Documentation of the CWE FB MC solution as basis for the formal approval-request (Brussels, 9th May 2014)

Annex 16.13 Intuitiveness Analysis for the FB/FB(I) selection

Assessment Intuitive FB

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Creation

Version	Date	Name
1.0	April 1st, 2014	FBVTF

Approval

Version	Date	Name
1.0	May, 5th, 2014	CWE JSC

Distribution

Version	Date	Name

Previous versions

Version	Date	Author	Summary of changes

Location

Reference documents

CWE Enhanced Flow-Based MC feasibility report, Version 2.0 ("Feasibility report")	http://www.casc.eu/media/CWE%20FB%20Publications/CWE_FB-MC_feasibility_report_2.0_19102011.pdf
Intuitiveness report	http://www.casc.eu/media/CWE%20FB%20Publications/CWE_FB-MC_intuitiveness_report_Oct2013.pdf

EXECUTIVE SUMMARY

Within the CWE FB project two alternative market coupling modes are considered, namely FB "plain" and FB "intuitive". The difference is that under FB "intuitive" additional constraints are, when needed, added to the market coupling, forbidding exchanges from a high priced area to a low priced area, even in case this would result in higher day-ahead market welfare.

To support a decision for either of the alternatives, this documents aims to assess the merits of either alternative along a number of criteria. Where possible these criteria area assessed quantitatively using results from the FB parallel run of 2013.

An overview of the findings is provided in the table below.

Criterion	In favour of FB "plain"	In favour of FB "intuitive"
Volatility	inconclusive	
Price Signal	Negligible difference	
Liquidity	resilience analysis: inconclusive	
Welfare (global)	Unknown	Unknown
Welfare (DAMW)	X (though relatively small)	
Welfare repartition	No statistically significant difference	
ID	X (considering DA capacity should not be allocated to ID)	X (considering ID capacity is higher; mitigates DA welfare loss)
Investment	inconclusive	
SoS	inconclusive	
Communication to general public	Potential challenges for both alternatives	

Contents

Glossary

ATC	Available Transfer Capacity
CB	Critical Branch
CWE	Central Western Europe
DA	Day Ahead
FB	Flow Based
FBI	Flow Based "intuitive"
ID	Intraday
LT	Long Term
MCP	Market Clearing Price
MCV	Market Clearing Volume
UIOSI	Use It Or Sell It

1 Context

Within the CWE FB project two alternative market coupling modes are considered, namely FB "plain" (thereafter called FB) and FB "intuitive" (thereafter called FBI). The difference is that under FB "intuitive" additional constraints are added to the market coupling, forbidding exchanges from a high priced area to a low priced area, even in case this would result in higher welfare.

A broad and objective report analysing all aspects related to this question has already been published by Project Partners[1].

To support a decision for either of the alternatives, this documents aims to assess the merits of either alternative along a number of criteria. Where possible these criteria area assessed quantitatively using results from the FB parallel run of 2013.

[1] http://www.casc.eu/media/CWE%20FB%20Publications/CWE_FB-MC_intuitiveness_report_Oct2013.pdf

2 Assessment “plain” and “intuitive” flow based

In the following sections we will explore the effects the “intuitive” patch has on market outcomes, compared to the “plain” application of flow based market coupling. The criteria we will monitor are:

1. Frequency and occurrence of non-intuitive flows;
2. Impact on volatility;
3. Impact on price signal;
4. Impact on liquidity;
5. Impact on global welfare and welfare repartition;
6. Impact on intraday;
7. Impact on investment decisions and Security of Supply
8. Communication of results

2.1 Frequency and occurrence of non-intuitive flows

Looking back at the 2013 parallel run we can observe that under FB “plain” 421 hours resulted in non-intuitive situations. Out of the 307 days of parallel run results this corresponds to 5.7% of the time. When we only consider the congested hours (since this is a pre-condition for non-intuitiveness) we find that 8.2% of the time congested hours led to non-intuitive results.

The fact that 5.7% of the hours are affected does not suggest a preference for either alternative. It merely suggests that 5.7% of the hours are affected and any choice cannot be made lightly, since a significant amount of prices will be affected.

Finally we note that there is a bias in the areas involved. If we define the areas involved as:

- The largest set of areas with the highest prices such that all areas of the set are exporting;
- The largest set of areas with the lowest prices such that all areas of the set are importing;

We find that BE and NL are frequently involved (140 and 113 hours respectively), whereas DE and FR are less frequently involved (65 and 13 hours). This supports an earlier observation from the intuitiveness report: larger areas tend to have less extreme flow factors due to averaging effects. If an area has the most extreme (i.e. largest or smallest) flow factor of an active CB, it can more effectively relief congestions, and end up involved in non-intuitive situations.

2.2 Impact on volatility

A first aspect when looking into the impact the "intuitiveness" patch may have on prices is looking at the volatility: the amount by which prices may change over time. Before looking at the data we need to define a statistical indicator.

We start by introducing the concept of velocity, defined as the relative (to the base load price) change for an hourly instrument:

$$v_d^h = \frac{mcp_d^h - mcp_{d-1}^h}{\left|\overline{mcp_d}\right|}$$

And we define volatility as the standard deviation over our full set (307 days) of velocities:

$$volatility_h = \sqrt{\frac{\sum_{d \in D}\left(v_d^h - \overline{v^h}\right)^2}{|D|-1}}$$

We applied this statistic to both the flow based "plain" (FB) and flow based "intuitive" (FBI) results and looked at the difference with the ATC results. The results are illustrated in Figure 1, Figure 2, Figure 3 and Figure 4. Positive values imply larger volatility under FB/FBI than ATC whereas negative numbers imply the ATC had a larger volatility.

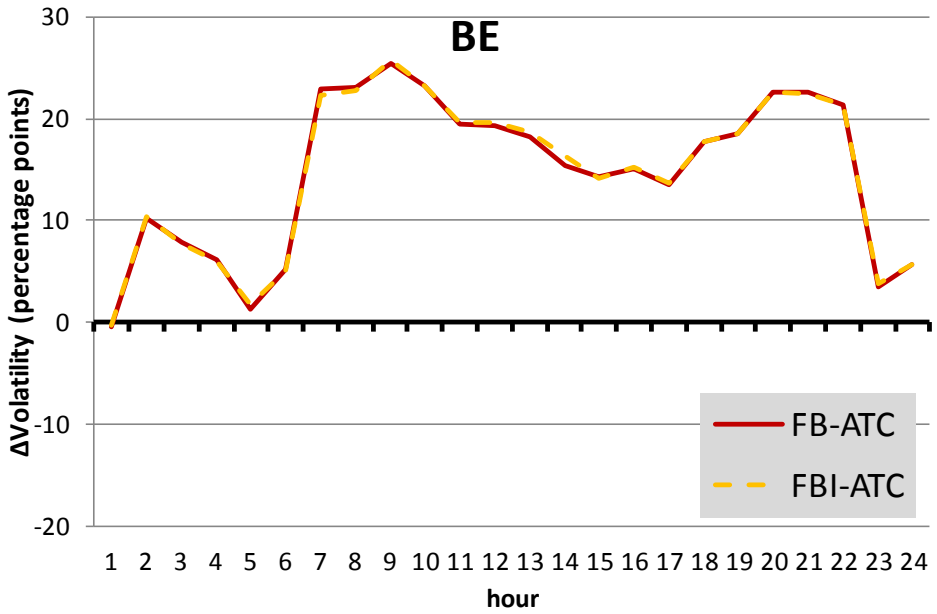


Figure 1 volatility BE

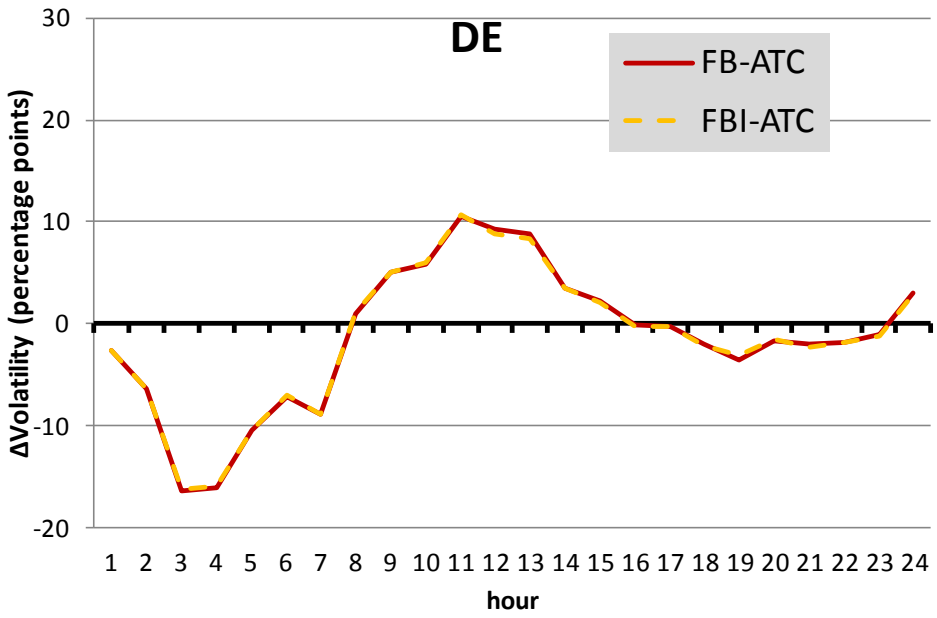


Figure 2 volatility DE

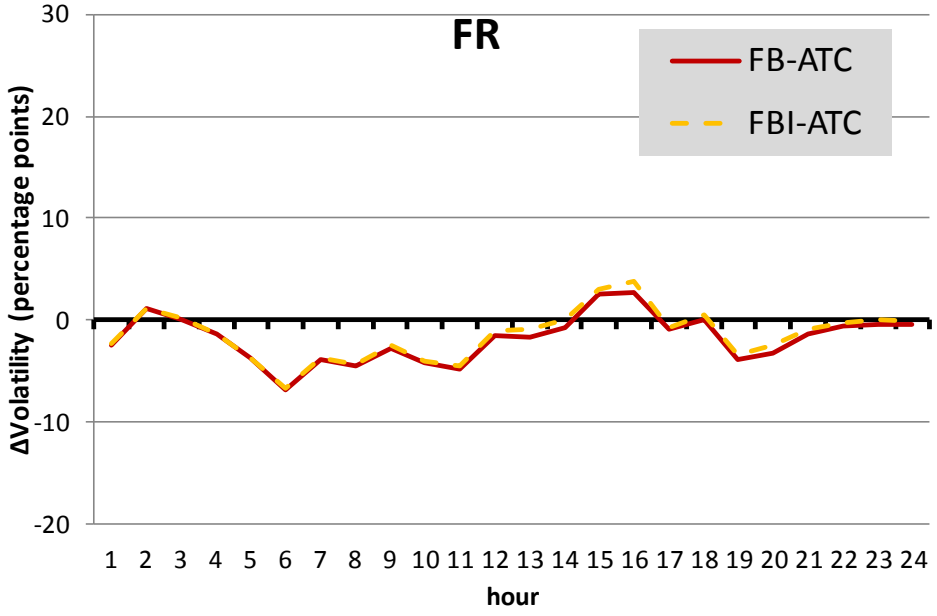


Figure 3 volatility FR

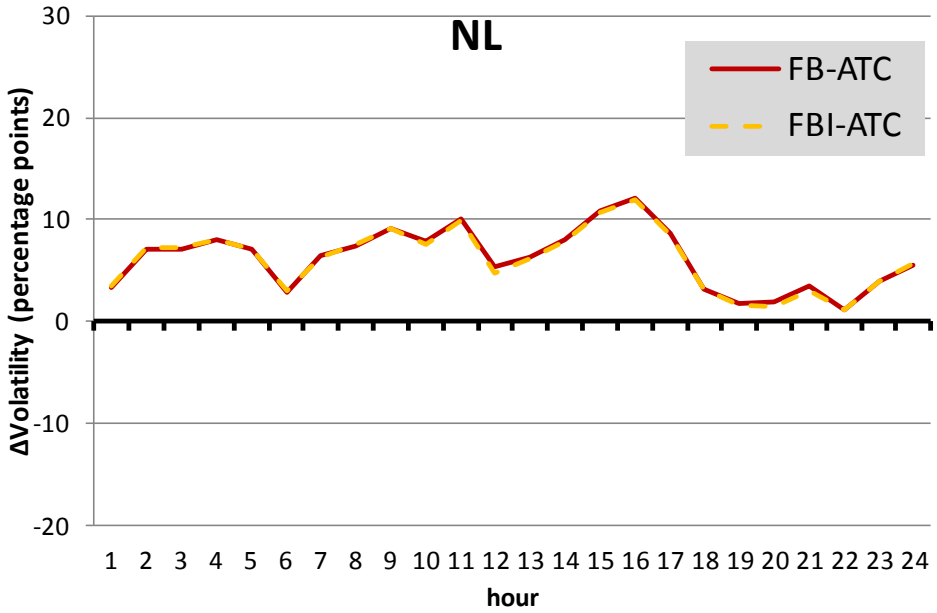


Figure 4 volatility NL

Observations

Perhaps what strikes first is that for BE and NL this volatility indicator goes up when switch from ATC to either FB or FBI. However the interest in this text is to compare FB "plain" and FB "intuitive", and we conclude there is very little difference between the two, especially compared to the change with ATC. The largest differences between FB and FBI can be observed for France, where some individual hours see slightly larger volatility under FB "intuitive". Again when contrasted with the change between FB and ATC this change seems insignificant.

Perhaps since for the majority of hours there is no difference between FB and FBI results, it should not surprise us to see this reflected in the volatility indicators: little difference is observed. Hence when considering highly aggregated indicators, such as the one for volatility, we observe no discernible difference between the two alternatives.

2.3 Impact on price signal

In order to assess how pricing under FB "plain" and FB "intuitiveness" are affected we consider some indicators that should capture this. We consider some more aggregated indicators:

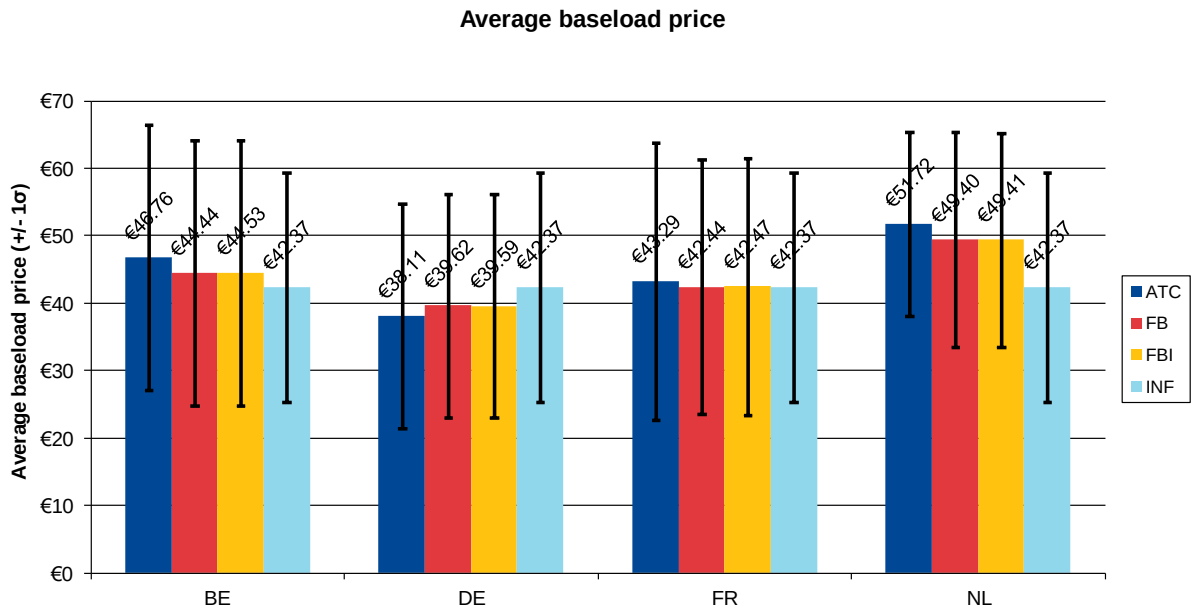
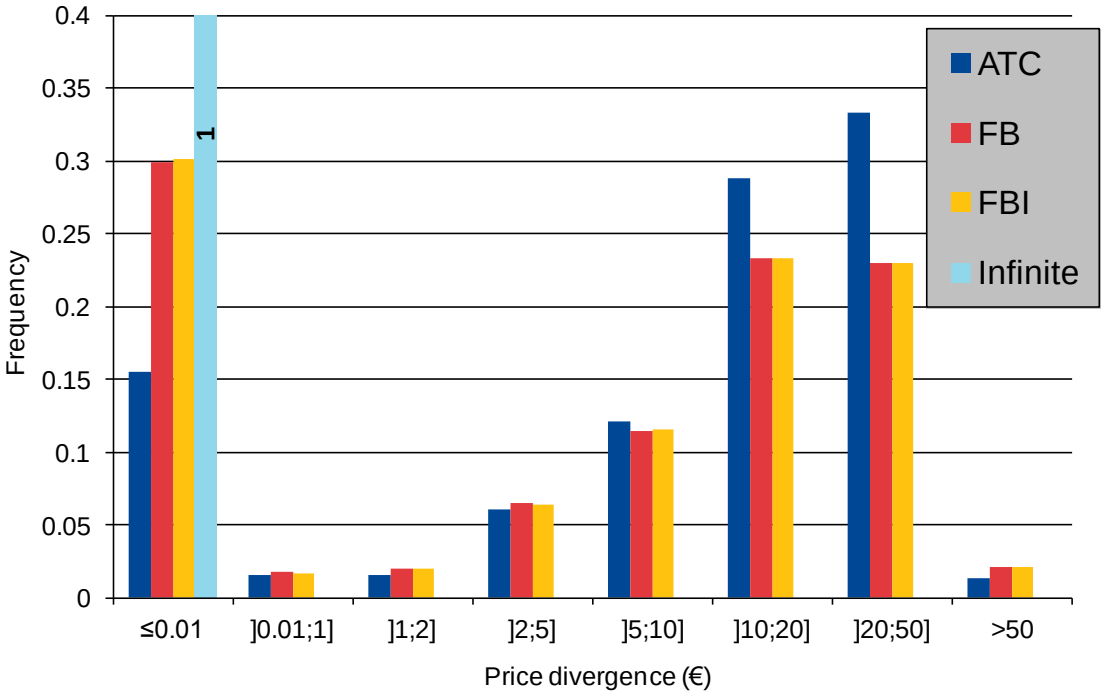


Figure 5 overall base load prices

For the base load prices over all data from the parallel run there appears to be little difference between FB and FBI. BE experiences the largest difference: FB results are € 0.09 lower the FBI results. The differences compared to the standard deviations are too small though to draw statistically relevant conclusions from.

We consider the price spreads results:

Distribution of price divergence (highest - lowest CWE price)



For most hours the price differences between the highest and lowest priced CWE area is comparable between FB and FBI.

The two above indicators did not show any material difference between FB and FBI. The indicators presented here were highly aggregated indicators, not revealing the differences for individual hours. In section 2.8 we will explore individual cases in some more detail.

2.4 Impact on liquidity

To assess the impact between FB "plain" and FB "intuitive" on liquidity we consider the impact the two models can have on resilience: if one or the other is resulting in less market resilience we would consider this an indication of an adverse effect on liquidity.

The resilience study consists in adding buy (resp. sell) base load bids at the maximum (resp. minimum) price and to study the impact on prices. In a given situation, the more resilient method is the one for which the price change is lower. This study has been done on available dates from the 2013 parallel run.

To summarize the findings, the X^{th} centile of the price difference (change in price due to the additional volume) is computed . For example, if the 90th percentile of the price difference after the addition of a 1000 MW buy order is 6 €/MWh, it means that, in 90% of situations, the price difference is lower than 6€/MWh and in 10% of situations, the price difference is larger than 6 €/MWh. For sell orders, the definition is reversed: if the 90th percentile is -6 €/MWh, it means that, in 90% of situations, the price difference is larger than -6 €/MWh (i.e. lower in absolute value).

We focus on the 90^{th} and 97.5^{th} percentiles: these levels are somehow more stringent than the level used in usual market resilience analysis . Indeed, the indicator ordinarily used is the average price difference over all situations. It explains why the price difference are higher in this report than in usual studies. The advantage of using indicators based on high centiles is that it focuses on the most sensitive situations only. Indeed, the resilience should be evaluated on highly tensed situations, whereas averaging over all situations damps the strong effect of highly congested situations with the mild effect of "copper-plate" situations.

Results are given in Figure 6 and Figure 7. We note that the differences between FB and FBI are small, but if anything resilience might be slightly better for FB "plain" for at least the BE market and to a lesser extent FR.

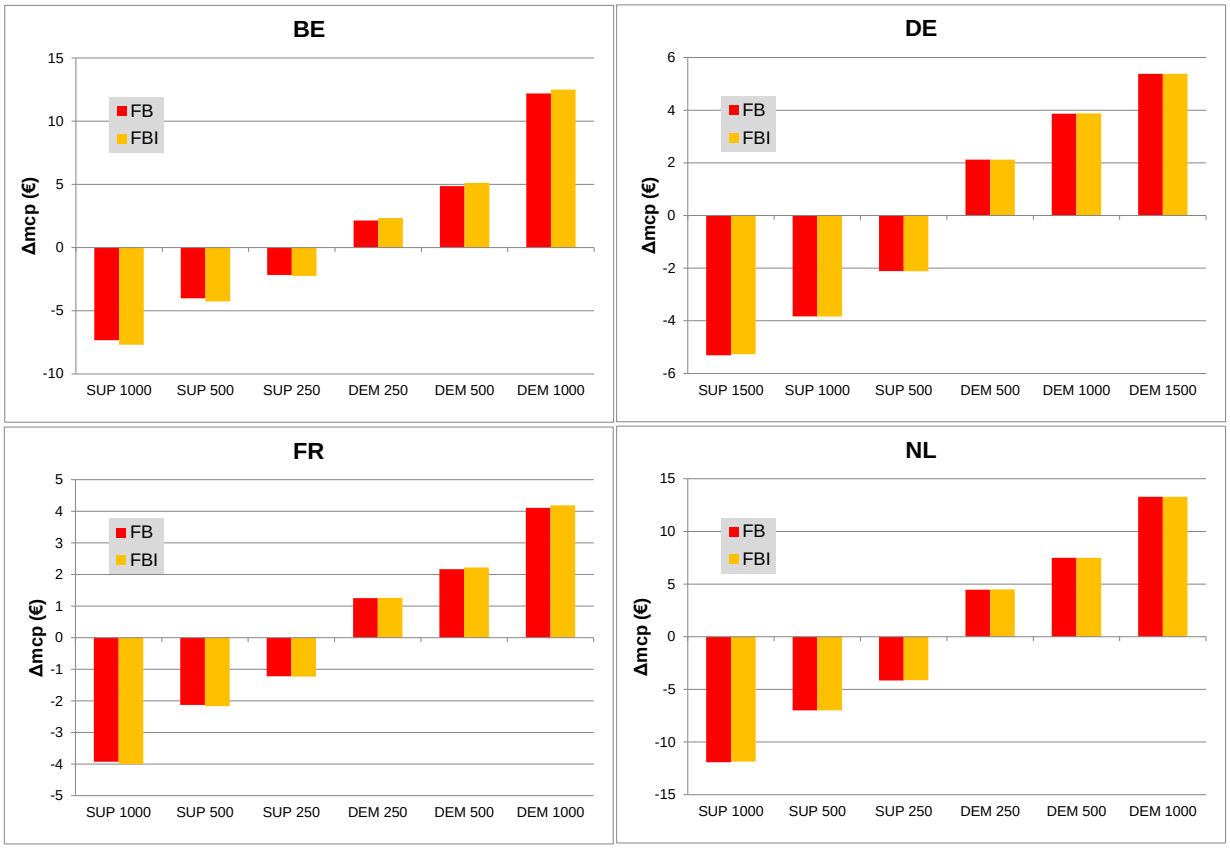


Figure 6 Resilience per bidding area at 90% in €/MWh

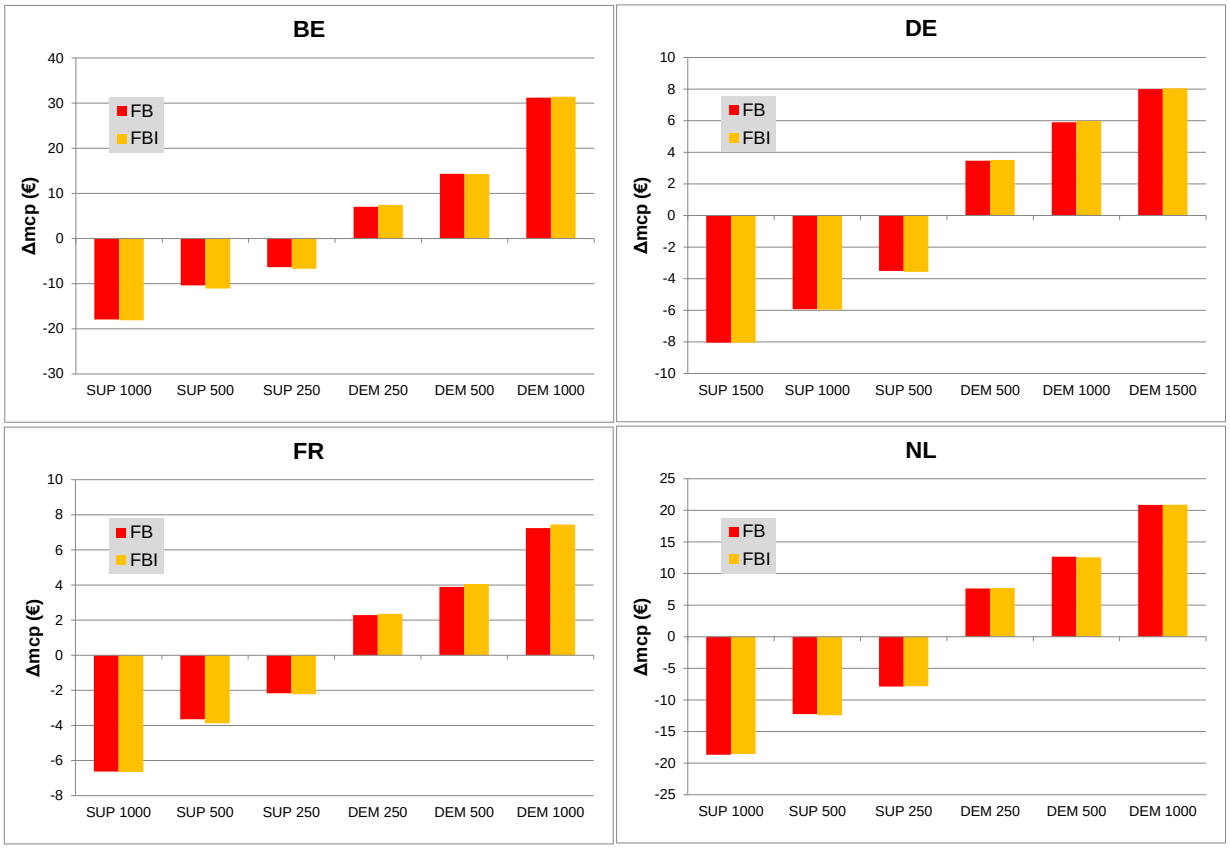


Figure 7 Resilience per bidding area at 97.5% in €/MWh

2.5 Impact on welfare and repartition of welfare

We need to distinguish between "real social welfare" on the one hand and the "Day-Ahead Market Welfare" (DAMW) on the other hand. Only the second is optimized in capacity allocation.

As a general concept, the social welfare is the total wealth generated by the energy community as a whole. "Real" welfare is thus the difference between all the incomes generated via the entire energy market (sell of power for producers, purchase thereof for industrials and end-consumers, revenues of grid owners, etc…) minus all the costs incurred because of it (cost of fuel, investment and operation of generation and transmission assets, grid losses and congestions management, security measures, specific risk premiums and hedging, transactions, etc…).

In the more restrictive definition of the standard model, social welfare is limited to the gains from trading on a particular market, that is, the sum of the differences of the order prices and the clearing prices, scaled by the volumes of the bids. This is the welfare as computed by COSMOS/Euphemia, here called DAMW.

The challenge of welfare computation as an objective criterion for choosing capacity calculation methods hence consists in defining the appropriate elements to be taken into account besides DAMW and their respective computation methodologies in order to choose the best capacity calculation and allocation method.

The difference between "plain" FB and "intuitive" FB is that "intuitive" adds constraints that energy exchanges between high and low priced areas are excluded. Therefore in the welfare optimization of the market coupling the resulting welfare figures will by definition be lower under "intuitive" FB, i.e. using DAMW as a criterion will favour "plain" FB over "intuitive" FB. This indeed is confirmed when looking at the parallel run results: FB "intuitive" resulted in 1.5M€ less welfare than FB "plain", which represents 2% of the welfare gain relative to ATC.

Since only the DAMW figures are available from the parallel run simulation, we will further explore these, focussing also on the repartition of welfare. Furthermore when assessing congestion rents we have to account for the resale costs (costs from UIOSI from not nominated LT rights). Since we use 2013 data and the LTA inclusion was not yet enforced during this period, those periods where LTA was outside the FB domain have been discarded from the analysis. For the remaining hours we could work out the allocation of congestion rents to different areas, and retrieve the distribution of welfare per area. The results are presented in Figure 8.

The chart illustrates the difference between FB "plain" and FB "intuitive" results. Positive values correspond to situations where FB "plain" yields more welfare, negative when FB "intuitive" yield more welfare. We can see a transition of welfare between buyers and sellers within each market: if prices go up sellers benefit, buyers are disadvantaged, if prices go down the situation is inverse. The blue line accrues the welfare from its different components. Since the changes in welfare are relatively small, but fairly volatile from one day to the next, the differences do not indicate a statistically significant direction.

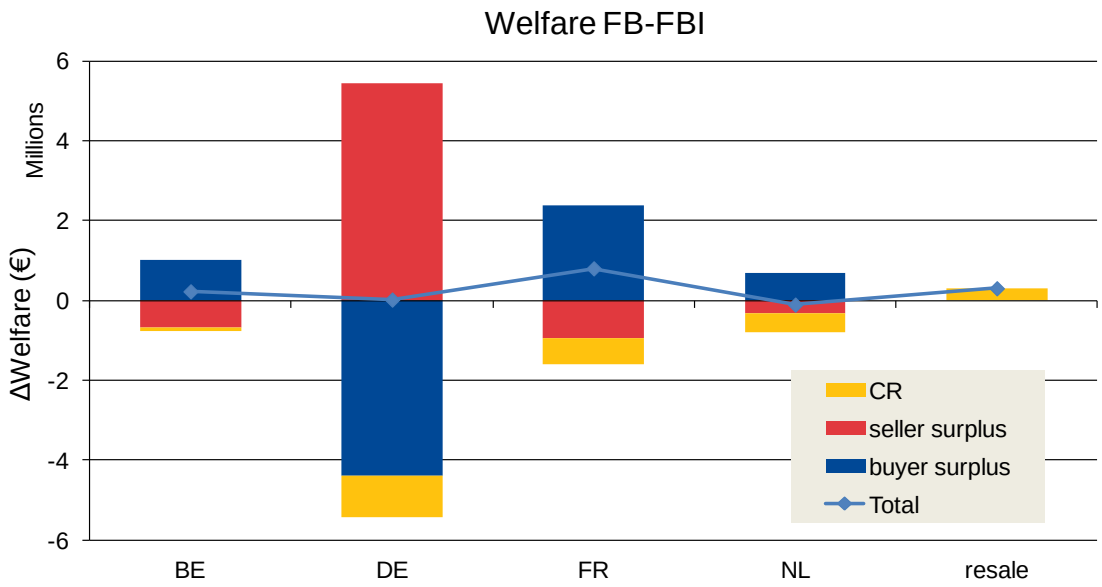


Figure 8 Distribution of DA market welfare per area

The distribution effects appear larger in DE than in the other markets. Bear in mind this is mainly due to the larger market depth in DE: a change in price suggests a transition of welfare from sellers to buyers (or vice versa) across the entire market. We can contrast Figure 8 by scaling the same figure by the market clearing volume for the parallel run period:

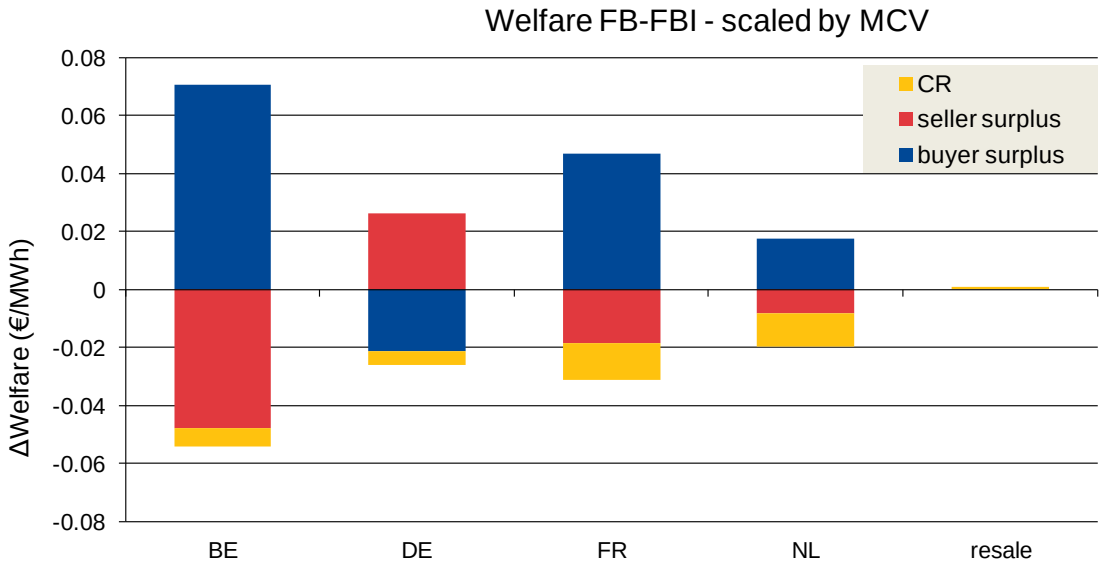


Figure 9 Distribution of DA market welfare per area scaled by market clearing volume

The disparity of welfare allocation is reduced, and in fact the impact on DE seems to be below, rather than above average.

Conclusion

We cannot measure the actual welfare, and instead focussed in the section on DA market welfare. We know from theory that FB "plain" is superior to FB "intuitive" and for 2013 the difference was 1.5M€, or 2% of the welfare gain from ATC to FB "plain".

When assessing the reparation of the welfare between FB "plain" and FB "intuitive" we effectively explored how the 1.5M€ was allocated across the 4 markets. Because this repartition changes day by day, no statistically significant pattern emerged.

2.6 Impact on ID

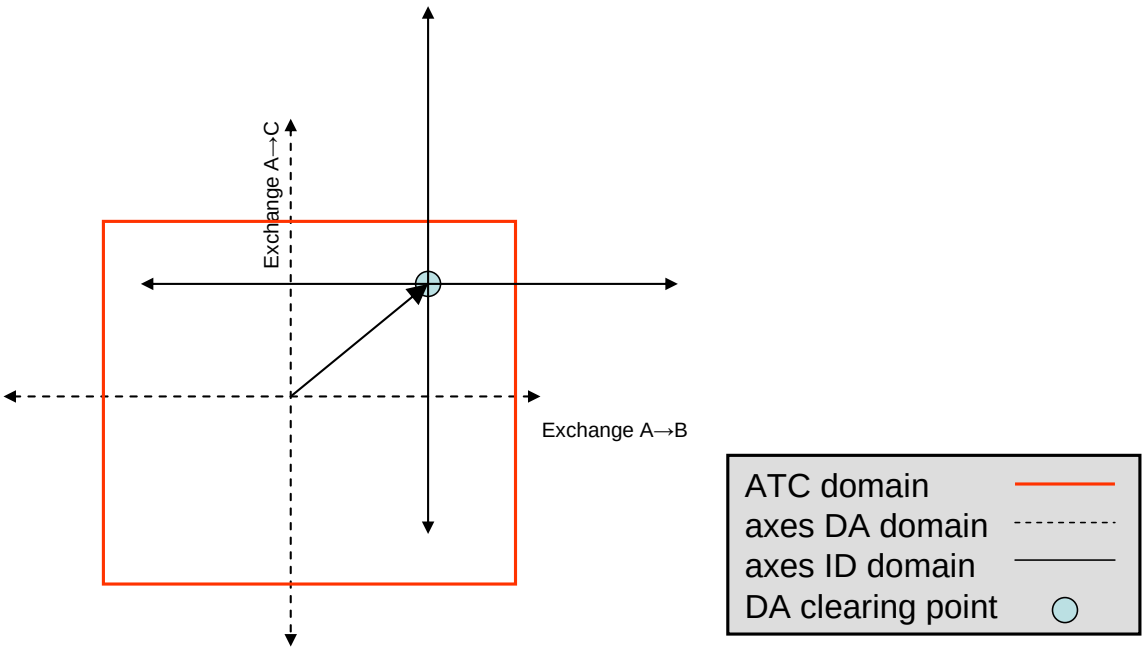
Calculation of ID ATC

To assess the impact on the intraday capacities we have limited our study to the "intial ID domain", i.e. the ID capacity that is available directly after the DA stage, i.e. the remainder of the DA. Under ATC for a connection A→B this would be:

$$ATC^{ID}_{A\to B} = ATC^{DA}_{A\to B} - bex^{DA}_{A\to B} + bex^{DA}_{B\to A}$$

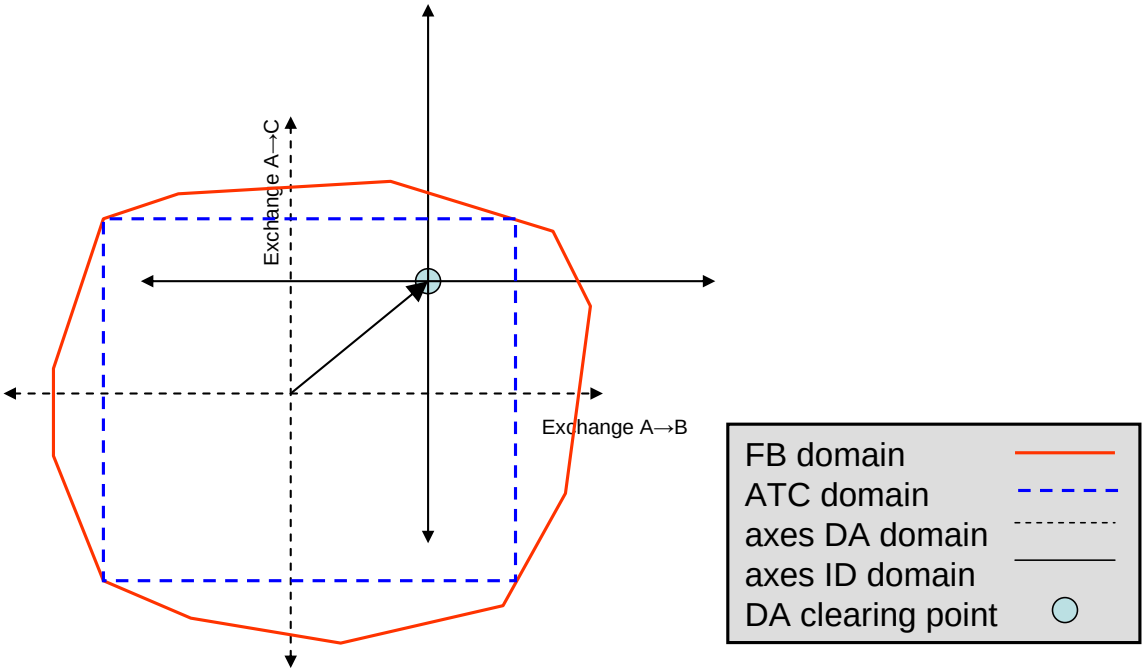
$$ATC^{ID}_{B\to A} = ATC^{DA}_{B\to A} - bex^{DA}_{B\to A} + bex^{DA}_{A\to B}$$

The A→C and C→A directions follow analogously. Graphically it is perhaps easier illustrated:



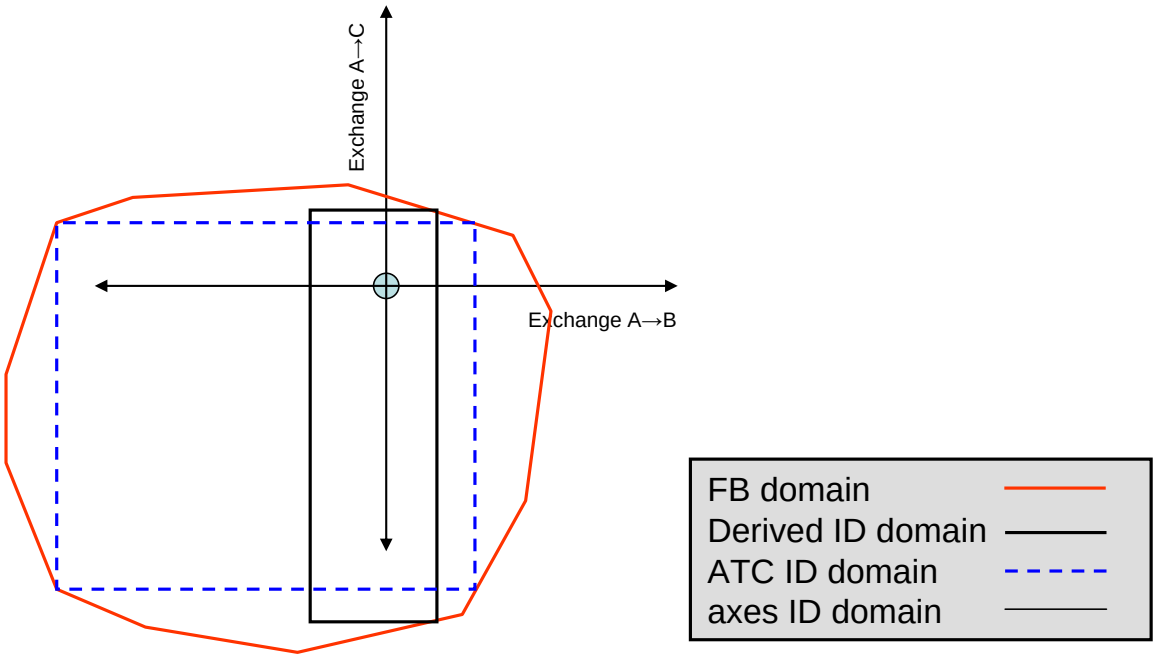
From the graphical illustration it is immediately apparent that the ATC domain remains as is, but rather the axes translate to a new origin, namely the DA clearing point.

For FB the situation is not different: the FB domain remains as is, and the axes translate:

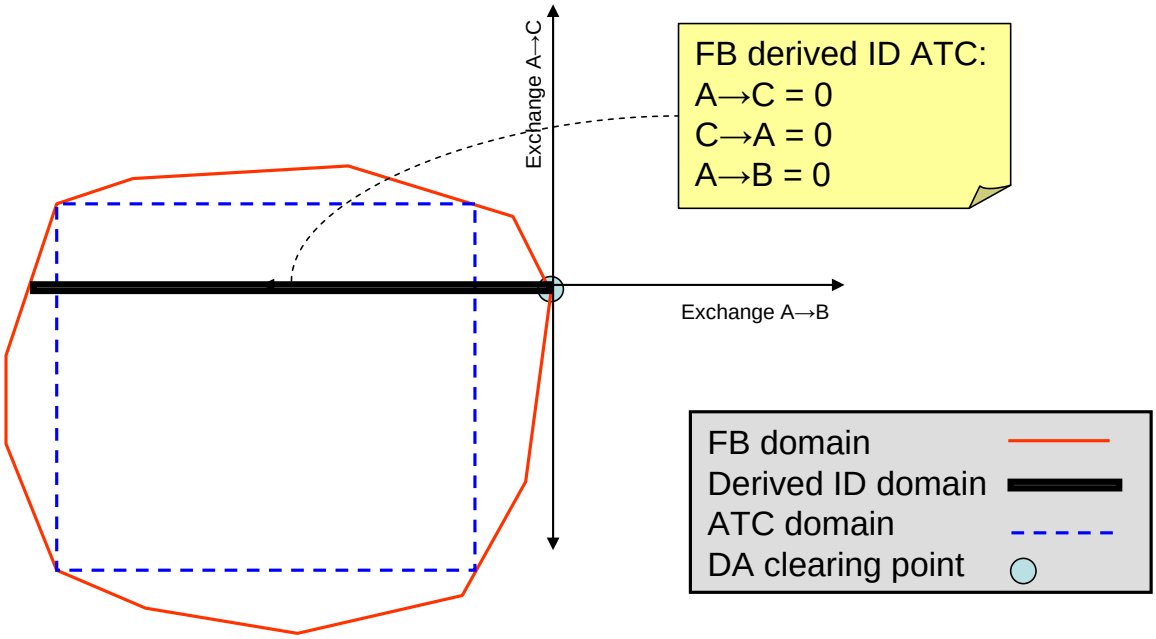


But this would yield an ID **FB** domain, whereas an ID **ATC** domain is required. Hence an algorithm was devised to derive an ATC domain from this FB domain for ID. This algorithm is described in section 2.6.3 of the feasibility report and chapter 4.4 of the approval document at hand.

The idea is to distribute the remaining margin across the different borders. A possible outcome of the ID ATC domain is graphically indicated below. Please note for illustrations purposes the difference between the ATC ID domain and the ATC ID domain derived from the FB domain has been exaggerated.



But what can happen in FB, but not in ATC is that the DA solution is at a corner point of the FB domain that is not feasible under ATC, but is under FB. Cf. illustration below. What's more is that for this point any further exchange A→C and any further exchange C→A would move outside the FB domain. I.e. both ID ATC A→C and C→A must be zero. This is new to FB and is not possible under ATC. The enduring solution for this problem would be to implement FB in ID too. In the short run where ID ATC domains are derived from the DA FB domain this artefact is an unavoidable consequence.



Assessing ID capacity

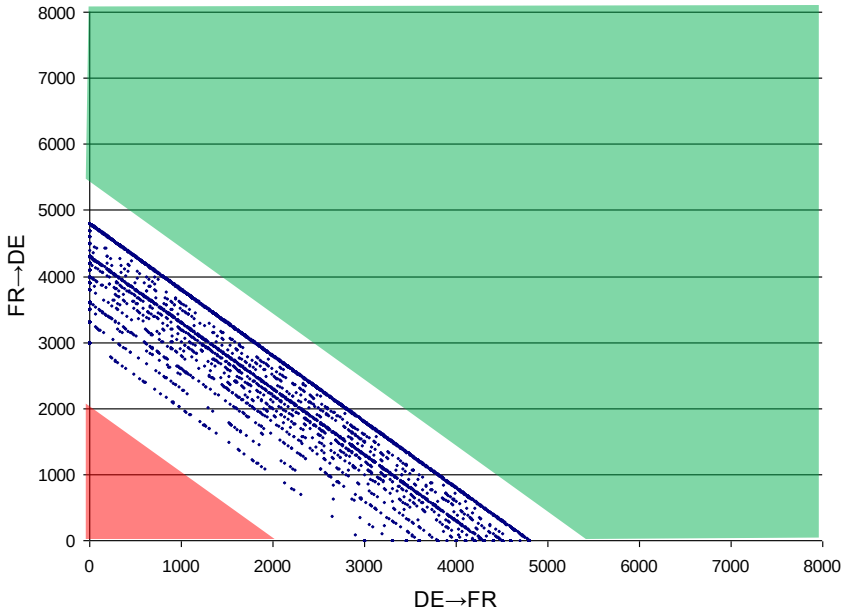
Data

The data used in this section are 2013 ID ATCs derived from the FB domain using either the FB or FBI clearing points. To make a comparison against DA ATC, the initial ID ATC domain was used, i.e. the remaining ATC domain.

FB vs ATC

The focus of this paper is to compare FB "plain" with FB "intuitive". First we have a short intermission looking at FB and ATC ID capacities, to better illustrate the materiality of the aforementioned point that ID capacities can be zero in both directions.

ATC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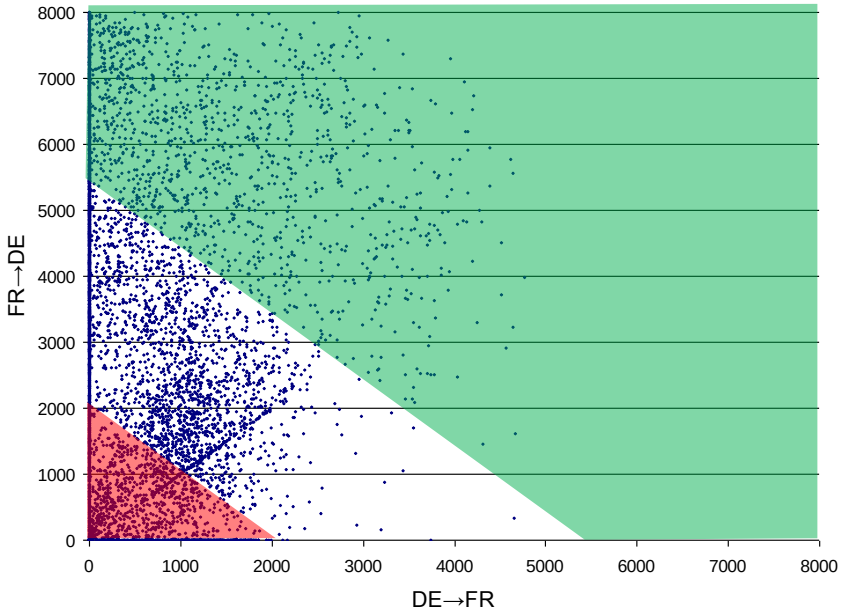
FB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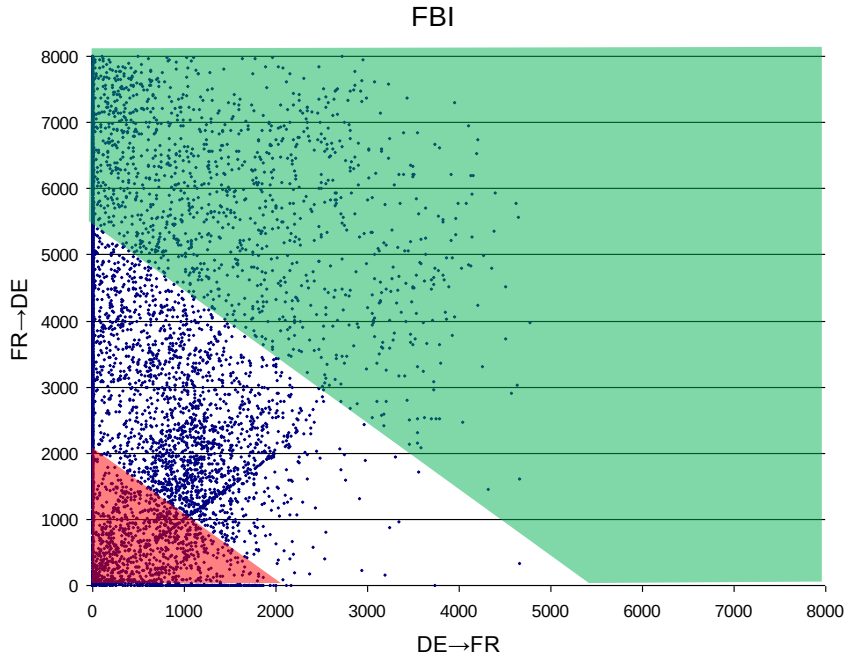


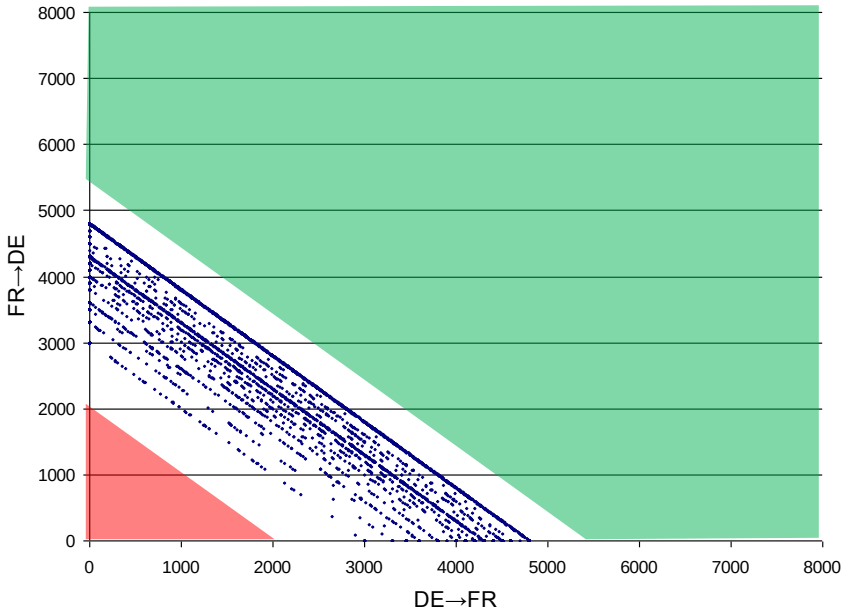
Figure 10 illustrates the remaining ID capacity after DA for the DE-FR border by means of a scatter plot. The axes of the plot are the capacity in the directions DE→FR and FR→DE. For the ATC values we recognize sloped lines: for each point the sum of the DA ATCs of both directions remains unchanged, but is differently allocated across the borders. The lines form, because the ATC values are fairly static: different days / hours had similar NTCs. For ID we have a guarantee that if capacity is not available in one direction (because fully used in DA), it will become available in the opposite direction.

Caveat

It is important to note that a direct comparison between initial ID capacity after DA between FB and ATC is not completely valid: the DA clearing points between ATC and FB were different, hence the decrease in ID capacity under FB for some borders should be offset against the additional welfare realized in DA.

The FB and FBI results on the other hand illustrate a much more scattered view: capacity calculation varies from hour to hour, so capacities can assume a range of values. Furthermore on the ATC plot it does not happen that simultaneously both borders have little capacity available (the arbitrary red triangle), whereas under FB and FBI this can and does happen.

ATC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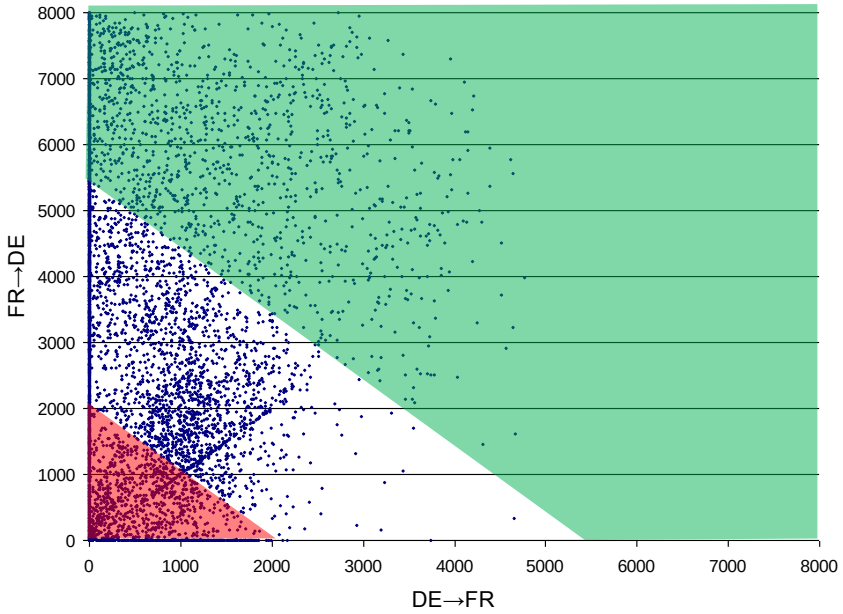
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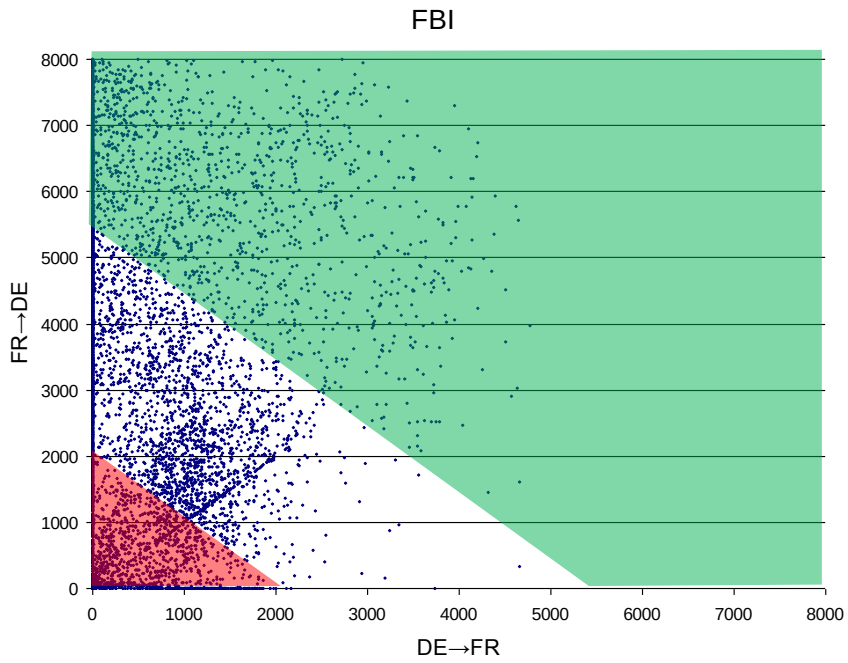


Figure 10 remaining ID ATC capacities after DA (ATC, FB and FBI) for DE→FR and FR→DE

The scatters reveal that unlike ATC there no longer is guaranteed to be capacity on each border in at least one direction. We consider per border the available ID capacity as the sum of the two directions. In Figure 11 histograms of capacity per border are illustrated. Clearly the ATC values are fairly consistent, whereas under FB things range from very low to very high levels of capacity. It appears that mainly BE-FR and BE-NL experience zero ID with some frequency.

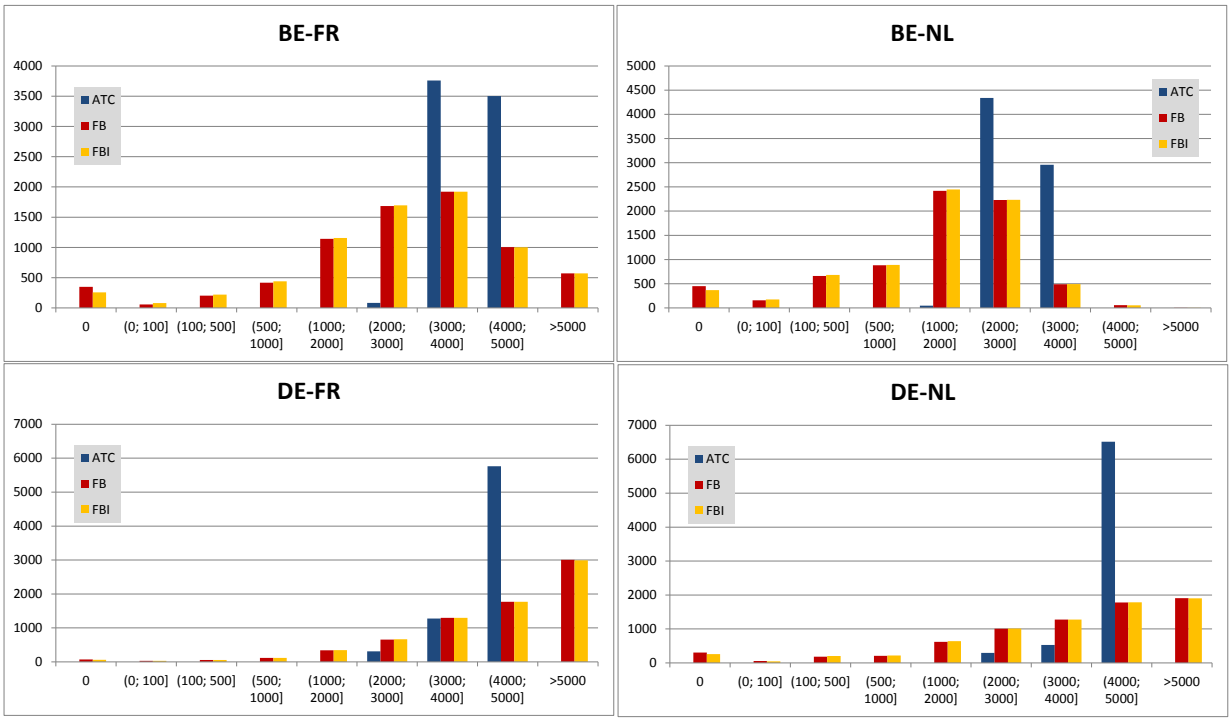
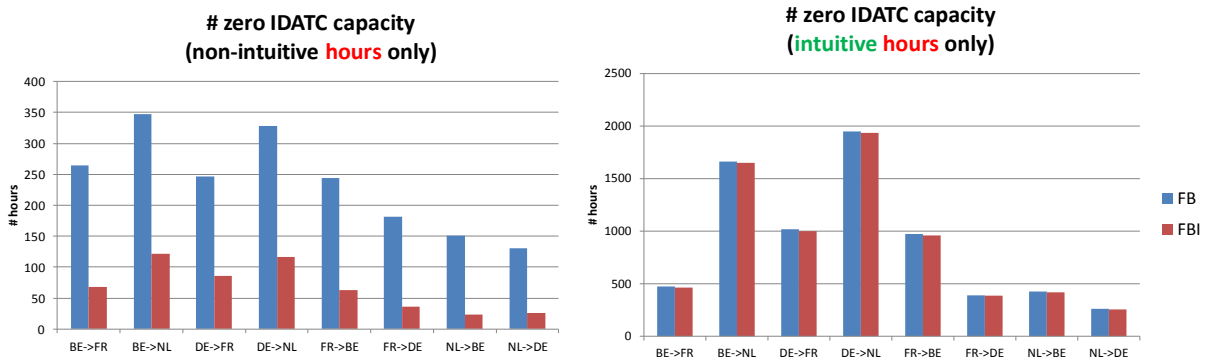


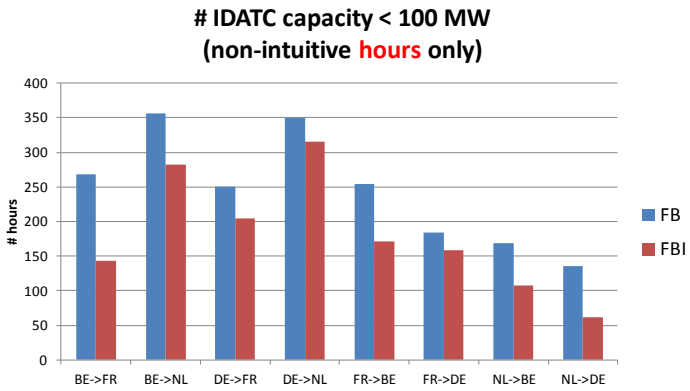
Figure 11 Histogram of ID capacity per border (sum of both directions). Vertical axes contain frequencies in number of hours.

The above histograms already reveal some difference between FB and FBI. We focus on the particular case of zero ATC and its frequency. We distinguish between non-intuitive and intuitive hours:



For the hours that are non-intuitive we notice that FB "intuitive" results in less hours resulting in zero initial capacity, whereas for the hours that also for FB "plain" were intuitive there is no difference. What happens is that under FB "intuitive" some trades on DA are prevented to be executed, leaving some capacity unused. This capacity becomes available again for ID.

Now consider only for the non-intuitive hours the frequency of hours where less than 100MW of ID capacity was available:



The histogram shows a similar trend as before: FBI less frequently results in low ID capacity values. However the difference starts becoming less pronounced. This suggests that for many hours where FB resulted in zero ID capacity, and FBI in nonzero capacity, the available capacity was still small.

Discussion

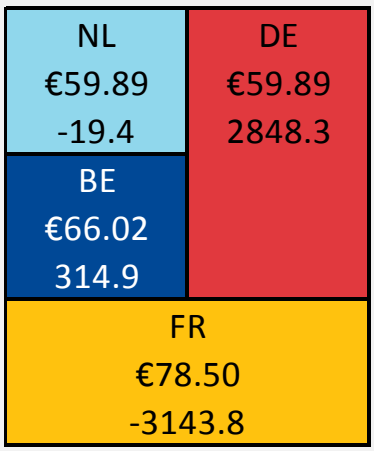
The previous has shown that FBI occasionally results in some more capacity being made available to ID. Linked to the welfare discussion this means that some capacity that had a known value in DA was not realized there. Instead the capacity moves to ID where it may or may not be used and generate value. One reason why we may expect it generates value in ID is the increases in renewable generation, and linked to that the increased demand for flexibility. Part of this flexibility could come from cross border ID trading.

As already mentioned in the section on welfare we ideally measure the "real social welfare". If this could be measured we could strike the balance taking into account the value this ID capacity holds versus what was lost on DA. Unfortunately this view is not a realistic one: we cannot measure "real social welfare". Instead we rely on some more pragmatic insights.

What has not yet been touched is a point first made in the intuitiveness report in relation to ID capacity. It is explained that the intuitive constraints as created by the "intuitive" patch in DA might need to be enforced for ID too: some trading directions available in DA were blocked by the patch. Failing to block them on ID suggests that capacity could become available on ID whereas a favourable DA spread exists.

Example

Consider the FBI results for 13 December, h21



FBI MC clearing

And available capacities are:

BE->FR	BE->NL	DE->FR	DE->NL	FR->BE	NL->BE	FR->DE	NL->DE
6	2014	4	2010	3496	3	4503	5

Evidently some ID capacity is now made available on borders where against the DA prices more trades would be favourable.

The project decided against enforcing the intuitiveness constraint on ID. In its current configuration some capacity that holds value according to the DA price is freely made available on ID. However now this capacity could benefit favourable ID trades, whereas not making it available (enforcing the intuitive constraint) guarantees this benefit cannot be realized. Moreover we should realize that DA and ID pricing already today is different. It does happen that cross border ID trades are scheduled in the opposite direction of the DA prices.

2.7 Impact on investment and SoS signals

In order to support investment decisions, either by MPs or TSOs, an outlook of future price developments is required. Forecasting long term prices requires modelling the electricity market, which includes the market coupling model. Arguably FB "plain" is easier to model, since it does not involve the application of the "intuitive" patch and its dependency on long term nominations. However where LT modelling is concerned many uncertainties remain (dependency on future fuel costs, renewable penetration, changes in grid, assets, etc.) that the differences in prices resulting from FB and FBI might well be considered below the resolution of the model. In this case either FB or FBI would suit investment decisions.

For SoS we can consider two aspects: for the short run no impact should exist: both FB and FBI respect the constraints indicated by the TSOs via the FB domain. An impact could result from the supply-demand balance:

- In case FB "plain" would non-intuitively cause an already stressed high priced market to export, this could adversely impact this market's demand-supply balance;
- In case FB "intuitive" would fail to allocate a relieving exchange a third market is hindered to import energy. Much like the first example it is now this third market where demand-supply balance is impacted;

Conceivably either FB "plain" or FB "intuitive" could have an impact.

2.8 Communication of results

When communicating about market outcomes to the general public (e.g. administration, press, etc.) the project needs to be able to justify results. Some more challenges come from the fact that justifications are typically requested in more extreme situations, e.g.

- Cold waves;
- Peak prices (very high or very low);
- Nuclear phase out;
- Etc.

Examples of difficulties associated with FB "plain":

- Justifying non-intuitive cases forcing Belgium to export while having the highest prices, for instance in case of cold wave, would be impossible, especially knowing that public money is invested to guarantee SoS
- Conversely, explaining the non-intuitive cases where Belgian units are not allowed to export even if they offer the cheapest price is incoherent with the efforts to encourage investments in cheap and flexible generation units
- Justifying why DE exports its (off market) RES to adjacent markets where prices are already lower

Examples of difficulties with FB "intuitive":

Some extreme market situations can be identified (e.g. price spikes, because adjacent markets were not willing to make some relieving non-intuitive exchanges) that could be mitigated by FB "plain".

Existing non-intuitive situations

Before focussing on some examples that illustrate the challenges associated to explaining "plain" and "intuitive" results, we consider non-intuitive situations that exist outside of the FB context. We consider two known examples where non-intuitive situations exist or existed.

Example 1: ITVC

The first example was already briefly mentioned in the report on intuitiveness: the interim tight volume coupling (ITVC) between CWE and Nordic countries. This solution pre-dates NWE and was a two step approach: in a first step EMCC (European market coupling company) ran an optimization that anticipated CWE and Nordic prices on the basis of their order books, and worked out the

optimal flow between these regions. In a subsequent step the CWE and Nordic regions ran there respective markets, taking the optimal cross regional flows into account. After 10 days of operation it turned out that due the volume coupling it frequently happened that flows were under or over scheduled, resulting in either price differences without congestions, or non-intuitive price differences. Especially the latter led to rejection of the solution by the market. Even if the FB "plain" MC non-intuitive situations are fundamentally different from these non-intuitive EMCC exchanges, as the former correspond to the DAMW maximization while the latter are due to bad algorithms and bad processes, the prejudice is there.

Example 2: NWE

Today in NWE non-intuitive situations exist. In NWE some lines have ramping restrictions: the exchange between two areas cannot change by more than a certain limit from one hour to the next. Due to welfare maximization some hours may lead to non-intuitive results (cf. example in box below). NRAs accepted these non-intuitive situations, since they allow the overall welfare to increase.

We must note that there is some difference with the non-intuitive situations resulting from ramping restrictions and those from FB "plain": the ramping non-intuitive situations are temporal: the welfare loss for one hour is compensated in another. The areas losing welfare are the same ones that gain welfare. The non-intuitive situations under FB "plain" are spatial: welfare is lost on some borders, but welfare is gained on other borders.

Example

- Two markets: A and B
- Two hours
- Markets coupled with 1000MW of capacity for all hours;
- Ramping limit of 400MW / h

Imagine market A only has sell orders, B only has buy orders, namely:

Hour 1	Hour 2
$sell_A$: 2000MWh@10 buy_B: 2000MWh@100	$sell_A$: 2000MWh@50 buy_B: 2000MWh@40

Solution 1

Hour 2: the order prices do not match, so no favourable trade can be made. No energy is exchanged;

Hour 1: due to the 400MW/h ramping limit and a zero exchange for hour 2, only 400MWh can be matched. This will generate 400MWh x (100 – 10€/MWh) = 36k€ welfare;

Total: 36k€ welfare;

Solution 2

hour 1: we match the full 1000MW (capacity between A and B) and generate 1000MWh x (100-

10€/MWh) = 90k€ welfare;

hour 2: we cannot change the flow by more than 400MW (ramping limit), so we still flow from A to B 600MWh at a welfare loss of 600MWh x (40-50€/MWh) = -6k€

Total: 90k€ - 6k€ = 84k€ welfare

The example illustrates that the non-intuitive result for hour 2 is compensated by the intuitive result of hour 1, resulting in an overall higher welfare.

The two examples show that non-intuitive situations are either rejected by the market (initial ITVC solution), or tolerated (NWE ramping). Both examples resulted in non-intuitive results, neither example has non-intuitive results that are directly comparable to the ones occurring under FBMC.

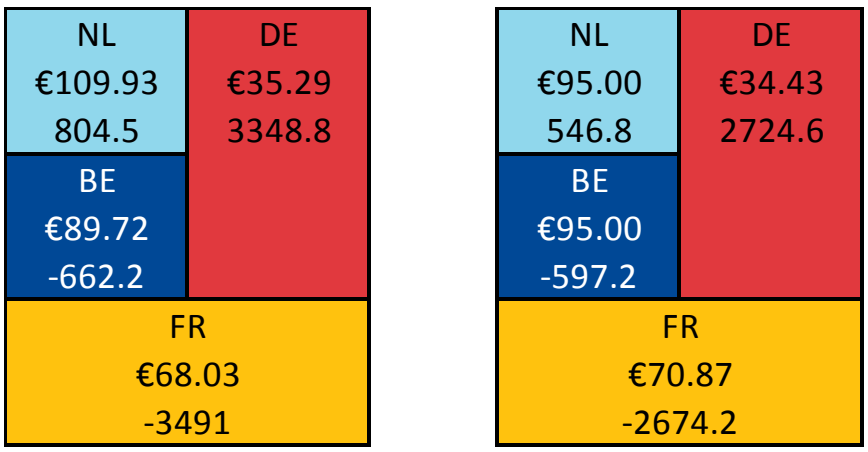
It should also be underlined that these cases of non-intuitive exchanges are fundamentally different than the ones that can be observed with CWE FB "plain" as they are not resulting in situations where a bidding zone with highest price is forced to export or forced to import with the cheapest price. These two last cases happen in CWE with plain flow-based, at least for the bidding zone(s) without any electrical border outside of the CWE capacity calculation region.

In the following we will therefore focus on some of the extremes that can under either FB "plain" or FB "intuitive".

Extreme situations

To get a better idea of these difficulties in the following we collect a number of individual examples either from the parallel run data, or from one of the resilience scenarios:

Case 1 – hour where CWE price spread was most reduced due to application of "intuitive" patch



FB MC clearing FBI MC clearing

Figure 12 parallel run 4 February 2013 h19

The FB "plain" result is not intuitive, since NL as the most expensive area is non-intuitively exporting. The "intuitive" patch restores intuitiveness by creating a partial convergence between BE and NL. Consequently FR can import less and sees its price increase, whereas DE can export less and has its price decreased. The spread under FB "plain" was € 109.93 - € 35.29 =€ 74.64, under FB "intuitive" it becomes € 95.00 - € 34.43 = € 60.57

Case 2 – hour where CWE price spread was most increased due to application of "intuitive" patch

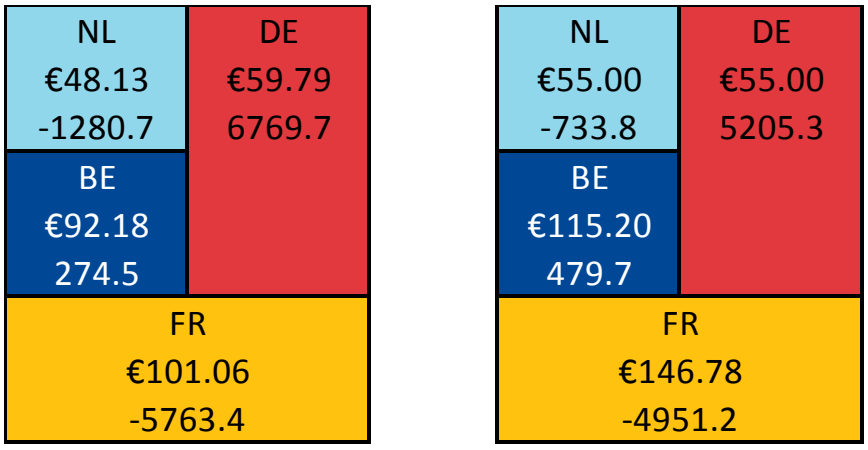


Figure 13 parallel run 25 February 2013 h16

The FB "plain" result is non-intuitive because NL as the cheapest area is importing. Intuitiveness is restored by creating a partial convergence between DE and NL. Consequently the FR import is reduced, leading to an increase in price. The spread under FB "plain" was € 101.06 - € 48.13 =€ 52.93, under FB "intuitive" it becomes € 146.78 - € 55.00 = € 91.78

Observation

Looking at the parallel run results for 40% of the time the "intuitive" patch decreased the spread, 60% of the time it increased the spread. The average decrease was € 2.44; the average increase was € 2.36

We can also consider the involvement of areas. We take a very restricted definition of involvement:

Involved area: either the area with the lowest price that is importing, or the area with the highest price that is exporting.

With this limited definition some hours are considered non-intuitive, yet have no involved area. We can now assess the impact of the "intuitive" patch on the development of the price spread for the different types of non-intuitiveness:

	# hours where price spread **decreased** under FBI	# hours where price spread **increased** under FBI	average **decrease**	average **increase**
BE	98	26	€2.43	-€1.56
DE	11	56	€1.20	-€1.08
FR	3	12	€1.52	-€1.20
NL	33	77	€3.61	-€4.37
No single hub	23	83	€1.50	-€1.78

When DE or FR are involved more likely than not the price spread actually increases when the patch is triggered. When it does the average decrease of price spread is typically larger than the average increase in price spread. When either NL or no area at all is involved, we also observe that intuitiveness more frequently tends to increase the price spread. Here we even see that the average increase is larger than the average decrease.

Finally, considering that indicator and this 2013 dataset, BE is the area for which the patch could make most sense: when applied the spread tends to come down, and it decreases by a larger amount than it increases.

Cases from the resilience analysis

Case 3 – resilience better under FB "intuitive"

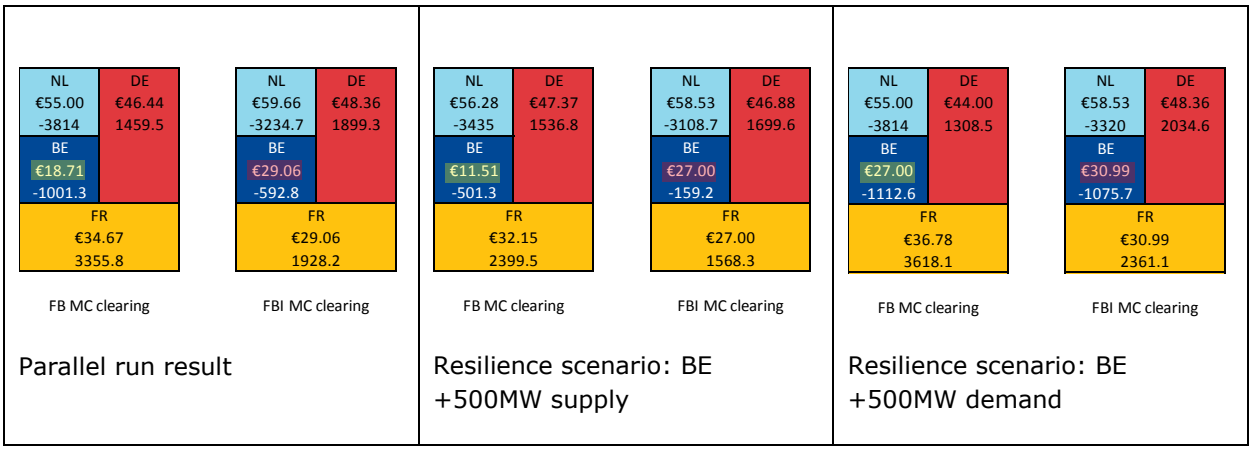


Figure 14 Resilience analysis 8 July h9

The FB result forces BE to import non-intuitively. The "intuitive" patch restores intuitiveness by creating a partial convergence with FR. This patch is active in all three scenarios. Consequently the BE price under FB "intuitive" is comparable (ranging from € 27 to € 30.99), and BE experiences good resilience.

Under FB "plain" however the added 500MW causes the BE price to move steeply away from its initial value: BE price ranges from € 11.51 to €27.00. BE resilience is adversely impacted.

Case 4 – resilience better under FB "plain"

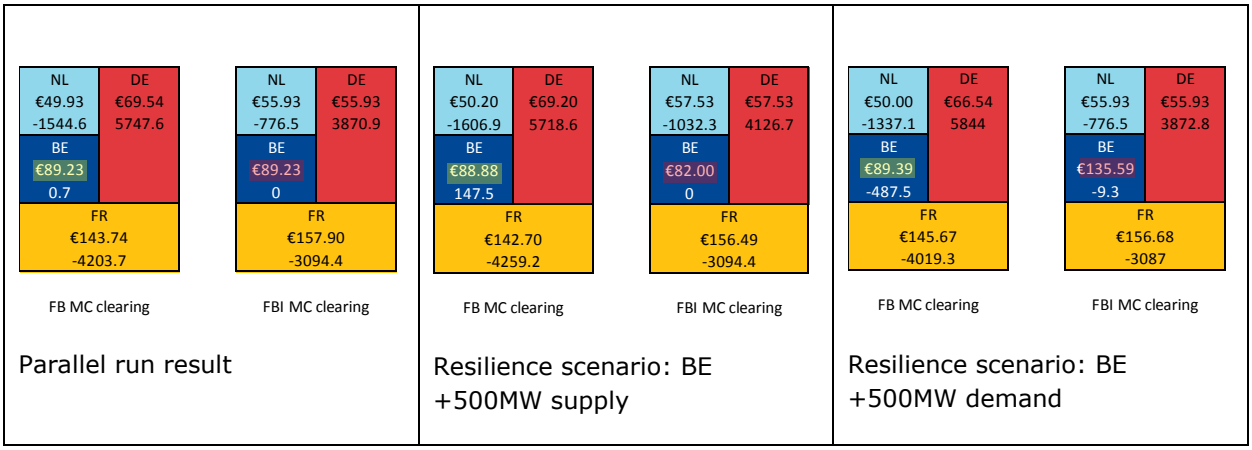


Figure 15 Resilience analysis 27 November h19

The FB results forces NL to non-intuitively import. Intuitiveness is restored by creating a partial convergence with DE. In turn this leaves less import possibilities for BE and FR. BE resilience is affected in this case, because in the scenario where 500MW demand is added, BE needs to import more energy. This is possible under FB "plain", but not under FB "intuitive", causing the BE price to spike for the FB "intuitive" results under the demand scenario.

Conclusion

Examples exist to either illustrate the merits of "intuitive", or illustrate its pitfalls. Challenges exist for either alternative.

We did manage to show that when considering the CWE price spread, it more frequently increases under "intuitive" FB (60%) than it decreases (40%). Only in case the patch is triggered to restore a non-intuitive situation where BE was involved, it more likely decreases the market spread.

3 Overview

This document assessed the respective merits for FB "plain" and FB "intuitive" in accordance to the criteria set by NRAs. Not all criteria resulted in conclusive answers, but the table below compiles the overview:

Criterion	In favour of FB "plain"	In favour of FB "intuitive"
Volatility	inconclusive	
Price Signal	Negligible difference	
Liquidity	resilience analysis: inconclusive	
Welfare (global)	Unknown	Unknown
Welfare (DAMW)	X (though relatively small)	
Welfare repartition	No statistically significant difference	
ID	X (considering DA capacity should not be allocated to ID)	X (considering ID capacity is higher; mitigates DA welfare loss)
Investment	inconclusive	
SoS	inconclusive	
Communication to general public	Potential challenges for both alternatives	