CREG

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Note

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Review of CWE day-ahead market results during May 1 2017

Carried out in application of Article 23, §2, second paragraph, of the Law of 29 April 1999 concerning the organisation of the electricity market

Non confidential

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TABLE OF CONTENT

EXECUTIVE SUMMARY

The CREG has carried out a review of the day-ahead market results for delivery of wholesale electricity products in Belgium and in Germany on the 1st of May 2017. In addition, the constraints restricting the distribution of welfare by means of the flow-based market coupling have been analysed.

In the Belgian bidding zone, during hours 1 to 19, the market clearing price is equal to €36/MWh except for hour 16. Traded volumes range from 2911 MWh/h to 5009 MWh/h during the same period indicating strangely robust day-ahead prices. After an analysis by the CREG, it is confirmed that the day ahead prices were caused by an erroneous order that was manually introduced by one market participant: the short time period still available before the day-ahead gate closure time, the unconventional procedure of manually entering orders, and the absence of verification processes to assess the validity of the created order resulted in an order being created to buy 3000 MWh/h at €36/MWh instead of 36 MWh/h at €3000/MWh. To prevent a similar error to occur in the future, the market participant has communicated to the CREG that he implemented validity rules which check whether the volume size of the order exceeds a certain threshold value.

Because of a low residual demand curve, i.e. the remaining part of the total load curve after accounting for wind and solar generation, day-ahead wholesale market prices in the German bidding zone were very negative from hour 1 to hour 18. The high resulting price spread between the German bidding zone and the other bidding zones in the CWE region indicates that the maximisation of the welfare in the region by means of the flow-based market coupling was constrained by active constraints in the network. Counterintuitively, net export and import positions in the CWE region from hour 9 to 15 were the lowest while coinciding with hours 7 to 14 when price spreads were highest. Six congested network elements causing the observed market results could be identified, of which a half are located internally in the control areas of Amprion and Tennet NL, while the remainder were located around the borders of bidding zones in the CWE region. Loop flows up to 1683 MWh/h caused congestion of a PST in the Belgian bidding zone.

1. INTRODUCTION

The CREG has carried out a review of the day-ahead market results for delivery of wholesale electricity products in Belgium and in Germany on the 1st of May 2017. In addition, the constraints restricting the distribution of welfare by means of the flow-based market coupling have been analysed.

The profile of day-ahead wholesale market prices justified contacting the relevant market participant to explain the observed behaviour. The causes that led to the observed prices as well as the short- and long term solutions are provided in this document.

On the same day, strong negative prices were observed in the German bidding zone causing large price spreads to occur in the CWE region. At the hours when the largest price spreads occurred commercial exchanges from the German bidding zone to the other bidding zones in the CWE-region were the lowest of the day. The causes of the low net import and export positions of the bidding zones in the CWE region during the hours when price spreads were largest have been analysed and are described in this document.

The goal of this document is to provide feedback to all market participants and any other stakeholder on how prices have been formed on the 1st of May 2017. The CREG highly appreciates feedback and comments on the document and encourages stakeholders to communicate interesting or remarkable events. Any event of interest is encouraged to be communicated, including those that seem not motivated by a reasonable doubt of market manipulation or inside information.

The CREG has already published a similar review concerning the day-ahead wholesale electricity prices for delivery at hour 12 on April 6, 2017 and at hour 10 on April 10, 2017[1].

2. REVIEW

2.1. CONTEXT OF THE OBSERVATION

The following figure illustrates the day-ahead prices and volumes for delivery of wholesale electricity products during May 1, 2017. During hours 1 to 19, the market clearing price is equal to €36/MWh except for hour 16. Traded volumes range from 2911 MWh/h to 5009 MWh/h during the same period indicating strangely robust day-ahead prices. The baseload price equals €37,75/MWh.

During the whole day, the Belgian and Dutch bidding zones have the highest prices in the CWE-region, enabling them to import volumes that are in total equal to the available day-ahead import capacity. The German bidding zone has the lowest prices during the whole day, with extremely low (negative) prices during hours 9 to 14, yet the available commercial capacity to exchange electricity between bidding zones in the CWE region is lower than the available commercial capacity right before and right after the large price spread occurred.

[1] Note 1633 on the review of day-ahead prices for delivery at hour 12 on April 6 and hour 10 on April 10, http://www.creg.be/sites/default/files/assets/Publications/Notes/Z1633EN.pdf

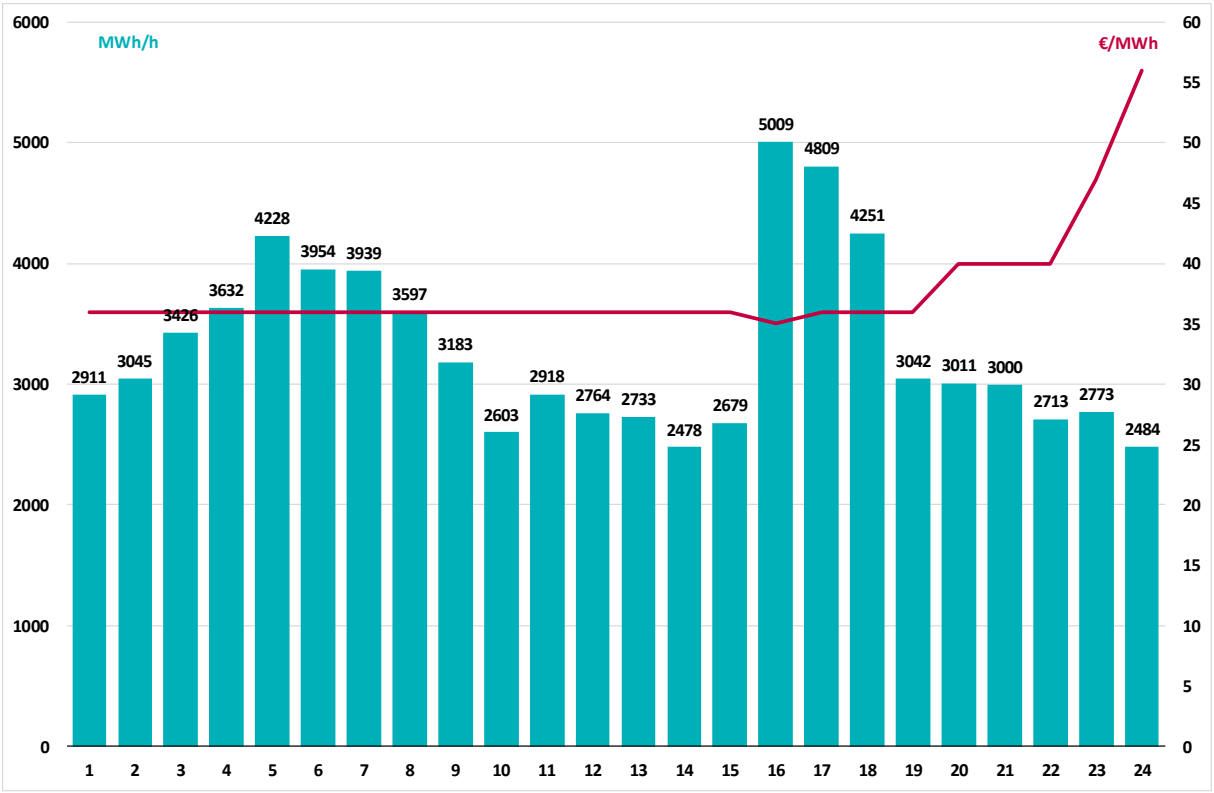

Figure 1 – Day-ahead wholesale electricity prices and traded volumes for delivery in the Belgian bidding zone on May 1, 2017
Source: CREG, EPEX SPOT Belgium

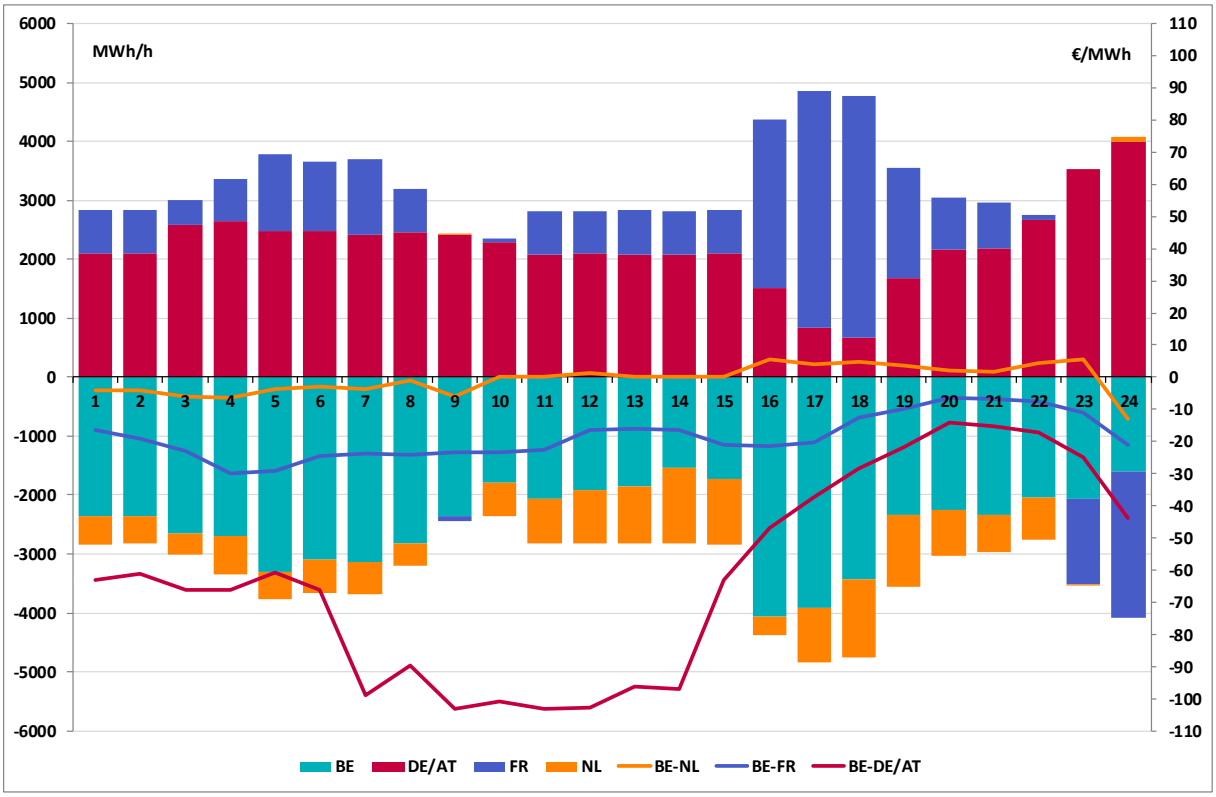

Figure 2 – Day-ahead wholesale electricity net import and export positions per bidding zone and price spread between the Belgian bidding zone and the other 3 bidding zones in the CWE-region.
Source: CREG, Joint Allocation Office (JAO)

2.2. ANALYSIS

2.2.1. Day-ahead market results in the Belgian bidding zone

The analysis of the orderbook revealed that one market participant had bid for each hour a volume of 3000 MWh/h at €36/MWh. The order is accepted during hours 1 to 19. Given the type of order used, a limit order, the large volume contained by the order, and the competitive price at which the order was bid, the algorithm has sufficient commercial flexibility available to maintain the balance between commercial supply and demand. Thus, the order is the marginal order during most of the day, thereby setting also the market clearing price.

The unusually large volume by one market participant, offered for delivery on a public holiday in Belgium, triggered the organisation of a meeting between the CREG and said market participant to better understand the reasons for this behaviour.

The creation of bids and offers by the market participant is typically fully automated based on technical and economic input parameters that are collected from its portfolio and an optimisation process. On Sunday April 30, 2017, the day of introducing the orders for delivery on May 1, 2017, the automated process to create a particular bid had not been available because necessary data had not been provided by a third party. Since data was lacking, the order had to be manually created. The short time period still available before the day-ahead market gate closure time, the unconventional procedure of manually entering orders[2], and the absence of verification processes to assess the validity of the manually created order resulted in the order input parameters being switched around so that finally an order was created to buy 3000 MWh/h at €36/MWh instead of 36 MWh/h at €3000/MWh.

The error resulted in the market participant to be long once the day-ahead market results were calculated. In order to negate the position, a variety of actions were undertaken which led to a partial recovery of the position.

To prevent a similar error to occur in the future, the market participant has implemented validity rules which check whether the volume size of the order exceeds a certain threshold value.

2.2.2. Day-ahead market results in the German bidding zone

A limited numeric analysis regarding the day-ahead wholesale electricity market results in the German/Austrian bidding zone has been carried out as the German orderbook could not be analysed in detail.

Publicly available data on the ENTSO-E Transparency Platform website show that during hours 8 to 14 on May 1, 2017 the generation of electricity from wind and solar power plants annulled the expected increase of total load. The resulting residual load increases from hour 16 onward to reach its peak load at hour 20. This observation explains why the price spread between the Belgian and German bidding zone is smaller after hour 16 than before.

[2] The market participant confirmed that manually creating orders in this context had never happened before.

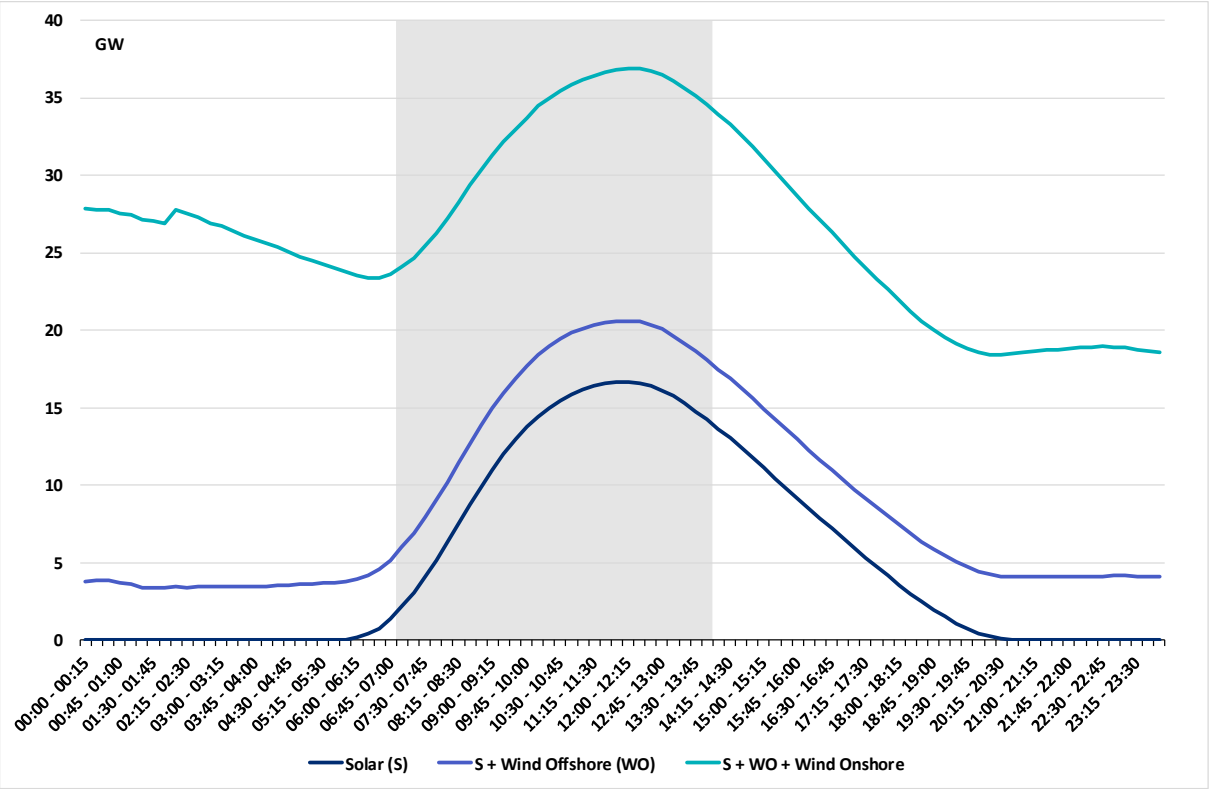

Figure 3 – Day-ahead forecasts of the expected quarter-hourly generation profile of solar (dark blue) power plants, offshore wind (WO) farms (purple, including solar) and onshore wind farms (turquoise, including solar and offshore wind).
Source: CREG, ENTSO-E Transparency Platform (website)

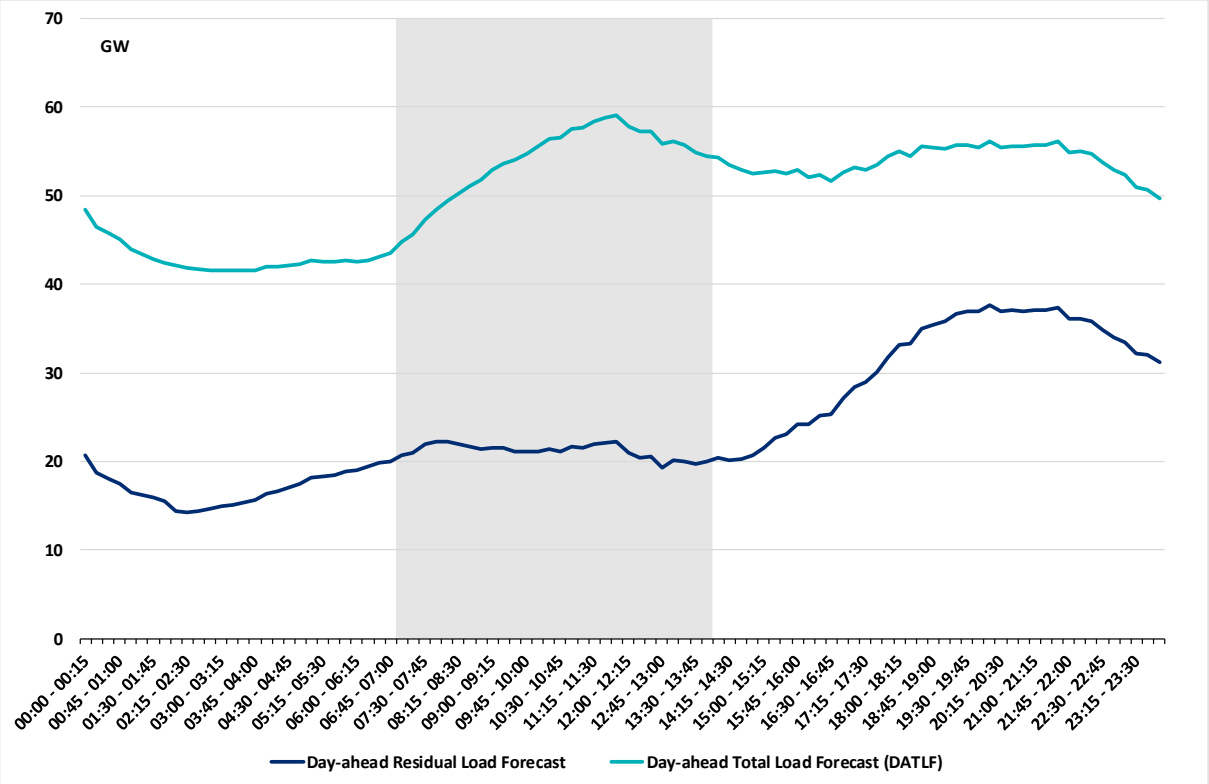

Figure 4 – Day-ahead forecasts of the expected quarter-hourly total load profile (DATLF, turquoise) and the residual load profile (i.e. after subtracting the ahead forecasts of the expected quarter-hourly generation profile of solar power plants, offshore wind and onshore wind farms, dark blue) in the German bidding zone
Source: CREG, ENTSO-E Transparency Platform (website)

The residual load that still needed to be covered equals around 20 GW, or even less. Must-run power plants such as CHPs were expected to generate a fairly high amount of electricity. This means that flexibility is expected from conventional power plants (hard coal, lignite, and nuclear power plants). The negative prices can hence be explained as an incentive for either must-run generation plants (including renewables) or relatively inflexible or inflexible power plants to provide downwards flexibility. Negative prices around €-60/MWh could indicate that commercial flexibility is provided by renewable energy plants as subsidies are around that price level while other negative prices might indicate a shutdown of conventional thermal power plants.

2.2.3. Flow-based market coupling: active transmission network constraints

An hourly price spread indicates that one or more network elements constrain the maximisation of welfare in the CWE region. Since the absolute price spread between the German bidding zone and any other bidding zone in the CWE region takes on a very high value throughout the first 16 hours of the day, the CREG has additionally analysed the flow-based parameters.

On the 1st of May, several transmission lines in the network were expected, before the day-ahead market coupling process had started, by TSOs, to be highly preloaded. The inclusion of this expectation in their reference program reduced the area of the flow-based domain[3] to the extent that, on all hours, the flow-based domain had to be virtually enlarged[4] to guarantee coverage of already allocated long term cross-zonal capacities. The resulting small flow based domain explains the low volumes of day-ahead cross-zonal exchanges despite the large price spread (see Figure 2).

Through the JAO Utility tool[5], one can retrieve which critical branches – critical outages (CBCOs) have limited the cross-zonal trade. The active CBCOs on the 1st of May are listed in Table 1. The active critical branches were:

- Diele-Meeden, an interconnector between the Tennet DE - Tennet NL areas (11 hours)
- Ens-Lelystadt, an internal line in the Tennet NL area (7 hours)
- Diemen-Lelystadt, an internal line in the Tennet NL area (6 hours)
- Gronau-Hanekenfaehr internal line in the Amprion area (6 hours)
- Van Eyck-Maasbracht, an interconnector between the Elia -Tennet NL areas (5 hours)
- Bechterdissen – Guetersloh, an internal line in the Amprion area (3 hours)
- PST Zandvliet, phase shift transformers on the Belgian Northern border, Elia area (2 hours)
- PST Van Eyck , phase shift transformers on the Belgian Northern border, Elia area (1 hour)
- Dörpen/West – Hanekenfähr, an internal line in the Amprion area (1 hour)
- Aubange – Moulaine, an interconnector between the Elia – RTE areas (1 hour)
- Gronau – Kusenhorst, an internal line in the Amprion area (1 hour)

During 16 of the 24 hours, two or more constraints were simultaneously active (Table 1).

[3] The flow-based domain determines all feasible commercial exchanges, or net positions, between bidding zones in the CWE region and is delineated by the set of network constraints

[4] Virtual enlargement of the flow-based domain is called LTA-inclusion or LTA coverage. Even though the LTA-inclusion has been introduced to guarantee the availabilities long term allocated capacities, it has proven to be an important feature that prevents the network being fully congested by non-competitive flows. For more information, see section II.5.2 of study 1520 (http://www.creg.info/pdf/Studies/F1520EN.pdf).

[5] Since the 1st of July 2017, the names of the Critical Branches and Critical Outages (CBCOs) are published in "human readable format", along with the anonymized fixed IDs (see: http://www.jao.eu/marketdata/implicitallocation). With this information, one can trace back the location of the CBCOs for the period before the 1th of July 2017 when only the anonymized fixed IDs were published.

DATE	HOUR	Critical Branch	Outage Name	TSO	max PTDF	RAM (MW)
01-05-17	1	Gronau - Hanekenfaehr	Muenst	D7	5%	115
01-05-17	1	Gronau - Kusenhorst	Meppen - Hanekenfaehr	D7	14%	229
01-05-17	2	Gronau - Hanekenfaehr	Muenst	D7	5%	117
01-05-17	3	Van Eyck - Maasbracht	PST_Zanvliet	BE	34%	683
01-05-17	3	Diele-Meeden S	Diele-Meeden WS	D2	19%	366
01-05-17	3	Gronau - Hanekenfaehr	Muenst	D7	5%	126
01-05-17	4	PST_Zanvliet	PST_VanEyck	BE	46%	937
01-05-17	4	Diele-Meeden S	Diele-Meeden WS	D2	19%	366
01-05-17	4	Ens-Lelystad Z	Ens-Lelystad W	NL	16%	344
01-05-17	5	Van Eyck - Maasbracht	PST_Zanvliet	BE	34%	685
01-05-17	5	Ens-Lelystad Z	Ens-Lelystad W	NL	16%	345
01-05-17	6	PST_VanEyck	PST_Zanvliet	BE	34%	684
01-05-17	6	Diele-Meeden S	Diele-Meeden WS	D2	8%	168
01-05-17	6	Ens-Lelystad Z	Ens-Lelystad W	NL	16%	345
01-05-17	7	Van Eyck - Maasbracht	PST_Zanvliet	BE	34%	685
01-05-17	7	Diele-Meeden S	Diele-Meeden WS	D2	18%	363
01-05-17	7	Ens-Lelystad Z	Ens-Lelystad W	NL	16%	342
01-05-17	8	PST_Zanvliet	Boxmeer-Maasbracht	BE	43%	873
01-05-17	8	Diele-Meeden S	Diele-Meeden WS	D2	20%	392
01-05-17	8	Ens-Lelystad Z	Ens-Lelystad W	NL	14%	312
01-05-17	9	Diele-Meeden S	Diele-Meeden WS	D2	20%	392
01-05-17	9	Dörpen/West-Hanekenfähr	Niederlangen-Meppen	D2	12%	184
01-05-17	9	Bechterdissen - Guetersloh	Wehrendorf - Ohlensehlen	D7	4%	93
01-05-17	10	Diele-Meeden S	Basecase	D2	12%	231
01-05-17	10	Gronau - Hanekenfaehr	Muenst	D7	4%	101
01-05-17	11	Diele-Meeden S	Diele-Meeden WS	D2	19%	387
01-05-17	11	Bechterdissen - Guetersloh	Wehrendorf - Ohlensehlen	D7	3%	73
01-05-17	12	Diele-Meeden S	PST_Gronau	D2	15%	306
01-05-17	12	Bechterdissen - Guetersloh	Wehrendorf - Ohlensehlen	D7	6%	135
01-05-17	13	Diele-Meeden S	Doerpen/West - Hanekenfaehr	D2	11%	234
01-05-17	13	Gronau - Hanekenfaehr	Muenst	D7	4%	109
01-05-17	14	Diele-Meeden S	PST_Gronau	D2	16%	376
01-05-17	15	Gronau - Hanekenfaehr	Muenst	D7	4%	106
01-05-17	16	Van Eyck - Maasbracht	PST_Zanvliet	BE	34%	677
01-05-17	16	Diemen-Lelystad Z	Diemen-Lelystad W	NL	13%	305
01-05-17	17	Aubange-Moulaine	Achene-Lonny	BE	11%	458
01-05-17	17	Diemen-Lelystad Z	Diemen-Lelystad W	NL	13%	305
01-05-17	18	Ens-Lelystad Z	Ens-Lelystad W	NL	13%	295
01-05-17	19	Ens-Lelystad Z	Ens-Lelystad W	NL	13%	296
01-05-17	20	Diemen-Lelystad Z	Diemen-Lelystad W	NL	12%	285
01-05-17	21	Diemen-Lelystad Z	Diemen-Lelystad W	NL	12%	277
01-05-17	22	Diemen-Lelystad Z	Diemen-Lelystad W	NL	14%	308
01-05-17	24	Van Eyck - Maasbracht	PST_Zanvliet	BE	34%	705
01-05-17	24	Diemen-Lelystad Z	Diemen-Lelystad W	NL	13%	306

Table 1 : Active network constraints for May 1th, 2017. The network constraint is characterized by a set of Power Transfer Distribution Factors (PTDF) and the Remaining Available Margin (RAM). TSOs are Elia (BE), Tennet NL (NL), Tennet DE (D2) and Amprion (D7). On May 1th, 2017, there were no active constraints in the area of RTE (FR) or Transnet BW (D4).

The shadow price[6] of the active constraints for the 1st of May was high, especially for the internal lines with low values for the maximum Power Transfer Distribution Factors (PTDF, in MW/MW or %) and low values for the Remaining Available Margin (RAM, in MW), see Figure 5.

Active CBCOs on May 1th, 2017, are very often characterized by low maximum PTDF and low RAM.

- A low PTDF indicates that a CBCO is only marginally impacted by physical flows arising from commercial cross-zonal trade. A PTDF of 5% means that 5% of the physical flows arising from a commercial exchange between two zones, is estimated to flow through that line (e.g. 50 MWh/h for a 1000 MWh/h zone-to-zone commercial exchange).
- A low RAM indicates that a CBCO has little capacity available for cross-zonal trade. The capacity is used before cross-zonal trade, i.e. for physical flows resulting from trade inside a bidding zone (domestic flows and loop flows) – and for the flow reliability margin (FRM) which is a security margin to cope with the uncertainties resulting from trade inside a bidding zone.

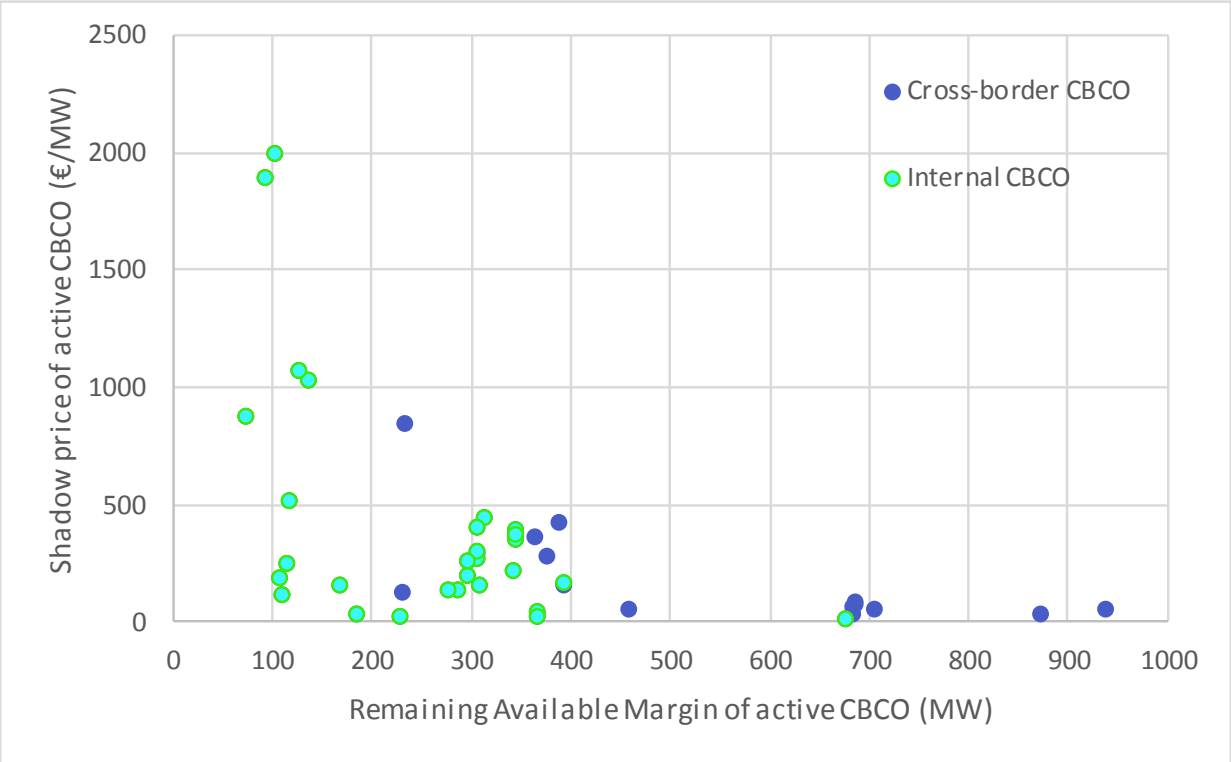

Figure 5 : Shadow price of the active Critical Branches – Critical Outages (CBCO) which constrained cross-border exchange on May, 1th, 2017 (all hours). The larger the shadow price, the more severe the impact of the CBCO on the cross-zonal trade. When a CBCO has a low Remaining Available Margin (RAM), it tends to constraint cross-zonal trade more severely. In general, CBCOs with low RAM were transmission lines inside a bidding zone ('internal lines'). On the interconnectors ('cross-border CBCOs), typically more RAM is available.

[6] The shadow price of a constraint indicates how much the objective function would increase if the constraint is relaxed by one unit. Analytically speaking it's the derivative of the objective function at the calculated solution. The higher the shadow price, the more value relaxing the constraint would bring. In this context, the shadow price indicates the social welfare that could be added to the CWE region if the capacity of the transmission line is increased by 1 MW. Ideally, the shadow price should equal to zero (the calculated solution equals the optimal one of the unconstrained problem), or, if not equal to zero, should be allocated to a network element that is at, or very close to, the border between bidding zones (efficient pricing principle).

The occurrence of congestion on the Dutch-Belgian interconnectors and PSTs is correlated with loop flows in the North-South direction in the CWE region. On May 1, 2017, the loop flows through the Belgian bidding zone were on average 1030 MWh/h in the North-South direction[7], ranging from 1683 MWh/h at hour 1 down to 736 MWh/h at hour 24 (Figure 6).

From a grid management perspective, the market results of May 1, 2017 illustrate two points:

- Managing congestion on internal lines impacted the efficiency of the market coupling, resulting in low cross-border volumes and the persistence of high price spreads during the day.
- Loop flows through the Tennet NL and Elia network reach high values. These physical flows arise from domestic trade in (mainly) the DE/AU/LU bidding zone and preload the transmission lines. As a consequence, the capacity available for commercial trade is reduced, triggering congestion on those lines during the day-ahead market.

To improve the functioning of the market coupling, the CREG, with support of other CWE NRAs, urges for a revision of the CBCO selection method currently adopted by TSOs. The CREG has proposed a CBCO selection method with higher PTDFs thresholds and minimal RAM requirements, which implies, amongst others, the limitation of loop flows in the base case. This way, FBMC can more efficiently manage congestion arising from cross-zonal trade since the revised method would provide more capacity for cross-zonal trade.

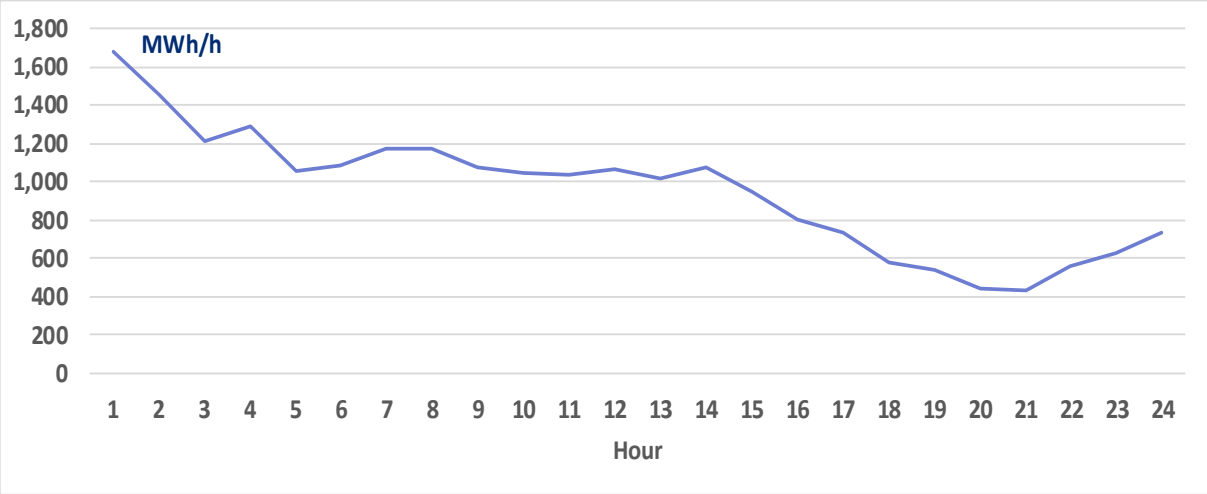

Figure 6 : The expected loop flows in D-2 through the Elia network on May 1th, 2017 were on average 950 MW in the North-South direction. The loop flows were especially high during the first 14 hours of the day, with an average of 1173 MW.

[7] Hourly data on the loop flows on the Elia network can be downloaded from the Elia website > Grid data > Data download > Interconnection > Loop flows. Data are available on a daily basis since January 2017. http://www.elia.be/nl/grid-data/data-download

3. CONCLUSION

The CREG has carried out a review of the day-ahead market results for delivery of wholesale electricity products in Belgium on the 1st of May 2017. During hours 1 to 19, the market clearing price is equal to €36/MWh except for hour 16. Traded volumes range from 2911 MWh/h to 5009 MWh/h during the same period indicating strangely robust day-ahead prices.

The day ahead prices were caused by an erroneous order that was manually introduced by one market participant following unusual circumstances. The short time period still available before the day-ahead market gate closure time, the unfamiliar procedure of manually entering orders (as it had never happened before), and the absence of verification processes to assess the validity of the created order resulted in an order being created to buy 3000 MWh/h at €36/MWh instead of 36 MWh/h at €3000/MWh. To prevent a similar error to occur in the future, the market participant has implemented validity rules which check whether the volume size of the order exceeds a certain threshold value.

Additionally, several network constraints were active on the 1st of May, limiting the maximisation of welfare in the CWE region. Network constraints were located on the border between the control areas of Tennet DE and Tennet NL and on the border between the control areas of Tennet NL and Elia. More remarkably, network constraints also persisted inside the TenneT NL control area and inside the Amprion control area, both limiting the efficiency of the flow-based market coupling mechanism in terms of providing capacity for cross-border trade. The shadow prices of these active network constraints located inside the bidding zones were especially high.

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