ACER
European Union Agency for the Cooperation of Energy Regulators

entsoe

5th WORKSHOP

on the electricity long term flow-based allocation: simulation results and collaterals

Thursday, 04.05.2023
09:00 - 11:30 CET
Online

www.acer.europa.eu

Link to join the Teams meeting

1. Welcome and Introduction: Agenda

	DRAFT AGENDA		
09:00-09:10	Introduction		ACER & ENTSO-E
09:10-09:40	HAR & collaterals	HAR amendments and collaterals	ENTSO-E
09:40-09:50		Market Participants' position	EFET&Eurelectric
09:50-10:00		Discussion	All
10:00-10:40	LTFBA simulations	LT FB allocation simulations	ENTSO-E
10:40-10:55		LT FB allocation benefits	ACER
10:55-11:10		Market Participants' position	EFET&Eurelectric
11:10-11:25		Discussion	All
11:25-11:30	Wrap-up		ACER

ENTSO-E HAR – Proposed way forward for collateral requirements for LT FBA

Introduction

Background

- Long-term flow-based allocation will require the LTTRs for all bidding zone borders in a flow-based CCR to be allocated in a single auction.
- The current NTC based allocation use sequential auctions of LTTRs
- Long-term flow-based allocation may therefore require more collaterals from market participants at the time of the auction.
- If market participants are not able to provide sufficient collaterals some of their bids need to be rejected
- During summer 2022 JAO consulted on the solution of bid prioritisation for JAO collaterals

Market participants raised concerns that bid prioritisation can not sufficiently address the issue

- The deletion of bids in the order books of the auction and could have a negative impact on the economic surplus generated by auctioning LTTRs
- The discussed solutions therefore should focus on reducing collateral requirements in the LTTR bidding phase

When setting the collateral requirements, the following objectives should be considered:

- Avoid financial losses for TSOs
- Put reasonable financial burden on stakeholders
- Ensure adequate punishment for MPs in case of non-payment
- Prevent gaming

ENTSO-E HAR – Proposed way forward for collateral requirements for LT FBA

TSO Proposal for reducing collaterals – setting of a price cap for collaterals of bids

Background

- According to the current formulation in HAR, 100% of bids have to be covered by collaterals available from MPs
- ACER, NRAs and TSOs discussed several options for reducing collateral requirements for market participants in long-term flow-based auctions of LTTRs. (available in Annex)
- TSOs propose to set a max price cap per bid for collateral calculation using an average of historical Market Spreads.
- When a MP places a bid above historical DA market spread, then the potential liability will be calculated using the max cap
- When a MP places a bid below historical DA market spread, then the potential liability will be calculated using bid price
- This information on a price cap will be provided to MPs during the publication of the auction specification (final)

Setting of a max Price cap

- Price cap for the yearly auctions is to be set using the Average DA Market Spreads prices from the past 6 months prior to the auction (May –October)
- Price cap for the monthly auctions is to be set using the Average DA Market spreads price from the previous month of the auction
- Calculation of Market Spread is to be done by summing up the positive market spreads for each BZB direction and dividing this by the number of subsequent hours

ENTSO-E HAR – examples – including positive spreads

BE->FR

LTTR yearly 2023	LTTR yearly 2022	LTTR December 2022	Average price spread last half 2022	Average price spread Nov. 2022
98	29.23	143.29	56.13	24.07
			FR->BE	
LTTR yearly 2023	**LTTR yearly 2022**	**LTTR December 2022**	**Average price spread last half 2022**	**Average price spread Nov. 2022**
4.43	1.75	1.21	8.92	9.60

AT->HU

LTTR yearly 2023	LTTR yearly 2022	LTTR December 2022	Average price spread last half 2022	Average price spread Nov. 2022
10.82	6.8	14.13	32.13	35.13
			HU->AT	
LTTR yearly 2023	**LTTR yearly 2022**	**LTTR December 2022**	**Average price spread last half 2022**	**Average price spread November**
3.58	0.88	5.53	16.86	13.40

Example for BE -> FR:

Case 1: If a MP places a bid for the yearly 2023 auction of 90EUR/MWh, then the collateral requirement for that bid would have been 56,13 EUR/MWh (instead of 90EUR/MWh with the current collateral requirements)
Case 2: If a MP places a bid for the yearly 2023 auction of 50EUR/MWh, then the collateral requirement for that bid would have been equivalent to the original bid price (50EUR/MWh)

HU->SK

LTTR yearly 2023	LTTR yearly 2022	LTTR December 2022	Average price spread last half 2022	Average price spread Nov. 2022
0.67	0.09	2.35	5.41	4.60
			SK->HU	
LTTR yearly 2023	**LTTR yearly 2022**	**LTTR December 2022**	**Average price spread last half 2022**	**Average price spread Nov. 2022**
5.91	4.31	9.28	10.93	16.60

SI->HR

LTTR yearly 2023	LTTR yearly 2022	LTTR December 2022	Average price spread last half 2022	Average price spread Nov. 2022
2.32	0.62	2.42	15.21	13.13
			HR->SI	
LTTR yearly 2023	**LTTR yearly 2022**	**LTTR December 2022**	**Average price spread last half 2022**	**Average price spread Nov. 2022**
1.66	0.07	3.06	17.63	17.71

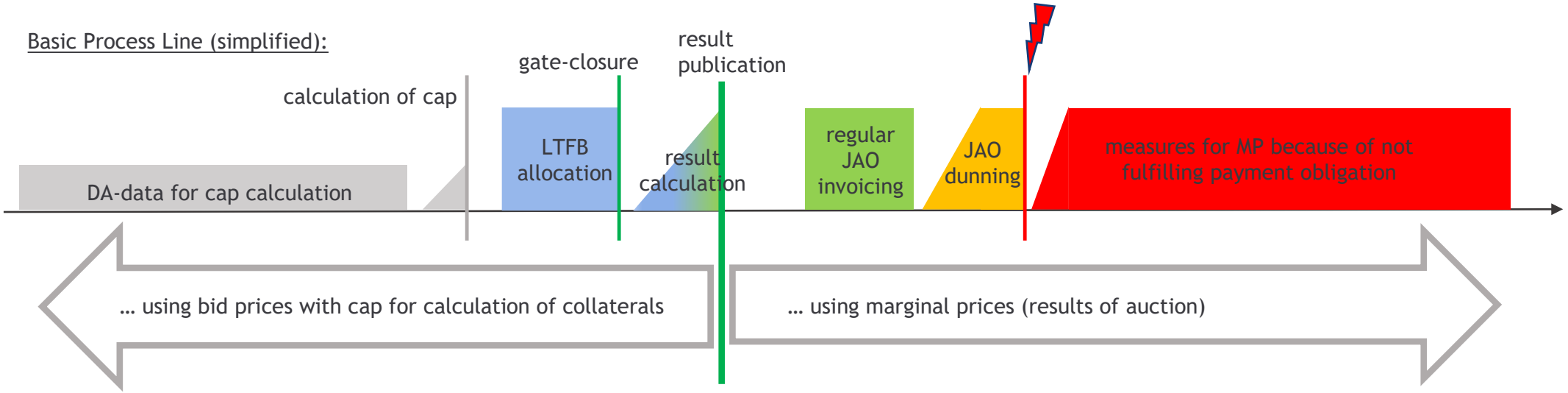
Disclaimer: the Price period analysed had one of the highest DA Market Price spread volatility in the past years

LT FBA – Proposed way forward for collateral requirements for LT FBA

Measures in case of non fulfilling payment obligations of MP for awarded LT-capacity products

Based on current TSO proposal the requested collaterals for bids during Bidding Period (BP) could be lower than the bid price for the awarded capacity. This could lead to a situation that the MP does not have enough collateral to cover their actual liabilities. To consider such new kind of risk for TSOs, the process if a MP does not fulfill his payment obligation shall be updated as following:

- If a MP does not fulfil this, JAO will immediately start a reminder (dunning process) to the concerned MP (several additional working days for the MP to pay).
- If such dunning process is again not successful, the MP will lose all awarded LT-rights related to LTFB-allocation from the day after the dunning process was ended. JAO will raise the outstanding payment obligations from the Market Participant.
- Furthermore, the concerned MP shall be excluded for all further auctions until all open invoices have been settled, but for a duration minimum of two months.
- Also, if a MP is concerned by such dunning process for several times/for more than 3 times within the same year, JAO has the obligation to suspend MP for two month from all auctions (this is needed to avoid regularly delayed payment using the dunning cycle).



Disclaimer: The exact measures to be put in place in case of payments incidents are still under discussion between TSOs & JAO

EFET

European Federation of Energy Traders

Market Participants' views on Long-Term Flow-Based Allocation of transmission rights

LTFBA workshop, 4 May 2023

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The collateral question is not solved yet

- Proposed solution is to cap the price used to compute the requested collateral
  - Proposed cap = average observed realized spread
    => *we suggest using the average observed forward spread instead* (do not compare apples and pears)
- LTTRs allocation at all borders at once has a huge collateral impact
  - Performing an auction with only a limited set of buying orders challenges the potential merit of such an auction
    => *we suggest performing an analysis to test to which extent the set of buying orders would be limited by collateral*

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ENTSO-E LTFBA Simulations

Background

- In preparation of the switch to Long-Term Flow-Based Allocation for the Core & Nordic regions, TSOs have run simulations on the Core region to get a first insight on possible outcomes of this allocation process;
- These simulations were run using an allocation algorithm as described in the SAP, preliminary FB domain (with 20% Min RAM) coming from Core LTCC simulations and different bid scenarios (Past bids from 2022 & 2023 for NTC yearly auctions);
- However please consider the results presented in the next slides are preliminary as the tools used are prototypes on both capacity calculation side and allocation side.

Feedback from TSOs on this first preliminary Simulation Results

- Overall allocated Capacity under FBA is in same magnitude as under NTC-allocation

	2022	2023
NTC	20,6 GW	16,9 GW
FB	16,9 GW	17,4 GW

- **However independent of values of overall allocated Capacity there is a chance that the allocation algorithm could provide some borders with 0MW or low values of allocation.** Possible reasons could be:
  - Historical Market participants' bids designed for NTC allocation,
  - The size of FB domain respectively available RAM;
  - The switch from NTC to FB;
  - The objective function;
  - The competition among borders.

ENTSO-E LTFBA Simulations

Tests performed

	Test #1	Test #2
Bid file	Bid file **2022**	Bid file **2023**
FB domain (same for 2022 -2023)	MinRAM 20%	MinRAM 20%
External constraints	PSE import & export	PSE import & export

Assumptions

- Allocation simulations are currently performed on an LTCC FB domain based on 4 Seasonal time stamps, whereas in operations this will be based on a final FB domain composed of up to 24-time stamps (scenarios).
- In the current simulations historical NTC bids were used
- Alegro cable (BE-DE border) is currently not included in the prototype allocation tool
- The prototype allocation algorithm as still not been entirely tested
- In the current simulations, Polish allocation constraints were set to 0 and therefore no capacities were allocated on the Polish borders.
- In the current simulations the following processes have not been performed: yearly/monthly splitting rules, TSO individual validation processes

ENTSO-E LTFBA Simulations - Run with 2022 bids, 2023 bids

	Yearly Auction 2022 (NTC)		Bids 2022				Yearly Auction 2023 (NTC)		Bids 2023			
Transfer	Clearing price [EUR]	Allocated Capacity [MW]	Requested capacity [MW]	W Average bid price [EUR]	Clearing price [EUR]	Allocated Capacity [MW]	Clearing price [EUR]	Allocated Capacity [MW]	Requested capacity [MW]	W Average bid price [EUR]	Clearing price [EUR]	Allocated Capacity [MW]
APG>CEPS	1.38	250	2,925	0,30		0	2.11	200	2,445	0,82		0
APG>DE	0.35	2,940	31,739	0,03	99.99	1	0.97	1960	20,480	0,35		0
APG>ELES	5.55	349	2,335	3,95	7.45	293	9.22	300	3,180	4,47	12.08	152
APG>MAVIR	6.80	300	2,874	4,64	8.41	106	10.82	250	3,737	4,36	13.33	115
CEPS>APG	4.51	200	2,619	0,31		0	15.11	200	2,214	5,84	18.12	73
CEPS>DE	0.94	800	8,971	0,06		0	3.12	299	6,873	0,99	2.87	612
CEPS>SEPS	3.44	700	7,976	0,46	1.17	1698	7.38	600	3,798	3,32	3.33	1,311
DE>APG	**5.05**	**2,940**	**24,927**	0,92	**99.99**	**1**	**18.44**	**1,960**	**17,433**	7,54	30.00	249
DE>CEPS	3.19	240	3,361	1,80	2.72	1204	7.77	150	4,139	3,12	12.00	27
DE>PSE	4.26	260	5,777	0,03		0	0.00	0				
DE>RTE	30.26	600	7,774	2,16	3.22	2,680	80.01	600	5,629	33,91	46.67	2,213
DE>TTN	4.83	827	7,879	0,98	2.10	1,172	8.99	827	10,982	3,27	7.55	1,297
ELES>APG	0.23	349	2,661	0,02		0	2.23	300	3,503	0,90	13.55	30
ELES>HOPS	0.62	600	6,462	0,23	0.49	857	2.32	500	4,112	1,06	0.91	1,041
ELIA>RTE	29.23	250	3,268	0,78	3.56	10	98.00	250	3,603	30,97	99.00	232
ELIA>TTN	4.79	473	5,591	0,64	3.81	5	13.24	473	6,548	3,76	42.69	10
HOPS>ELES	0.07	600	5,972	0,05	0.56	176	1.66	500	3,845	0,66	2.26	310
HOPS>MAVIR	0.55	500	4,298	0,16	0.74	162	3.50	400	3,560	1,50	2.64	629
MAVIR>APG	0.88	300	3,007	0,05		0	3.58	250	4,178	1,19		0
MAVIR>HOPS	0.67	600	5,022	0,32	0.57	533	4.27	500	3,994	2,07	2.97	909
MAVIR>SEPS	0.09	799	4,434	0,02	0.31	100	0.67	800	6,270	0,27	0.54	995
MAVIR>TEL	1.28	350	2,391	0,62	0.92	582	2.56	350	4,596	0,80	2.21	462
PSE>DE			5,780	13,66		0	0.00	0				
RTE>DE	4.34	1,000	10,404	0,50	1.08	1,669	6.95	1,000	13,562	1,81	6.11	1,274
RTE>ELIA	1.75	1,400	12,579	0,50	1.12	2,170	4.43	1,450	18,136	1,20	3.25	1,646
SEPS>CEPS	0.07	600	7,036	0,01		0	0.41	400	4,389	0,15	1.01	105
SEPS>MAVIR	4.31	700	3,173	3,24	1.02	2,085	5.91	699	5,199	2,66	3.22	1,844
TEL >MAVIR	2.27	350	2,649	0,49	0.76	637	7.37	350	3,802	2,91	5.01	564
TTN>DE	3.51	827	5,457	0,31	1.21	230	19.27	827	9,518	5,53	29.01	352
TTN>ELIA	3.11	473	5,989	1,01	2.53	520	10.33	473	7,073	3,38	7.20	936
Total		**20,577**				**16,890**		**16,868**				**17,389**

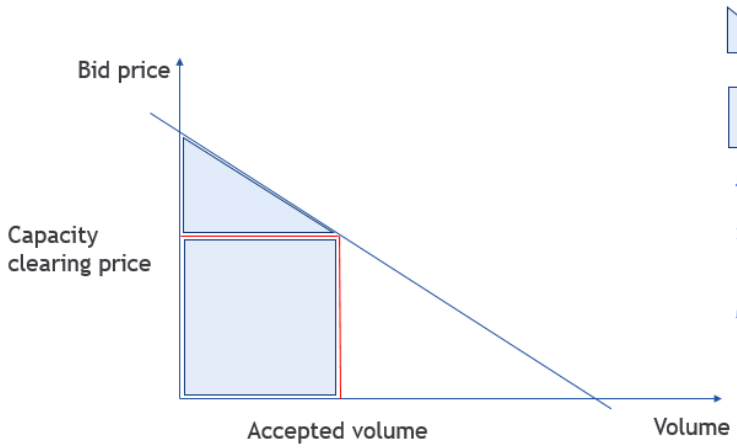
ENTSO-E LTFBA Simulations

Simulation results

	Formulation	Yearly Auction 2022 (NTC)	FB Auction Bids 2022 - MinRAM 20%*	NTC vs FB	Yearly Auction 2023 (NTC)	FB Auction Bids 2023 – MinRAM20%*	NTC vs FB
Allocated capacity (MW)	Sum Allocated Capacity per BZB	**20,577**	**16,890**	**-18%**	**16,868**	**17,389**	**+3%**
Congestion Revenue (EUR/MTU)	Sum Allocated Capacity * Clearing Price	**74,829**	**29,625**	**-60%**	**189,280**	**202,029**	**+7%**
Total welfare (EUR/MTU)	Objective function optimize the (accepted volume)*(Bid price).	**92,004**	**46,572**	**-49%**	**256,208**	**310,004**	**+21%**
Market participants' Surplus (EUR/MTU)	Total welfare - Congestion Revenue	**17,175**	**16,947**	**-1%**	**66,928**	**107,975**	**+61%**

Conclusions

- Compared to the NTC 2023, FBA2023 resulted with increase of social welfare (approx. 20%)
- Total allocated capacities remained rather stable while congestion in FBA2023 is slightly increase (approx. 7%) compared to NTC2023.
- Due to different bids in FBA2023, distribution of allocated capacities per border/direction is different. The following has been noted FBA2023 vs FBA 2022 (ref. to NTC2023 and NTC2022 respectively):



Market participant surplus

Congestion revenue

The objective function :

$\max(\sum_{BZB} P_{offered} * V_{accepted})$

Maximizes the surface

** The same FB domain was used for 2022 & 2023*

ENTSO-E LTFBA Simulations

Limiting elements

- The following network elements (Critical Network Elements ; CNECs) are those elements that were limiting the allocation of additional bids during the respective FB simulation run.
- Increasing the capacity available on any of those elements (Remaining Availability Margin; RAM), would increase the size of the FB domain and would allow additional allocations to be made by the simulation algorithm.

2022

Location of element	Contingency Element 2022 run	RAM [MW]	Fmax [MW]	% RAM	Shadow price [EUR/MWh]
Austria	Strass-Thaur273B_AT_CO_00096_Jan_2020	69	345	20%	90.07
Germany - Austria	Westtirol1-Westtirol2WTRH_D4-AT_CO_00003_Jan_2020_2	200	795	25%	34.23
Hungary	Dunamenti-Oroszlany_HU_CO_00011_Jan_2020_2	158	249	63%	12.66
Romania	Resita-Timisoarac1_RO_CO_00027_Jan_2020_1	68	339	20%	10.27
Belgium - France	Achene-Gramme38010_BE-FR_CO_00005_temp_Jan_2020_1	1140	1801	63%	7.88
Belgium	PSTZandvliet1_BE_CO_00032_Jan_2020	465	1415	33%	6.62
Romania	Paroseni-TarguJiuNord_RO_CO_00021_Jan_2020_1	68	347	20%	6.39
Belgium	PSTVanEyck1_BE_CO_00035_Jan_2020	397	1415	28%	5.18

2023

Location of element	Contingency Element 2023 run	RAM [MW]	Fmax [MW]	% RAM	Shadow price [EUR/MWh]
Belgium - France	Achene-Gramme38010_BE-FR_CO_00005_temp_Jan_2020_1	468	1801	26%	283.90
Austria	Strass-Thaur273B_AT_CO_00096_Jan_2020	69	345	20%	173.66
Romania	Paroseni-TarguJiuNord_RO_CO_00021_Jan_2020_1	69	347	20%	51.24
Germany - Austria	Westtirol1-Westtirol2WTRH_D4-AT_CO_00003_Jan_2020_2	200	795	25%	47.78
Belgium	PSTZandvliet1_BE_CO_00032_Jan_2020	465	1415	33%	37.40
Hungary	Dunamenti-Oroszlany_HU_CO_00011_Jan_2020_2	158	339	47%	33.34
Romania	Resita-Timisoarac1_RO_CO_00027_Jan_2020_1	68	339	20%	15.71
Belgium	PSTVanEyck1_BE_CO_00035_Jan_2020_1	1206	1415	85%	15.20
Croatia	220kVBrinje-VEPadene__Jan_2020	243	304	80%	0.49

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The benefits of long term flow based allocation

5th ACER - ENTSO-E workshop on electricity long term flow-based allocation

5 May 2023

Deeper look at the results

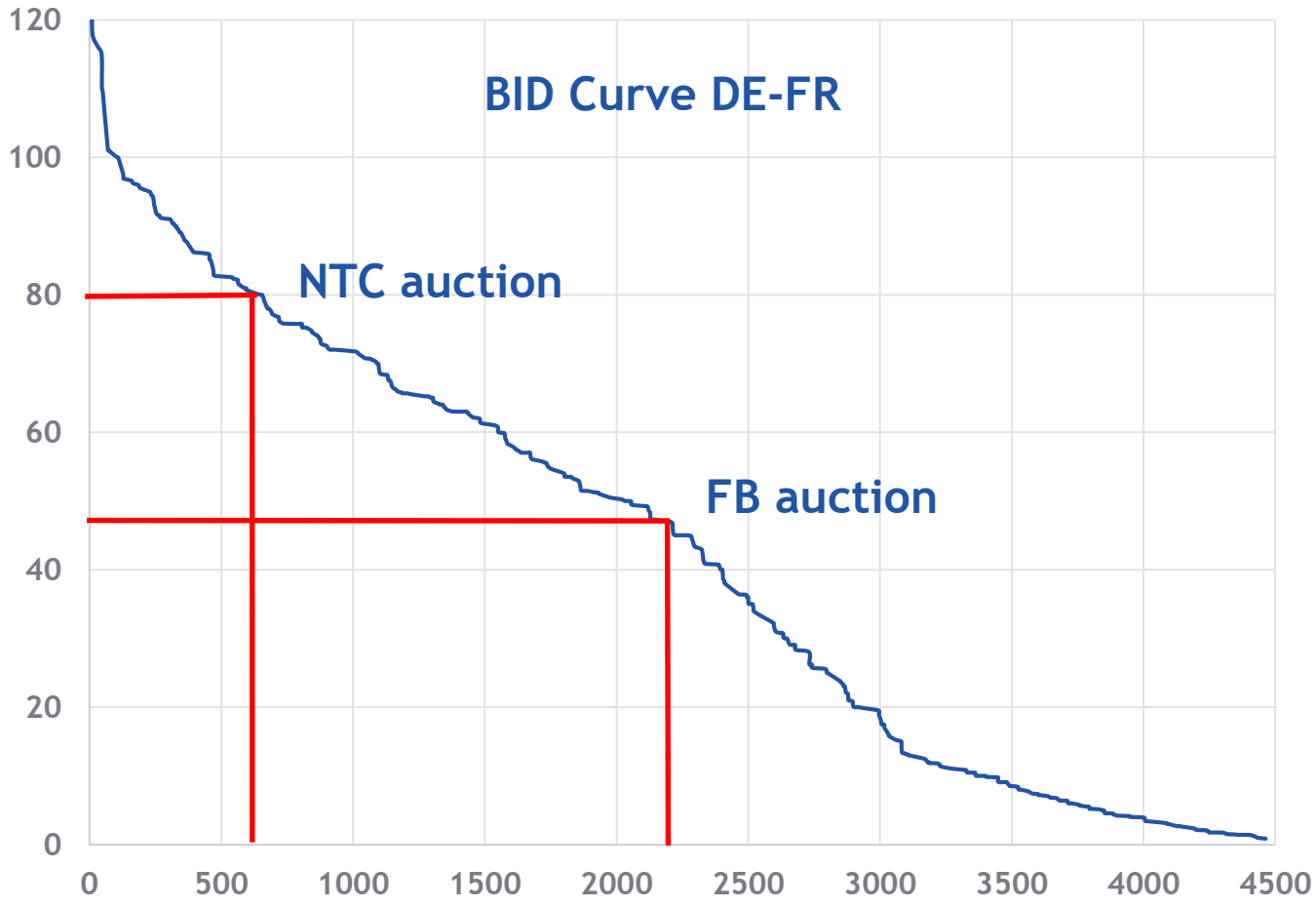
Competition between the borders

		BIDS 2023	NTC 2023		Flow-Based 2023	
From	To	Requested capacity / MW	Clearing price €/MWh	Allocated capacity / MW	Clearing price €/MWh	Allocated capacity / MW
DE	FR	5,629	80.01	600	46.67	2,213 ↑
DE	AT	17,433	18.44	1,960	30.00	249 ↓
DE	NL	10,982	8.99	827	7.55	1,297 ↑
BE	FR	3,603	98.00	250	99.00	232 =
DE	CZ	4,139	7.77	150	12.00	27 ↓

Deeper look at the DE-FR border

Analysing DE – FR auction results

- Action gate closure time: **23 Nov 2022, 14:00**
- Latest trade in DE (EEX futures baseload 2023): **350** €/MWh
- Latest trade in FR (EEX futures baseload 2023): **424.5** €/MWh
- Forward price spread DE-FR: **74.5** €/MWh
- Undervaluation: forward spread indicator: TR_DE>FR – TR_FR>DE = 80.01 - 6.95 = **73.06** €/MWh (1.9%)



Observations

Observations

1. **Flow-based allocation (compared to NTC) bring some forward markets closer together:**
   - Arbitrage pricing theory: LTTR prices directly affect forward market prices and vice versa
   - DE and FR (directional) forward market price spread reduced from 80 €/MWh to 46.7 €/MWh
   - Given that DE hub is a reference hub, French forward market price reduced by ~33.3 €/MWh
   - French consumers able to buy electricity in forward market ~33.3 €/MWh cheaper
2. **Flow-based allocation (compared to NTC) pushed some forward markets further apart:**
   - DE and AT forward market price spread from 18.4 €/MWh to 30 €/MWh
   - Electricity in forward market for AT consumers ~11.6 €/MWh more expensive

Observations

Observations

3. **The overall impact on forward market integration is positive**
   - assuming equal level of capacity being offered (e.g. 2023, but not 2022)
   - forward markets on average closer together (increase of economic surplus)
4. **The redistribution effects between borders depend on:**
   - Prices offered on specific borders
   - The impact on specific borders on CNECs (i.e. PTDF)
   - The location of most binding CNECs (and their shadow prices)

Conclusions

Transmission rights have (at least) dual purpose

1. Integrate forward markets – trade arbitrage between markets (expressed as expected positive day ahead market spread)
2. Hedge variability in day-ahead market spread (expressed as risk premium)

Both values are expressed in €/MWh

- They are both treated equally
- They both have a positive economic impact

Long-term flow-based allocation leads to better integration of forward markets and hedging opportunities

(assuming equal level of offered capacities)

Thank you.
Any question?

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Market Participants' views on Long-Term Flow-Based Allocation of transmission rights

LTFBA workshop, 4 May 2023

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Flow-Based allocation is not appropriate for forward markets

- Flow-based works in day-ahead when you have the best possible information on fundamentals and marginal costs
  - Forward markets don't have this efficiency built in. They can remain far from "fair value" and for long periods of time.
    - CRE's enquiry into price action in France last summer: a large factor identified as causing the extreme price movements was credit / futures coverage /margin (cash) management – something LTFB will not factor in.
  - LTFB allocation on forward - spreads can completely flip soon after the LTFB auction
  - DA Flow based maximizes one direction in spot, but how will the allocated capacity volumes in the "out of the money" direction be maximized in the LTFB approach?

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ACER observations are disconnected from their positive conclusion on LTFBA

- ACER observations do not point to undoubtedly positive outcomes:
  - Observation 1 and 2 on random borders ("some markets get closer, some not") are anecdotal
    - Disagree with the estimated impact on BZ prices which is highly overestimated: the impact of FTRs on the BZ price does not equal the previous price minus FTR price !
  - Observation 3 ("overall positive market impact") seems to be conditional to equal volume to be offered: ***could TSO confirm this is a realistic assumption ?***
  - Observation 4 ("uncertain redistributive effects") implies that the success of FB calculation and allocation is arbitrary, and that TSO choices will determine which border get capacity or not: ***are ACER and NRAs truly fine with that?***
- All this does not reassure market participants about future forward capacity

Simulations show isolated bidding zones

- The 0/low allocation at some borders would prevent MPs in those BZ to benefit from cross-border hedging
  => *could ACER clarify whether this is acceptable to them? What is the view of NRAs?*
- Solution to mitigate that issue are necessary before going further: eg, imposing a min volume at each border, based on historical values
  => *could ACER/NRAs indicate what is the state of discussions on this?*
- Results seem highly depending on the construction of the PTDF matrix
  => *have ACER/NRAs and TSOs started discussing how to ensure proper governance ?*

Annexes

1. Capacity Calculation

Two approaches on how to define cross-zonal capacity

Physical conditions
Electricity is transmitted using power lines and other equipment in the power stations and grid
All these elements have limited transmission capacity due to their physical limits

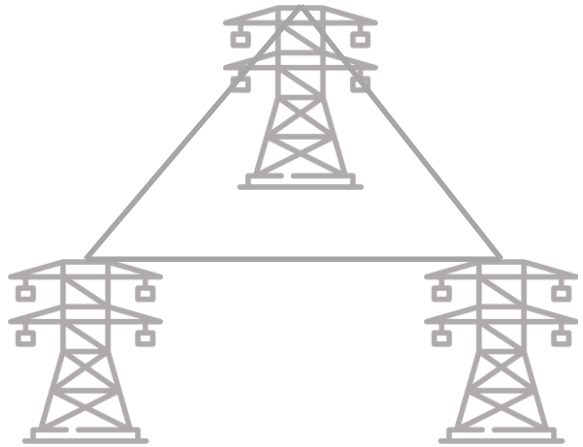
Within a bidding zone we assume **unlimited capacity**

For **cross zonal transactions, transmission rights** have to be **bought** in case of **congestions**

Cross-zonal capacities are **calculated and coordinated by TSOs** and **offered to the market** in different **time-frames:**
Long-term (yearly/monthly)
Day-ahead
Intraday

2 types of cross-zonal capacity calculation:
Net Transfer Capacity (NTC)
Flow Based (FB)

➔By **capacity calculation**, we refer to **cross-border capacities** and the **methodology how to compute the available capacities in a certain region**



1. Capacity Calculation

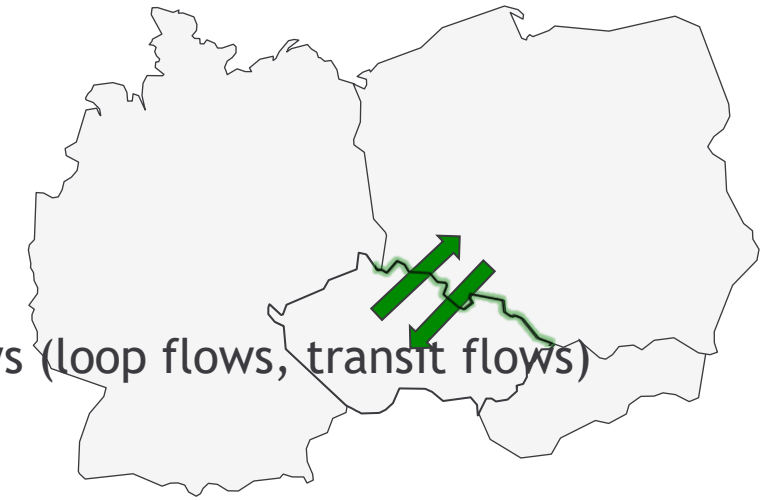
NTC – Approach suitable for independent borders

Net Transmission Capacity (NTC) calculation - main features

One value per bidding zone border and direction

Every TSO performs **individual calculation**

Harmonization between neighbors



Limited representation of the physical nature of the flows (loop flows, transit flows)

Offered capacities have to be **independent**

Low utilization of capacity on one border does not allow increase on other border

NTC harmonization	CZ->PL	PL->CZ
CZ NTC value	**1000 MW**	1000 MW
PL NTC value	2000 MW	**700 MW**
Final NTC	1000 MW	700 MW

1. Capacity Calculation

NTC – Calculation principle

Net Transmission Capacity (NTC) calculation principles

Calculation is performed **using a grid model:**

Prediction of load and generation

Prediction of grid status

Prediction of status of other countries (loopflows, parallel flows)

Applying the N-1 criterion

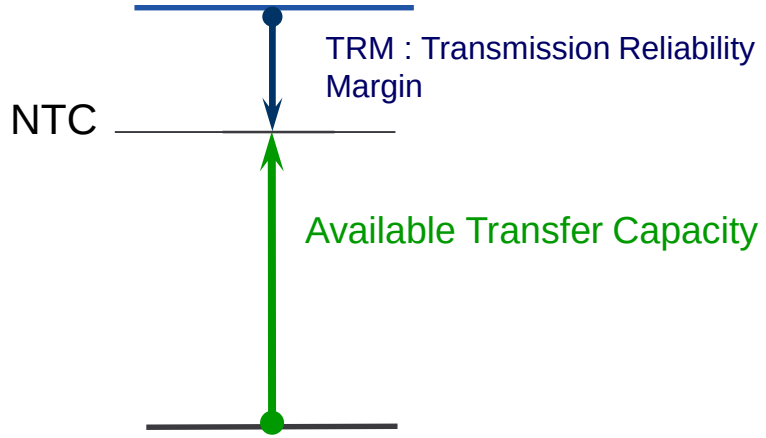
Iterative process of increasing cross-zonal flow as long as no security limits are breached

The **resulting NTCs need to be independent** (simultaneously feasible)

NTC: Capacity by border - bilateral exchanges

NTC: Net Transfer Capacity

TTC: Total Transfer Capacity of a border, taking into account N-1, and possibly loopflows and interdependency with other borders



Allocation: based on the principle that an exchange from bidding zone A to bidding zone B uses the $NTC_{A>B}$ defined on the respective Bidding Zone Border

1. Capacity Calculation

FB – Advanced approach for meshed grids

Flow based (FB) capacity calculation – main features:

Separate capacity for **every critical element** (relevant elements)

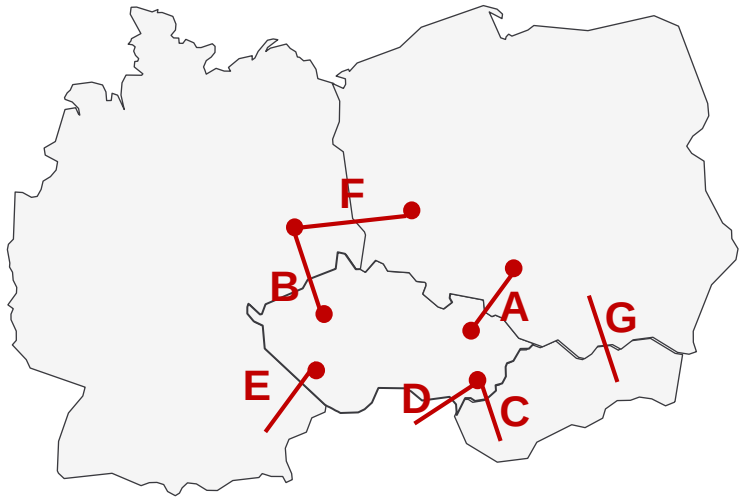
Calculation is **performed centrally** using coordinated rules and common input

Less assumptions than NTC approach: Simultaneous feasibility of cross-zonal exchanges is ensured at allocation time (not by fixed bilateral exchange limits at capacity computation, as with NTCs)

Results for every critical network element:

RAM – Remaining Available Margin

PTDF – Power Transfer Distribution Factor



CNEC	RAM	PTDF CZ->PL	PTDF DE->PL
A	1000 MW	0,6	0,15
B	2000 MW	0,15	0,3
C	800 MW	0,2	0,1

Transaction of 1 MW between CZ and PL will result in flow of 0,6 MW on CNEC A, 0,15 MW on CNEC B and 0,2 MW on CNEC C.

1. Capacity Calculation

FB – Calculation principle

Flow based capacity calculation principles

Every participating TSO submits:

Its **grid model** including their **prediction**

List of Critical Network Elements and Contingencies (**CNECs**)

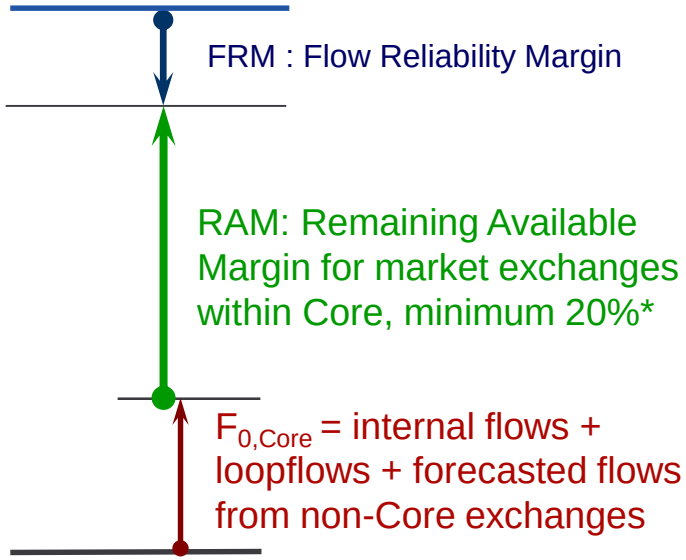
Calculation is performed **using a merged common grid model**

For every CNEC its **RAM and PTDF** are calculated

Flow based: Margin by electrical branch, expressed in N-1 (CNE + Contingency)

CNE: Critical Network Element

F_{max}: thermal capacity of the electrical branch



Allocation: optimizes exchanges by considering how much RAM each exchange uses on each CNEC (relationship = PTDF)

* And minimum 70% for all market exchanges (Core and non-Core) – subject to different values according to national action plans or derogations

1. Capacity Calculation

Capacity domain is a graphical representation of the capacities

Capacity domain defines a space of **allowed cross-zonal transactions**

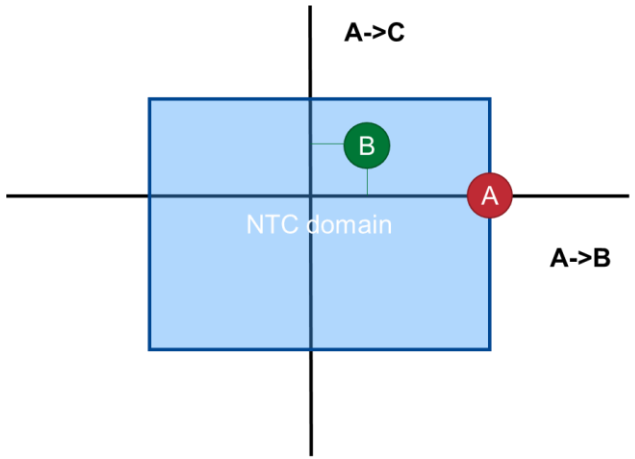
Axis – bilateral exchanges

Allowed transaction – inside the domain

2D example (12 Bidding Zones (+2 virtual ALEGrO Bidding Zones) in the Core CCR – 12 dimensional Domain)

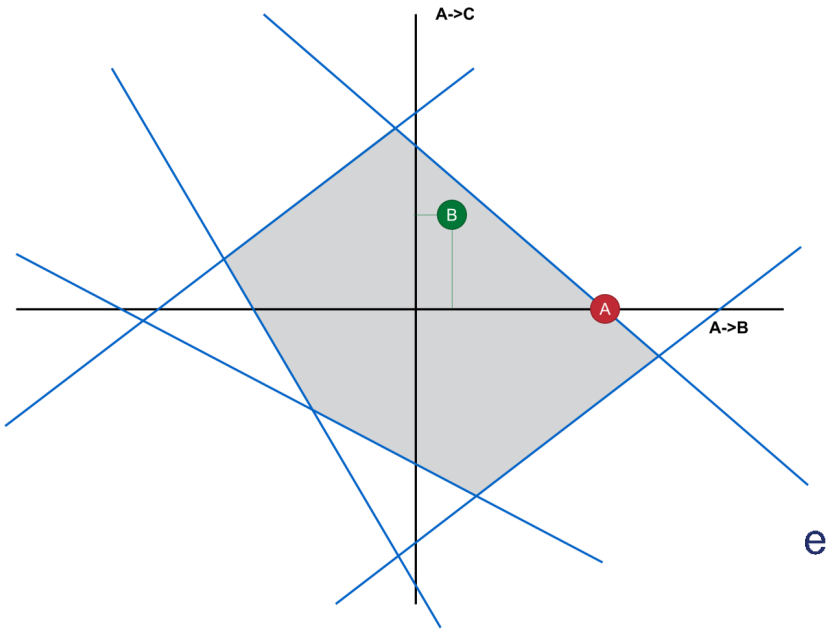
NTC Domain

- **NTC limits:** import and export limit for every border
- **Market result A:** Capacity in A→B direction is used fully, no Exchange in direction A→C
  - Regardless of Exchange in A→C direction, more Exchange in A→B direction is not allowed
- **Market result B:** Transaction in direction A→B and A→C



FB Domain

- **FB limits:** lines = CNEC
  - RAM – distance from origin, PTDF – incline
- **Market result A:** Capacity in A→B direction is used fully, no Exchange in direction A→C
  - More transaction in A→B direction is allowed if there is negative transaction in A→C direction



31

1. Capacity Calculation

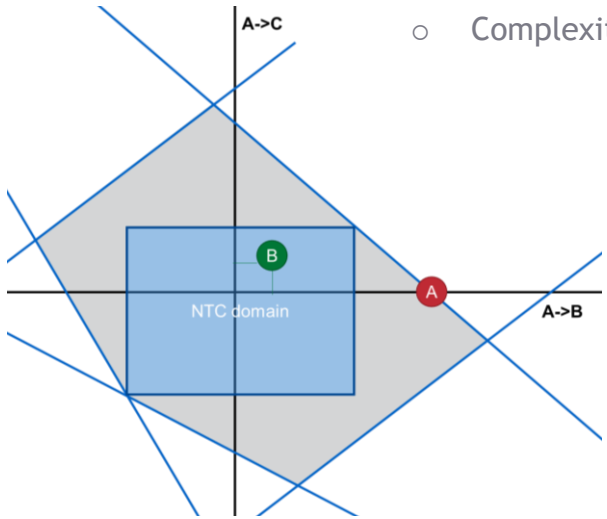
Summary of the two approaches

NTC capacity calculation

- **Result**
  - Constraint per border (import/export)
- **Calculation**
  - Individually by TSOs
  - Harmonization by neighbors
- **Pros**
  - Simple approach
  - Proven concept
  - Coordinated NTC suitable for regions with low dependency between borders
- **Cons**
  - Limited representation of physical flows (loop flows, transit flows)
  - Final NTC are fixed independent values

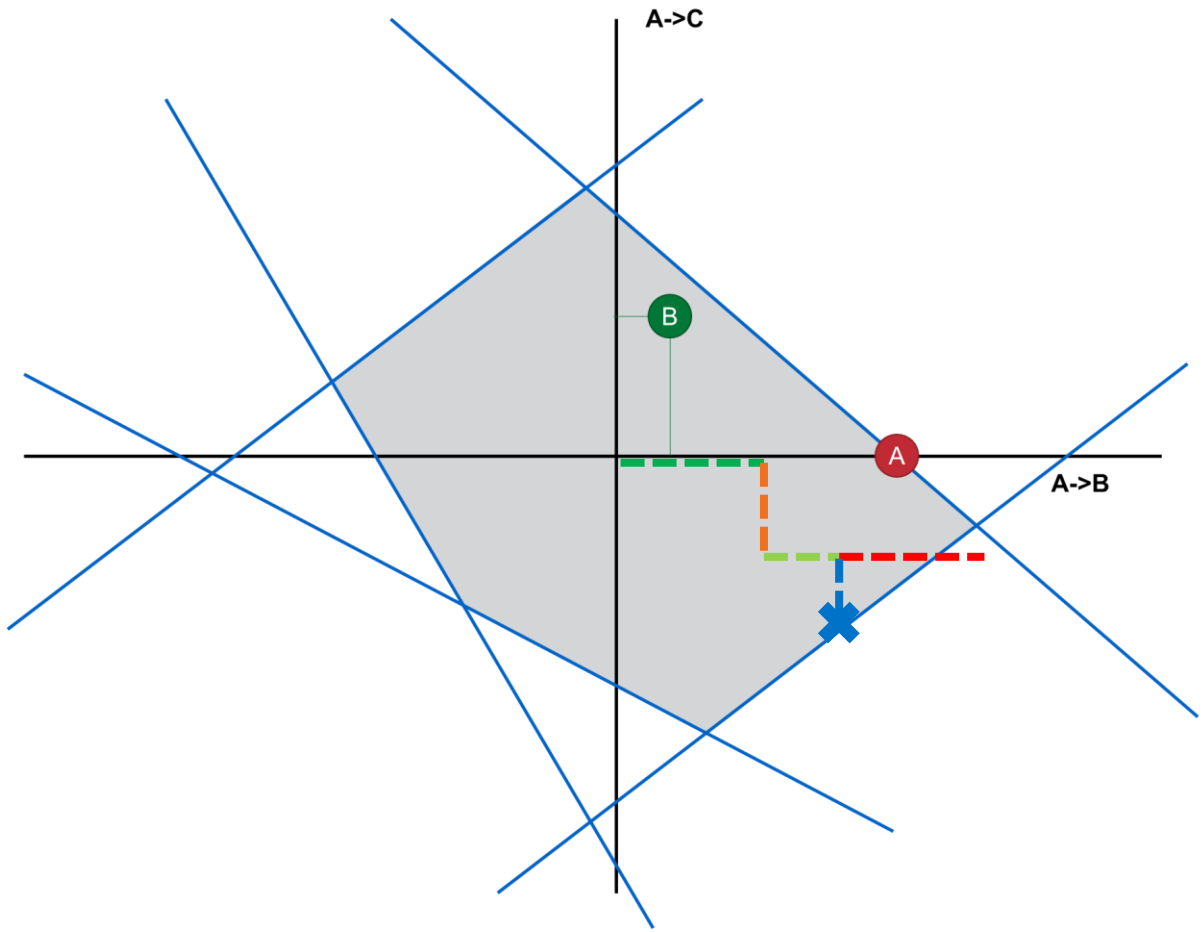
FB capacity calculation

- **Result**
  - Constraint per critical network element and contingency (CNEC)
- **Calculation**
  - Coordinated within a capacity calculation region
- **Pros**
  - Common inputs and rules
  - Good representation of physical flows (loop flows, parallel flows are included)
  - Final constraints are linked
  - More flexible utilization for those exchanges that are highly valued by the market participants.
- **Cons**
  - Complexity of the process



32

LT FBA Simulations – Simplified explanation of allocation algorithm



- The allocation algorithm will start by accepting bids generating the most social welfare: highest (bid * capacity)
- The allocation algorithm will continue accepting bids until either:
  - **A.** one of the limiting elements for allocation (provided through the FB domain) is reached
  - **B.** all bids provided could be accepted resulting in price convergence.

Example of bids on 3 BZs (A, B, C)

Order book of Bids on border A->C & A -> B

- Ranking and consideration of bids based on highest bid first
- **Bid 1 : Border A-> B 80 EUR/ MW - 100 MW**
- **Bid 2 : Border C-> A 70 EUR/ MW - 80 MW**
- **Bid 3 : Border A-> B 60 EUR/ MW - 50 MW**
- **Bid 4 : Border A-> B 50 EUR/ MW - 90 MW - NOT CONSIDERED - outside FB domain**
- **Bid 5 : Border C-> A 40 EUR/ MW - 80 MW**

ENTSO-E LTFBA Simulations – Further observations

Focus* >> LT FBA with real NTC (Y) Bids of 2023 (ref. to NTC allocation results)

Compared to the NTC 2023, FBA2023 resulted with **increase of social welfare** (approx. 20%)

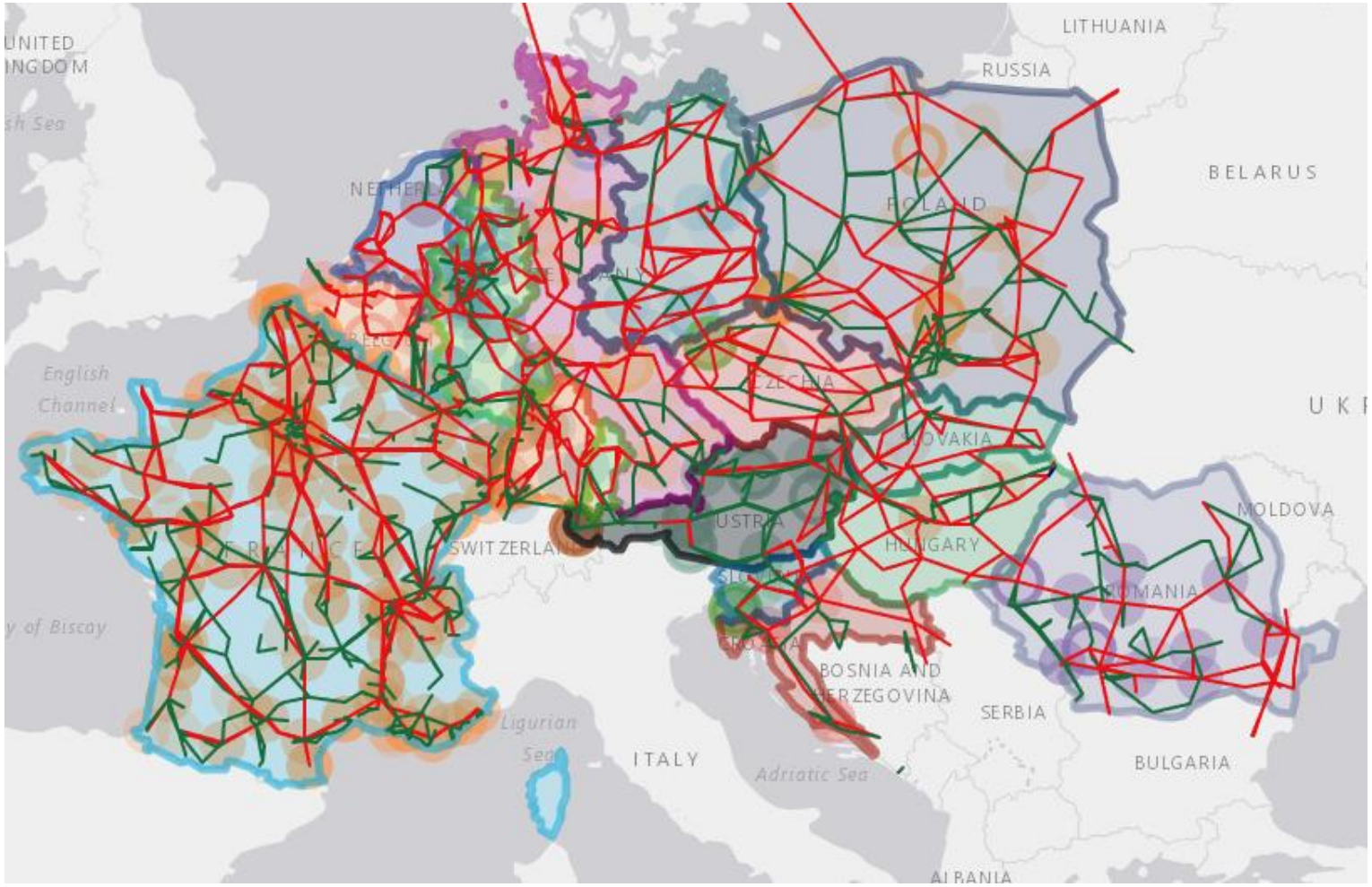
Total allocated capacities remained rather stable while congestion in FBA2023 is slightly increase (approx. 7%) compared to NTC2023.

Due to different bids in FBA2023, distribution of allocated capacities per border/direction is different. The following has been noted FBA2023 vs FBA 2022 (ref. to NTC2023 and NTC2022 respectively):

- Increase of number of directions with more allocated capacities i.e 14(FBA2023) vs 11(FBA2022)
- 10 directions (CEPS > SEPS, DE > RTE, DE>TTN, ELES >HOPS, MAVIR > TEL, RTE > DE, RTE > ELIA, SEPS > MAVIR, TEL > MAVIR, TTN > ELIA) are the directions with higher allocated capacities both with 2022 and 2023 Y bids
- Swing directions: CEPS > DE, HOPS > MAVIR, MAVIR > HOPS, MAVIR > SEPS (higher in FBA2023), DE > CEPS (higher in FBA 2022)
- Directions CEPS > SEPS and SEPS > MAVIR double- and on DE > RTE triple amount of capacities has been allocated in both FBA2022 and FBA2023, respectably. In addition three times more capacities on DE > CEPS has been allocated in FBA2022 and two times more in FBA 2023 in directions CEPS > DE, CEPS > SEPS, ELES > HOPS and SEPS > MAVIR
- Decrease of number of directions with low (>=10%) allocated capacities i.e. 5(FBA2023) vs 11 (FBA2022).
- Decrease of number of directions with no allocated capacities i.e. 3(FBA2023) vs 7(FBA2022). No capacities allocated on 2 directions (APG > CEPS and MAVIR > APG) both in 2022 and 2023

**: LT FBA with real NTC (Y) Bids of 2022 resulted with different distribution of allocated capacities including no/low allocations on several borders (reported in 25.01.2023 consultation call with ACER)*

ENTSO-E LTFBA Simulations – Further observations



Options for reducing collateral requirements in LTFBA auctions

Using a Percentage of today's collateral requirements

Concept summary:

- Same as today but reduce the required collaterals to a defined percentage
  - 100% means no change from today's approach
  - 0% means no collateral requirements

Challenges:

- Impact of any % reduction of collateral requirements should be assessed
  - → How to agree/assess on which % is 'the right one'?
- How to consider different collateral requirements in auction and after auction

Socialised pot for collaterals

Concept summary:

- No need for individual collaterals of MPs but establishment of a socialised 'pot' e.g. fuelled by fees from MPs and used in case of default of a MP

Challenges:

- High complexity to establish such system, setting a fee, etc. and several remaining open questions
- Ensure individual responsibility/consequences for non-payment

Options for reducing collateral requirements in LTFBA auctions

Using results from first iteration of calculated auction results for bid rejection

Concept summary:

- Collaterals requirements in auction phase not based on bid price but subject to auction results

Challenges:

- Complex process (e.g. would be subject to feasibility assessment)

Max price level for collateral requirement

Concept summary:

- Collaterals requirements in auction phase based market participant's bid price or max price cap for collateral consideration:
  - Min(MP's bid price; cap for collaterals) * bid volume
- If the MP's collaterals are insufficient after the clearing of the LTTR auction (e.g. price of LTTRs in auction is higher than cap), the MP would need to pay the remaining collateral within *X* days

Challenges:

- How to consider eventual gaps in collateral requirements in auction and after auction (e.g. prevent gaming)
- Setting the cap (e.g. fixed or methodology for dynamic cap)

ENTSO-E HAR – Examples – including positive and 0 spreads

BE->FR

LTTR yearly 2023	LTTR yearly 2022	LTTR November 2022	Average price spread last half 2022	Average price spread November
98	29.23	149.82	34.86	17.14
			FR->BE	
LTTR yearly 2023	**LTTR yearly 2022**	**LTTR November 2022**	**Average price spread last half 2022**	**Average price spread November**
4.43	1.75	1.57	0.69	0.57

AT->HU

LTTR yearly 2023	LTTR yearly 2022	LTTR November 2022	Average price spread last half 2022	Average price spread November
10.82	6.8	14.09	12.55	17.98
			HU->AT	
LTTR yearly 2023	**LTTR yearly 2022**	**LTTR November 2022**	**Average price spread last half 2022**	**Average price spread November**
3.58	0.88	4.65	5.12	3.36

Example for BE -> FR:

if a MP places a bid for the yearly 2023 auction of 50 EUR / MW then the collateral requirement for that bid would be 34,86 EUR/MW

HU->SK

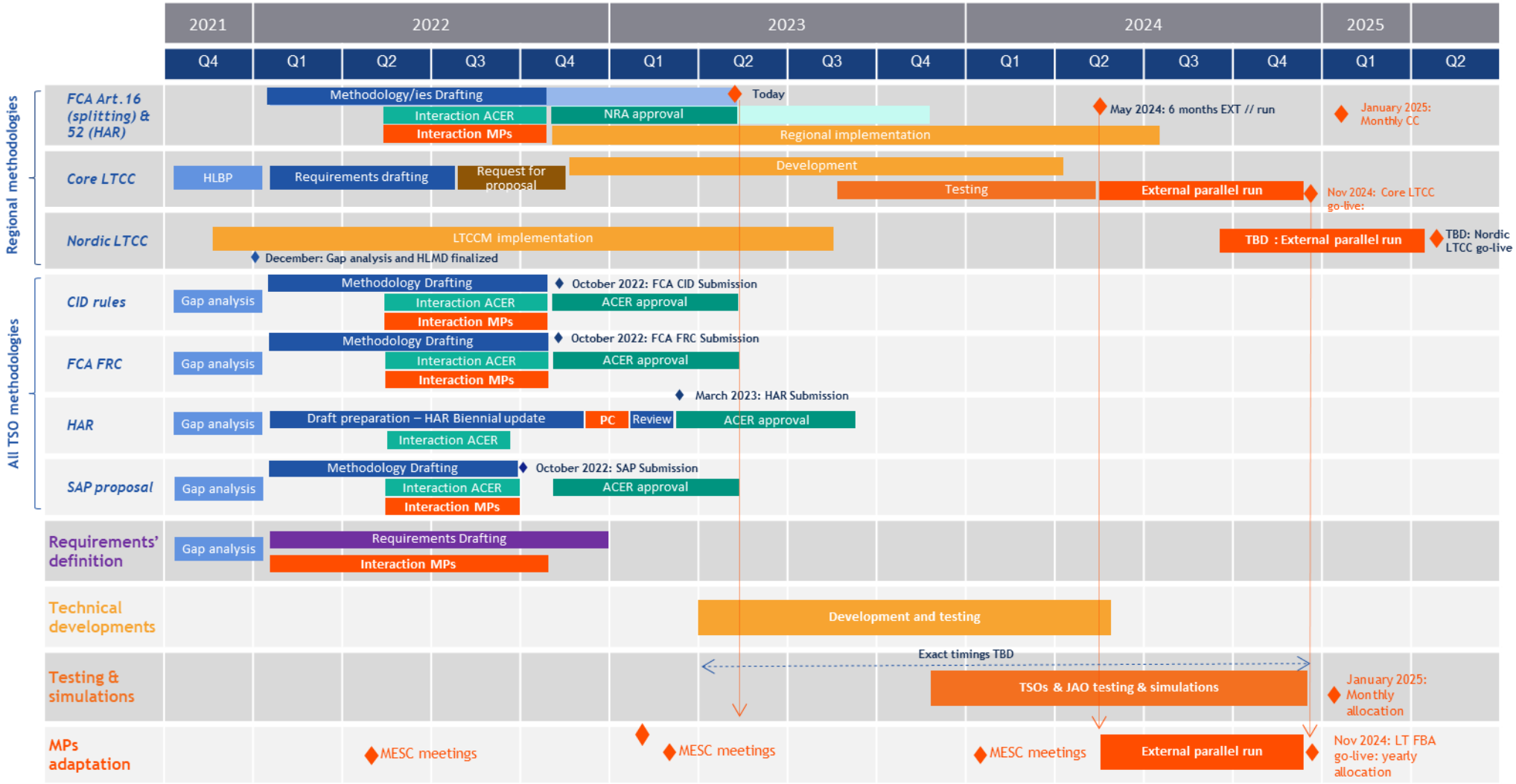
LTTR yearly 2023	LTTR yearly 2022	LTTR November 2022	Average price spread last half 2022	Average price spread November
0.67	0.09	2	1.11	1.08
			SK->HU	
LTTR yearly 2023	**LTTR yearly 2022**	**LTTR November 2022**	**Average price spread last half 2022**	**Average price spread November**
5.91	4.31	10.06	5.08	7.46

SL->HR

LTTR yearly 2023	LTTR yearly 2022	LTTR November 2022	Average price spread last half 2022	Average price spread November
2.32	0.62	2.1	4.61	4.84
			HR->SL	
LTTR yearly 2023	**LTTR yearly 2022**	**LTTR November 2022**	**Average price spread last half 2022**	**Average price spread November**
1.66	0.07	3.31	6.61	6.22

Disclaimer: the Price period analysed had one of the highest DA Market Price spread volatility in the past years

Timeline



*Timings may slightly vary from the planning above