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COMMISSION DE REGULATION
DE L'ELECTRICITE ET DU GAZ

STUDY

(F)110915-CDC-1099

on

'the price spike on Belpex DAM for 28 March 2011'

15 September 2011

INTRODUCTION

In this study, the « COMMISSION DE REGULATION DE L'ELECTRICITE ET DU GAZ » (hereafter referred to as "CREG") investigates the price spike on the Belpex Day Ahead Market (hereafter referred to as "Belpex DAM") for 28 March 2011.

This study has three parts. The first part investigates the causes of the price spike. This implies any other behaviour of market parties that is not directly linked to the price spike will not be analysed in this study. The second part studies the measures that could be taken to improve the working of the Belpex DAM and wholesale electricity market. The last part lists the conclusions of the CREG.

This English version is a non-official version and for information purposes only. The official version is the Dutch and the French version of this study.

The official study has been approved during the management board's meeting of 15 September 2011.

I. CAUSES OF THE PRICE SPIKE

1. The Belgian power exchange is price coupled with the Dutch, French and German power exchanges since 10 November 2010. This price coupling algorithm runs at 12 o'clock the day before delivery.

2. For Monday 28 March 2011, this was on Sunday 27 March 2011. During the night from Saturday 26 to Sunday 27 March, the wintertime was abandoned in favour of summertime, with the hour 2 to 3 being skipped. Due to a bug in the date calculation, this lead to a decoupling of the power exchanges[1].

3. Due to this decoupling, a message was sent to the market parties, interconnection capacity was allocated explicitly (through the CASC shadow auction) and the order books were re-opened. There was no Request for Quotes (hereafter 'RfQ'), and hence no price information. The detailed course of events can be found in the annexe.

4. The reopening of the Belpex order book was from 14:06 to 14:20, giving market participants less than 15 minutes to reconsider their bids based on the results of the shadow auction of interconnection capacity and on the information that the power exchanges would be decoupled (a message that was sent at 14:01, five minutes before the reopening of the order books). It should be noted that the procedure for this kind of events (including the short time to adjust the order book) was agreed upon by the stakeholders and was followed by the market operators.

5. The result of the isolated Belpex DAM clearing was an average price of 206,1 €/MWh for a baseload delivery during 28 March 2011, with a price spike of 2.999 €/MWh for delivery during hour 8 (i.e. from 7 to 8 am) of that day. This gives the following figure.

[1] The bug has been fixed since then. For more details, see the annexe.

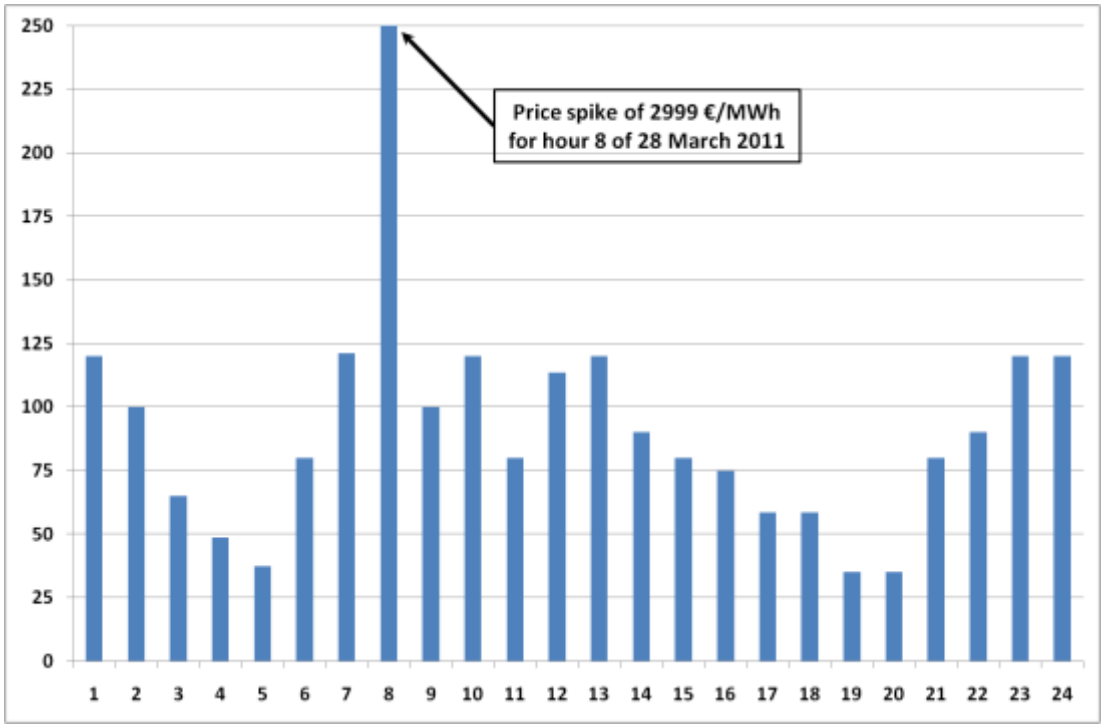


Figure 1: hourly prices on Belpex DAM for 28 March 2011 (in €/MWh)

6. Besides the price spike at hour 8 and higher prices than normal during some other hours, the price pattern was clearly not the average price pattern during the period from 1 January 2011 until 27 March 2011 as is shown in the figure below. The average price during this period is 53,1 €/MWh.

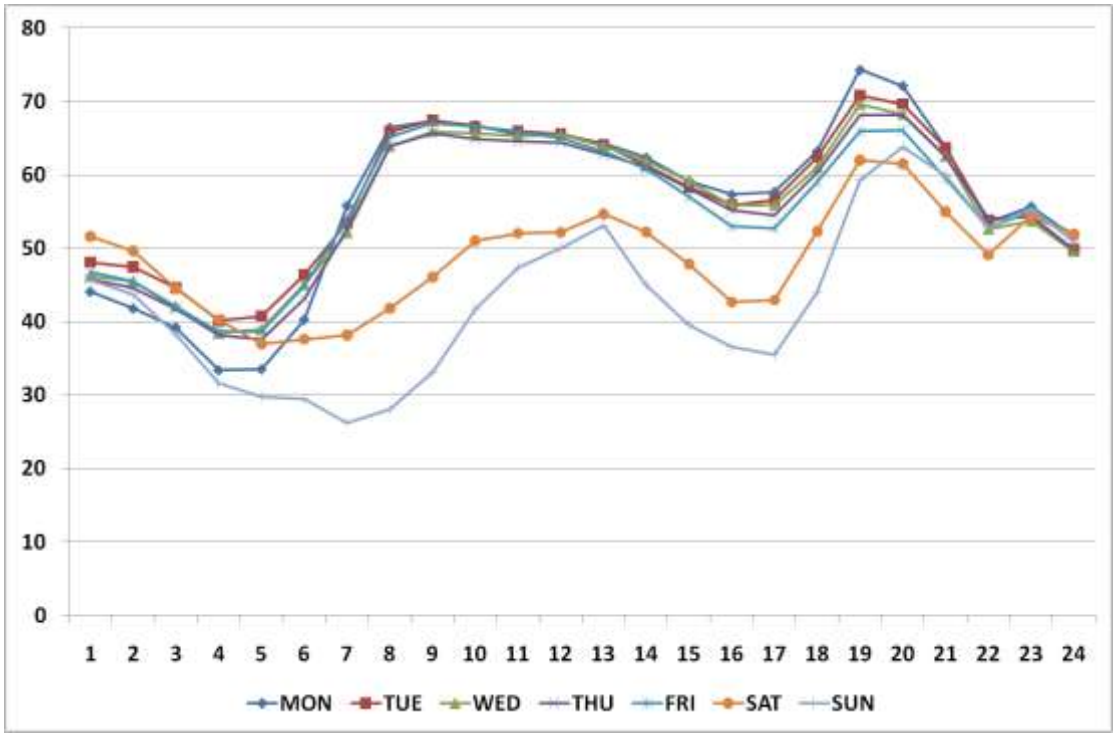


Figure 2: average hourly prices on Belpex DAM for each day of the week during the period from 1 January 2011 until 27 March 2011 (in €/MWh)

7. If the market coupling would have run as normal, the prices would likely not have spiked at all.

8. It is clear the software bug in the coupling algorithm is the cause of the decoupling and consequently of the price spike. However, based on the aggregated data published by Elia, the Belgian TSO, there was more than 14.000 MW of available generation capacity during hour 8 of 28 March. With a forecasted load of about 10.000 MW and a net export in day ahead of 286 MW, this implies 3.700 MW of unused generation capacity in the Belgian control area. The figure below shows these data.

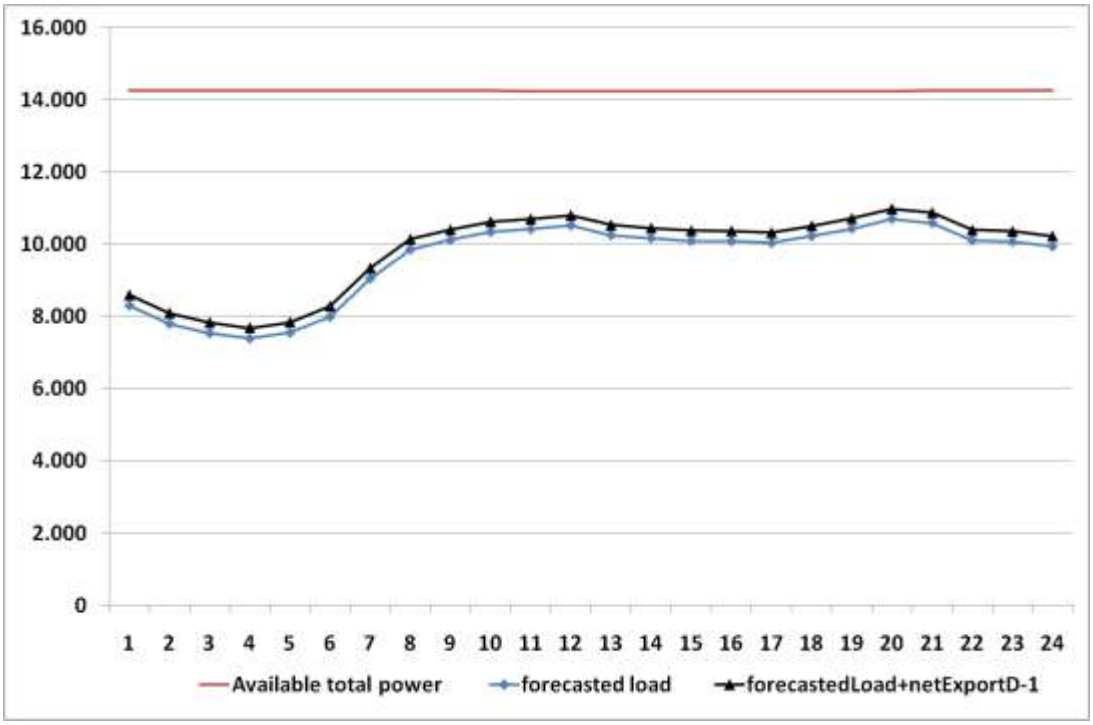


Figure 3: total available production capacity, total forecasted load and the total forecasted load + day ahead nominated net export for 28 March 2011 (in MW)

9. Elia also publishes the type of generation capacity that is available. The following figure gives the break-down of the total capacity into the various types. From this figure, it is clear that wind, water, 'liquid fuel' and 'other' make up more than 2.000 MW.

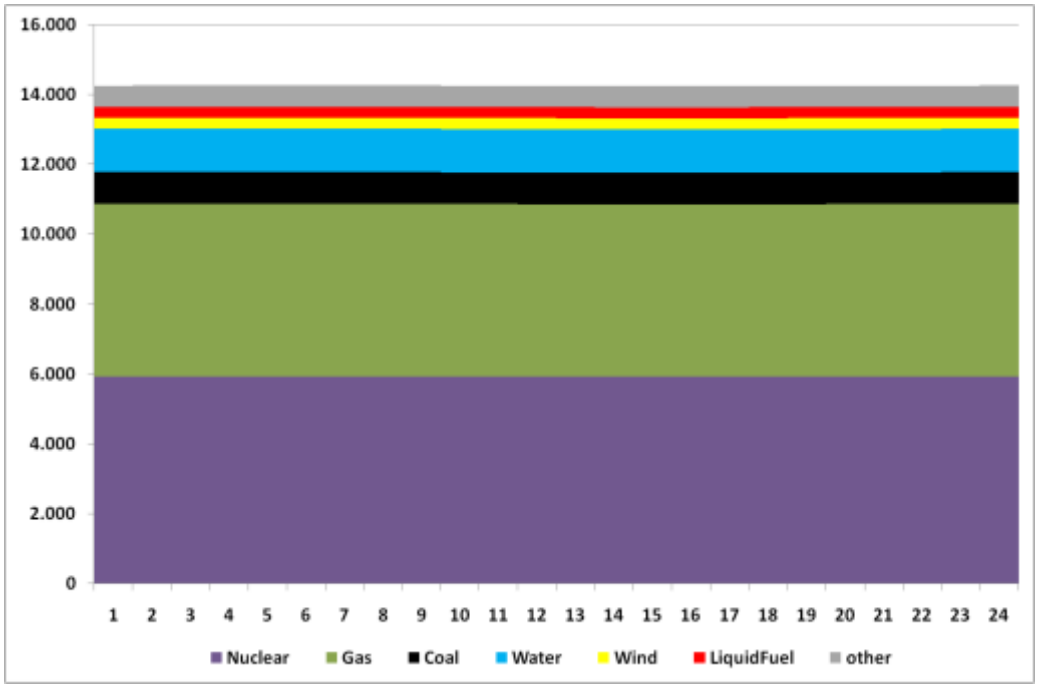


Figure 4: total available production capacity per fuel type in day-ahead foreseen for 28 March 2011 (in MW)

10. Elia also publishes the aggregated nominations that were made in day ahead on each type of unit. This can be compared with the aggregated available capacity of each type of unit to calculate the non-used production capacity per type. This gives the figure below. From these data, it is clear the 4.000 MW of non-used capacity mostly comes from unused water capacity[2] (1.200 MW) and unused gas capacity (1.730 MW).

[2] The unused water capacity has a constant level of 1.200 MW throughout the day. This would mean pumped storage was not used. This is a mistake in the publication by Elia: pumped storage was not planned to be during the day (although not (significantly) during hour 8). When CREG remarked this error, Elia quickly fixed it and corrected the historic data for 2010 en 2011 (not only for the production forecast, but also for the real production). CREG stresses Elia needs to correct all the data, so also before 2010.

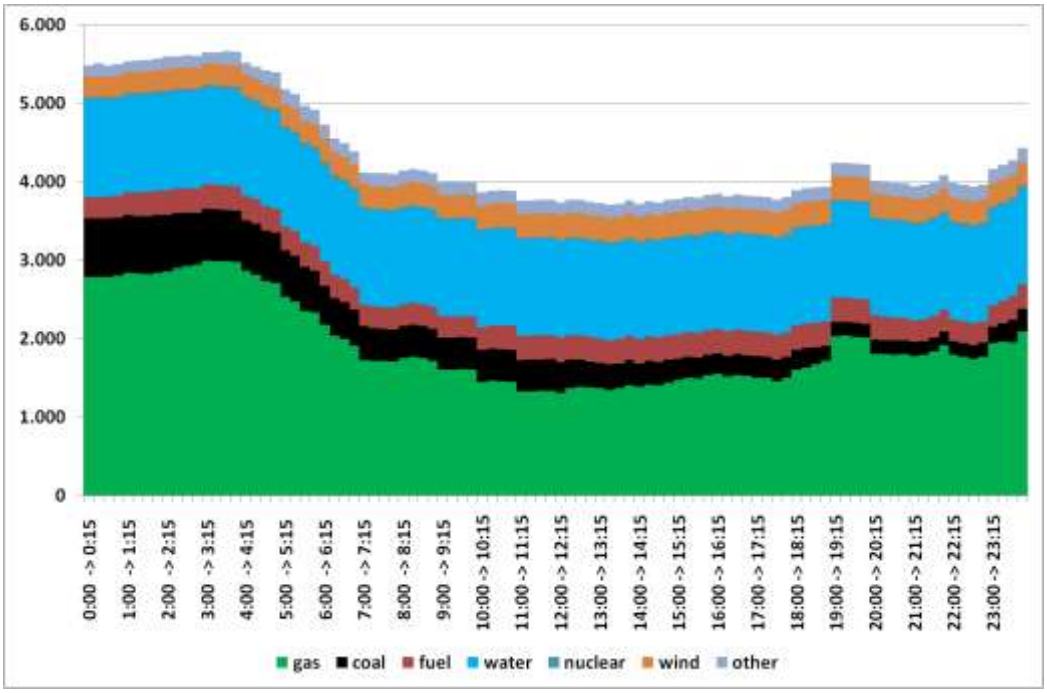


Figure 5: total non-used available production capacity per fuel type in day-ahead foreseen for 28 March 2011 (in MW)

11. The CREG looked at the individual generation units and made 10 fuel categories: 'thermal', 'nuclear', 'biomass', 'run-of-river', 'pumped storage', 'cogeneration', 'incinerator', 'T-power', 'turbojets' and 'wind'. The CREG considers 'thermal', 'nuclear' and 'pumped storage' as manageable whereas the others are not[3]. For 'wind' and 'run-of-river' this is clear. But 'biomass', 'cogeneration' and 'incinerator' are also considered as non-manageable in the sense that other constraints than just the power price drives the decision for production. 'Turbojets' are units that can only be used as reserves (210 MW). T-power (400 MW) was in a testing phase (was available, but did not produce). This gives the following table of non-used capacities per fuel type for hour 8:

type	Pmax	nomination	Pmax-nomination
nuclear	5.922	5.907	16
thermal	4.779	3.376	1.403
pumped storage	1.150	134	1.016
cogeneration	989	816	173
T-power	400	0	400
wind	334	49	285
turbojet	210	0	210
run-of-river	92	24	68
biomass	52	48	5
incinerator	32	32	0

[3] This is an assumption the CREG makes in the scope of this investigation and for reasons of simplicity.

Grand Total	**13.960**	**10.385**	**3.575**

12. This leaves 1.403 MW of non-used thermal capacity that should be explained and 1.016 MW of pumped storage.

13. The non-used thermal capacity can be divided as follows:

    - Part is explained by the necessity of holding reserves (primary, secondary and tertiary): in total, thermal units were providing 453 MW of reserves. So, only 950 MW of thermal non-used capacity should be explained.
    - Four units have a non-used capacity of more than 100 MW; these four units represent a non-used capacity of 733 MW.
    - Without those four units, there is 217 MW of non-used capacity divided over about 15 units.

14. This means the 3.575 MW of non-used capacity essentially breaks down to 4 thermal units with a aggregated non-used capacity of 733 MW and the non-used pumped storage capacity of 1.016 MW.

15. The CREG performed an analysis of the bidding behaviour of Electrabel, SPE and E.ON and of their nomination behaviour on the manageable production units, with special attention for the four units with a non-used capacity of over 100 MW and for the pumped storage. Due to confidentiality, the CREG cannot publish the findings of this analysis. However, the CREG is able to publish some important conclusions.

16. As regards the four units with a non-used capacity of over 100 MW, the CREG concludes sufficient capacity on these units was offered on the market that could have avoided the price spike. This capacity was offered through sell block orders but starting later than hour 8.

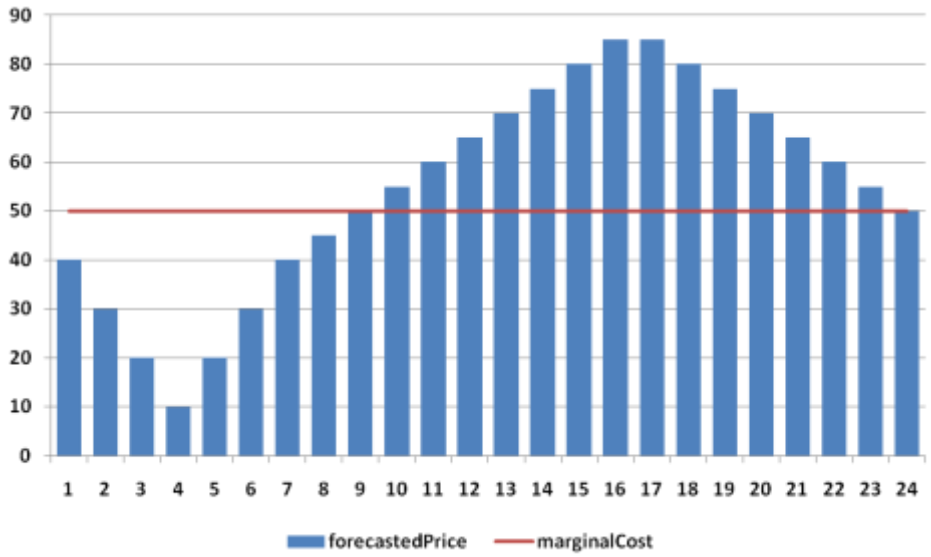
17. The block order is the only bid type that is available for a market party if it wants to sell a thermal unit on the power exchange. Block orders are a static type of order. If prices are badly forecast (as was the case for 28 March due to the decoupling), the use of block orders leads to an inefficient allocation of the scarce resources in day ahead.

18. For the CREG, an important lesson of the event of 28 March is that day ahead power exchanges need additional products that enable the allocation of the scarce resources in the most efficient way even if price forecasts by market participants were badly done (for whatever reason). Now, the optimal allocation in day ahead is only possible when

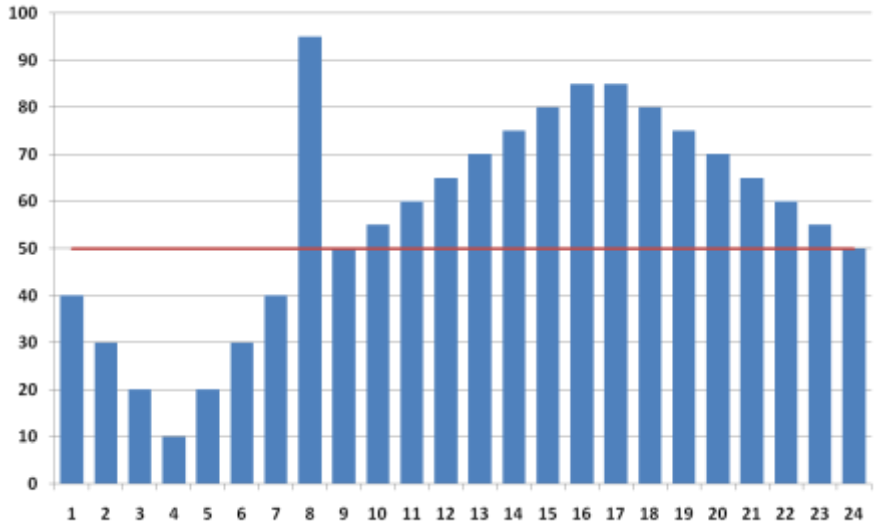
all market parties can forecast prices adequately. But as the event of 28 March clearly illustrates, a perfect price forecast is not always the case. The next example will illustrate why additional products are needed to address bad price forecasts.

19. If a producer wants to sell electricity coming from a generation unit which is not a must-run unit, one will use a block order, since one wants to be sure not to be obliged to switch on and off the unit as prices vary, since switching on and off will lead to additional costs. Optimizing its profit, the producer will have to forecast prices. An example can illustrate this.

- A producer has a unit of 250 MW with marginal cost of 50 €/MWh. The unit is not producing at the moment.
- The producer does the following price forecast.



- Hence, the producer submits a sell block order for hour 9 to 24 at 50 €/MWh for 250 MW.
- However, the clearing prices deviate from the forecasted prices, in the following way.



- The sell block order is selected, but it now (ex-post) looks like the producer is withholding production capacity during hour 8. However, ex-ante, there was no such thing.
- If the producer could be given a second chance (e.g. by a reopening the order book with price information), it could (and should) adjust its sell block bid by letting it start from hour 8 on, instead of hour 9.
- Also, if the producer would be allowed to offer its unit by several mutually exclusive block offers, each with a different starting hour[4], hour 8 would also have been included.

20. In the paragraphs above, it was made clear that a producer needs to use price forecasts if one wants to sell its generation units with start-up costs in the day ahead market. Price forecasts are also needed for selling pumped storage. Ex-post it is easy to see the pumped storage should have been nominated for maximal output during hour 8. However, ex-ante, this price information was not available. If the owner could have had a second chance after the price clearing (e.g. by a reopening the order book with price information), it could (and should) have adjusted its sell limit orders by selling more energy on hour 8 and less on other hours.

21. However, producers who offered their available capacity through sell block orders starting at a time after hour 8, say hour 9, should also have offered this same capacity –if available- through sell block orders starting from hour 1 and ending at hour 8. In this way, producers offer all available capacity, as they are required to do.

[4] Also, possibly at different prices to cope with start-up costs which then need to be paid back during different numbers of hours

22. One could argue that it was most unlikely that capacity offered during hours 1 to 8 would have been sold given the historic prices during these hours, and so producers should not be bothered to offer this capacity. However, the cost of offering this capacity is very little, whereas the potential negative impact is very large: a price spike which does not reflect the supply-demand balance implies not only an incorrect higher price for buyers, but also acts as a signal that the day-ahead power exchange is riskier than one might have thought, given the fundamentals. This makes the day-ahead power exchange less attractive and could drive market players away from the power exchanges to the OTC-market or even away from the Belgian market. Therefore, the CREG urges that producers offer all their capacity (that is not limited in energy) on the day ahead market when it is available, even if it is unlikely the capacity will be sold.

23. As regards the price of 2999 €/MWh, this is explained by the fact that when the order book reopened, a trader wanted to submit a buy order at 3000 €/MWh, but this offer was rejected by its system. Since there was little time, the trader decided to resubmit its bid at 2999 €/MWh; this bid was accepted.

24. Also, there was a lot of interconnection capacity that was not used due to the fact there were not much participants bidding in the shadow auction and there was even less use of the ultimately acquired interconnection capacity through these auctions. Possibly, this low participation can be blamed on the low participation of the market participants due to the fact it was a Sunday. On the other hand, shadow auctions are only efficient when a sufficient number of participants use it. This was not the case on the Belgian borders, nor on the other borders (although on the other borders there seems to be a better use of it). This could be explained by the fact interconnection capacity is only considered a valuable asset if there is price information. Without price information, one could ask why to use interconnection capacity[5]. And in this case, there was no price information, since there was no RfQ. So both low use of import interconnection capacity and low use of pumped storage and other production capacity seem to have the same explanation in this case: no price information.

[5] The single most important reason to have markets coupled, is the fact the coupling algorithm can use all the information that is available to use the available interconnection capacity in the most efficient way. The case for introducing smart bids has the same reasoning and arguments as the case for price coupling.

II. MEASURES

25. In the following section, the CREG will propose corrective measures to improve the functioning of the Belpex DAM towards a more efficient allocation tool in day ahead of the available resources. This section treats the following corrective measures:

    - Improved rules for Request for Quotes (RfQ)
    - Introduction of various types of more sophisticated types of bids ('smart bids')
    - Transparency of production units > 100 MW

    CREG considers these three proposals as indispensable. The first measure is already being implemented by Belpex.

Measure 1 – Improved rules for Request for Quotes (RfQ)

26. As was explained in the previous section, a sufficient capacity was offered on the market which could have avoided the price spike. This capacity was offered through sell block orders but starting later than hour 8. Also, there was more than sufficient capacity on the pumped storage to eliminate the price spike. Because the market parties had no information ex-ante on the price spike on hour 8, they could not adapt their bidding behaviour.

27. Even if a producer has offered all its available generation capacity and even if there are smart bids, an RfQ can be needed if there are clearly human errors that were made. However, this should be exceptional.

28. If there would have been a request for quotes (RfQ), with the information that there was a price spike during hour 8, the market parties would have been able to adapt their block sell orders to sell their thermal units from hour 8 on (or even earlier) and to sell some pumped storage energy.

29. The rules for issuing a Request for Quotes were in line with other CWE markets. Only the price levels for triggering a RFQ were different. Belpex NV now harmonize those price levels. The new price levels are the following: if for at least one hour the indicative market clearing price is lower than -150 €/MWh or higher than 500 €/MWh an RfQ is sent out to all market parties and the market clearing time is delayed.

30. Also, the rules for an RfQ are now applicable in both coupled and decoupled mode.

31. An RfQ is a tool that ideally is not used at all. However, there are several factors that could justify the trigger of an RfQ, like a significant error of a trader or the inefficient

allocation of cross-border capacities.

Measure 2 – Introduction of various types of smart bids

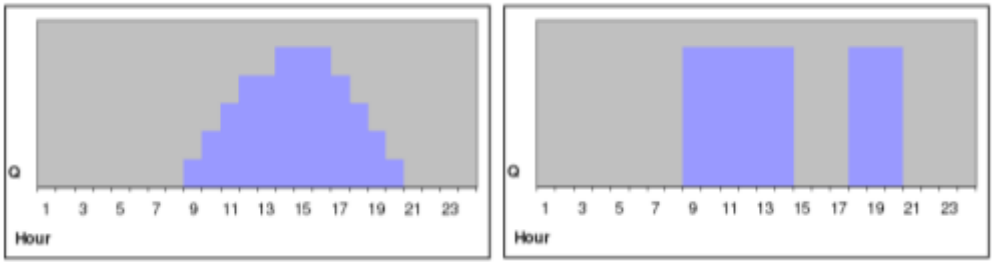
32. At this moment, there is only one type of flexible bid, namely the block bid. If a market party submits a block bid e.g. to sell 200 MW from hour 8 to 24 at 50 €/MWh, than this market party will sell 200 MW during hours 8 to 24 if the average clearing price during these hours is higher than 50 €/MWh. This type of bid allows for an owner of a unit with start-up and shut-down cost to control its risk if she wants to sell the unit on the day ahead market.

33. However, as shown above, for submitting a block order one needs a price forecast. If one is not sure what the price pattern is, one could submit several mutually exclusive block orders. E.g. if one is not sure if prices are going to start rising from hour 8 or from hour 9 on, one could submit two mutually exclusive block orders with the first block starting from hour 8 and the second block starting from hour 9. If the one of hour 8 yields more, than this one is selected and the other abandoned. These kind of bids are, however, not possible yet, although they are feasible.

34. Also, for pumped storage there are types of complex bids which are tailor made for this kind of production. One could submit a sell order (with several constraints such as its Pmax) for a certain amount of energy, say 2.000 MWh, but without specifying a period of the day. The algorithm will than find the most appropriate hours to sell this energy. These kind of bids are, however, not possible yet, although they are feasible.

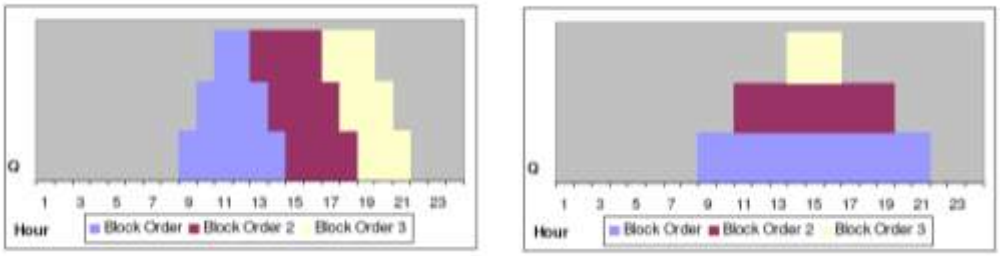
35. There are many more types of smart bids, which are listed hereunder (non-exhaustive). The introduction of smart bids has to be harmonized with the other power exchanges.

    - Already implemented in the market coupling and decoupling algorithm and available for use:
        - ‘Limit order’: bid for 1 hour, with one price and -by definition- a fixed volume; either fully filled or fully rejected
        - ‘Block order’: bid for a period of consecutive hours, with one price and a fixed volume; either fully filled or fully rejected
    - Not yet available for use:
        - ‘Profile block order’: bid for a period of consecutive hours, with one price but with the possibility to have different hourly volumes (also 0 MW); either fully rejected or filled for x%



(source: Belpex)

- ‘Linked block order’: the execution of one (profile) block may be subject to the execution of another block with the possibility to design complex linked structures (i.e.families); this is currently in use at Nordpool.



(source: Belpex)

- ‘Exclusive block order’: out of a group of orders, only one can be executed. This type of order could be used to bid block orders at different starting hours in order to sell production units in the spot market.
- ‘Flexible order’: sale orders for a single hour with a price limit and volume (+ “all or nothing condition”). The hour is not specified, but instead the offer will be accepted in the hour that maximizes total welfare, given that the price is higher than the limit set in the offer. In practice, this means that the order is accepted at the hour with the highest price, if possible. Flexible orders are implemented as hourly orders, but could also be multi-periods (i.e. is a specific construction of exclusive block orders). This is currently in use at Nordpool. This type of order could be used to sell pumped storage in the spot market, although there are types of order who are better tailored for pumped storage (see next).
- ‘Energy order’: include an energy limit on the total of energy sold within the trading period, and optional hourly power limit, but without restrictions about the fact that the order must be executed in full and/or at one hour only. This might mean that the order will be split up over several hours. These orders might be interesting for generation units with energy limitations (e.g. pumping stations …) or industrials who want to do arbitrages on the energy they bought for their own use. These orders

could also be very interesting for consumers, to concentrate purchases over the cheapest hours.

- ‘Storage order’: tailored for pumped storage, with specific restrictions (e.g. efficiency of cycle). The full dispatch of the storage facility is automated in the most efficient way.

36. The introduction of smart bids on the day ahead power exchange will allow for the most efficient allocation in day ahead of the available resources and will strengthen the liberalised market by offering less volatile prices and prices that reflect the true supply-demand balance. Also, the spot price sensitivity will be decreased because e.g. storage orders will look for the highest price and sell electricity during this hour, making the market more resilient. This should increase confidence in the spot market and can attract new players, increasing liquidity. All this would be have a structural impact on the spot market leading to less risk in the spot market. This structural decrease of risk in the spot market could decrease the (positive) risk premium in the forward market leading to lower forward prices, and eventually, to lower prices for end consumers.

37. The introduction of the mentioned smart bids will not avoid price spikes if there is a shortage of supply compared to demand. But these kind of price spikes should be welcomed since they are an important economic signal towards investors. This was certainly not the case for the price spike for hour 8 of 28 March 2011, since it did not reflect a stressed situation at all: there was about 950 MW of thermal capacity unused and about 1.000 MW of unused pumped storage capacity. If the smart bids would have been available and if they would have been used[6], then there would not have been a price spike at all. And this would be the correct reflection of the non-stressed situation for 28 March.

38. A more efficient allocation in day ahead of available resources can be achieved by the introduction of smart bids on the day ahead power exchanges and so CREG supports its introduction. As said above, for the CREG, an important lesson of the event of 28 March is that power exchanges need smart bids that enable the allocation in day ahead of the scarce resources in the most efficient way, even if price forecasts by market participants were badly done.

Measure 3 – Transparency of production units > 100 MW

[6] Note that if smart bids are available but not used by the market parties who should use them, this could be regarded as a practice of withholding generation capacity.

39. The CREG also advocates more transparency in the generation market. Market players only had aggregated and therefore insufficient information on the non-used generation capacity the Belgian TSO publishes. Elia should publish the per unit information on the ex-ante unavailability of generation units with a capacity higher than 100 MW. A non-exhaustive list of these units can be found in annexe 2 of this study. This publication should be done on the website of Elia.

40. Elia has all the necessary information to pursue this publication.

III. CONCLUSIONS

1. Principal conclusion

41. Due to a bug in the price coupling algorithm with regard to the date calculation during 27 March 2011, the Belpex DAM was operated in isolation for 28 March 2011. This lead to a price spike for hour 8 of 28 March 2011 of 2999 €/MWh. Also during other hours for 28 March, prices were higher than normal.

2. Additional conclusions

42. The CREG focused on the dispatching and bidding behaviour of the three largest producers in the Elia-control area: Electrabel, E.ON and SPE. During hour 8 there were 733 MW on 4 available manageable thermal units that was not used. However, the CREG concludes sufficient capacity on these units was offered on the day ahead market that could have avoided the price spike. This capacity was offered through sell block orders but starting later than hour 8. Also, about 1000 MW of pumped storage capacity was not used during hour 8. The fact that pumped storage and the four thermal units were not offered or used during hour 8 can be explained by the fact the price outcome of hour 8 was not expected by the market participants (see the graphs on pages 9 and 10). The introduction of more sophisticated types of bids ('smart bids') can avoid that capacity is not offered because market participants did a bad price forecast.

43. The outcome of the analysis clearly shows the electricity system was not under stress. This means the price on 28 March did not reflect the real balance between available production capacity and demand. The absence of a Request for Quotes and the absence of smart bids prevented a efficient allocation in day ahead of the available resources. With a proper use of smart bids and/or with a proper use of a Request for Quotes, the price spike would not have occurred.

3. Measures

44. Belpex has already introduced new rules on the use of Request for Quotes. The rules are now in harmonization with the coupled pricing zones and are also applicable on Belpex DAM when the markets decouple.

45. For the CREG, an important lesson of the event of 28 March is that power exchanges

need smart bids that enable the allocation in day ahead of the scarce resources in the most efficient way, even if price forecasts by market participants were badly done (for whatever reason). Now, the optimal allocation in day ahead is only possible when all market parties can exactly forecast prices. However, as the event of 28 March clearly illustrates, a perfect price forecast is not always the case.

46. Also in normal conditions, smart bids would lead to a more efficient allocation of available resources. This would in turn lead to a spot market that would be more resilient and less volatile. This would favour a decrease of risk in the spot market, potentially leading to a lower risk premium in the forward market. Finally, this would lead to lower prices for end consumers. Therefore, the CREG strongly supports an accelerated implementation of the various types of smart bids, especially the smart bids that are tailor made for pumped storage and for generation units with start-up and shutdown costs.

47. The introduction of smart bids will take some time. In the mean time, the CREG urges that producers offer all their capacity (that is not limited in energy) on the day ahead market when it is available, even if it is unlikely the capacity will be sold.

48. Besides the implementation of smart bids, the CREG also advocates more transparency in the generation market. Market players only had aggregated and therefore insufficient information on the non-used generation capacity the TSO publishes. Elia should publish the information on the ex-ante unavailability of generation units with a capacity higher than 100 MW. A non-exhaustive list of these units can be found in annexe 2 of this study. This publication should be done on the website of Elia.

49. The CREG will send this study to the regulators of the CWE-region, as well as to the Belgian Competition Authority.

For the Commission for Electricity and Gas Regulation:

Dominique WOITRIN
Director

François POSSEMIERS
Chairman of the Management Board

ANNEXE 1

27 March 2011 CWE Incident

Public message to the market parties by

ANNEXE 2 – TRANSPARENCY: NON-EXHAUSTIVE LIST OF GENERATION UNITS

nr	ARP	Generation plant	Type	Max. Power (MW)
1	Electrabel	Amercoeur 1 R TGV	CCGT	420
2	Electrabel	AWIRS 5	CL	294
3	Electrabel	Belwind Phase 1	WT	165
4	Electrabel	COO I T	HU	474
5	Electrabel	COO II T	HU	690
6	Electrabel	DOEL 1	NU	433
7	Electrabel	DOEL 2	NU	433
8	Electrabel	DOEL 3	NU	1.006
9	Electrabel	DOEL 4	NU	1.038
10	Electrabel	DROGENBOS TGV	CCGT	460
11	Electrabel	ESCH-SUR-ALZETTE STEG	CCGT	376
12	Electrabel	EXXONMOBIL	WKK	140
13	Electrabel	HERDERSBRUG STEG	CCGT	460
14	Electrabel	KALLO 1	CL	261
15	Electrabel	Knippegroen	CL	305
16	Electrabel	PLATE TAILLE T	HU	144
17	Electrabel	RODENHUIZE 4	CL	268
18	Electrabel	RUIEN 3	CL	130
19	Electrabel	RUIEN 4	CL	122
20	Electrabel	RUIEN 5 + REPOWERING	CL	333
21	Electrabel	RUIEN 6	CL	294
22	Electrabel	SAINT-GHISLAIN STEG	CCGT	350
23	Electrabel	TIHANGE 1N	NU	481
24	Electrabel	TIHANGE 1S	NU	481
25	Electrabel	TIHANGE 2	NU	1.008
26	Electrabel	TIHANGE 3	NU	1.046
27	Electrabel	Zandvliet Power	CCGT	395
28	Enel Trade	Marcinelle Energie (Carsid)	CCGT	410
29	EON Energy Trading SE	LANGERLO 1 + REPOWERING	CL	278
30	EON Energy Trading SE	LANGERLO 2 + REPOWERING	CL	278
31	EON Energy Trading SE	VILVOORDE TGV	CCGT	385
32	RWE Supply & Trading	INESCO WKK	CCGT	133
33	SPE	ANGLEUR TGV3	CCGT	110
34	SPE	RINGVAART STEG	CCGT	357
35	SPE	SERAING TGV	CCGT	460
36	T-Power	T-power Beringen	CCGT	422