split: Busbar coupler in Ernestinova (HR) opens because of overload protection tripping at 2 kA. This causes a cascading effect and a network split splitting off South-Eastern Euopa. Frequency drops to 49.75 Hz at 14:15 in Elia's part of the grid.

mar

12-13/03: Line 380.28 Vanyk-Maasb tripped 2 days in a row without short circuit. A low voltage equipment issue triggered this.

apr

10-12/04: Reducing Doel 3 & 4 to maximum 1 GW combined, to allow busbar outage in Doel380.

21/04: Trip Tihange2 while Coo I & II were unavailable (result: imbalance prices around 3000 €/MWh and ACE of -1200 MW)

may

23/05: Voltage constraints. Voltage in Bruegel up to 421 kV

jul

15/07: Emergency plan activated for floodings along Vesder & Meuse rivers (Liege region)

24/07: System split between Spain and France

sep

11/09: Trip of Nemo (from Nemo side).

15/09: Trip of IFA1-pole1 during unavailability period of IFA1-pole2 (loss of 1000 MW, total 2000 MW FR-GB unavailable)

oct

13/10: Loss of Tools. EMS divergence, no security analysis or state estimator 09:00-09:50

nov

10/11: During the commissioning of PST Auban 2, a fire starts leading to a total loss of the PST

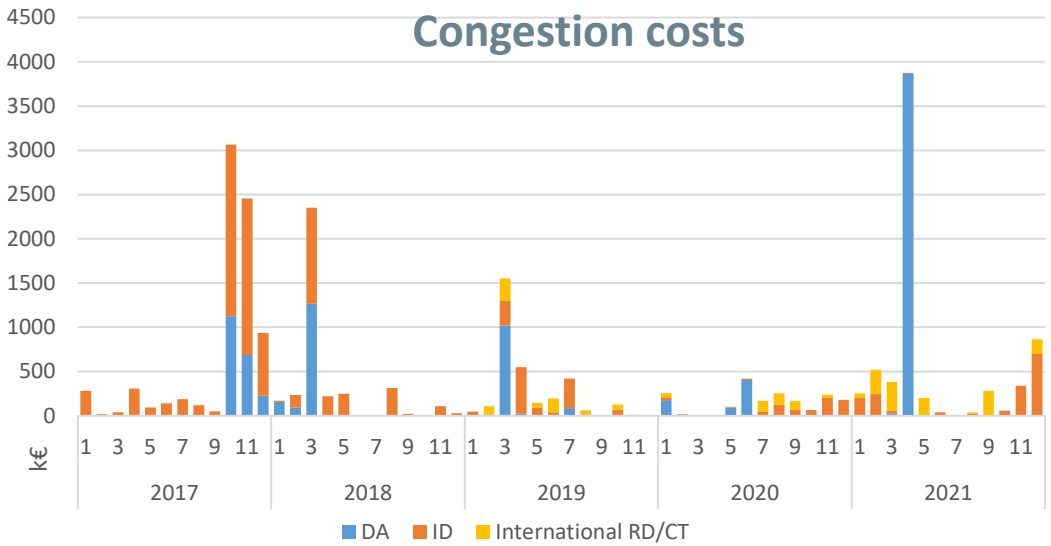
11/11: Starting 00:45 an enduring frequency deviation of around 40 mHz was present, leading to a cumulative time deviation of up to 6s

dec

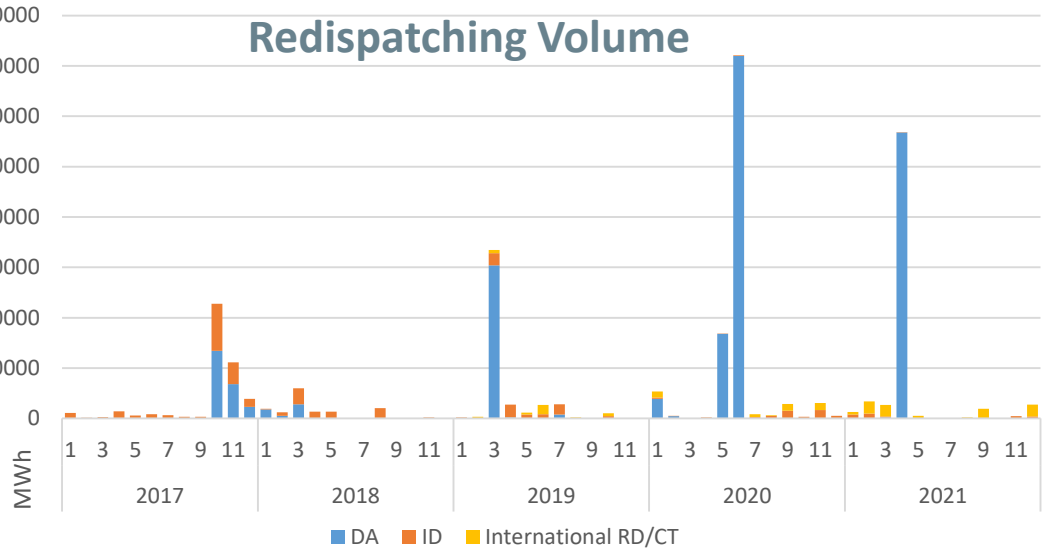
17-18/12: Shutdown of 2x1500MW Chooz NPP for inspections following detection of corrosion in similar type reactors of Civaux NPP

20/12: Alert state for high N->S flows. Several international countertrading and topological measures taken

Congestion costs



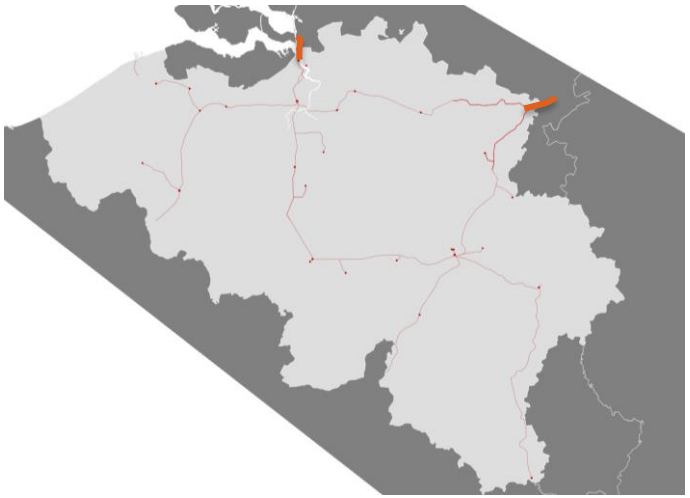
Redispatching Volume



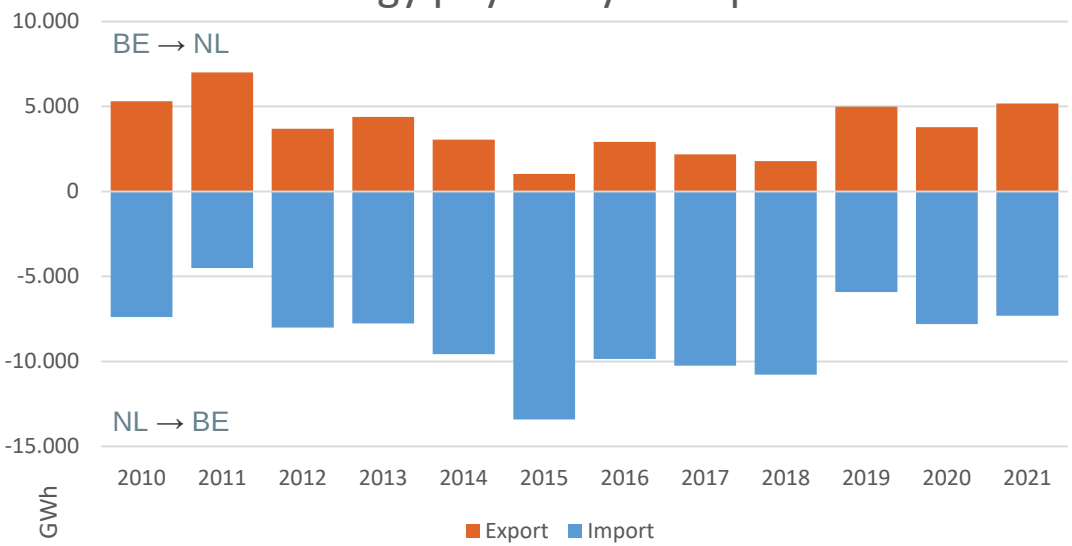
k€	National		International	Total
	DA	ID		
2017	2.047	5.646	0	**7.693 k€**
2018	1.515	2.191	0	**3.706 k€**
2019	1.131	1.418	657	**3.207 k€**
2020	688	714	443	**1.845 k€**
2021	3.889	1.646	1.314	**6.850 k€**

	National		International	Total
GWh	DA	ID		
2017	45	42	0	**87 GWh**
2018	10	18	0	**28 GWh**
2019	63	19	8	**89 GWh**
2020	186	11	9	**207 GWh**
2021	114	6	20	**141 GWh**

Physical flows BE-NL

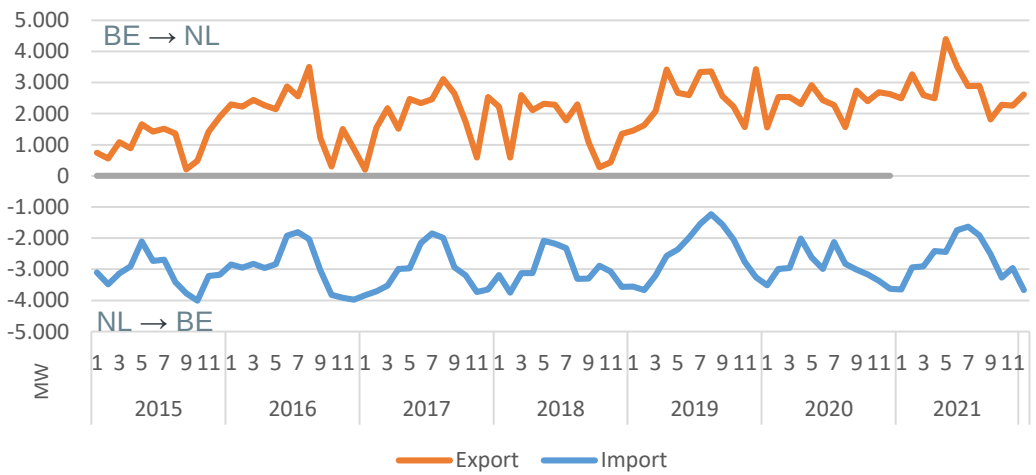


Energy physically transported

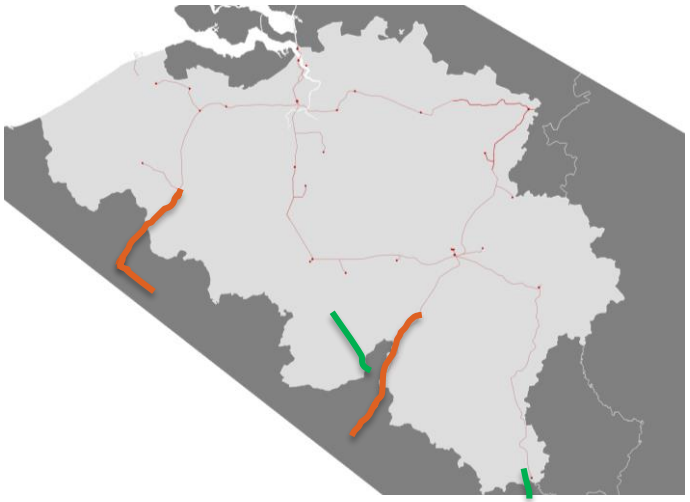


The maximum physical flow for the border BE -> NL reached a new all-time high of 4397 MW on 08/05/2021

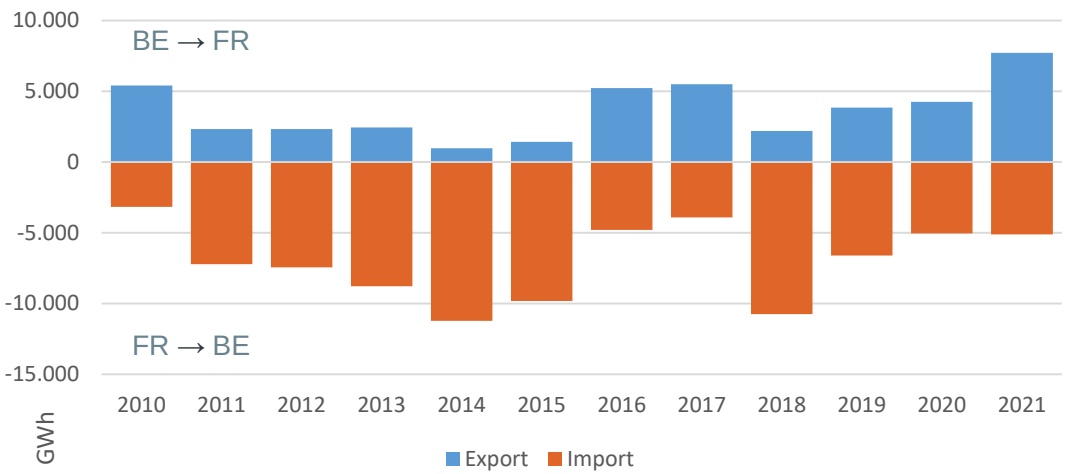
Maximum physical flows (15 min resolution)



Physical flows BE-FR

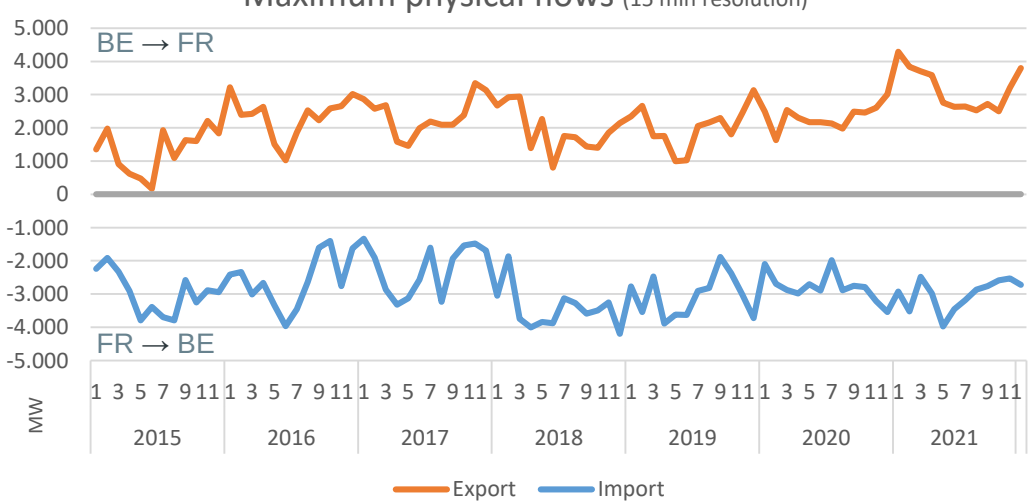


Energy physically transported

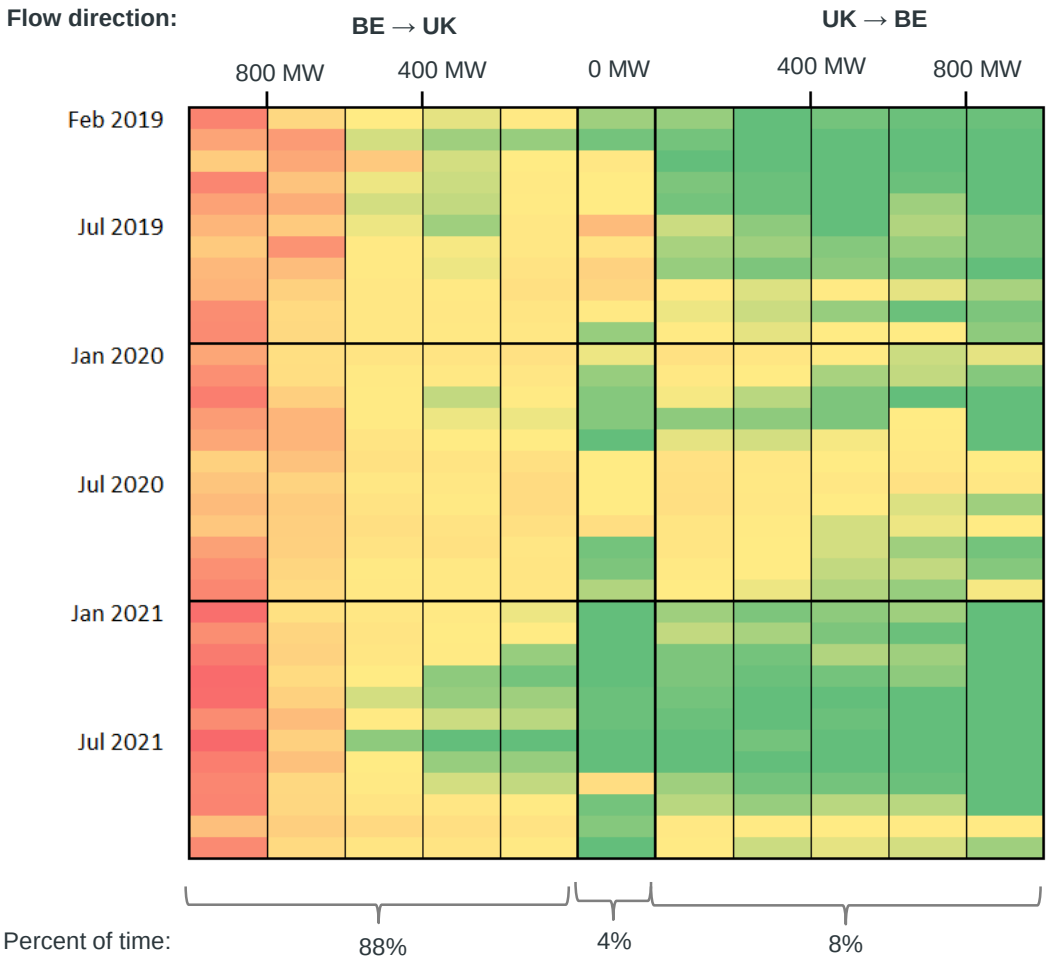


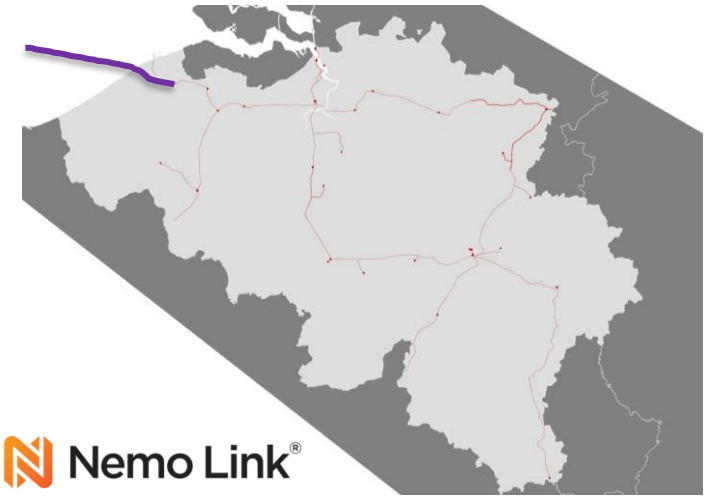
The maximum physical flow for the border BE -> FR reached a new all-time high of 4294 MW on January 2021

Maximum physical flows (15 min resolution)



Physical flows BE-UK





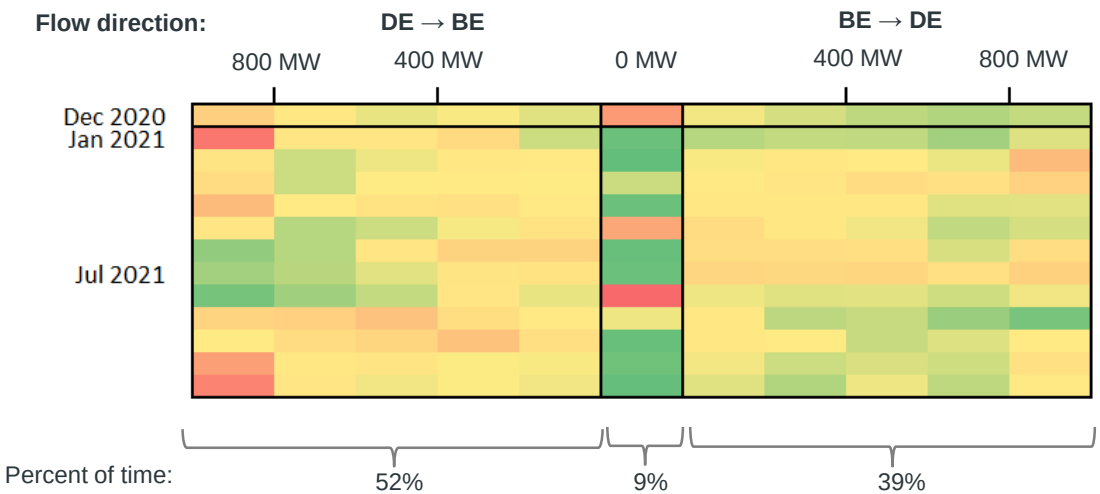
Go-live on 31/01/2019

Flows go overwhelmingly in the direction BE → UK

Legend:
- Distribution of flow per month
- Amount of time link is in a certain power interval:

high *low*

Physical flows BE-DE



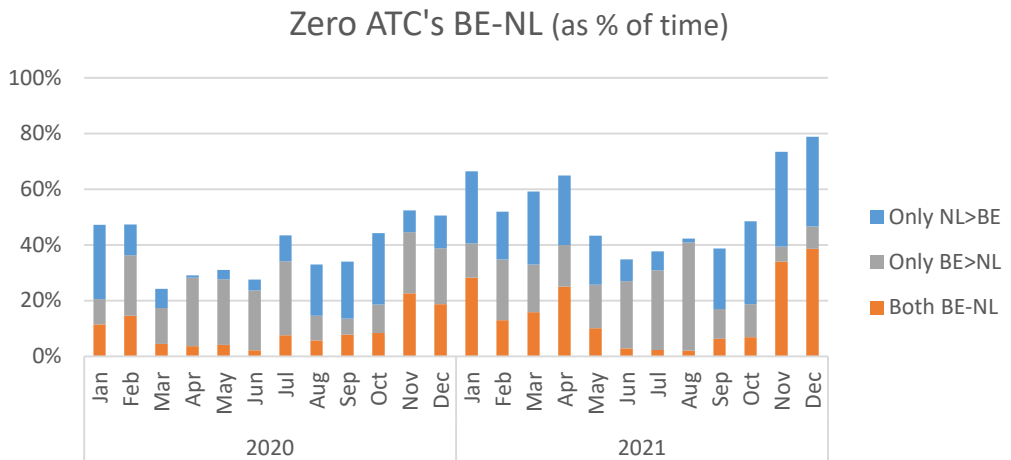
Go-live on 18/11/2020

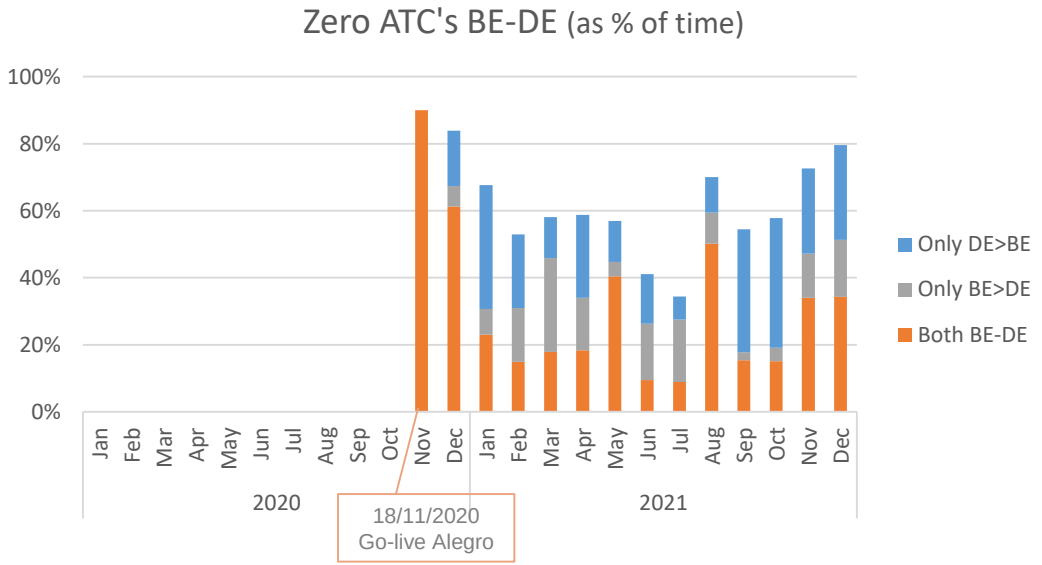
Flows are more balanced in both directions compared to Nemo link, but still a clear preference for the direction DE → BE can be observed so far

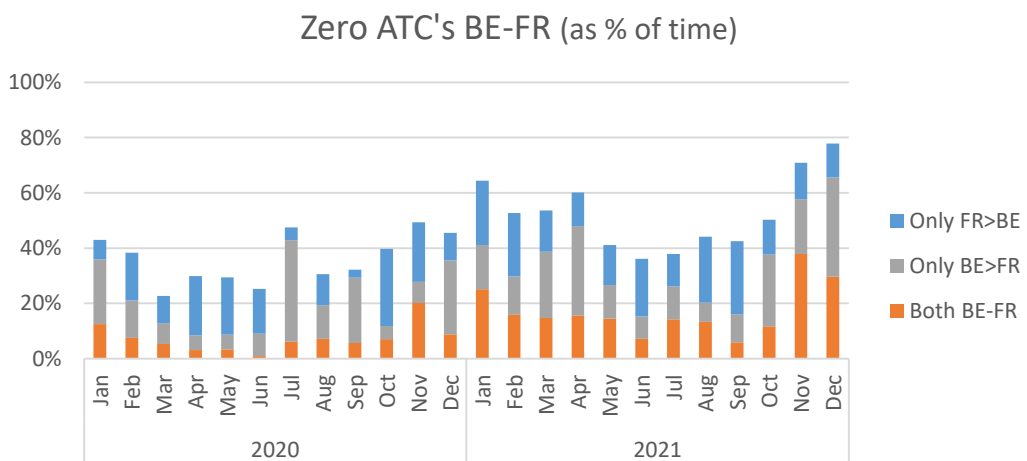
Legend:
- Distribution of flow per day
- Amount of time link is in a certain power interval:

high *low*

Occurrence of zero ATCs directly after FB market coupling



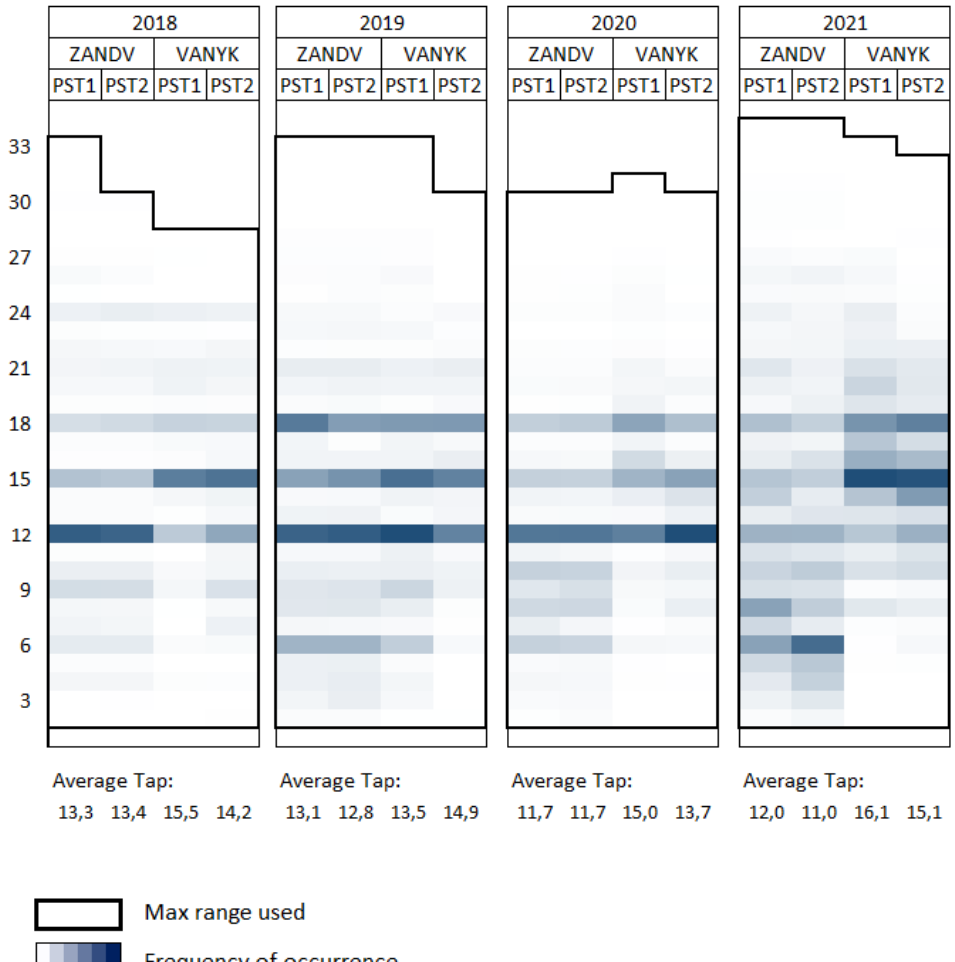


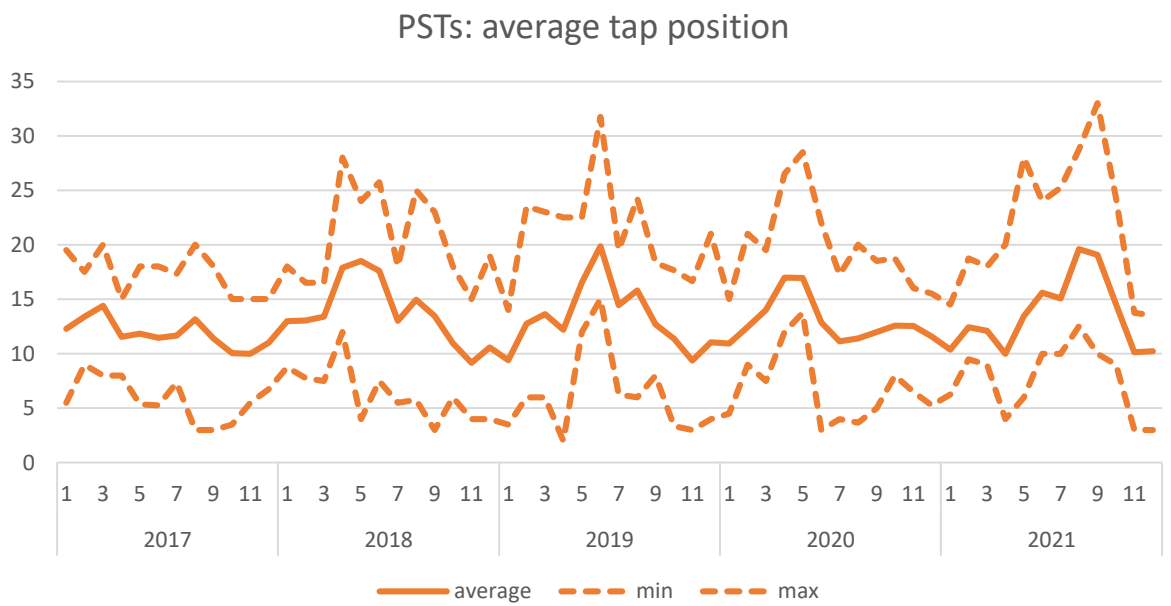


After FB market coupling, any remaining capacities are made available as ATCs to the market. The are very important for Intraday market, iGCC, Reserve sharing, Common aFRR & mFRR markets (Mari & Picasso). Whenever they're zero, these cannot function

Amount of time initial intraday ATC's are unavailable for both borders simultaneously (orange bars in the graphs) has increased significantly in 2021 compared to 2020:

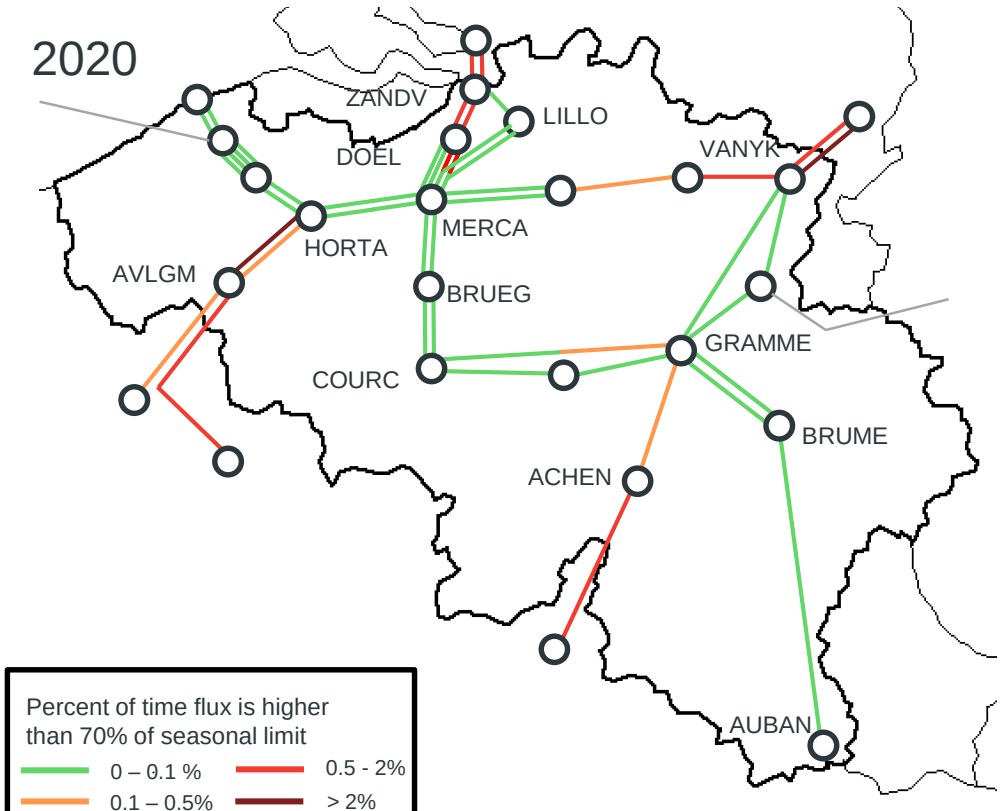
	BE-NL	BE-FR	BE-DE
2020	9%	7%	-
2021	15%	17%	23%

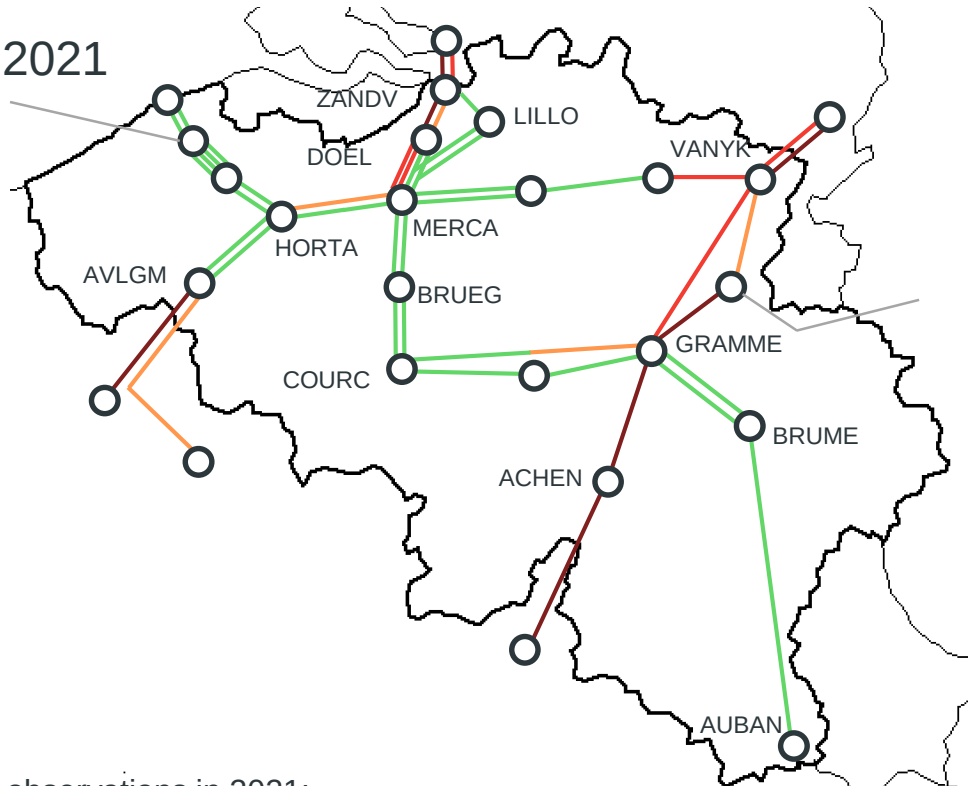




Average north border PST tap positions

	average	min	max
2017	11,8	3	20
2018	13,8	3	28
2019	13,3	2	32
2020	12,9	3	29
2021	13,5	3	33





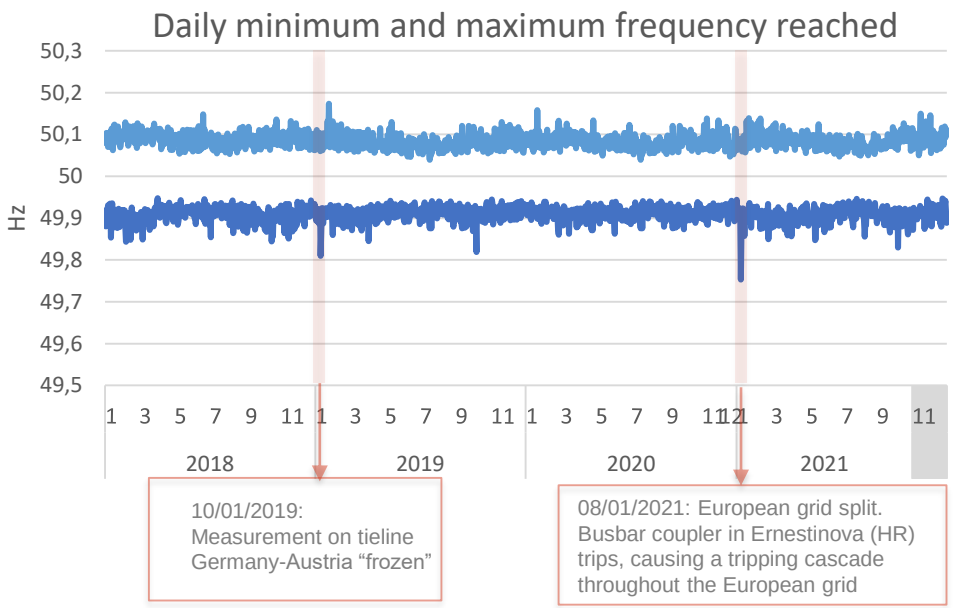
<u>Highest observed relative loading</u>
19/04/2021 03:00

- 380.10 Gramme -> Achen @ 1455 MW
- (110 % of seasonal limit / 81% of ampacimon limit)

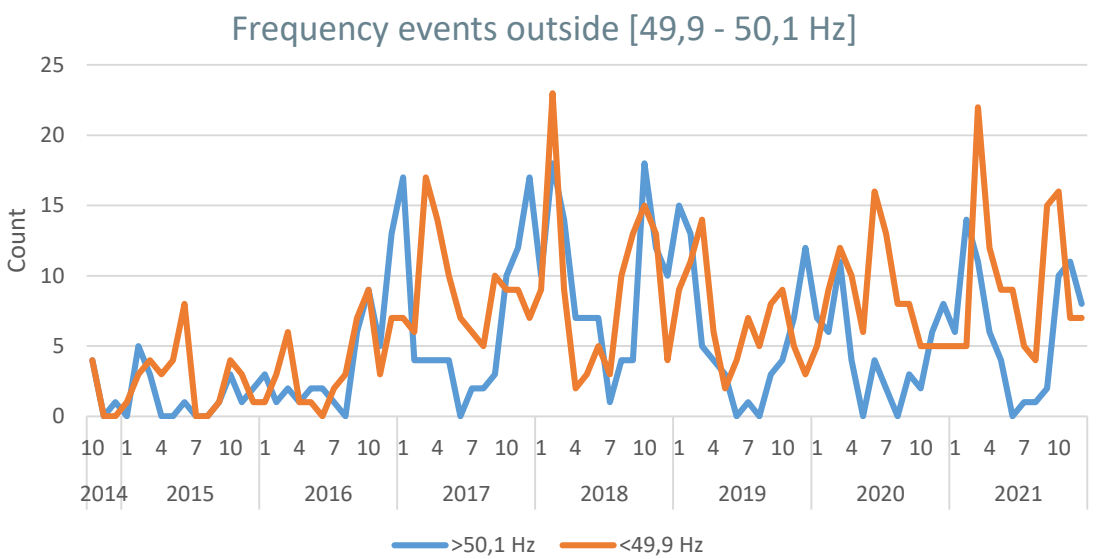
Some observations in 2021:

1. Remarkably the upgraded HTLS line 380.73 Merca-Horta reappears as a highly loaded line for some hours (during outage parallel line 380.74)
2. North and south borders show long periods of high loading
3. Doel 380 without longitudinal couplers causes a high loading on Doel-Merca because the flows are no longer distributed between 4 lines

Frequency min/max



Deterministic frequency disturbances



Frequency events:

Some notable enduring frequency events occurred in the past 4 years

Feb-mar 2018: A complex political issue between Serbia and Kosovo resulted in around 300 MW of load not being included in ACE balancing by any TSO. This caused frequency to drop structurally. Issue reappears somewhat in fall 2021

10 Jan 2019: A measurement on a tieline Austria-Germany was not redundant. It failed without being noticed, resulting in a wrong ACE calculation and frequency degradation

8 Jan 2021: A grid split going through Balkan & Romania caused the frequency in our part of Europe to drop to 49.75 Hz

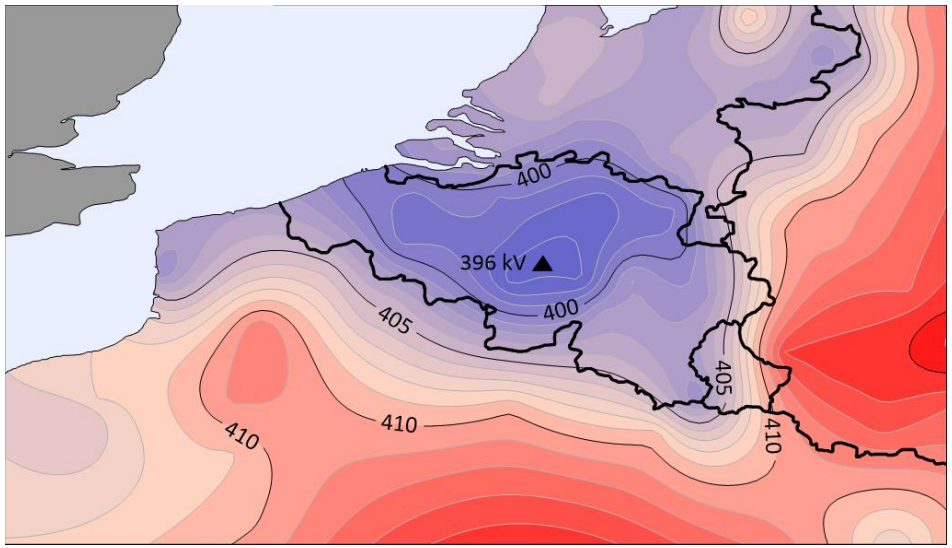
17 May 2021: Frequency dropped to 49.85 Hz due to a trip of 3300 MW generation in Poland

24 July 2021: Iberian grid split, all connections lost between FR and ES. However, no significant impact on frequency since the flow over that border was not huge

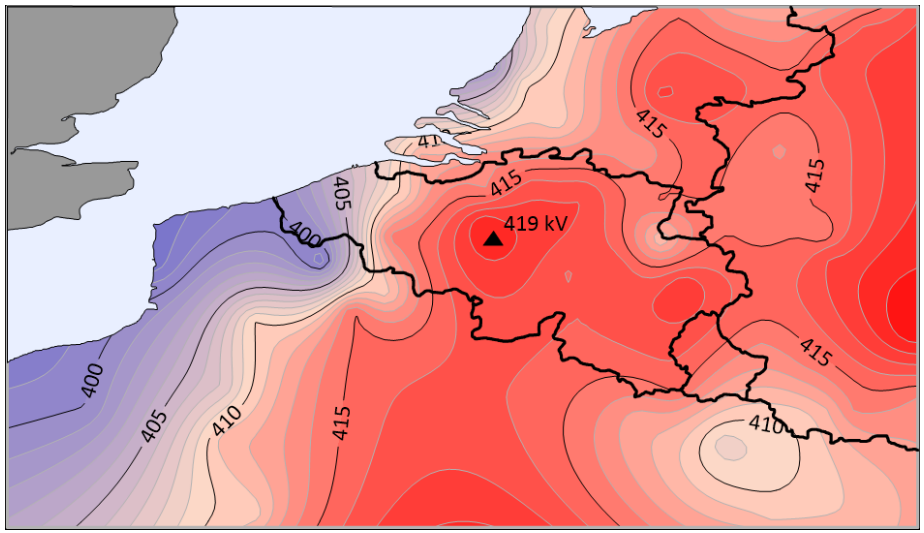
11 Nov 2021: A long-lasting frequency deviation of around -40 mHz was present during approximately 4 hours. Cause external to Elia

Oct-Dec 2021: High electricity prices cause market players to be short more often. But mainly KOST (Kosovo TSO) is structurally short again in fall/winter 2021. Frequency setpoints of 50,01 Hz increase dramatically during autumn, and still an accumulated grid time deviation of -87s is reached on December 24th (normal time deviation is +/- 20s)

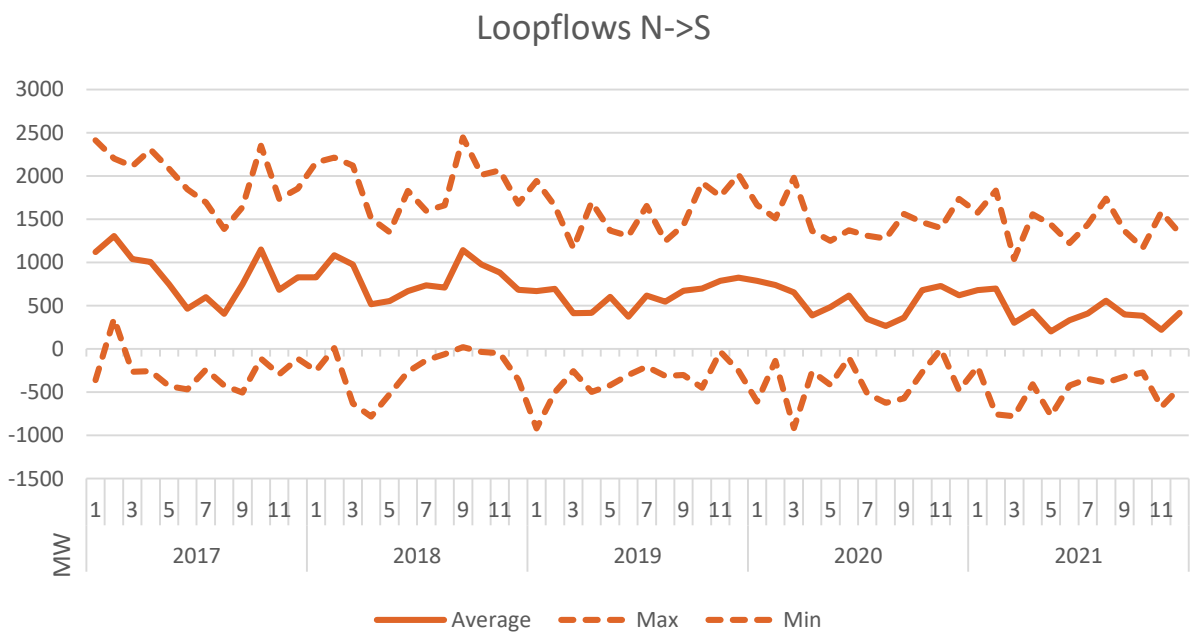
Highest & lowest average Belgian voltages reached



Lowest: Mon 11/10/2021 09:15
Lowest node: Courc @ 396 kV



Highest: Sat 23/05/2021 15:15
Highest node: Bruegel @ 419 kV



Loopflows N->S

	average	max
2017	838 MW	2413 MW
2018	813 MW	2448 MW
2019	610 MW	2018 MW
2020	555 MW	1981 MW
2021	421 MW	1834 MW

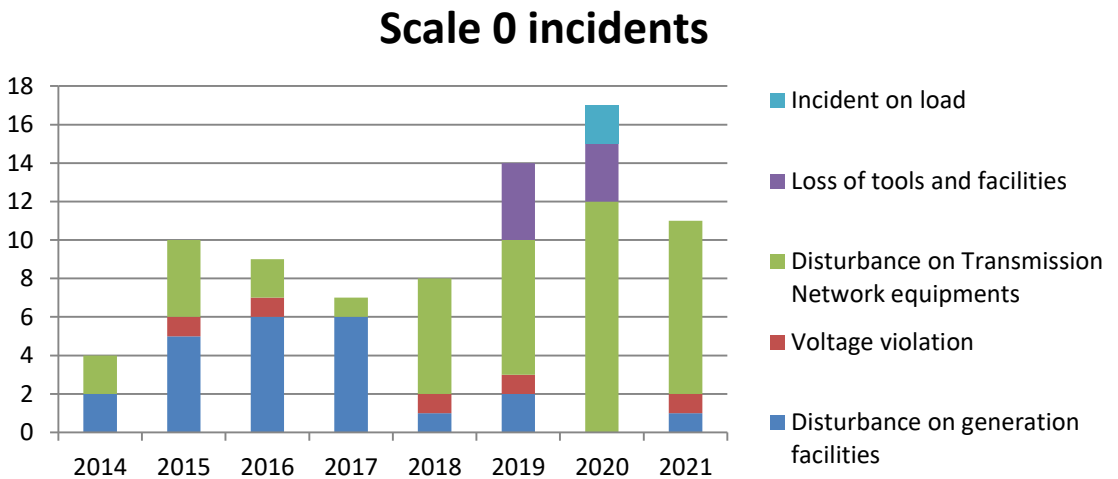
There is a slight downward trend in the last few years, with loopflows dropping to 421 MW on average last year

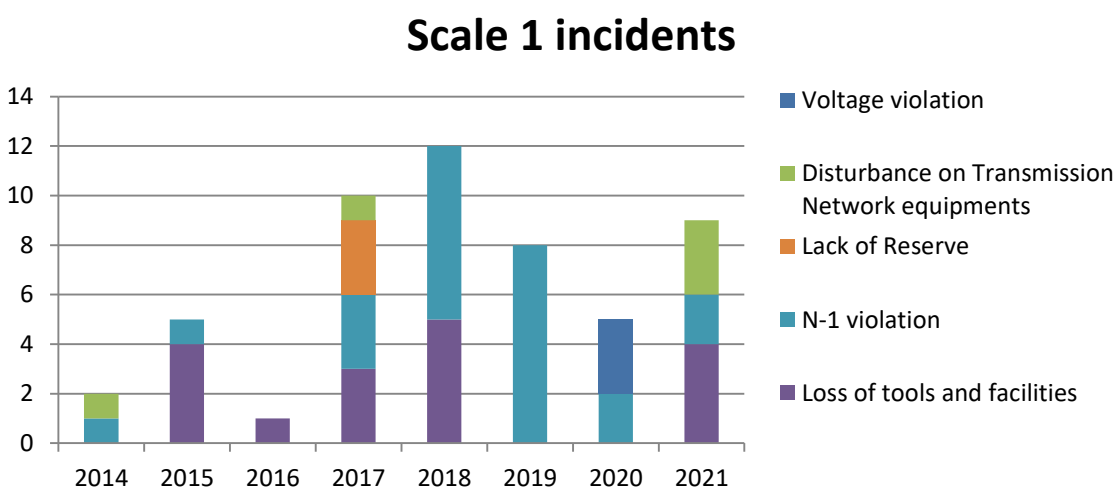
Incident classification scale

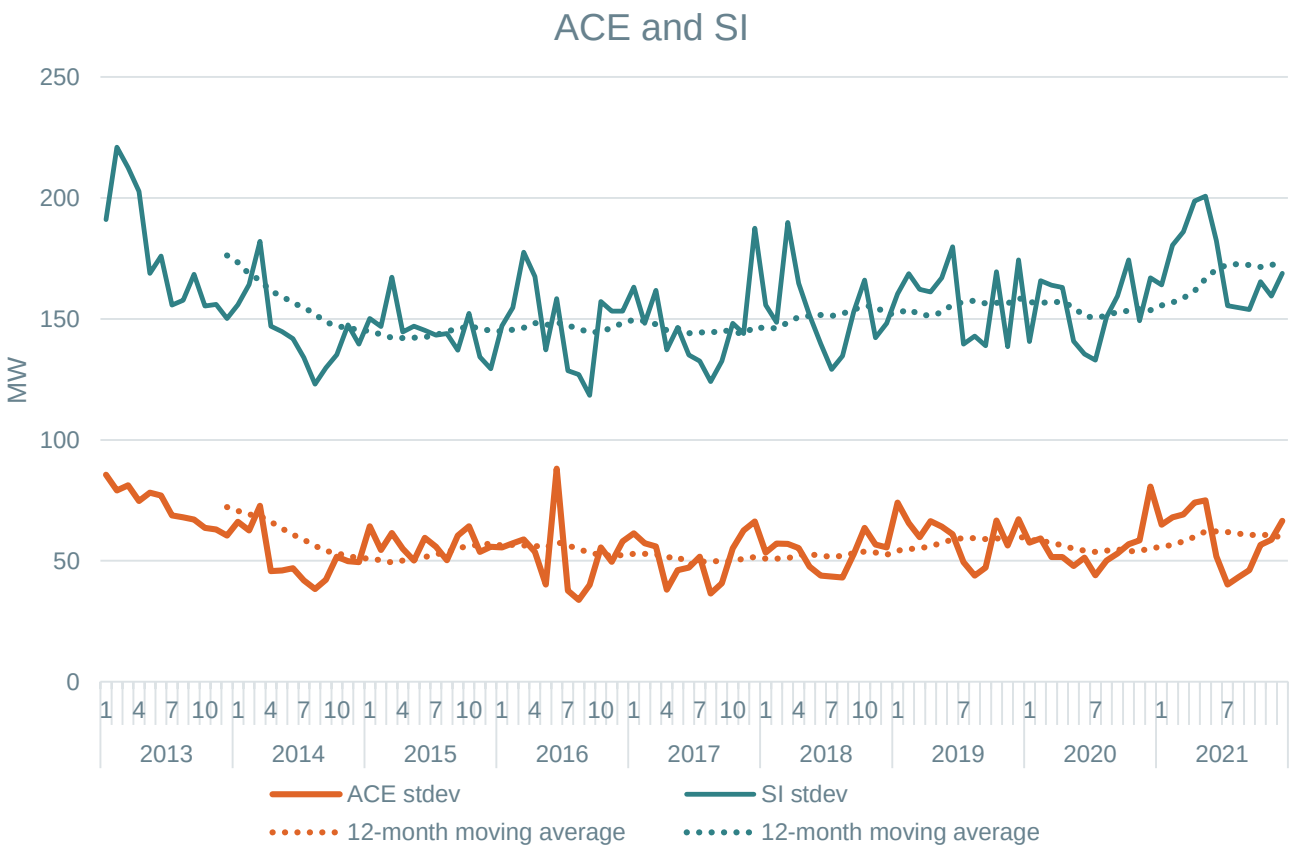
In 2020, a total of 22 events were recorded
- Scale 0: 17
- Scale 1: 5

In 2021, a total of 20 events were recorded
- Scale 0: 11
- Scale 1: 9

ICS classification definitions change slightly each year, so a comparison across multiple years has some limitations







System imbalance (MW)

	St. Dev	Net Position
2018	154	2
2019	158	5
2020	156	0
2021	173 +11%	**-30**

Area control error (MW)

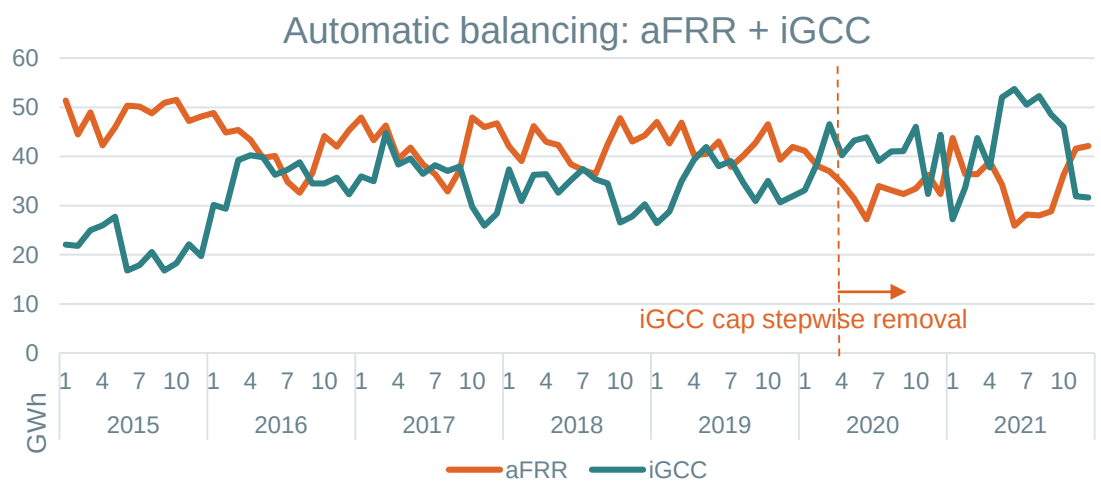
	St. Dev	Net Position
2018	53	-4
2019	61	2
2020	56	1
2021	59 +6%	-3

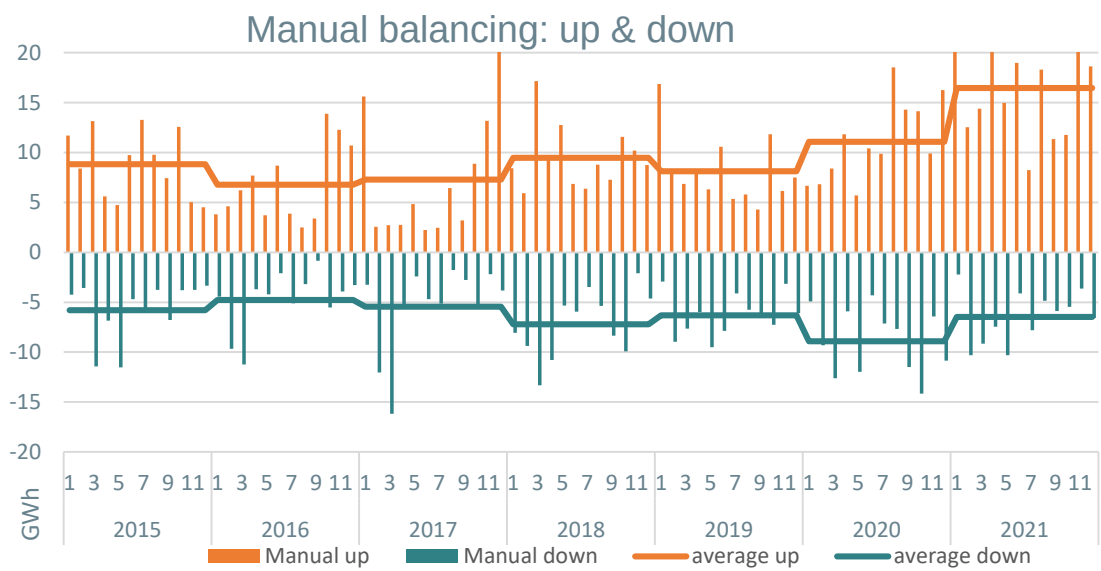
In 2021, the system imbalance Stdev. increased with 11% compared to 2020. The ACE grew more moderately by 6%, with the standard deviation now at 59 MW

The average SI for 2021 came to a net position of -30 MW, which is large historically speaking, caused by:

- BRP average imbalance: -7 MW
- Supply Gap*: 23 MW

*Supply gap = real losses – purchased losses. If the anticipation of losses was too low and too few energy was purchased, this will lead to a realtime system imbalance. Note: a positive supply gap causes a negative imbalance

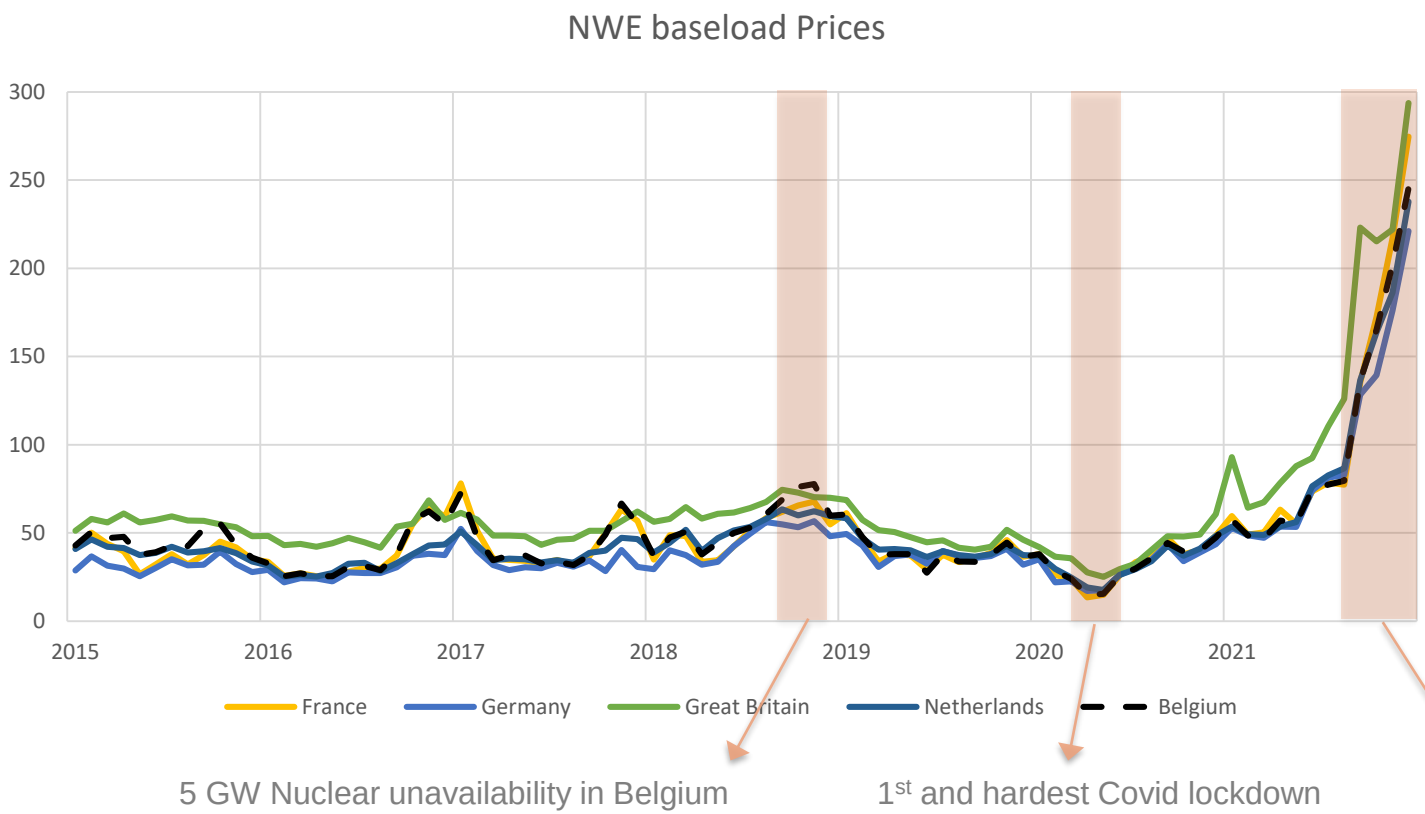




Balancing activations (GWh up and down combined)

	Manual (mFRR + interTSO)	Automatic (aFRR + iGCC)	Total
• 2017:	159	932	1090
• 2018:	201	903	1104
• 2019	174	921	1095
• 2020	240	901	1140
• 2021	277 ▲ +15%	930 ▲ +3%	1207 ▲ +6%

In 2021 total balancing activation volumes increased slightly. The structural system imbalance of -30 MW caused downward volumes to decrease somewhat, but caused a stronger growth in upward regulation volumes

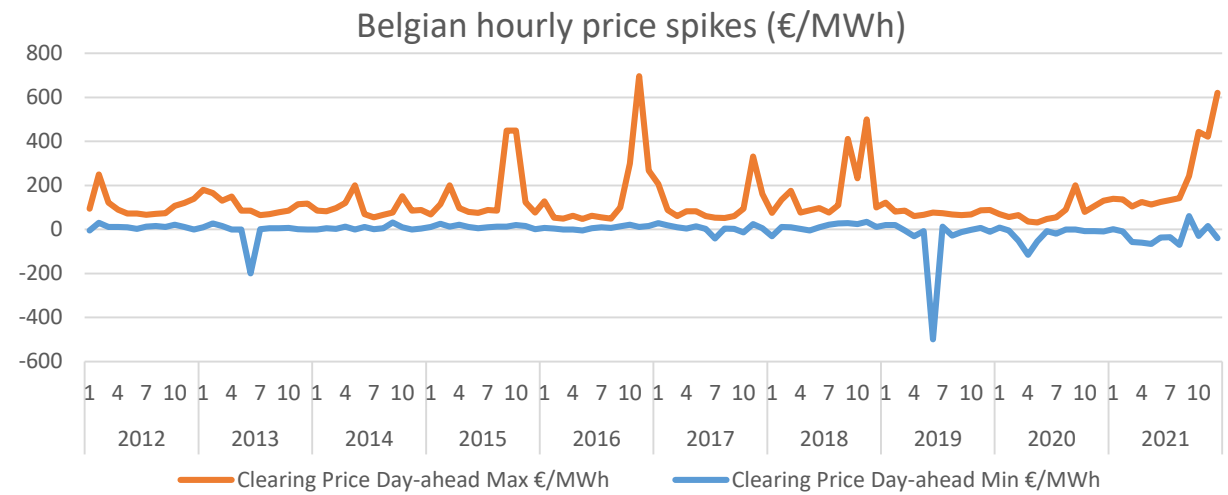


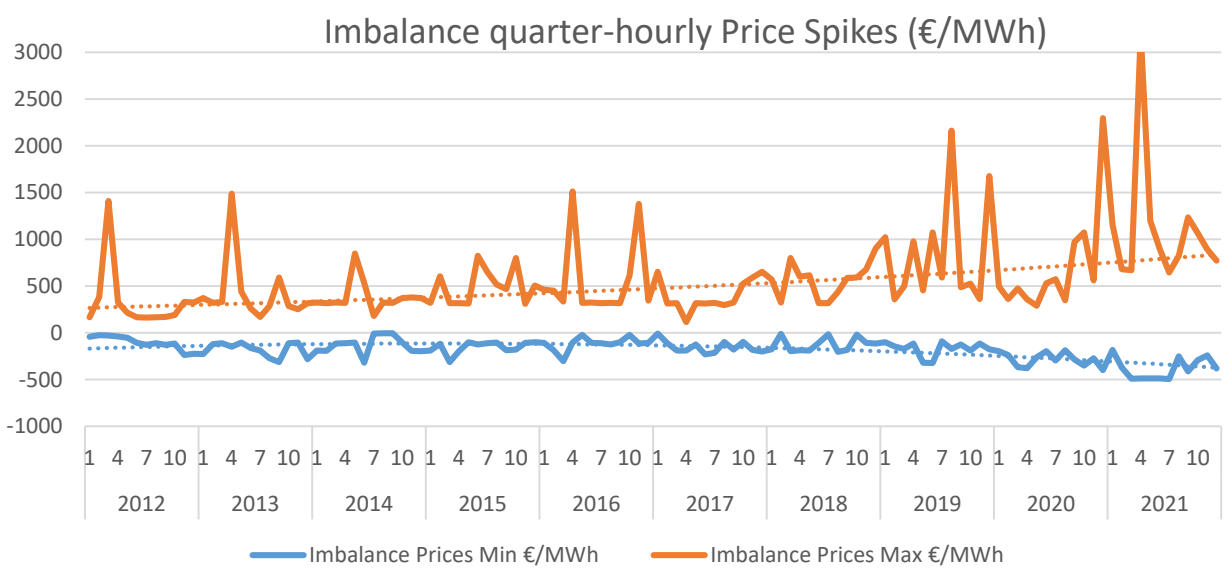
Average Belgian price (€/MWh)

	Baseload price
• 2015	45 €/MWh
• 2016	37 €/MWh
• 2017:	45 €/MWh
• 2018:	55 €/MWh
• 2019	39 €/MWh
• 2020	32 €/MWh
• 2021	98 €/MWh

X 3 vs. 2020

In 2021 baseload prices increased strongly compared to the multiyear trend, caused by an increase in gas prices towards the end of 2021





Day-ahead hourly price spikes (€/MWh)

	Up	Down
• 2019:	121 €/MWh	-500 €/MWh
• 2020	200 €/MWh	-115 €/MWh
• 2021	620 €/MWh	-66 €/MWh

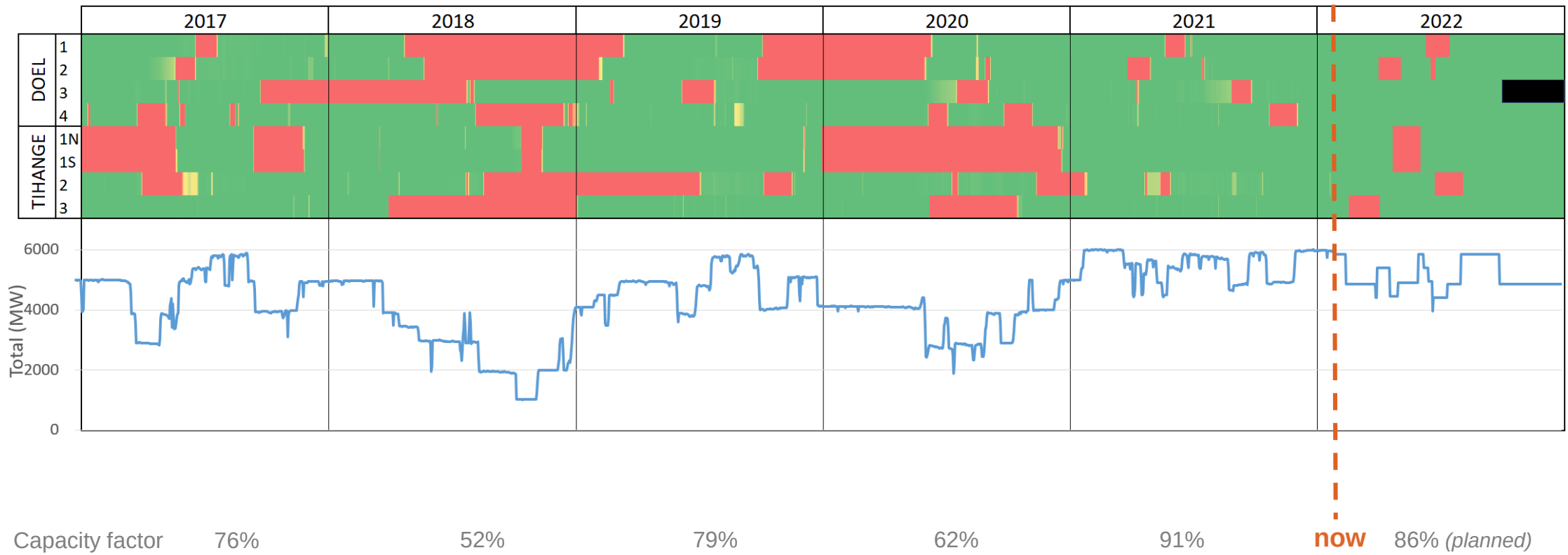
In late 2021 some very high price spikes occurred fueled by a general increase in baseload prices

Imbalance quarter-hourly price spikes (€/MWh)

	Up	Down
• 2019:	2163 €/MWh	-324 €/MWh
• 2020:	2297 €/MWh	-400 €/MWh
• 2021:	3199 €/Mwh	-565 €/MWh

The trends of the max and min imbalance price spikes are widening over the years

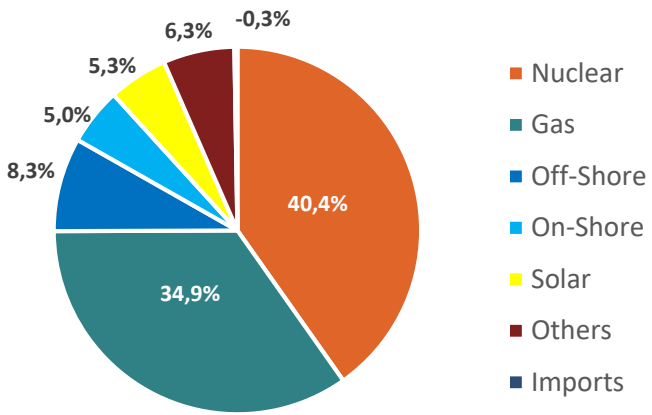
Downward price peaks are getting steadily more extreme, peaking at over -500 €/MWh. Also upwards imbalance prices reached an all-time high in 2021, not even caused by the general price increases since it was already in May



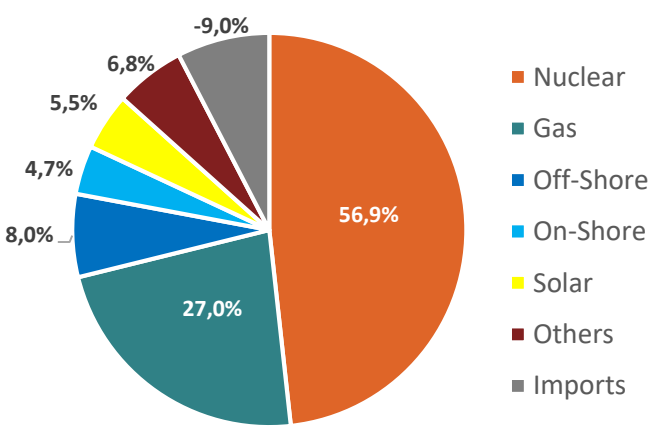
- 2021 had a planned total nuclear capacity factor of 94% at the beginning of the year, and a realized capacity factor of 91%. This is very close to the original goal and it was a very good year for nuclear power in Belgium

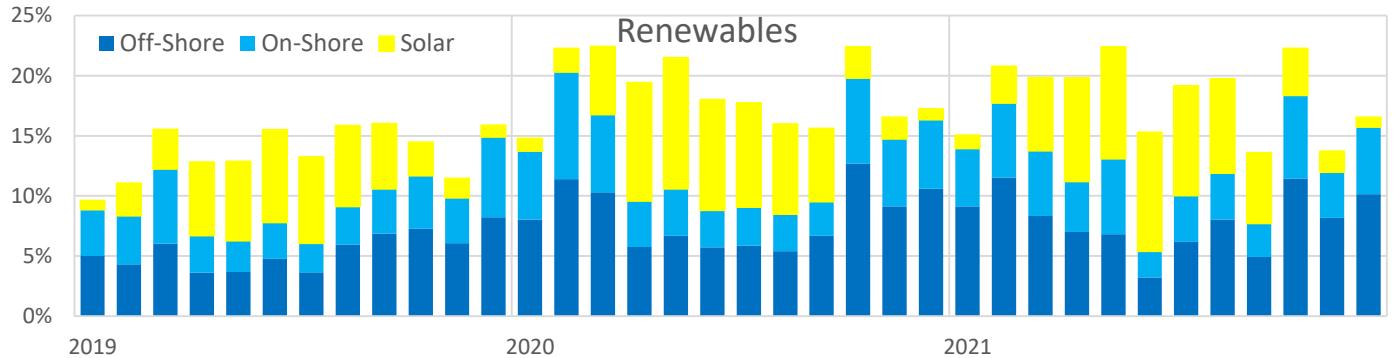
Energy Mix (as % of total load)

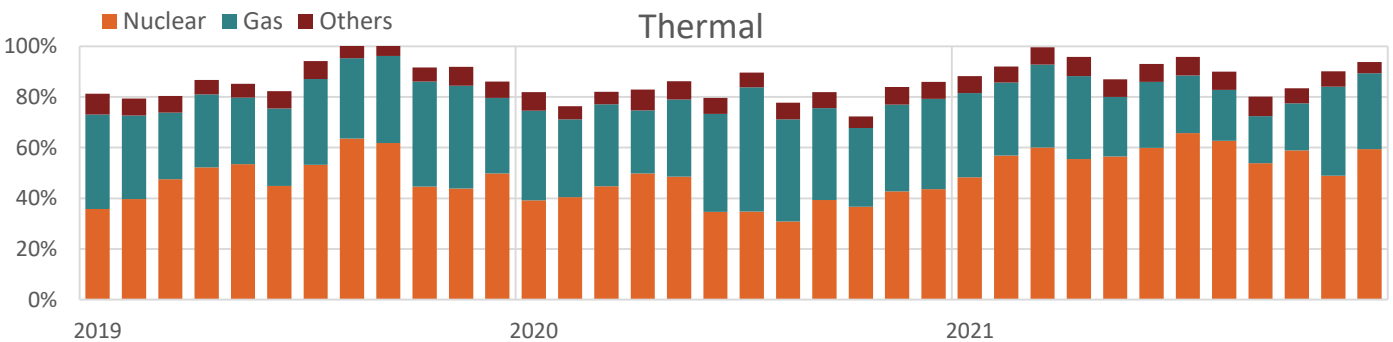
2020 (total load: 81.0 GWh)

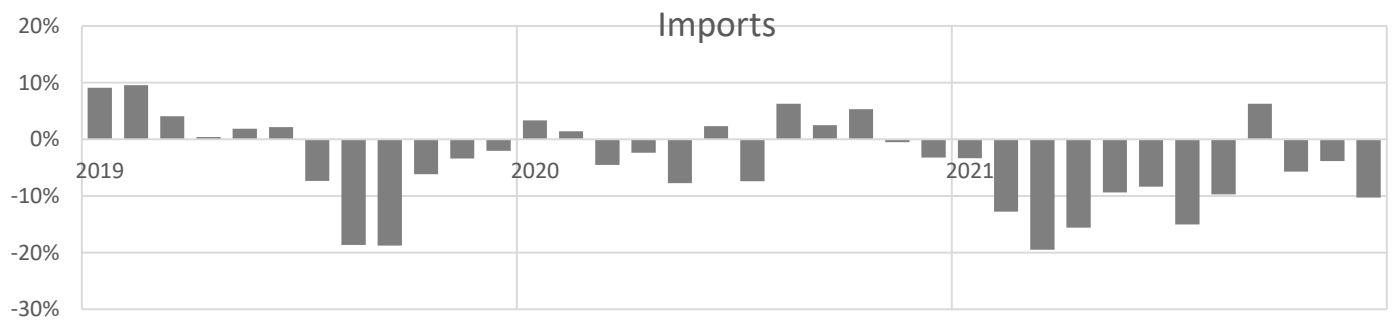


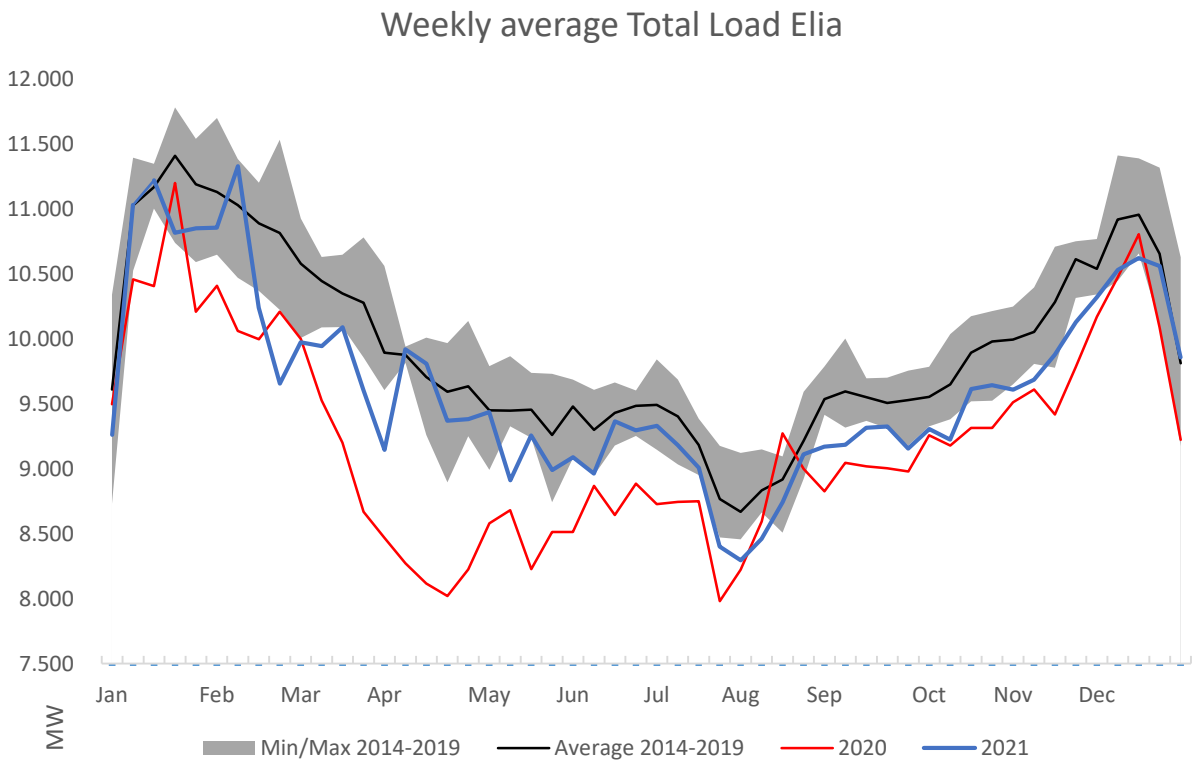
2021 (total load: 84.4 GWh)







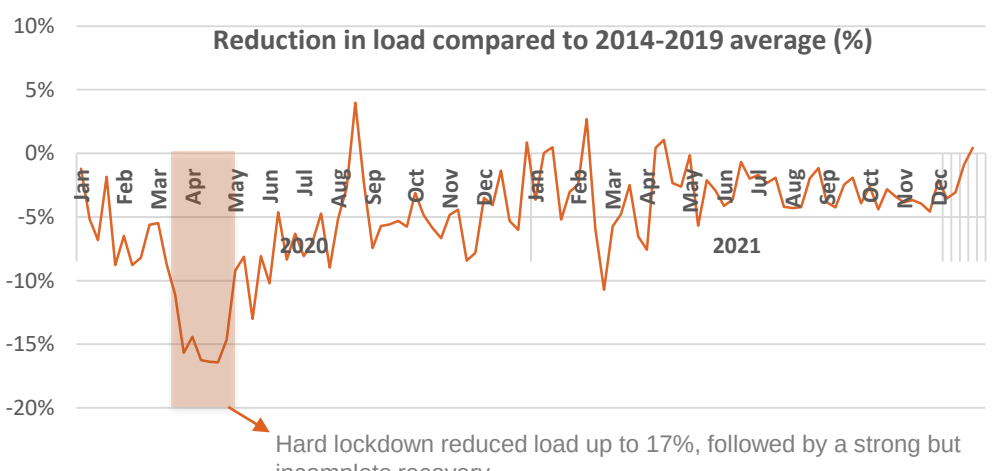


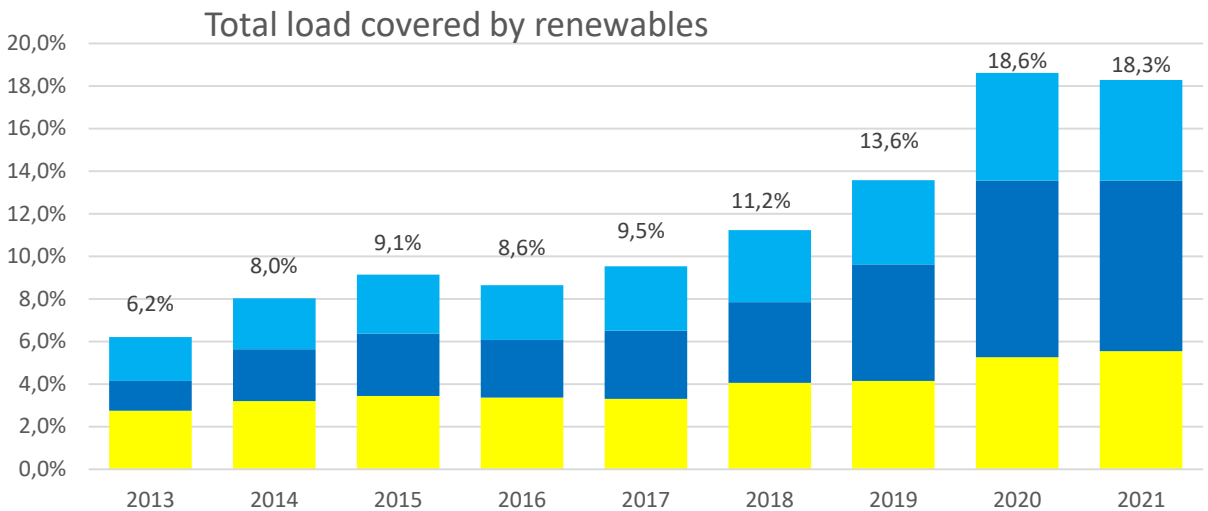


Total load in 2021 has largely recovered from the covid-year 2020. However total load in 2021 was still 3% lower than the multiyear pre-covid average 2014-2019

Total load (MW)

	Average	Max	Min
• 2014-2019	9936	13821	5744
• 2020	9224	13344	6146
• 2021	9641 +4,5% vs. 2020	13562	6627





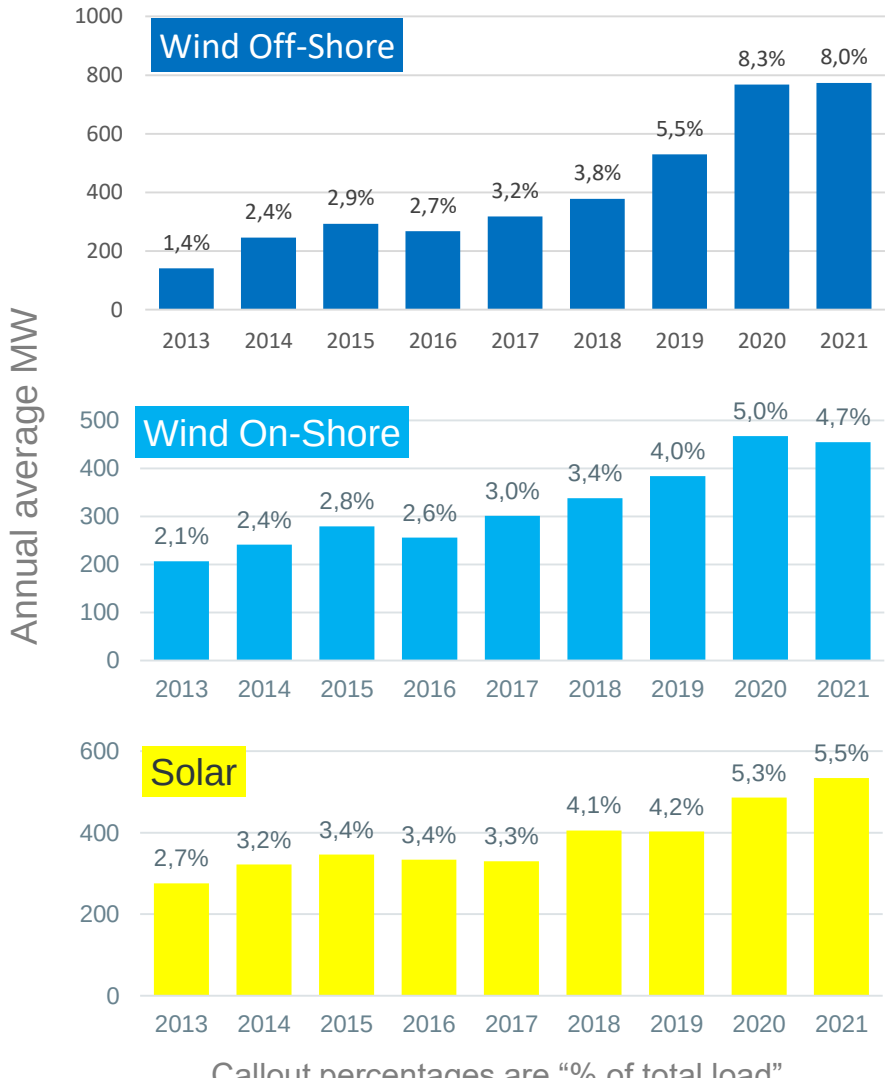
Peak absolute production:
- Solar: 3801 MW (26/04/2021 13:30)
- Wind: 4134 MW (02/10/2021 20:15)

Peak share in production:
The largest share of total load covered by all renewables combined was:
- 68% of total load (Sun 28/03/2021 11:30)

Installed base (at 31 December)

	Solar	Offshore	Onshore
• 2018	3369 MW	1178 MW	1978 MW
• 2019:	3886 MW	1548 MW	2248 MW
• 2020	4787 MW	2254 MW	2416 MW
• 2021	4787 MW*	2254 MW	2628 MW

*Solar cadaster and methodology will be updated soon. Should be closer to 6000 MW



2021 FB market limiting axis

(limiting as % of time)

1	NL-DE	Meeden - Diele	19.5%
2	BE-FR	Avlgm - Avelin/Masta	13.0%
3	DE-AT	StPeter - Pleinting	12.6%
4	BE	Zandv PSTs	11.7%
5	DE	Buers - Lambsheim	10.2%
6	FR-DE	Vigy – Ensdorf	9.4%
7	BE-FR	Gramme - Lonny	9.1%
8	AT	Sittling - Altheim	5.8%
9	NL	Lely - Dieme	4.6%
10	BE	Vanyk – Lixhe - Gramm	3.5%

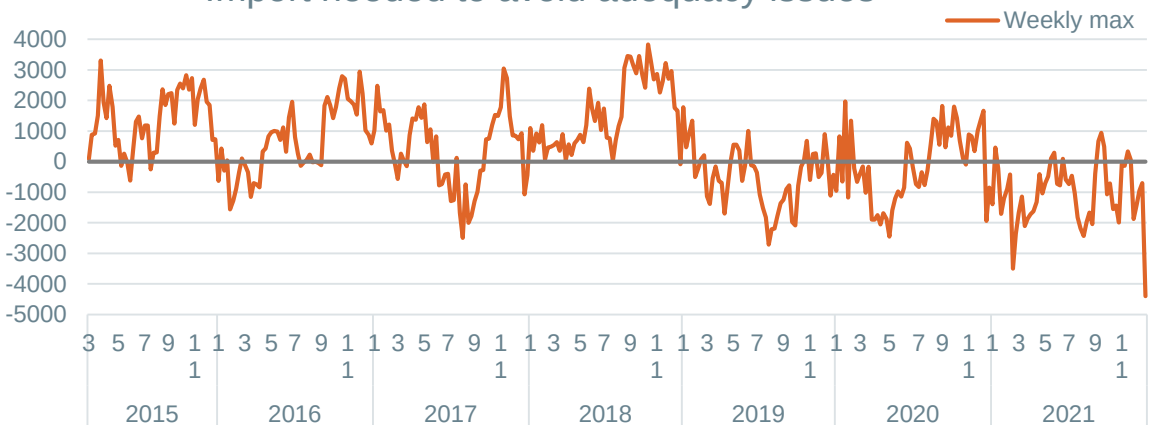
2020 FB limiting axis

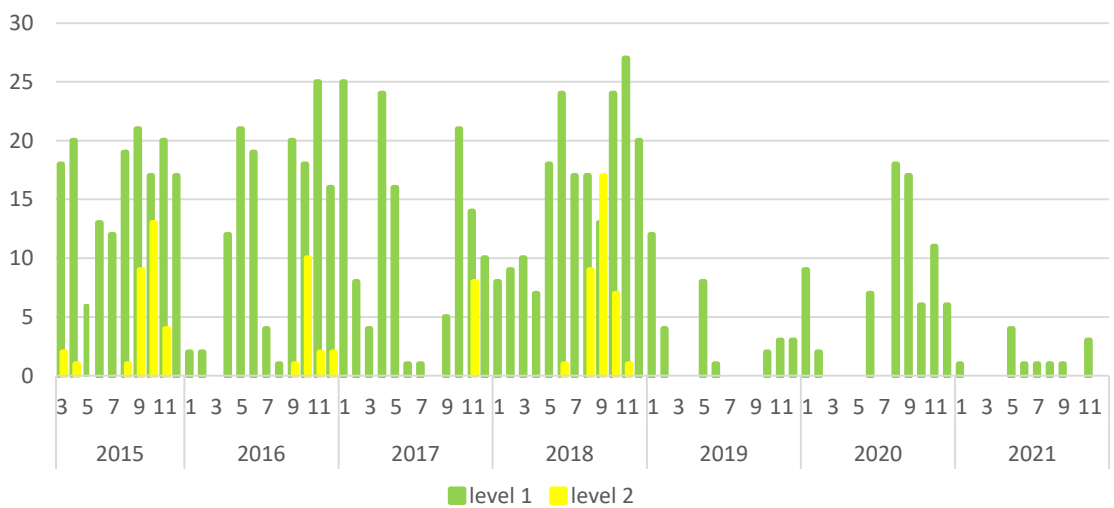
1.	NL-DE	Diele – Meeden	12.1%
2.	FR-DE	Vigy – Ensdorf	5.7%
3.	DE-AT	StPeter – Pleinting	5.4%
4.	BE	Horta – Avlgm	4.5%
5.	BE	Zandv PSTs	4.3%
6.	BE-FR	Gramme – Lonny	4.2%
7.	DE	Sittling – Altheim	3.5%
8.	DE	Buers - Lambs	3.4%
9.	DE	Gronau PST	2.5%
10.	NL	Ens – Lelystad	2.2%

Only axis that effectively limit the market are counted here. Each axis that limits market coupling during an hour is counted, and it's annual time per year it's blocking the market is represented here

Elia had the 2nd place spot, with Avelgem – Avelin/Mastaing. This was largely caused by the 3 month outage of 380.79 for HTLS conductors upgrade

Import needed to avoid adequacy issues





Highest dependency on imports reached per year:

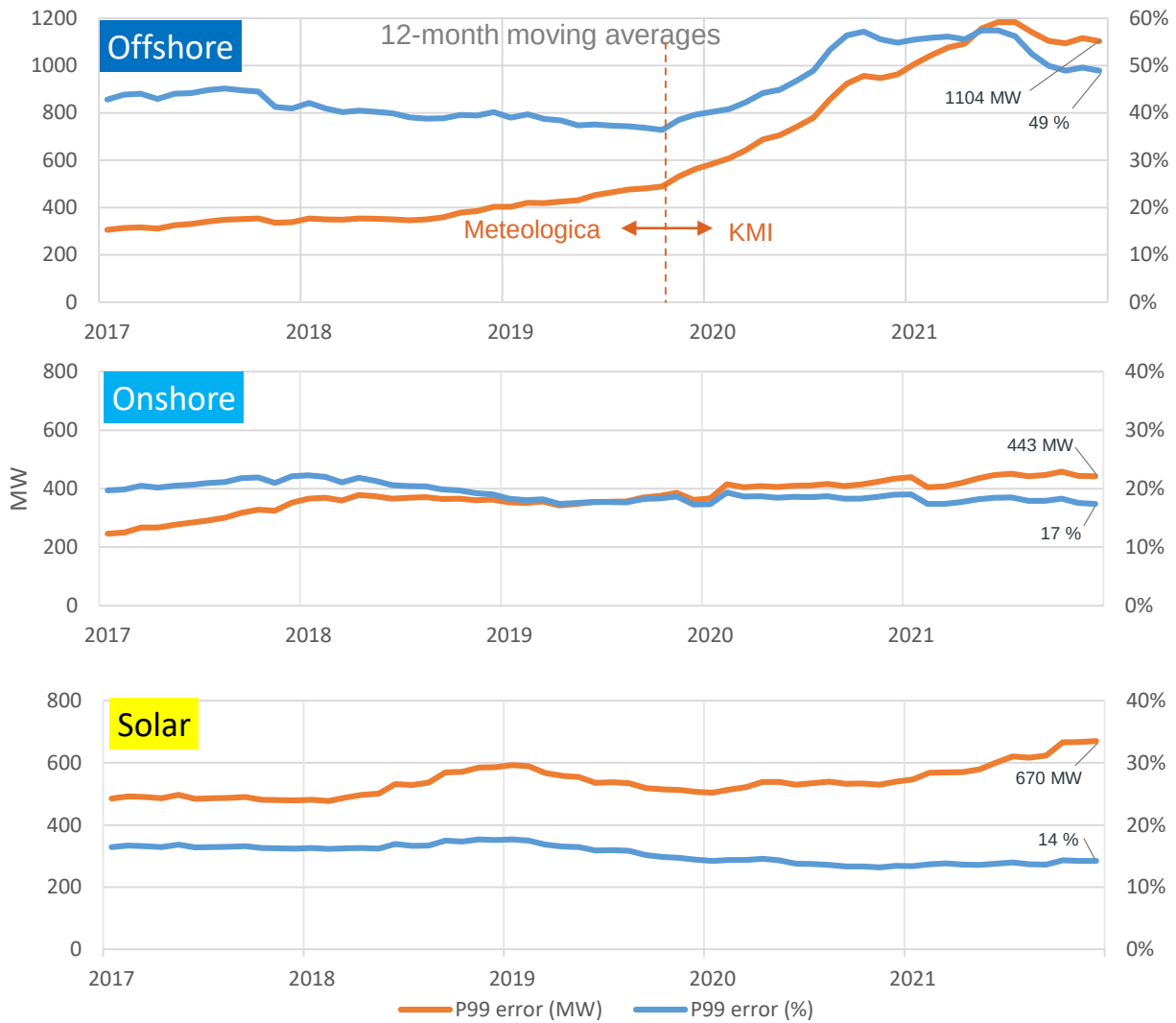
	Max import needed
• 2018	3832 MW
• 2019	1774 MW
• 2020	1965 MW
• 2021	935 MW

2021 was a good year for energy exports of Belgium, and dependence on imports was at a 7-year low

Number of days per year Belgium is self-sufficient

	Days per year (%)
• 2018	37%
• 2019	91%
• 2020	79%
• 2021	96%

Scarcity level 1 means Belgium's supply is not adequate without imports
Scarcity level 2 means even with all ensured imports, Belgium's supply is not adequate



Offshore

The change in service provider in November 2019 is clearly visible. The relative error, which was on a downward trend before, rose from a low of 36% to a peak of 55% as a result. It has stabilized since end of 2020. Some voluntary BRP power reductions not (yet) taken into account:

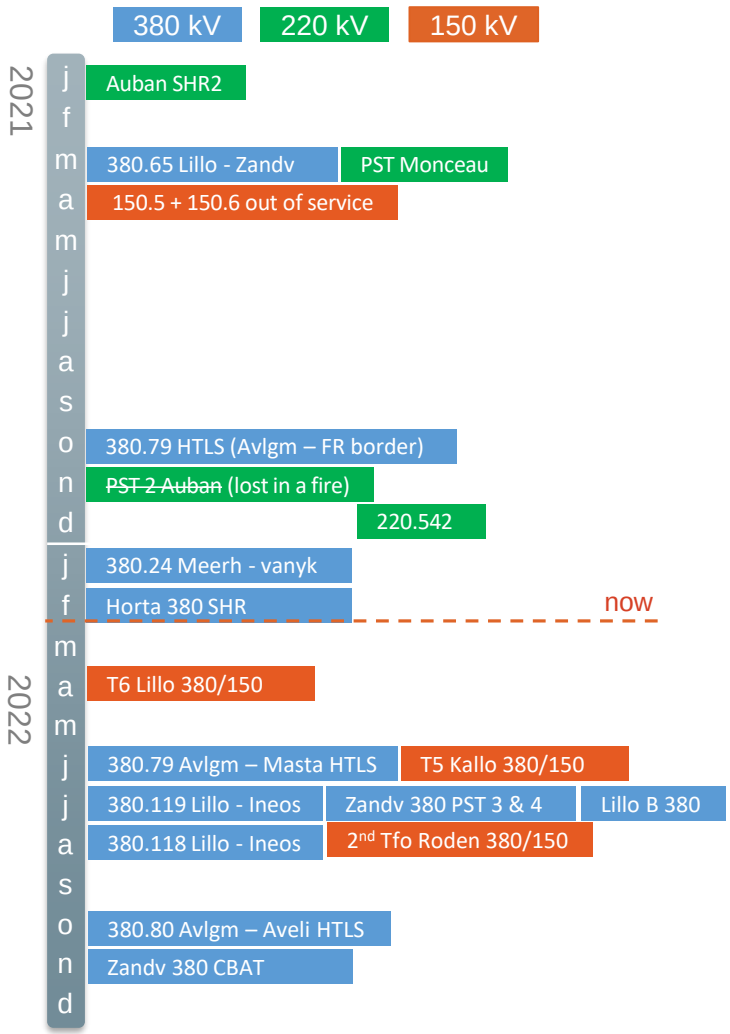
- preventive shutdowns for storm warnings
- very negative imbalance prices

Onshore

The relative forecasting error is trending downwards slightly since early 2018

Solar

The relative forecasting error is trending downwards slightly since 2019. In early 2021 the trend appears to start rising again, especially the absolute errors because of the increase in installed capacity. Solar installed capacity is unfortunately updated less than once a year, causing imprecision in the relative error. This will be fixed next year



Huge infrastructure program rolling out:

Large infrastructure projects of **2021**

- 380.65 (Brabo phase 2)
- Completing BE-FR 220 kV border PST upgrade → Unfortunately PST 2 of Auban was lost in a fire during commissioning tests. Otherwise all Belgian 220 kV interconnections would be equipped with a PST: Monceau PST, Auban 1 PST, Auban 2 PST, Schiff PST

Large infrastructure projects of **2022**

- 380.24 Meerh-Vanyk
- 380.79 HTLS upgrade
- 380.80 HTLS upgrade
- Zandv 380 PSTs 3& 4

* A very limited selection of all Elia projects is being summarized here, where a special interest for NCC exists