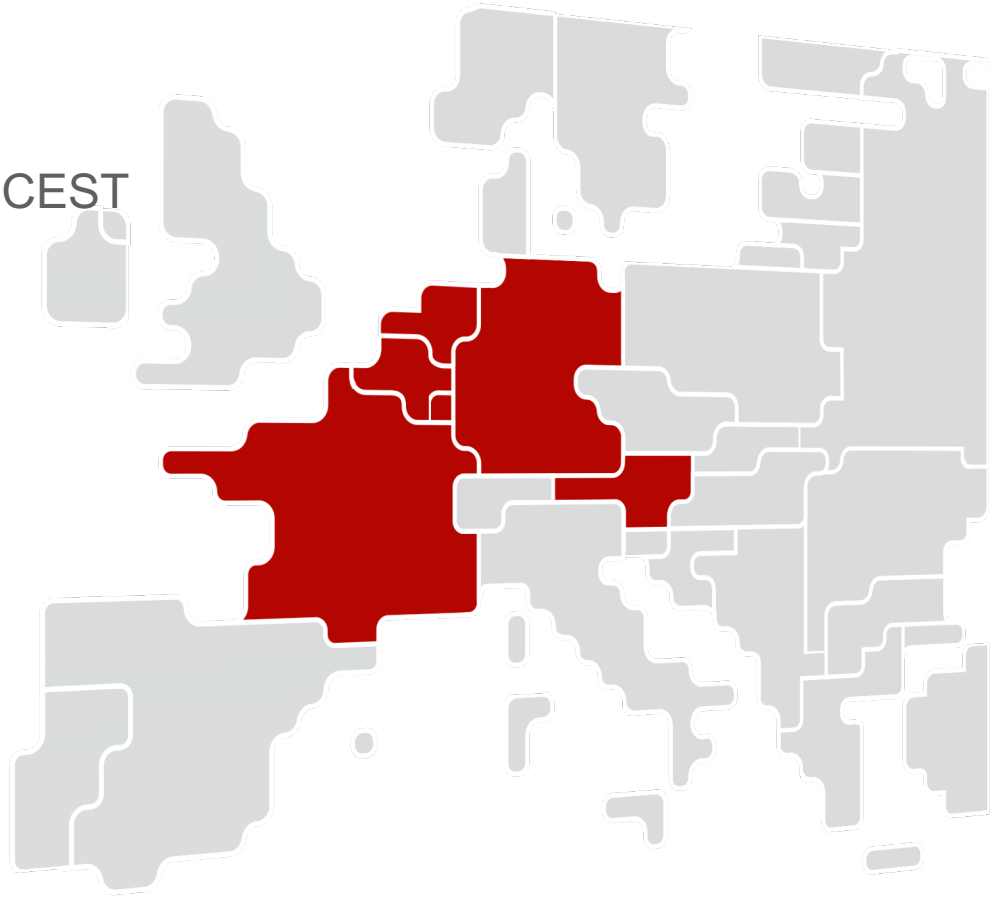
CWE Consultative Group

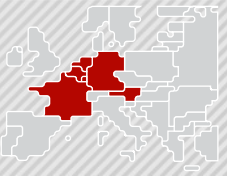
3rd of April 2020

Conference call 10:00-12:15 CEST



5. ALEGrO

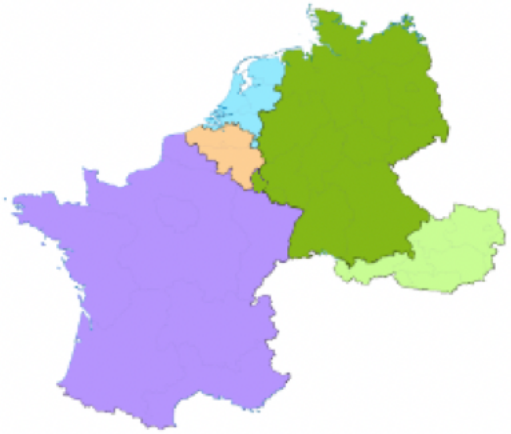
Status update



Amprion and Elia are developing a new HVDC connection between Germany and Belgium. We would like to inform MPs about the concepts and planning that will be used to implement this cable in FB MC.

Reminder: status quo in CWE

- Capacity is allocated in the DA market by a flow-based approach in the CWE area
- 5 bidding zones (FR, NL, BE, DE/LU, AT)
- The impact of commercial exchanges on load flows in the AC network is estimated as a function of the zonal net positions (by zonal PTDFs)
- Main FB allocation parameters are 5 zonal PTDFs and 1 RAM value for each CBCO



ALEGrO comes with an evolution of the methodology:

- ALEGrO requires the integration of a controllable HVDC link within the FB coupled area
- Approach: Evolved Flow-Based (EFB) concept
- Model the impact of the exchange over the HVDC link on the CBCOs in the AC network
- Determine the optimal exchange over the HVDC link as part of the day-ahead market welfare optimization („EUPHEMIA“ algorithm)

5. ALEGrO

Status update

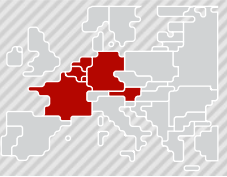
Implementation of EFB will be done by adding two virtual hubs

- At the two connection points of the HVDC link two new „virtual“ bidding zones are modelled in FBMC
- The net positions of these virtual bidding zones are equal to the injection/extraction of power at the connection nodes of the HVDC link
- Assuming no losses of the HVDC link, the net positions (NP) of the two virtual bidding zones are balanced:

$$NP_{BE}^{ALEGrO} = -NP_{DE}^{ALEGrO}$$

Modelling of HVDC link by HVDC parameters

- By adding the two virtual bidding zones, the impact of the injection/extraction at the HVDC links‘ ends (= net position of the virtual bidding zones) on flows in the AC network can be modelled by two new zonal PTDFs for the corresponding net positions
- From 5 to 7 zonal PTDFs per CBCO
- Further, the outage of the HVDC link needs to be considered as a new critical outage (CO) in the CBCO list
  - New CBCOs for the CO “outage of ALEGrO“



Example FB parameters with EFB

Status quo (without ALEGrO):
PTDF matrix with 5 columns

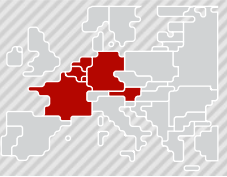
	PTDF FR	PTDF DE	PTDF BE	PTDF NL	PDF AT	RAM
CBCO 1	-0.3	0.16	-0.2	-0.1	0.05	…
CBCO 2	…	…	…	…	…	…
…	…	…	…	…	…	…

Two new PTDF-columns for the two virtual zones

EFB (with ALEGrO):
PTDF matrix with 7 columns and additional CBCOs

	PTDF FR	PTDF DE	PTDF BE	PTDF NL	PTDF AT	PTDF HVDC-BE	PTDF HVDC-DE	RAM
CBCO 1	-0.3	0.16	-0.2	-0.1	0.05	-0.2	0.2	…
CBCO 2	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…
New CBCOs for CO = outage of HVDC link						0	0	…

New CBCOs for HVDC outage



5. ALEGrO

Understanding the impact of EFB

In the PTDF matrix (7 columns) the PTDFs are expressed as zone to slack. To calculate the impact of an exchange from Bidding Zone A to Bidding Zone B, the zone to zone PTDF needs to be calculated via the following formula:

$$PTDF_{z2z\ A \rightarrow B} = PTDF_{z2s\ A} - PTDF_{z2s\ B}$$

For an HVDC implemented using EFB (ALEGrO), the impact of an exchange from BZ A to BZ B via an HVDC can be expressed as the sum of two exchanges:

1. First the energy needs to flow from BZ A to the converter station in BZ A where it will be transformed from AC to DC. Since the converter station is represented by its own virtual hub HVDC_A , the impact of this exchange on the AC grid can be expressed as:

$$PTDF_{z2z\ A \rightarrow HVDC\_A} = PTDF_{z2s\ A} - PTDF_{z2s\ HVDC\_A}$$

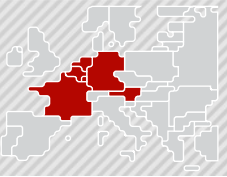
2. Second, the energy exchanged over the DC cable need to be converted back to AC and then exchanged again over the AC grid to Bidding Zone B. Again, the converter station is represented by its own virtual hub HVDC_B (at the other end of the HVDC cable). The impact on the AC grid from this second exchange can thus be expressed as:

$$PTDF_{z2z\ HVDC\_B \rightarrow B} = PTDF_{z2s\ HVDC\_B} - PTDF_{z2s\ B}$$

Putting the two exchange together, we see that an exchange between Bidding Zone A and Bidding Zone B over the DC cable can be expressed using the PTDFs oft eh virtual hubs:

$$PTDF_{z2z\ A \rightarrow B} = (PTDF_{z2s\ A} - PTDF_{z2s\ HVDC\_A}) + (PTDF_{z2s\ HVDC\_B} - PTDF_{z2s\ B})$$

The zone to zone PTDF of an exchange between BZ A and BZ B over the AC grid will thus be different when using the DC cable.



5. ALEGrO

Understanding the impact of EFB

Applying the calculation on an exchange between Germany and Belgium, we can calculate as illustration the impact of an exchange over the AC grid versus an exchange over Alegro

CB	CO	AT	BE	DE	FR	NL	AL_BE (Lixhe)	AL_DE (Oberzier)
PST Van Eyck	PST Zandvliet	-1%	-31%	+3%	-13%	+6%	-45%	+10%

AC grid exchange:

$$PTDF_{z2z\ DE\ \rightarrow BE} = PTDF_{z2s\ DE} - PTDF_{z2s\ BE}$$
$$PTDF_{z2z\ DE\ \rightarrow BE} = +3\% - (-31\%) = +34\%$$

In other words, if we exchange 1000 MW via the AC grid, then 340 MW will pass on the PST Van Eyck after the N-1 of the PST Zandvliet, **increasing** the flow over the PST in the NL ➔ BE direction.

An Exchange over Alegro where first the energy needs to flow from Germany to the converter station in Oberzier (where it is perceived as a load). Then, the converter station in Lixhe injects the power back into the grid to feed the Belgian nodes. So the zone to zone PTDF can be calculated as:

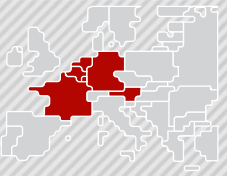
$$PTDF_{z2z\ DE\ \rightarrow BE} = (PTDF_{z2s\ DE} - PTDF_{z2s\ ALDE}) + (PTDF_{z2s\ ALBE} - PTDF_{z2s\ BE})$$
$$PTDF_{z2z\ DE\ \rightarrow BE} = (+3\% - 10\%) + (-45\% - -31\%) = -21\%$$

In other words, if we exchange 1000 MW via ALEGrO, then -210 MW will pass on the PST Van Eyck after the N-1 of the PST Zandvliet, **decreasing** the flow over the PST in the NL ➔ BE direction.

When the CB/CO is congested, then an exchange over ALEGrO will be preferred by the Market Coupling algorithm since it relieves the congestion. TSOs are not making the choice of one or the other path: the market coupling algorithm is choosing with the objective of maximizing the welfare.

5. ALEGrO

Status update



Project status:

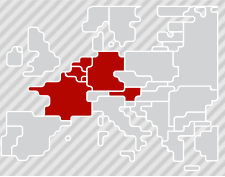
- The go-live will be communicated in due time and is expected to be during Q4.
- It is expected that there will be a technical go-live prior to the commercial go-live. At that time, the FB domain will include the virtual hubs but no PTDFs will be calculated and no capacity on ALEGrO will be made available to the market.

Additional remarks

- Notably, in the EFB approach the transmission over the HVDC link is determined by the FBMC allocation algorithm
- HVDC link setpoint is chosen optimally for maximizing day-ahead market welfare
- The EFB approach is part of the Core CCM. The modelling in detail for the seamless integration in EUPHEMIA is described in additional documents

Impact on the market

- The project aims at introducing all timeframes (DA / ID / LT) at, or shortly after, go live. The allocation will be performed in the CWE framework and will use existing processes.
- The project foresees to perform a long duration external parallel run to ensure sufficient transparency of the impact towards the market. As such, the external parallel run will replace an official SPAIC, however it could be that TSOs publish an additional SPAIC before the external parallel run.



5. ALEGrO

External parallel run principles

The ALEGrO external parallel run will start beginning of May until ALEGrO go-live

- The external parallel run is scheduled from beginning of May until ALEGrO go-live. The schedule is slightly shifted due to a delay in the back-office tools.
- There will be a ramp-up approach during the external // run. At first 2 BDs per week are going to be calculated. By mid of May 7 BDs per week should be calculated.
- The ALEGrO externall parallel run will apply FBP since this is the expected allocation method at the go-live.

Calculation

- Daily calculations will be done from D-2, with the final computation being run in D-1
- MC calculations will be performed in D+14 for publication

Publication

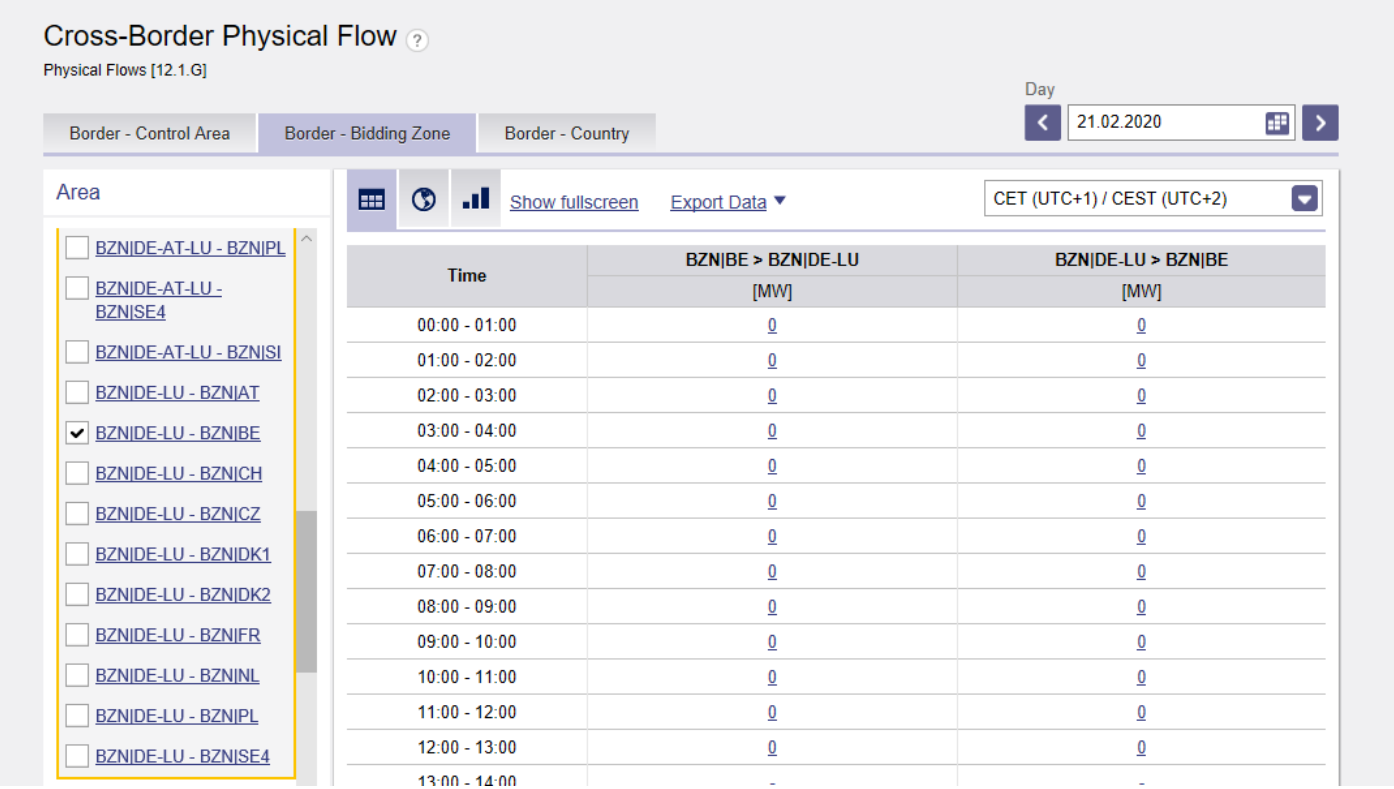
- Publication to market parties will be done in the updated version of the Utility Tool on a dedicated page on JAO. Further information will be provided there

Questions

- In case of questions, market parties can contact the ALEGrO project under alegro@magnus.nl

In line with the transparency regulation obligations (EU-543/2013), ETP will be updated for all data items for this new bidding zone border

- Example cross-border physical flow to be already published for the active power commissioning test-phase



Cross-Border Physical Flow

Physical Flows [12.1.G]

Day 21.02.2020

Border - Control Area | Border - Bidding Zone | Border - Country

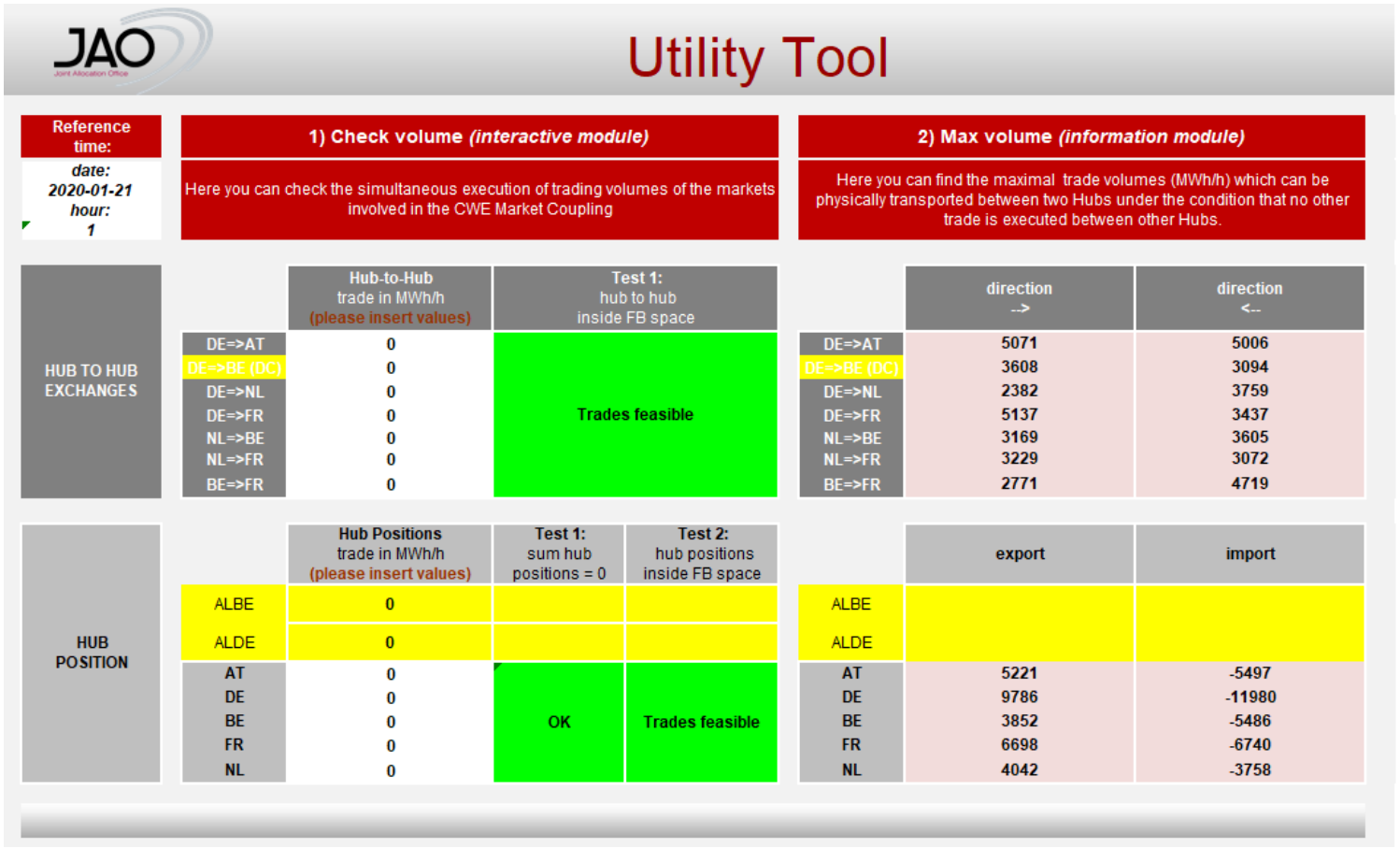
Area

- BZN|DE-AT-LU - BZN|PL
- BZN|DE-AT-LU - BZN|SE4
- BZN|DE-AT-LU - BZN|SI
- BZN|DE-LU - BZN|AT
- BZN|DE-LU - BZN|BE
- BZN|DE-LU - BZN|CH
- BZN|DE-LU - BZN|CZ
- BZN|DE-LU - BZN|DK1
- BZN|DE-LU - BZN|DK2
- BZN|DE-LU - BZN|FR
- BZN|DE-LU - BZN|NL
- BZN|DE-LU - BZN|PL
- BZN|DE-LU - BZN|SE4

Show fullscreen | Export Data | CET (UTC+1) / CEST (UTC+2)

Time	BZN|BE > BZN|DE-LU [MW]	BZN|DE-LU > BZN|BE [MW]
00:00 - 01:00	0	0
01:00 - 02:00	0	0
02:00 - 03:00	0	0
03:00 - 04:00	0	0
04:00 - 05:00	0	0
05:00 - 06:00	0	0
06:00 - 07:00	0	0
07:00 - 08:00	0	0
08:00 - 09:00	0	0
09:00 - 10:00	0	0
10:00 - 11:00	0	0
11:00 - 12:00	0	0
12:00 - 13:00	0	0
13:00 - 14:00	-	-

Utility Tool as main practical used data-provision resp. transparency tool will (only) change in details due to the fact that DE-BE bilateral exchanges are already feasible without ALEGrO.



JAO

Utility Tool

Reference time:	1) Check volume *(interactive module)*	2) Max volume *(information module)*
date: *2020-01-21* *hour:* *1*	Here you can check the simultaneous execution of trading volumes of the markets involved in the CWE Market Coupling	Here you can find the maximal trade volumes (MWh/h) which can be physically transported between two Hubs under the condition that no other trade is executed between other Hubs.

HUB TO HUB EXCHANGES

	Hub-to-Hub trade in MWh/h (please insert values)	Test 1: hub to hub inside FB space
DE=>AT	0	Trades feasible
DE=>BE (DC)	0	
DE=>NL	0	
DE=>FR	0	
NL=>BE	0	
NL=>FR	0	
BE=>FR	0	

	direction -->	direction <--
DE=>AT	5071	5006
DE=>BE (DC)	3608	3094
DE=>NL	2382	3759
DE=>FR	5137	3437
NL=>BE	3169	3605
NL=>FR	3229	3072
BE=>FR	2771	4719

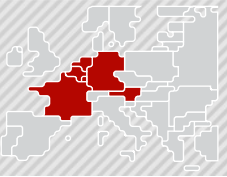
HUB POSITION

	Hub Positions trade in MWh/h (please insert values)	Test 1: sum hub positions = 0	Test 2: hub positions inside FB space
ALBE	0		
ALDE	0		
AT	0	OK	Trades feasible
DE	0		
BE	0		
FR	0		
NL	0		

	export	import
ALBE		
ALDE		
AT	5221	-5497
DE	9786	-11980
BE	3852	-5486
FR	6698	-6740
NL	4042	-3758

5. ALEGrO

Transparency - Utility tool (II)

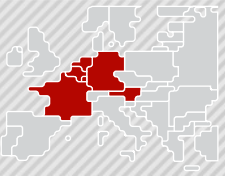


Two additional (virtual) hubs in the PTDF-sheets:

		ALBE-hub	ALDE-hub	AT-hub (MW)	BE-hub (MW)	DE-hub (MW)	FR-hub (MW	NL-hub (MW)	Sum	
Test Hub to Hub				0	0	0	0	0	0	
Test Hub Positions				0	0	0	0	0	0	
	ID	Critical Branch	EIC code	Critical Outag	EIC code	ALBE-hub	ALDE-hub	AT-hub	BE-hub	DE-hub
	98397	[BE-BE] PST_\	22T-BE-PST--(	[NL-BE] Maasb	10T-BE-NL-00002G			-0,01361	-0,30697	0,01324
	98579	[D4-AT] Buers	10T-AT-DE-00(	[AT-AT] Westti	14T-38220-WT041O			0,09613	0	0,00927
	98689	[AT-AT] Westti	14T-38220-WT	BASECASE				0,16886	-0,00371	0,02169
	98811	[D2-D2] Althein	11TD2L00000(	[D2-D2] Althein	11TD2L000000004J			-0,05382	0	0,00292
	99032	[NL-NL] Lelysta	49T000000000	[NL-NL] Doetinc	49T000000000014D			0,22195	0,14452	0,24631
	99108	[NL-NL] Lelysta	49T000000000	[NL-NL] Doetinc	49T000000000014D			0,21031	0,13276	0,23751
	99168	[AT-AT] Westti	14T-38220-WT	BASECASE				0,16567	-0,00364	0,01811
	99196	[D4-AT] Buers	10T-AT-DE-00(	[AT-AT] Westti	14T-38220-WT041O			0,0965	-0,00486	0,01585
	99374	[D4-AT] Buers	10T-AT-DE-00(	[AT-AT] Westti	14T-38220-WT041O			0,0941	-0,00614	0,01328
	99453	[AT-AT] Westti	14T-38220-WT	BASECASE				0,1667	-0,00194	0,01484
	99606	[D4-AT] Buers	10T-AT-DE-00(	[AT-AT] Westti	14T-38220-WT041O			0,09578	0	0,0081
	99914	[D2-NL] Diele -	10T-DE-NL-00(	[D2-NL] Diele -	10T-DE-NL-00002T			-0,03631	0,01985	0,0373
	99963	[NL-NL] Lelysta	49T000000000	[NL-NL] Doetinc	49T000000000014D			0,17884	0,07003	0,21038
	99968	[AT-AT] Westti	14T-38220-WT	BASECASE				0,16806	-0,0037	0,01837
	100076	[BE-BE] PST_2	22T20161020--	[NL-BE] Rilland	10T-BE-NL-00004C			-0,01197	-0,16504	0,01215
	100110	[BE-FR] Auban	10T-BE-FR-00(	[NL-BE] Maasb	10T-BE-NL-00001I			0,00337	-0,11887	-0,0035
	100293	[NL-NL] Lelysta	49T000000000	[NL-NL] Doetinc	49T000000000014D			0,17163	0,07625	0,20621
	100397	[AT-AT] Westti	14T-38220-WT	BASECASE				0,16464	-0,00362	0,0142
	100529	[BE-BE] Avelge	22T20161020--	[BE-BE] Avelge	22T20161020---1E			-0,01671	0,13371	0,01635
	100740	[NL-NL] Lelysta	49T000000000	[NL-NL] Doetinc	49T000000000014D			0,21117	0,13402	0,23818
	100790	[BE-FR] Auban	10T-BE-FR-00(	[NL-BE] Maasb	10T-BE-NL-00001I			-0,00337	0,11887	0,0035

5. ALEGrO

Transparency - Utility tool (III)



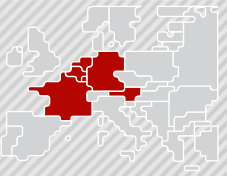
Additionally to the MAX/MIN NET POS of DE and BE, the max net pos of the virtual HUBs are provided:

- Helps MPs to better understand/ separate the impact of the DC-line

B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
Prog	**ALBE**	**ALDE**	**AT**	**BE**	**DE**	**FR**	**NL**		**hour**	**Min ALBE**	**Max ALBI**	**Min ALDE**	**Max ALDI**	**Min AT**	**Max AT**	**Min BE**	**Max BE**	**Min DE**	**Max DE**
MinALBE									1					-5497	5221	-5486	3852	-11980	9786
MaxALBE									2					-5476	5609	-5527	3831	-12817	9733
MinALBE									3					-5554	5348	-5470	3902	-12970	9381
MaxALBE									4					-5646	5545	-5602	3765	-12962	9546
MinAT			-5497						5					-5443	5831	-5683	3664	-13349	9700
MaxAT			5221						6					-5441	5439	-5975	3324	-12230	9874
MinBE				-5486					7					-4906	5128	-6000	3220	-12900	9833
MaxBE				3852					8					-4895	5029	-5982	3048	-12596	8638
MinDE					-11980				9					-4906	4936	-5831	3049	-12299	9078
MaxDE					9786				10					-4895	4958	-5702	3117	-12756	8772
MinFR						-6740			11					-4906	5016	-5576	3260	-12690	8835
MaxFR						6698			12					-4906	5061	-5528	3359	-12610	9165
MinNL							-3758		13					-4905	5034	-5673	3285	-12669	9218
MaxNL							4042		14					-4906	5075	-5806	3189	-12521	9228
MinAT			-5476						15					-4906	5004	-5763	3193	-12076	9746
MaxAT			5609						16					-4906	4978	-5810	3164	-11816	9968
MinBE				-5527					17					-4906	4906	-5918	3024	-11689	9449
MaxBE				3831					18					-4906	4965	-5841	3080	-11459	9793
MinDE					-12817				19					-4905	4947	-5611	3257	-12188	9001
MaxDE					9733				20					-4905	4966	-5576	3410	-12639	8761
MinFR						-6728			21					-4906	4897	-5516	3652	-12548	8718
MaxFR						7043			22					-4906	4990	-5575	3770	-12977	8727
MinNL							-3568		23					-5531	5381	-5781	3581	-12653	9335
MaxNL							4094		24					-5532	5407	-5717	3653	-12236	8642
MinAT			-5554																
MaxAT			5348																

5. ALEGrO

Outlook



ALEGrO project intends to provide further and more detailed information in the upcoming physical CCG Meeting foreseen in May/June 2020 (still to be scheduled) and to answer MPs' questions on

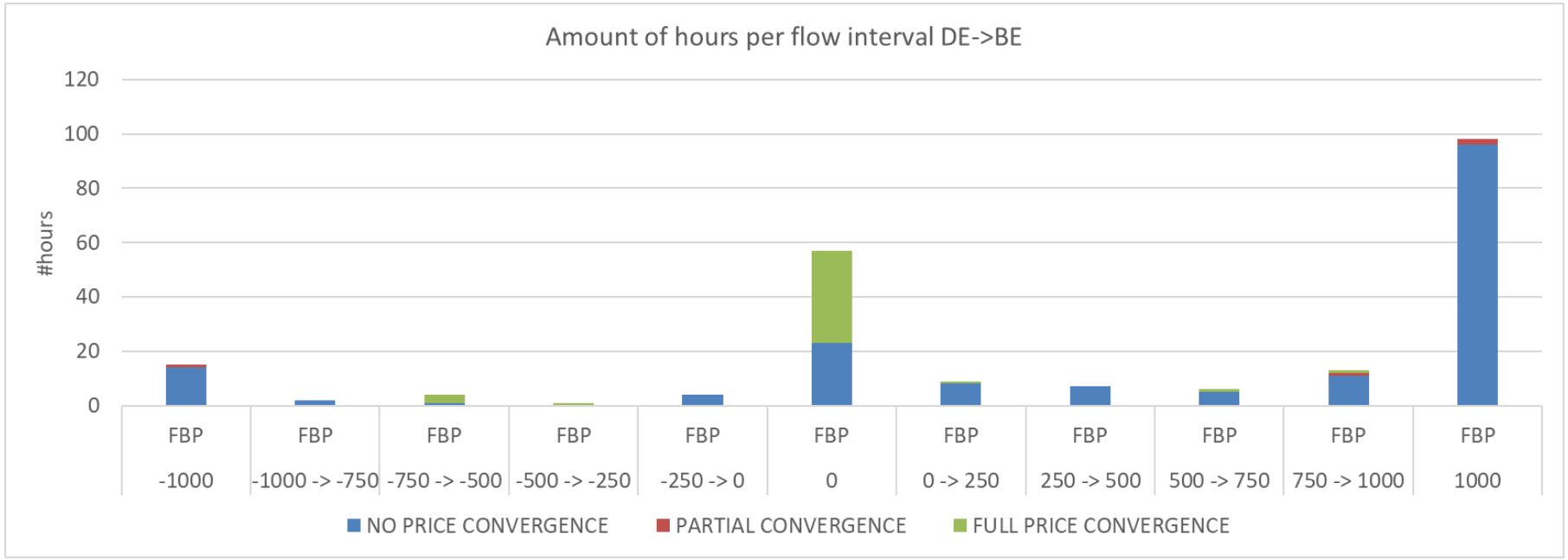
- Status of infrastructure project
- ALEGrO in different timeframes and related publications
- Discussion of external parallel run results
- Evolved Flow Based method
- Consideration of ALEGrO in market coupling
- Questions & Answers

5. ALEGrO

Understanding the impact of EFB

The figure below shows the distribution of allocated flow on Alegro for 10 BDs simulated during the internal parallel run. The results illustrate the effect of Evolved Flow Based.

- There are situation where the flow over the interconnector is less than 1000 MW even if there is no price convergence in the CWE region. In such cases, the market coupling algorithm explicitly made the trade off between and AC and DC exchange considering the impact on the congested CNEC.
- From the figure it cannot be deducted whether a flow on the interconnector was non intuitive or not (against the market spread BE-DE), however, with the application of FBP such situations can be expected.



Further details on the EFB and the impact of ALEGrO will be shared during the physical CCG.