

Stakeholder Workshop on:

**Cross Zonal Capacity Allocation for the
exchange of balancing capacity or
sharing of reserves**

PT CZCA

ENTSO-E, 04.02.2019

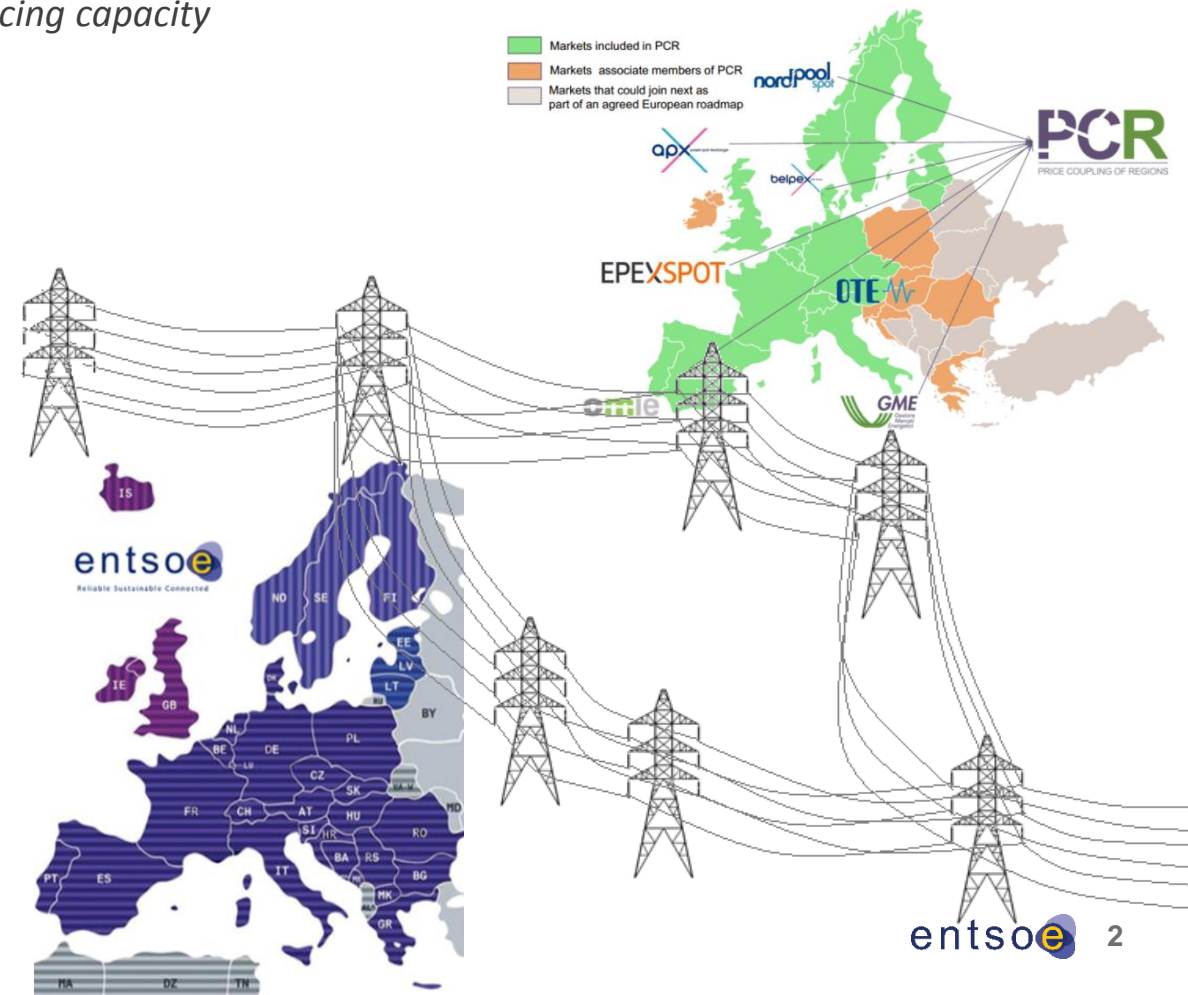
TSOs may allocate cross-zonal capacity

*Guideline on Electricity Balancing (EB GL) Art. 38 **allows** two or more TSOs to allocate a part of the cross zonal capacity (CZC) for the cross border exchange of balancing capacity or sharing of reserves.*

Balancing capacity markets may therefore compete with SDAC on the use of CZC in the DA timeframe.

Motivation for the allocation of CZC for reserve markets:

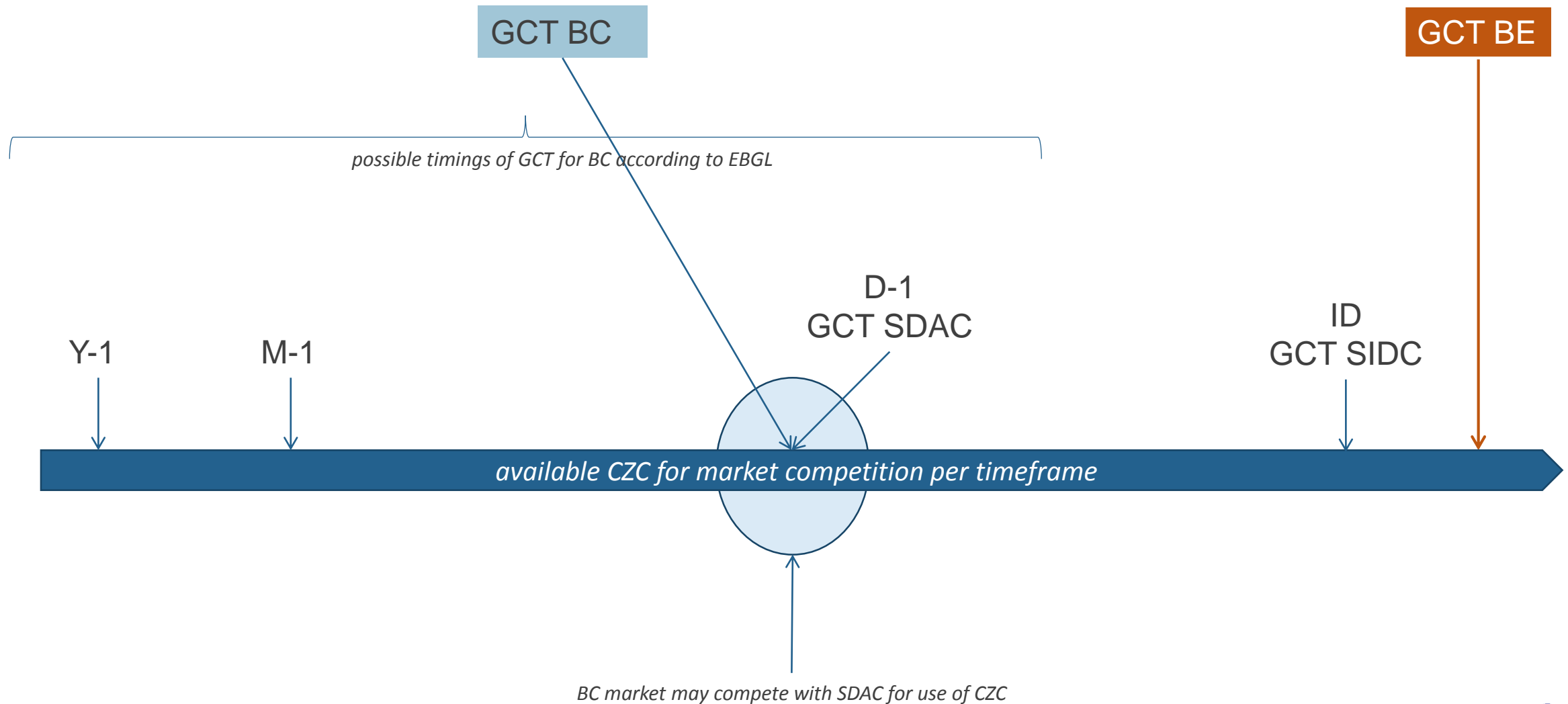
- enables TSOs to procure and use balancing capacity in an efficient, economic and market-based manner [EB GL (15)]
- can improve competition for balancing capacity markets
- can improve competition between different markets
- can facilitate regional procurement of balancing capacity



Abbreviations

BC	Balancing Capacity	GCT	Gate Closure Time
BZ	Bidding Zone	GOT	Gate Opening Time
BSP	Balancing Service Provider	IMB	Inverted Market-Based
CACM	Capacity Allocation Congestion Management	LFC	Load Frequency Control
CCR	Capacity Calculation Region	M	Month
CEP	Clean Energy Package	MB	Market-Based
CMOL	Common Merit Order List	MCO	Market Coupling Operator
CZC	Cross Zonal Capacity	NEMO	Nominated Electricity Market Operator
CZCA	Cross Zonal Capacity Allocation	PT CZCA	Project Team Cross-Zonal Capacity Allocation
CZCA OF	Cross Zonal Capacity Allocation Optimisation Function	PTR	Physical Transmission Rights
D	Day	RR	Replacement Reserves
DA	Day Ahead	RT	Real-time
EBGL	Guideline on Electricity Balancing	SDAC	Single Day-Ahead Coupling
EE	Economic Efficiency	SHW	Stakeholder Workshop
EIF	Entry Into Force	SIDC	Single Intra-Day Coupling
FB	Flow-Based	SOGL	Guideline on System Operation
FCR	Frequency Containment Reserves	TSO	Transmission System Operator
FRR	Frequency Restoration Reserves	W	Week
FTR	Financial Transmission Rights	Y	Year

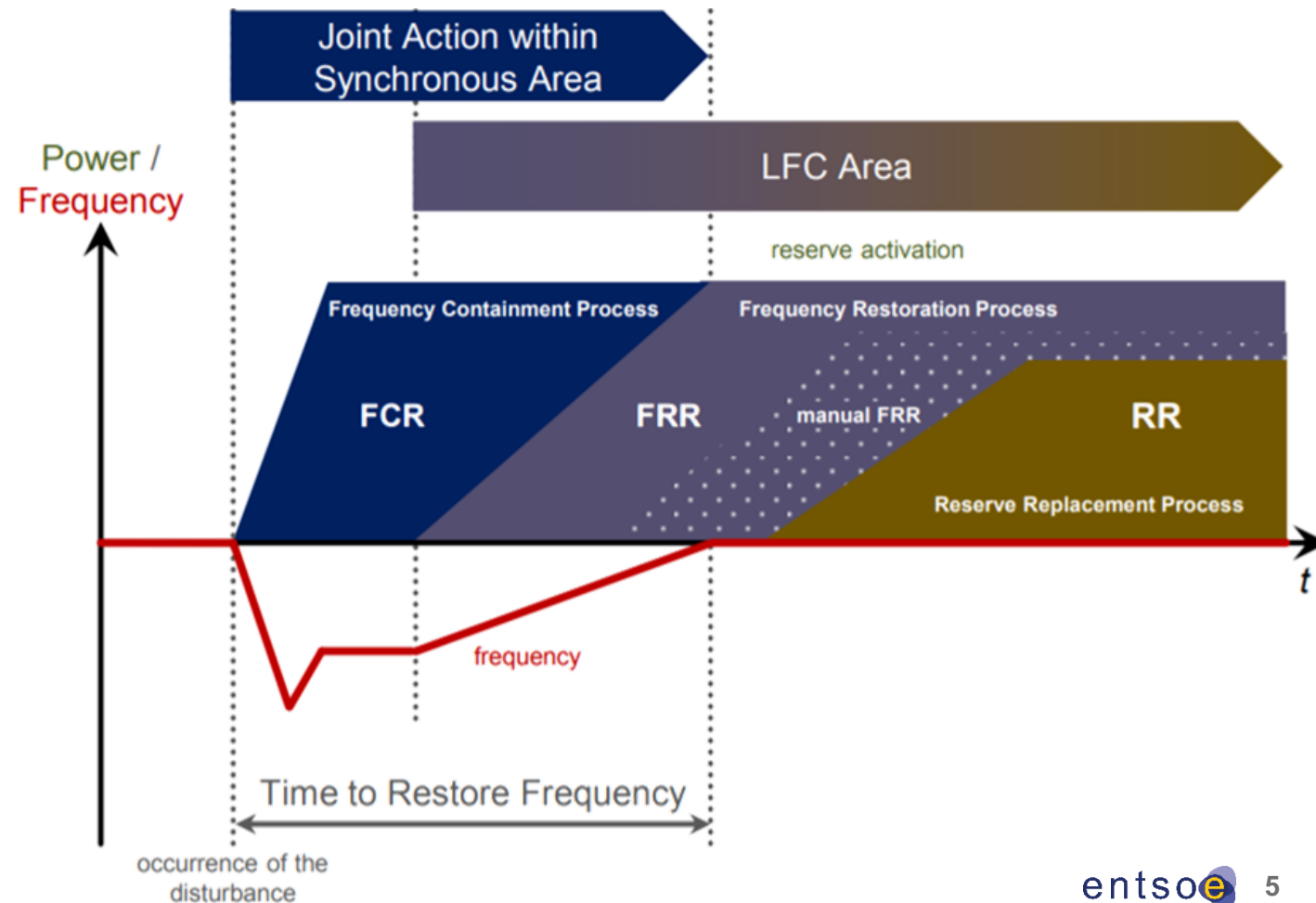
Reserve markets may compete with SDAC for CZC



Reserve market of balancing capacity

TSOs procure (far) ahead of real-time balancing capacity [MW] from Frequency Restoration Reserves and Replacement Reserves.

These reserves are the system's insurance to make sure that in real-time TSOs can activate at least a minimum amount of balancing energy bids [MWh]



TSO's procurement of balancing capacity

There are two options for cross-border cooperation for the procurement of balancing capacity for Frequency Restoration Reserves (FRR) and Replacement Reserves (RR):

1. Exchange of balancing capacity

means the provision of balancing capacity to a TSO in a different scheduling area than the one in which the procured balancing service provider is connected [EB GL]

- Exchange of balancing capacity between balancing areas may lead to a different geographical location of the balancing capacity from the dimensioning results for each area, to increase efficiency, competition and cost savings, however, the total amount of balancing capacity within the two areas is not reduced

2. Sharing of reserves

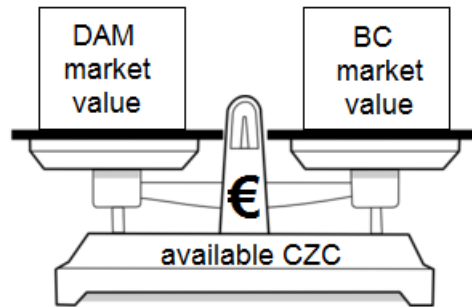
means a mechanism in which more than one TSO takes the same reserve capacity, being FCR, FRR or RR, into account to fulfil their respective reserve requirements resulting from their reserve dimensioning processes [SO GL]

- since TSOs not always use their maximum procured capacity simultaneously, TSOs can share their reserves, reduce the total amount of balancing capacity within the two areas and save procurement costs

How to decide to allocate CZC for balancing

Available CZC is a scarce resource and EB GL allows competition for CZC between SDAC and balancing capacity procurement.

The correct allocation of CZC for balancing shall be based on a **CZCA Optimisation Function (CZCAOF)**



The CBA calculates the market value of CZC [EB GL Art. 39] for day ahead market coupling and compares it with the calculated market value of CZC for the exchange of balancing capacity or sharing of reserves.

CZC may be allocated for the exchange of balancing capacity or sharing of reserves if:

Market value for exchange of balancing capacity > market value for day ahead market coupling

CZCA Optimisation Function

Objective function for allocation of CZC:

Maximisation of welfare surplus of the sum of the BC market and the SDAC

Welfare surplus SDAC:

- producer rent, consumer rent and
- congestion income

and

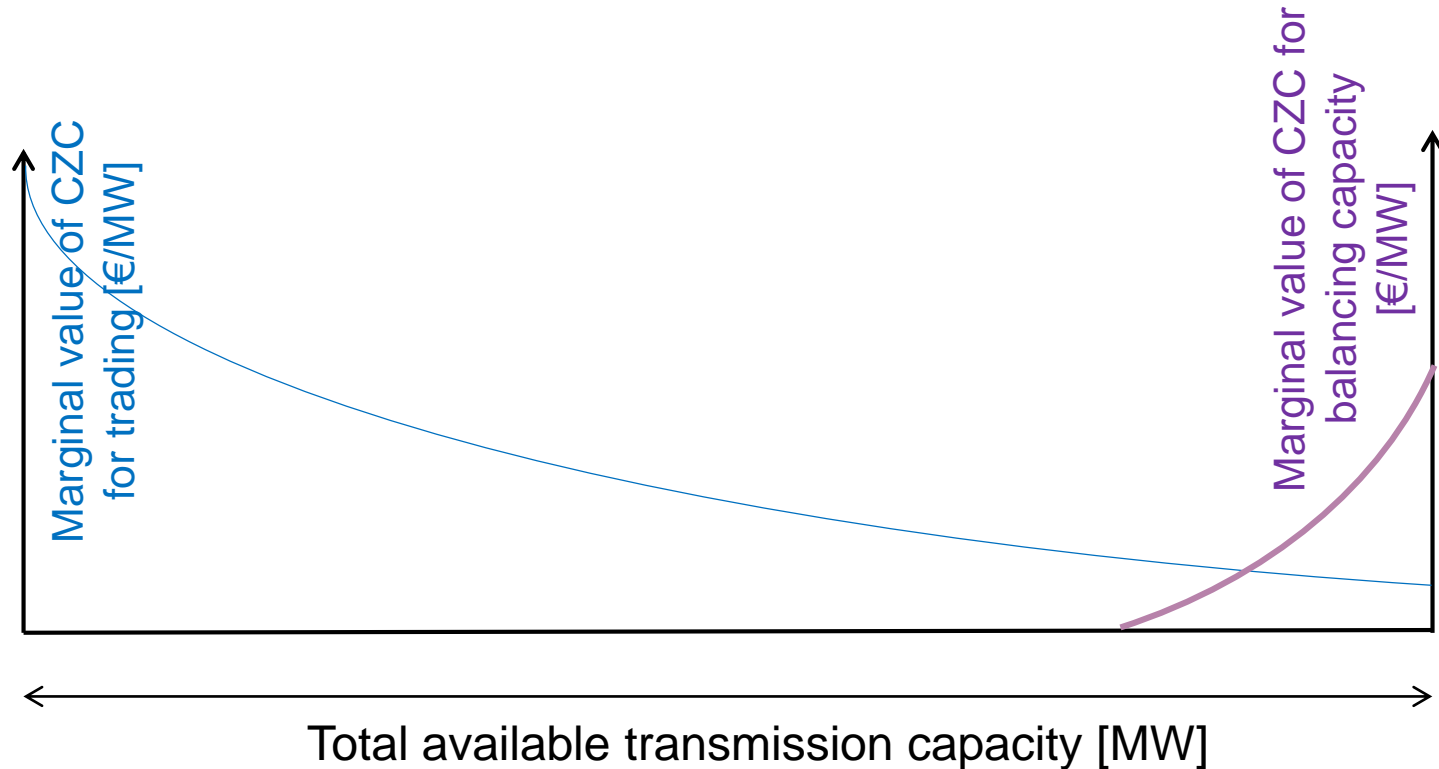
Welfare surplus balancing capacity:

Under pay-as-bid for BC:

- consumer rent, and
- if applicable congestion income

Under pay-as-cleared for BC:

- producer rent, consumer rent and
- congestion income



Overview of EB GL Articles

Title IV

Cross-zonal capacity for balancing services

Chapter 2

Exchange of balancing capacity or sharing of reserves

Article	Description per Article
Article 38: General requirements	List of general requirements belonging to the voluntary application of CZC allocation for the exchange of balancing capacity or sharing of reserves.
Article 39: Calculation of market value cross-zonal capacity	Description of the requirements how to calculate the actual and forecasted market value of CZC for the exchange of energy and for the exchange of balancing capacity or sharing of reserves to be compared in the CBA.
Article 40: Co-optimised allocation process	Description of the topics that must be included in the methodology co-optimisation that shall be developed by 2 years after EIF by all TSO , i.e. 18.12.2019.
Article: 41 Market-based allocation process	Description of the topics that must be included in the methodology market-based that may be developed by 2 years after EIF per CCR .
Article: 42 Allocation process based on economic efficiency	Description of the topics that must be included in the methodology economic efficiency that may be developed by 2 years after EIF per CCR .

No TSO is obliged to start a balancing cooperation to procure balancing capacity abroad

PT CZCA and deliverables

- Project Team Cross Zonal Capacity Allocation (PT CZCA) is responsible for the all TSOs proposal of Art. 40 on co-optimisation.
- Furthermore, PT CZCA also develops a template for the proposal of Art. 41 Market-Based allocation, and for Art. 42 Economic Efficiency allocation.
- CCRs themselves may finalise the proposals and start a public consultation.

Deliverables of the PT CZCA are:

- EIF+2y, proposal of Art. 40 Co-optimisation + explanatory document
- Template proposal of Art. 41 Market-based + explanatory document for CCRs
- Template proposal of Art. 42 Economic efficiency + explanatory document for CCRs

Agenda

- 1. EB GL allocation methods**
 1. Co-optimisation
 2. Market-based
 3. Economic efficiency
- 2. Additional information**
- 3. Nordic aFRR balancing capacity market**
- 4. DE-AT aFRR cooperation**
- 5. Conclusion and open discussion**

3 CZCA methods

According to EB GL Art. 38.1:

Two or more TSOs may at their initiative or at the request of their relevant regulatory apply allocation of CZC for balancing.

EB GL requires that the proposal is based on one of the 3 processes:

1. the co-optimisation process,
2. the market-based allocation process or
3. the allocation based on an economic efficiency analysis

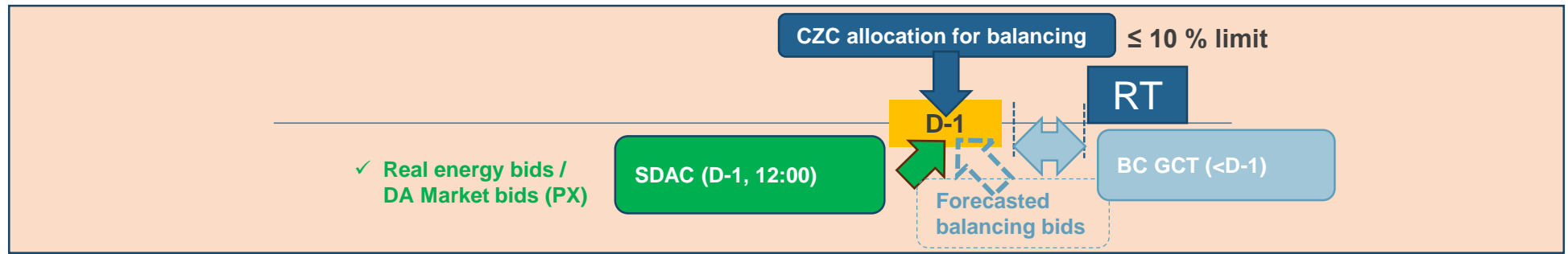
The 3 methods differ based on:

- when exactly the allocation optimisation is performed and the GCT of balancing capacity is organised
- if actual or forecast prices of balancing capacity and trading bids are used for the CZCA optimisation function

Method	Timing of CZC Allocation optimisation	Actual / forecast prices
Co-optimisation	At D-1 12:00	<ul style="list-style-type: none">• Actual bids/market value exchange of energy, and actual bids/market value exchange of balancing capacity
Market-based	At D-1 12:00, or At $\leq W-1$ and $> D-1$	<ul style="list-style-type: none">• Actual bids/market value exchange of energy, and forecasted bids/market value exchange of balancing capacity, or• Forecasted bids/market value exchange of energy, and actual bids/market value exchange of balancing capacity
Economic efficiency	At $>W-1$	<ul style="list-style-type: none">• Forecasted bids/market value exchange of energy, and forecasted bids/market value exchange of balancing capacity

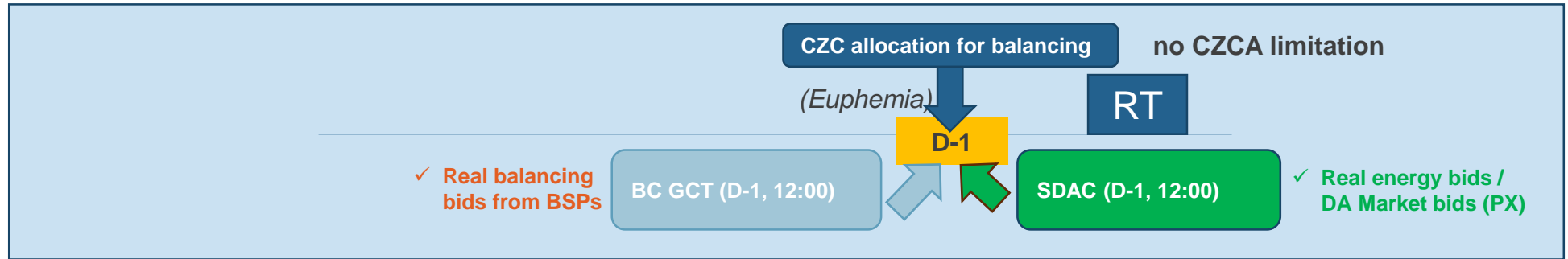
(Inverted) Market-based approach (D-1, 12:00)

- Real energy bids
- Forecasted balancing bids



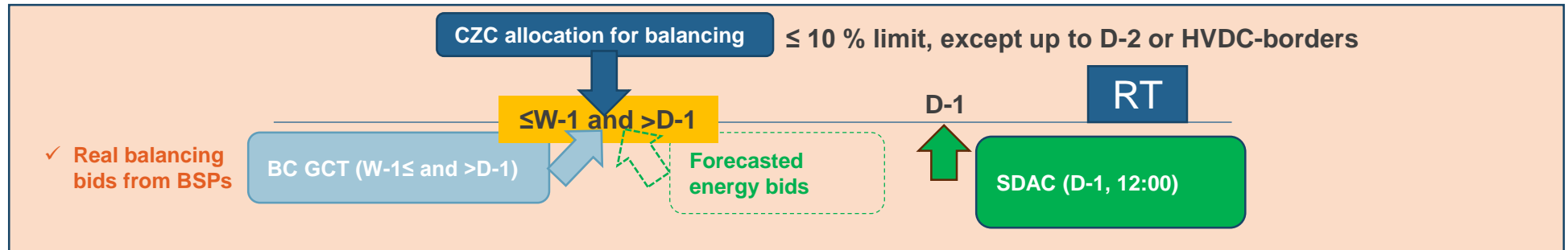
Co-optimization (D-1, 12:00)

- Real energy bids
- Real balancing bids



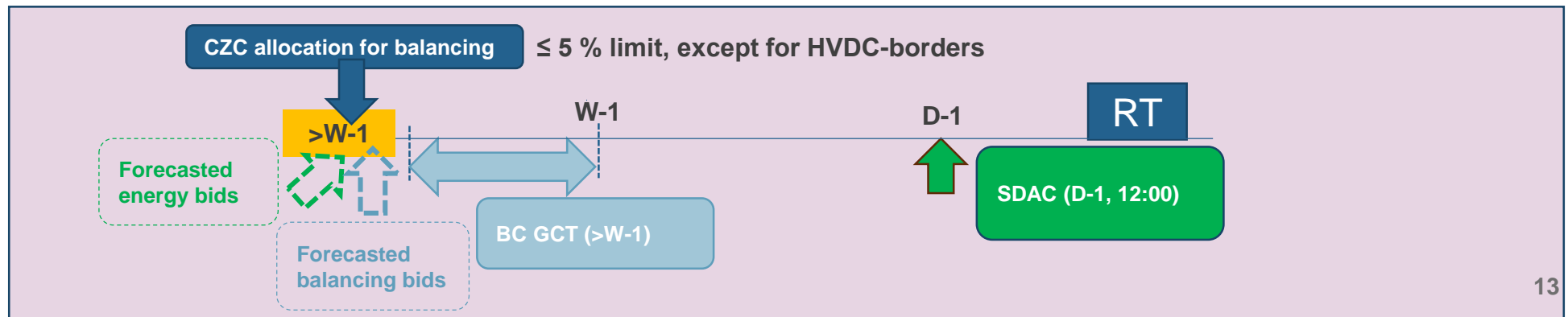
Market-based approach (≤W-1 and >D-1)

- Forecasted energy bids
- Real balancing bids



Economic efficiency (> W-1)

- Forecasted energy bids
- Forecasted balancing bids



Co-optimisation

Co-optimisation allocation principles

Principles for Co-optimised process according to EB GL

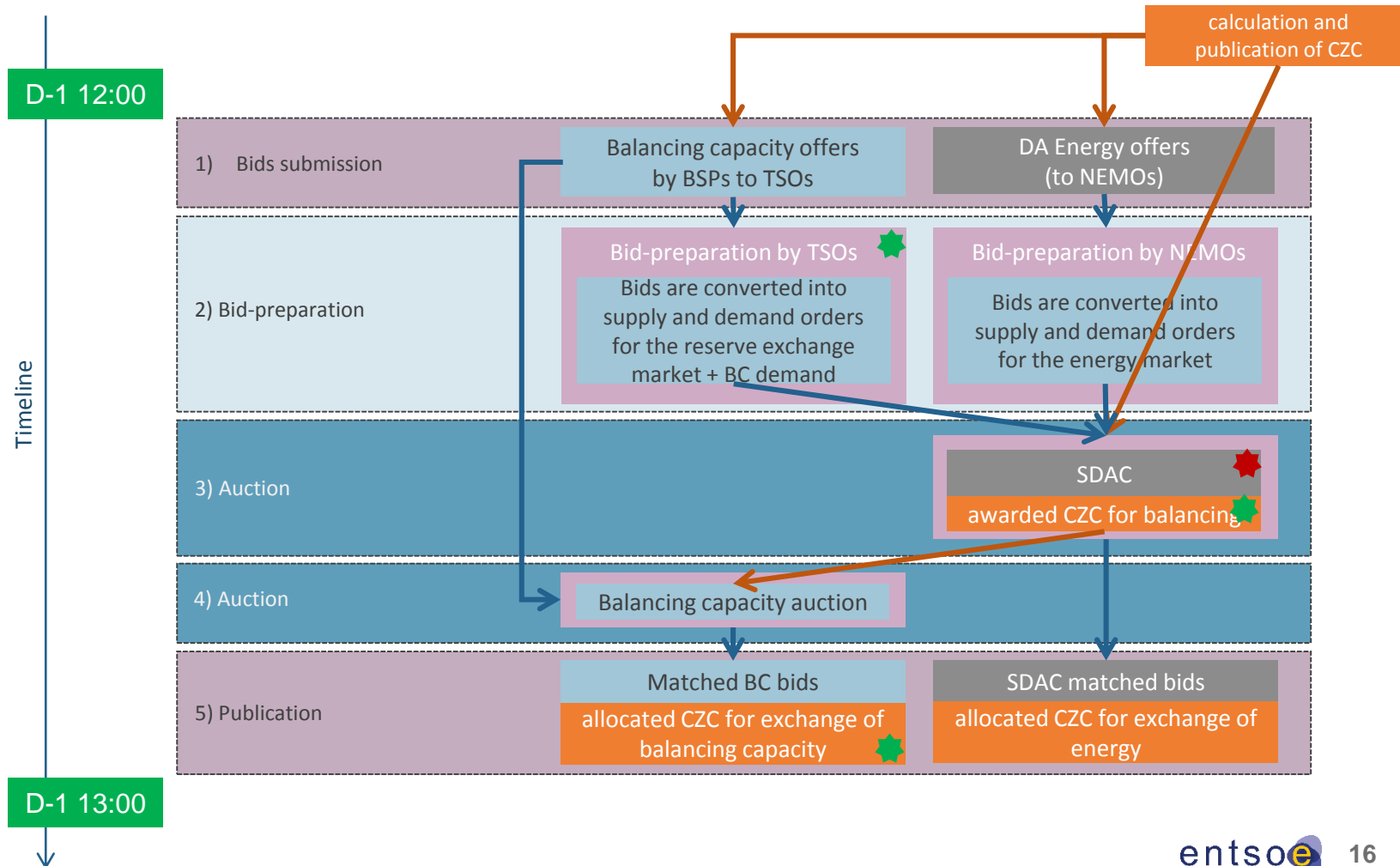
- Contracting period of balancing capacity : $\leq 24\text{h}$
- Time-frame of BC procurement: at D-1
- Limitation: none

- Principle: Actual DAM and balancing capacity bids are used to calculate actual market value of CZC for exchange of balancing or sharing of reserves and the actual market value of CZC for the exchange of energy (Art. 40)

Process of co-optimisation allocation

5 step approach:

- 0) CZC calculation
- 1) BC bids (upward/downward) and DA energy offers are submitted to TSO and NEMOs respectively.
- 2) The TSOs convert the BC bids in supply and demand orders likewise NEMOs do for exchange of energy, to prepare for the SDAC and include their BC demand.
- 3) The DAMC is run taking into account the value of CZC for balancing. Bids are matched and SDAC becomes firm.
- 4) Awarded CZC for balancing is used to build upward/downward CMOL for BC and becomes firm.
- 5) SDAC publishes the market outcome for trading and TSOs publish selected BC bids.



Co-optimisation allocation key-points

- No interaction between the CZCA optimisation function with capacity calculation
- GCT of balancing capacity equals GCT of energy (trading) markets
- TSOs (balancing) and NEMOs (trading energy) have the same timeslot to send data to the market coupling operator
- SDAC considers the market value of balancing capacity via supply and demand orders per bidding zone
- SDAC algorithm includes the CZCA optimisation function and therefore decides the allocated volume of CZC for the balancing capacity market
- CZC allocated for both markets will be shared with publication of selected bids to market participants

Market-based methodology

- *market-based approach*
- *inverted market-based approach*

Market-based allocation principles

Principles for Market-Based (MB) approach and Inverted Market-Based (IMB) approach according to EB GL

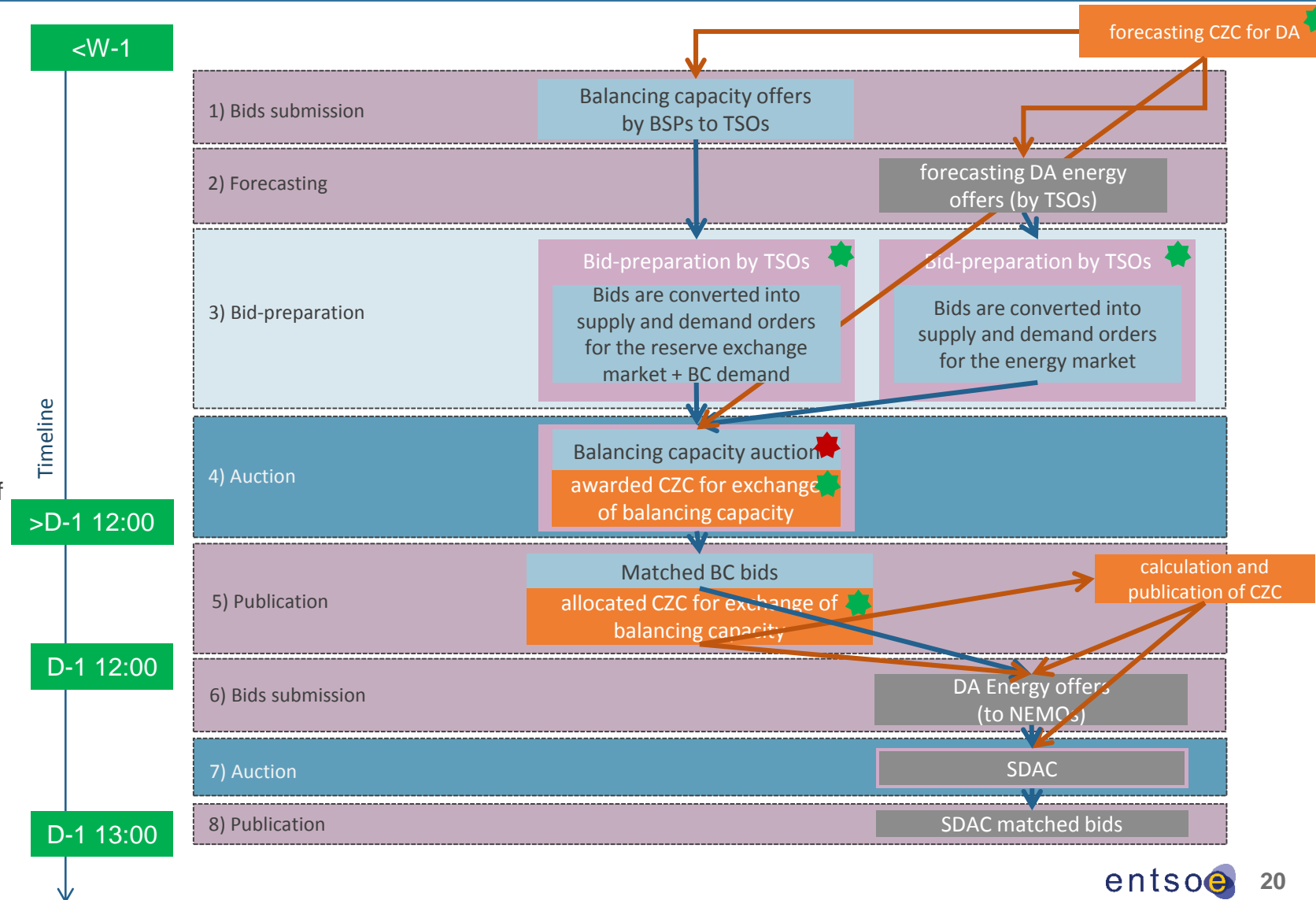
- Contracting period of balancing capacity: ≤ 1 day
- Time-frame of BC procurement: $\leq W-1$
- Limitation: 10 % unless the procurement process of BC is done not more than D-2 in advance or through DC interconnectors [EB GL Art. 41.2].
- Principle MB approach: Actual market value of CZC for exchange of balancing or sharing of reserves and the forecasted market value of CZC for the exchange of energy [EB GL Art. 41]
- Principle IMB approach: Forecasted market value of CZC for exchange of balancing or sharing of reserves and the actual market value of CZC for the exchange of energy [EB GL Art. 41]

Process of market-based approach

8 step approach:

0) an estimation is made on expected CZC available for the SDAC

- 1) BSPs submit balancing capacity bids.
- 2) TSOs make forecast of market value for exchange of energy
- 3) TSOs convert BC bids into supply and demand orders such that in the next step the market values can be compared taking BC demand into account.
- 4) TSOs run BC auction based on a CBA and CMOL becomes firm.
- 5) TSOs publish selected BC bids and allocated volume of CZC.
- 6) DA Energy offers are submitted to NEMOs.
- 7) SDAC uses demand and supply orders from NEMOs and runs auction which becomes firm.
- 8) SDAC publishes the market outcome for trading.



★ new (sub-)process required

★ performing CZCA optimisation function

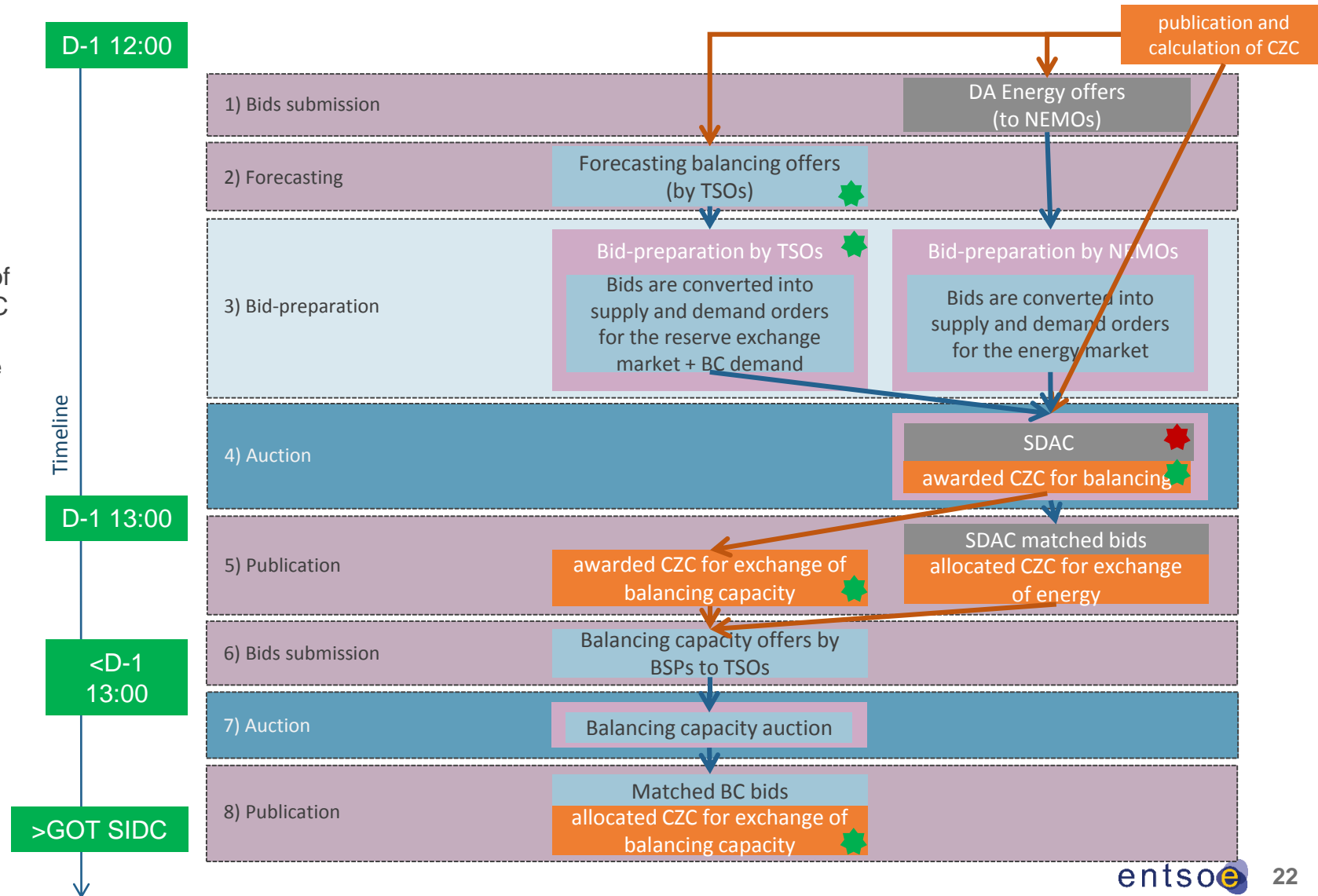
Market-based approach key-points

- Available CZC is not known, this information is not available for the BC market and therefore not considered in the preparation of BC bids by BSPs. Available CZC is also an additional forecast component in the CZCA optimisation function
- The closer the balancing gate closure time is set to SDAC (12:00), the more the MB-methodology interacts with timings of co-optimisation.
- The MB approach delivers timing freedom for TSOs to apply the CZCA optimisation function and the BC procurement and has no impact on current processes of capacity calculation and SDAC.
- The SDAC process does not need to perform the CZCA optimisation function

Process of inverted market-based approach

8 step approach:

- 0) CZC calculation
- 1) DA energy offers are submitted to NEMOs.
- 2) BC bids are forecasted by TSOs.
- 3) The TSOs convert the (forecasted) BC bids in supply and demand order likewise NEMOs do for exchange of energy, to prepare for the SDAC process, including BC demand of TSOs.
- 4) The SDAC auction is run taking into account the value of CZC for balancing. Bids are matched and SDAC becomes firm.
- 5) SDAC publishes the market outcome for trading and awarded CZC for balancing.
- 6) Balancing capacity bids are submitted to TSOs.
- 7) Awarded CZC for balancing is used to match bids and build CMOL for BC, and becomes firm.
- 8) TSOs publish the matched BC bids.



Inverted market-based approach key-points

- Resulting interaction between BC auction and SDAC is similar to the co-optimisation method, since SDAC needs to perform the CZCA optimisation function and takes into account the (forecasted) market value for exchange of balancing capacity.
- Not all TSOs feel safe with a balancing procurement process after SDAC, as the goal of the balancing capacity procurement is to ensure available balancing energy in real time.

Economic efficiency

Economic efficiency allocation principles

Principles for economic efficiency analysis according to EB GL

- Contracting period of balancing capacity: > 1 day
- Time-frame of BC procurement: > W-1
- Limitation: 5% of available capacity of the previous relevant calendar year for existing lines or 10% for new interconnectors and NO limitation apply for DC interconnectors
- Principle: Forecasted market value of CZC for exchange of balancing or sharing of reserves and the forecasted market value of CZC for the exchange of energy [EB GL Art. 42]

Process of economic efficiency

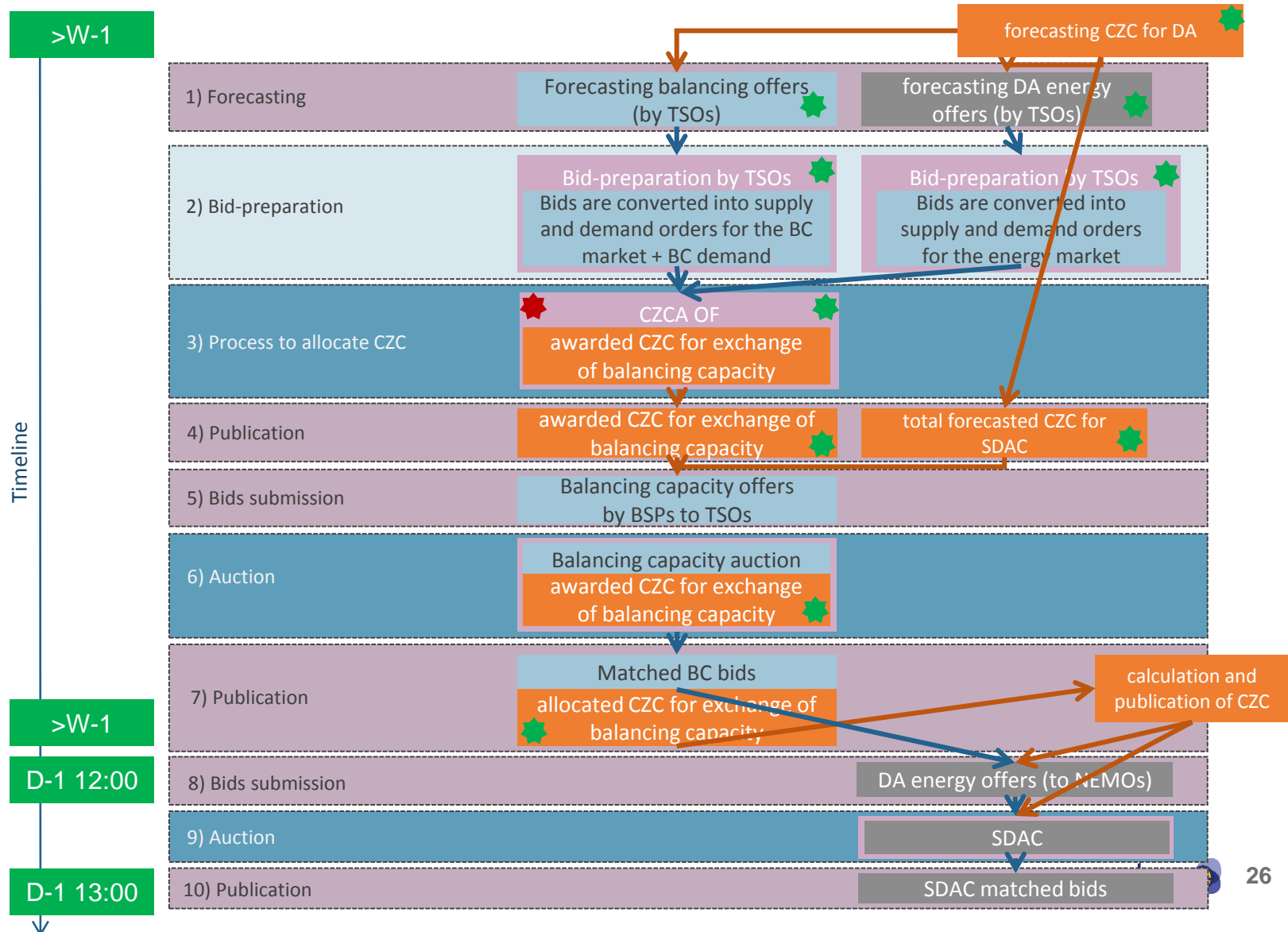
10 step approach:

0) an estimation is made on expected CZC available for the SDAC

- 1) Bids for BC and for DA energy trading are forecasted by TSOs.
- 2) Forecasted bids are converted by TSOs into supply and demand orders to determine the market value for both balancing and trading taking BC demand into account.
- 3) The TSOs compare the market value for balancing with trading and decide on volume of CZC allocated to balancing.
- 4) TSOs publish CZC allocated to BC.
- 5) BSPs submit BC bids.
- 6) TSOs run BC auction, match the bids and build firm CMOL.
- 7) TSOs publish matched BC bids and actually allocated CZC. Non used CZC goes back to SDAC.

CZC is calculated and published.

- 8) DA Energy offers are submitted to NEMOs.
- 9) The SDAC auction is run, bids are matched and becomes firm.
- 10) SDAC publishes the market outcome for trading



Economic efficiency allocation key-points

- Available CZC for SDAC might not be known, depends per timeframe and per CCR and therefore might be an additional forecast component for the CZCA optimisation function.
- This is the only allocation method where:
 - during Balancing Capacity auction and SDAC the market players know the CZC awarded/allocated for their market
 - CZC allocation, capacity calculation, balancing procurement and SDAC have no timely interaction
 - DA timings are not relevant for balancing procurement and CZC allocation
- The SDAC process does not need to perform the CZCA optimisation function

Additional information

1. **Forecasting**
2. **Table of content of proposals**
3. **Dashboard**

Forecasting

Forecasting market value

EB GL Art. 39.5

The forecasted market value of cross zonal capacity shall be based on one of the following alternative principles:

- (a) the use of transparent market indicators that disclose the market value of cross zonal capacity; or
- (b) the use of a forecasting methodology enabling the accurate and reliable assessment of the market value of cross zonal capacity.

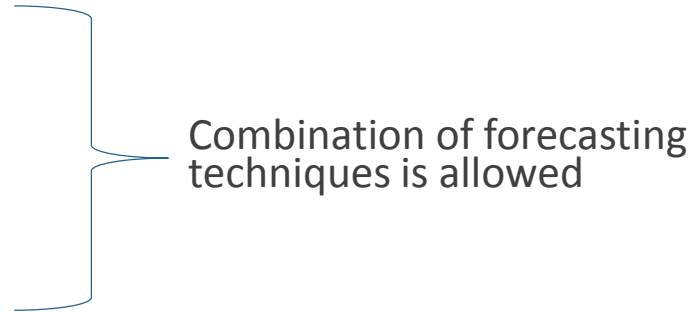
The forecasted market value of cross zonal capacity for the exchange of energy between bidding zones shall be calculated based on the expected differences in market prices of the day-ahead and, where relevant and possible, intraday markets between bidding zones. When calculating the forecasted market value, additional relevant factors influencing demand and generation patterns in the different bidding zones shall be taken duly into account.

Forecasting: forecasting methodologies

Each CCR must decide on one forecasting methodology for in their proposal.

PT CZCA proposes the following forecasting techniques or a combination of these to decide on one forecasting methodology.

1. Market indicators
2. Persistence method
3. Advanced statistical methods
4. Cost-based forecasting methods



Forecasting: market indicators

The PT CZCA provides the following types of market indicators which CCRs can choose to develop their forecasting.

1. Market-related indicators
2. Experience from previous periods
3. External factors
4. Regulatory requirements

- Available SDAC trading bids
- Available BC bids
- Required demand of BC per control block
- Available CZCs
- Available production/ consumption capacities and types
- Future prices and differences
- PTR/ FTR prices and differences
- Fuel prices
- Weather conditions
- Seasonal expectations
- Economic trends
- Market outcomes of similar time periods in the past
- DA and BC bid curves of similar time periods in the past
- CZC allocations in times of similar conditions
- Emission right price

Forecasting: criteria to evaluate

PT CZCA will provide CCRs an evaluation of the market indicators based on the following criteria:

1. Accuracy
2. Transparency
3. Applicability
4. Required information and accessibility for TSOs

Table of content of proposals

Table of Content Co-optimisation Proposal

Article 1	Whereas
Article 2	Subject matter and scope
Article 3	Definitions
Article 4	Notification process for the use of the co-optimised allocation process
Article 5	Timeframe of co-optimised allocation process
Article 6	Process to define the maximum volume of allocated cross zonal capacity for the exchange of balancing capacity or sharing of reserves
Article 7	Determination of the actual market value of cross zonal capacity for the exchange of energy
Article 8	Determination of the actual market value of cross zonal capacity for the exchange of balancing capacity or sharing of reserves
Article 9	Determination of the allocated volume of cross zonal capacity for the exchange of balancing capacity or sharing of reserves
Article 10	Firmness regime
Article 11	Sharing of congestion income
Article 12	Additional indications for the implementation of the methodology
Article 13	Language

Table of Content Market-based Proposal

Article 1	Whereas
Article 2	Subject matter and scope
Article 3	Definitions
Article 4	The notification process for the use of the market-based allocation process
Article 5	Timeframe of market-based allocation process
Article 6	Process to define the maximum volume of allocated cross zonal capacity for the exchange of balancing capacity or sharing of reserves
Article 7	Determination of the forecasted market value of cross zonal capacity for the exchange of energy for the market-based approach
Article 8	Determination of the actual market value of cross zonal capacity for the exchange of energy for inverted market-based approach
Article 9	Determination of the actual market value of cross zonal capacity for the exchange of balancing capacity or sharing of reserves for the market-based approach
Article 10	Determination of the forecasted market value of cross zonal capacity for the exchange of balancing capacity or sharing of reserves for inverted market-based approach
Article 11	Determination of the allocated volume of cross zonal capacity for the exchange of balancing capacity or sharing of reserves
Article 12	Firmness regime
Article 13	Sharing of congestion income
Article 14	Additional indications for the implementation of the methodology
Article 15	Language

Table of Content Economic Efficiency Proposal

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Article 2	Subject matter and scope
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Dashboard

Dashboard of proposals

<i>Milestones for co-optimisation methodology (all TSOs)</i>	2019											
	1	2	3	4	5	6	7	8	9	10	11	12
1 st stakeholder workshop: cross-zonal capacity allocation		■										
2 nd stakeholder workshop: co-optimisation							■					
Public consultation							■	■	■			
Submission to NRAs												■

<i>Milestones for market-based methodologies (per CCR) and economic efficiency methodologies (per CCR)</i>	2019											
	1	2	3	4	5	6	7	8	9	10	11	12
1 st stakeholder workshop: cross-zonal capacity allocation		■										
Workshop only for CCRs				■								
Informal stakeholder workshop on templates (TBD)				▨								
Stakeholder workshop on CCR methodologies (TBD by CCRs)							▨					
Public consultation (TBD by CCRs)							▨	▨	▨			
Submission to NRAs												■

Nordic aFRR balancing capacity market

Nordic TSOs' proposals on aFRR capacity market and cross-zonal capacity allocation methodology

ENTSO-E Stakeholder workshop 04.02.2019 - Martha Marie Oberg, Statnett

FINGRID

ENERGINET

Statnett



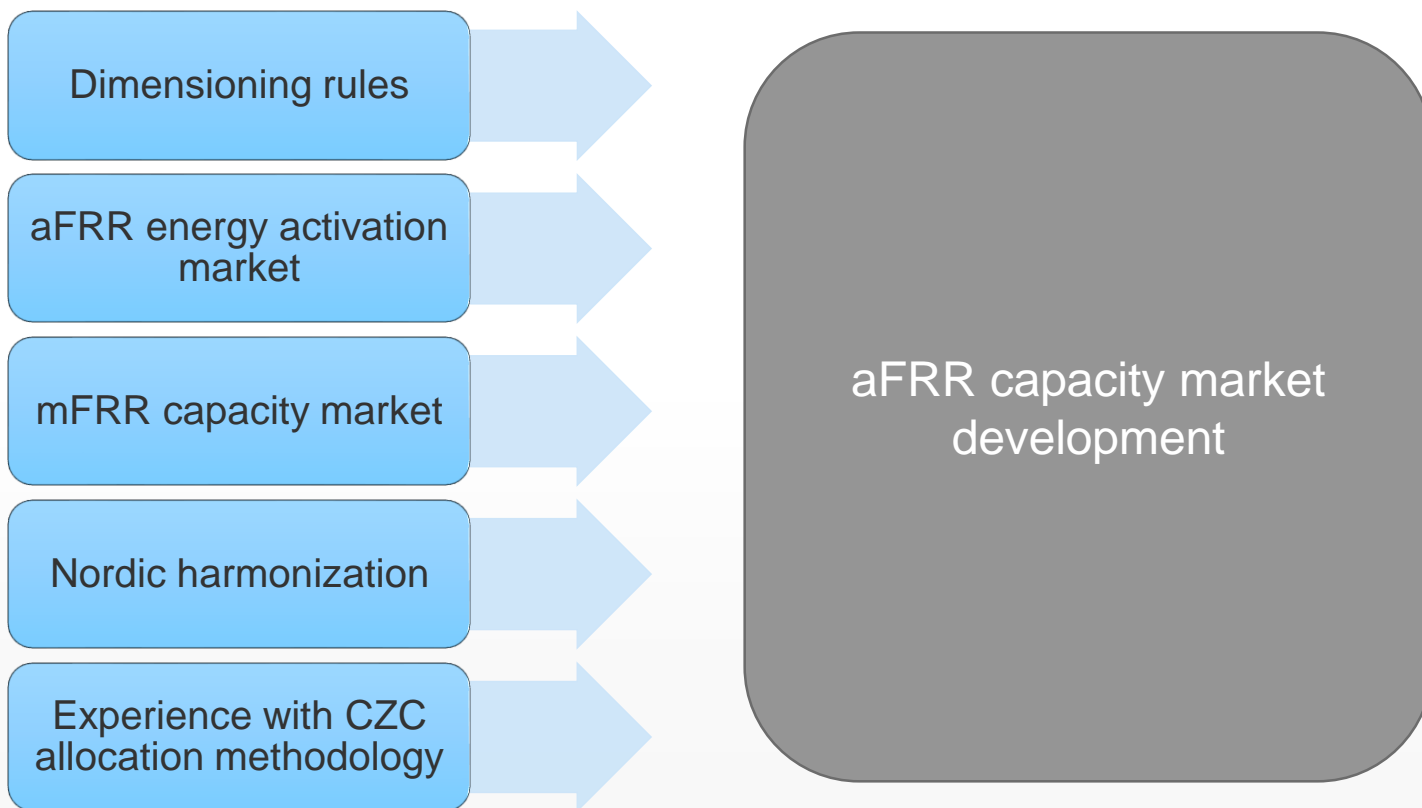
Agenda

- Background and process
- aFRR capacity market design
- Cross-zonal capacity allocation for aFRR capacity exchange
- Settlement
- Outlook
- Q&A

Background

- aFRR procured nationally since 2013
- Nordic TSOs have previously agreed to implement a Nordic aFRR market, and the proposals developed has to a large degree been based on previously agreed market design
- Voluntary initiative – not obliged to establish aFRR capacity market by EB GL, but regulated by EB GL when implemented
- The aim of the market is to:
 - ensure availability of aFRR reserves in accordance with the LFC block dimensioning rules
 - increase socioeconomic welfare on a Nordic level through exchange of aFRR capacity with allocation of cross-zonal capacity for this purpose

Step-wise development



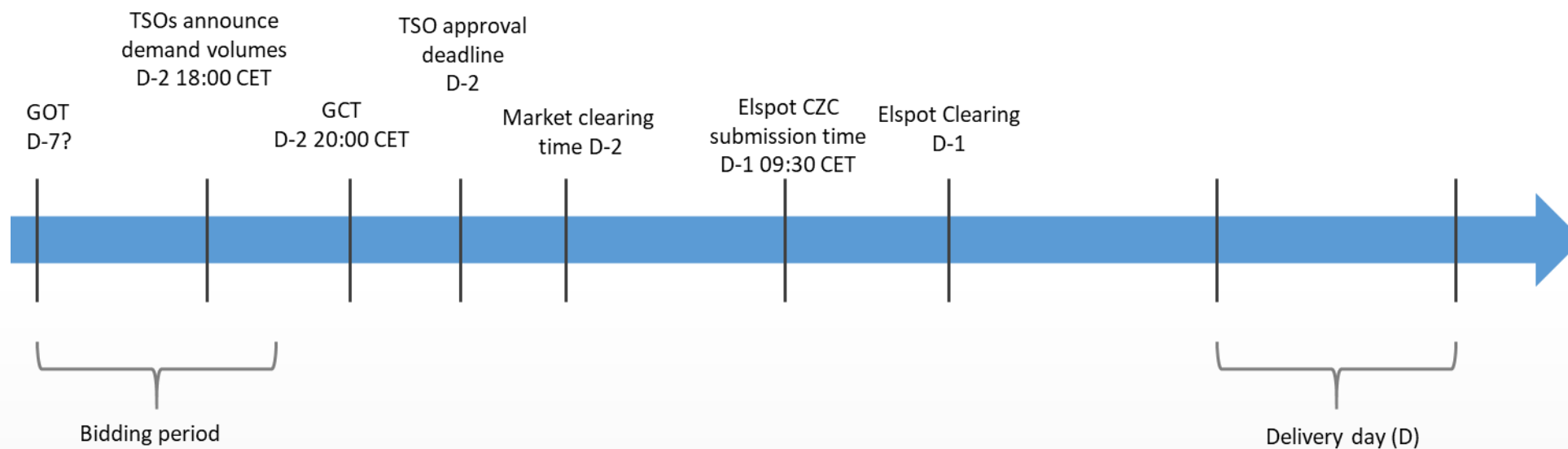
To some extent the proposals give flexibility for future changes, but amendments of the proposals are foreseen to be necessary

Consultation process

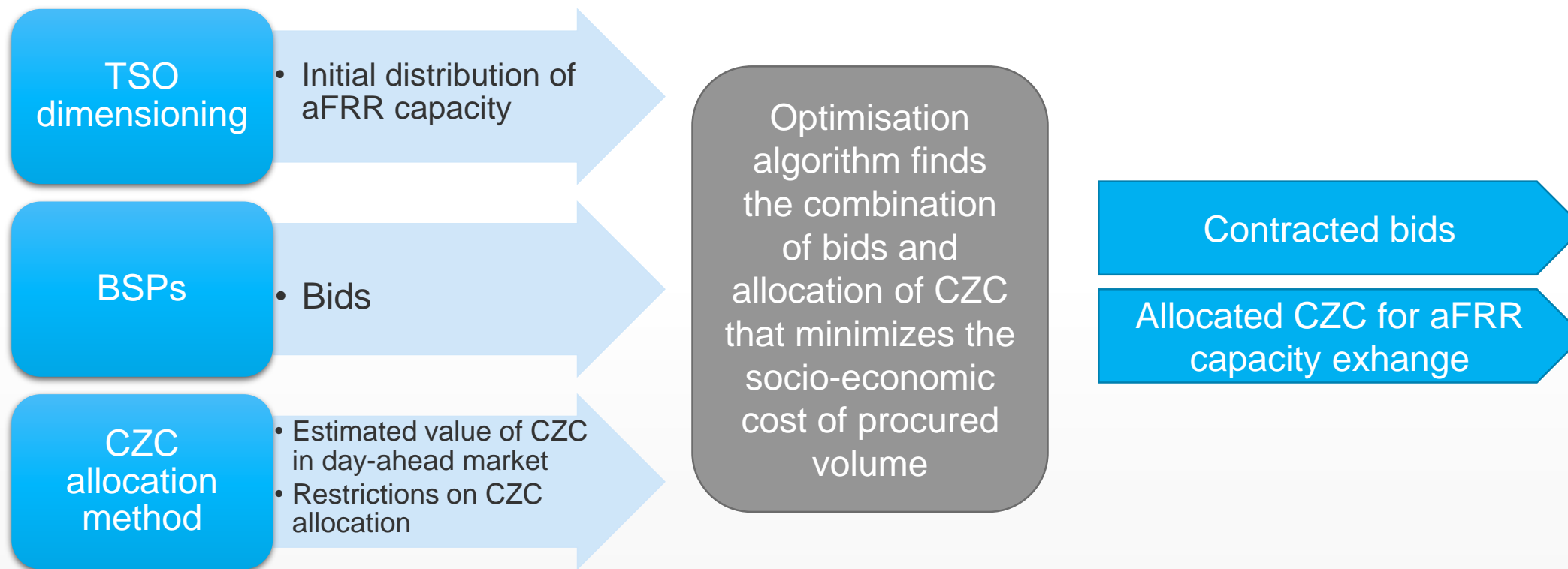
- Two proposals
 - Proposal for establishment of common and harmonized rules and processes for the exchange and procurement of aFRR balancing capacity (EB GL Article 33)
 - Proposal for the methodology for a market-based allocation process of cross-zonal capacity for the exchange of aFRR balancing capacity (EB GL Art 38 and 41)
- Public consultation 3rd of September – 4th of October 2018
- The TSOs have received a shadow opinion from the Nordic NRAs
- The Nordic TSOs will submit a modified proposal and explanatory document 1st of March 2019
 - More details and description of the CZCA methodology
 - Simulations and assessment of price impact on the energy market
- Go live September 2019

aFRR capacity market design

Timeline of the aFRR capacity market



Procurement optimisation function



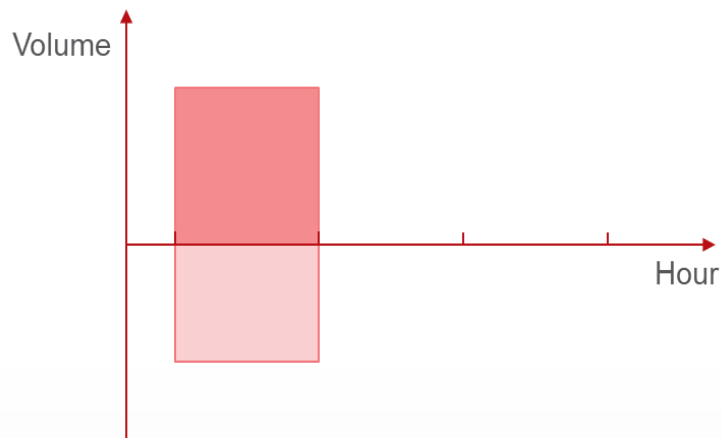
aFRR capacity product

- Full activation time (FAT) not harmonized from the start
 - BSPs must be pre-qualified according to national terms and conditions
 - In Norway and Sweden: Only 2 minutes FAT will be required
 - In Finland and Denmark: BSPs will be allowed to deliver according to 5 minutes FAT
- The Nordic TSOs aim to harmonize this at a later stage, but it must be ensured that negative impacts on the frequency quality and stability of the system are avoided
 - 5 minutes FAT is expected to be the future European standard product

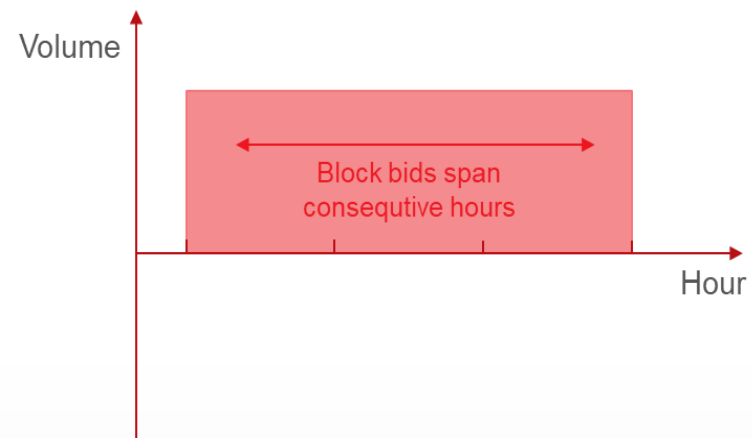
aFRR capacity product and bid formats

Full Activation Time	According to prequalification
Minimum bid quantity	1 MW
Bid granularity	Multiples of 1 MW
Location	Bid must include the bidding zone it belongs to
Indivisible bids	Allowed for bids less than 50 MW
Linking of bids	Upward- downward bids can be linked
	Linking in time ("Block bids")
	Bidding curve – mutual exclusive bids
	Bidding curve cannot be combined with linking of upward- and downward bids

Linking of bids

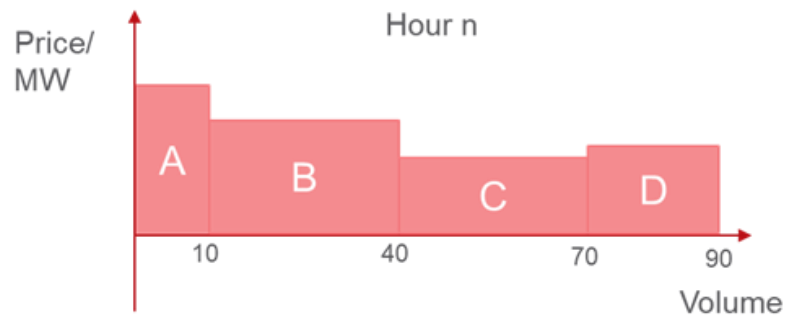


Linked upward- and downward capacity bids



Linking in time

Linking of bids



Bid	Price/MW	Volume	Min volume	Divisible?
A	50	10		No
B	40	40	10	Yes
C	30	70	40	Yes
D	35	90	70	Yes

Bid curve – mutual exclusive bids

Up Down	0	5	10	15	20	25	← Volume
0		U:20	U:12	U:8	U:6	U:5	
5	D:40	D:40 U:2	D:40 U:2	D:40 U:4	D:40 U:4	D:40 U:4	
10	D:30	D:30 U:2	D:30 U:2	D:30 U:3	D:30 U:3		← Prices
15	D:25	D:25 U:2	D:25 U:3	D:25 U:3			
20	D:25	D:25 U:3	D:25 U:3				
25	D:22	D:22 U:3					

Mutual exclusive pairs of upward-downward bids

Cross-zonal capacity allocation methodology

CZC allocation methodology

- The proposal shall apply one of three processes for allocation of CZC (EB GL article 38)

	Co-optimised allocation	Market based allocation	Economic efficiency analysis
Market value for CZC for energy exchange	Actual	Forecast	Forecast
Market value for CZC for aFRR capacity exchange	Actual	Actual	Forecast
Procurement frequency Contracting period	Daily – Simultaneously clearing of DAM and aFRR capacity market	Daily to weekly – Procurement before NTCs are determined for energy market	Typically for longer periods, week or years

Application of a market based method with daily procurement D-2

- Easy to implement
 - Co-optimised allocation can be considered more efficient, but is more complex to implement as it would change the optimisation algorithm of the DAM
- Experience with the "Hasle pilot" where CZC was allocated for aFRR exchange between Norway and Sweden
 - Showed that economic value of CZC could be increased significantly even with weekly procurement and a simple method for determining the forecast value of CZC used in the DAM
- The Nordic TSOs look to start conservatively, favouring the allocation for energy market in the start and gradually aim for a more optimal allocation to aFRR exchange as experience is gained

How to forecast the market value of CZC for energy exchange?

- Two methods are considered:
 1. Forecast based on price difference of corresponding hour of a reference day
 - Reference day is previous day unless an earlier day is more relevant due to weekend/holidays
 2. Forecast based on energy market model provided by external commercial provider

How to forecast the market value of CZC for energy exchange?

Commercial forecasts based on energy market model

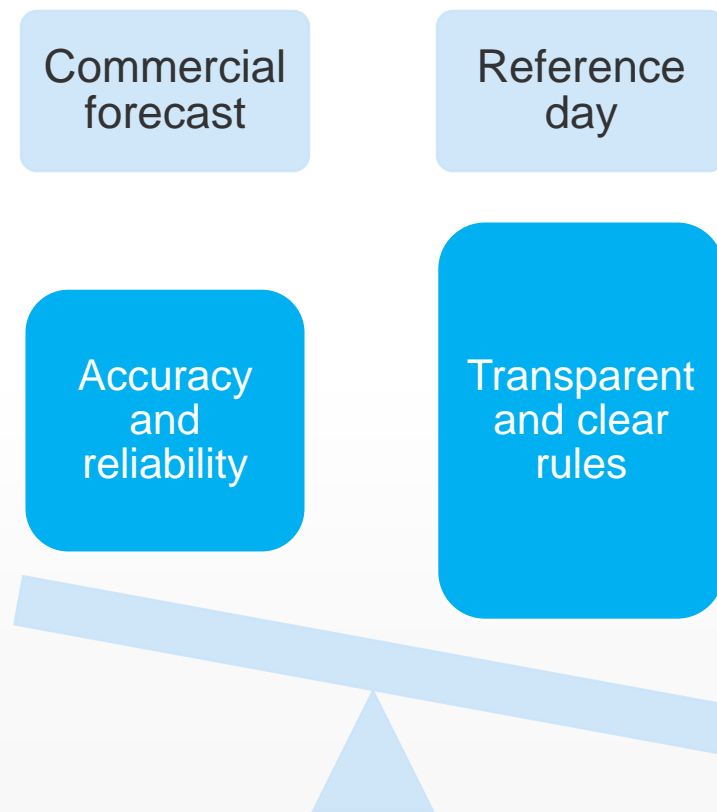
- Likely more accurate and reliable
- Forecast service publically available
- Easy to implement
- Role of the forecast service provider
- Require payment of BSPs

Forecast based on reference day

- Clear and transparent rules
- All data publicly available
- Performance can be improved with more experience
- Risk for forecast errors when market is changing

How to forecast the market value of CZC for energy exchange?

- Reference day method chosen in the proposal



Restrictions on CZC allocation

- Maximum volume of CZC that can be allocated for aFRR capacity exchange
 - 10 % of expected NTC
- Uplift of price difference of reference day used to value CZC in DAM
 - Direction without congestion: 0.1 €
 - Direction with congestion: 1 €

An example

Tuesday hour 08:00-09:00



	CZC for exchange of upward aFRR capacity	CZC for exchange of downward aFRR capacity
A→B	Value of CZC in DAM: 11€ Max allocation: 70MW	Value of CZC in DAM: 0,1€ Max allocation: 50MW
B→A	Value of CZC in DAM: 0,1€ Max allocation: 50MW	Value of CZC in DAM: 11€ Max allocation: 70MW

Conservative approach from the start

- The uplifts of the price difference will increase the cost of allocation of CZC to aFRR capacity market. Together with the maximum allocation volume this favours DAM in the allocation process and mitigates the impact of potential forecast errors for the energy market
- The Nordic TSOs will continuously monitor the performance of the method and foresee to modify the rules for the price difference of the reference day when the experience shows that this can improve the performance
 - All modifications of the method shall be announced to market participants prior to implementation

Settlement of procured bids

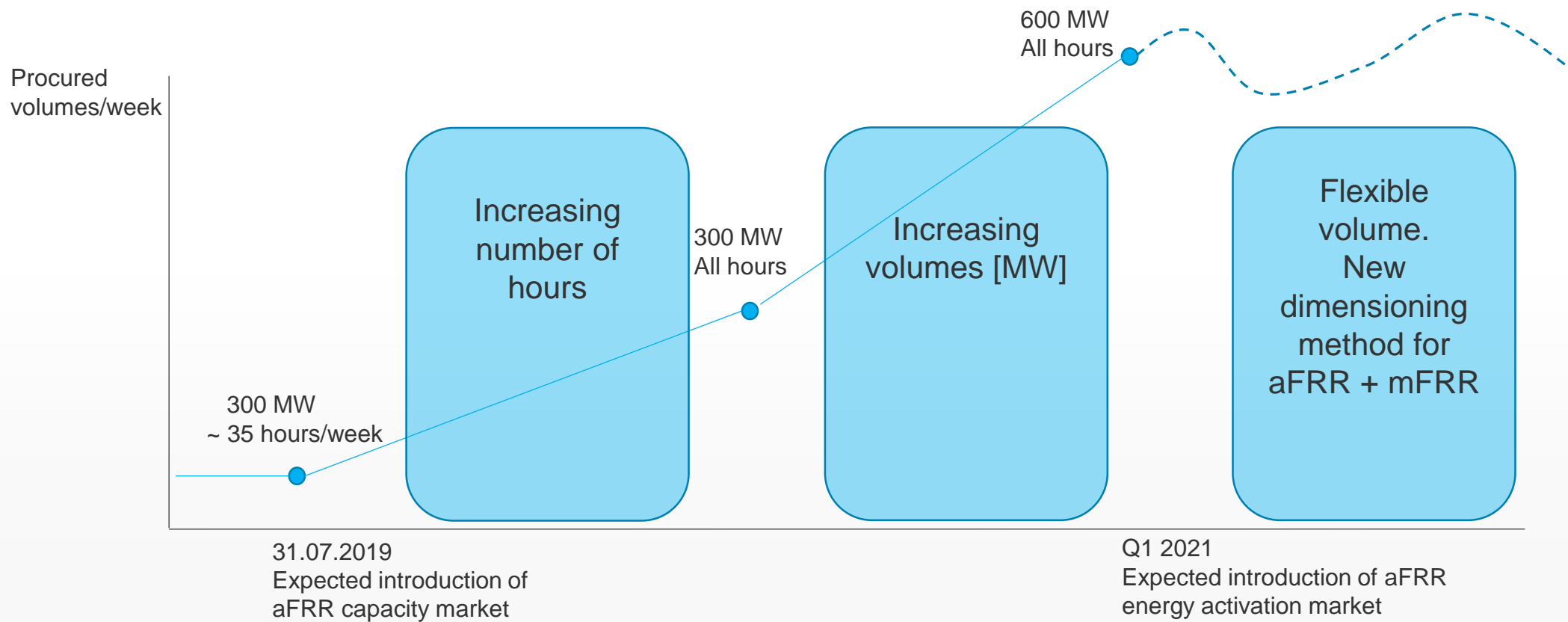
- Before the introduction of the aFRR activation energy market (maximally 2 years after go live of capacity market):
 - BSPs are remunerated with bid price
- After the introduction of the aFRR activation energy market
 - BSPs are remunerated with marginal price which is the highest upward/downward bid procured in an uncongested area

Publication of information

- Publication at the ENTSO-E transparency platform.
- Prices and volumes (anonymised). Published as soon market results are ready.
- The CZC allocated for the exchange of aFRR balancing capacity. Published after NTCs have been submitted to the day-ahead market.
- Estimated costs and benefits. Published within a week after delivery day.

Outlook

- The procurement volumes will be fixed in advance of procurement optimisation and gradually increase the first years after implementation



Questions and answers

FINGRID

ENERGINET

Statnett

 **SVENSKA
KRAFTNÄT**

Thank you for your attention

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DE-AT aFRR cooperation



Common Procurement of aFRR balancing capacity AT-DE (pilot project)

CZCA Stakeholder Workshop 4th February 2019

by Harald Haider; APG

1) Recent developments

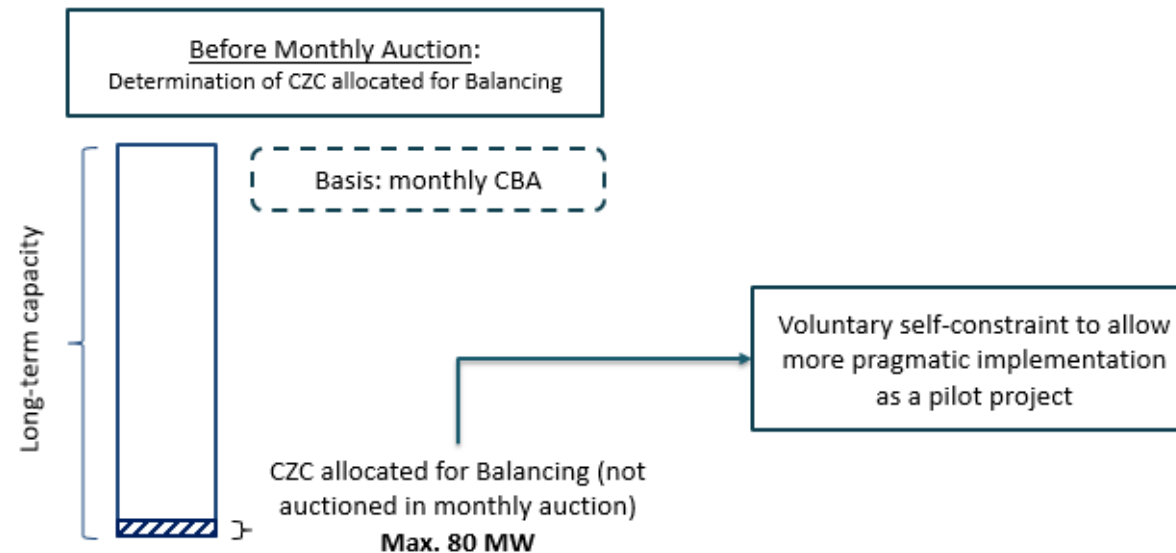
- TSOs of Austria and Germany are exchanging aFRR balancing energy since 07/2016.
 - Activation of aFRR balancing energy is based on a common merit order list.
 - Central activation optimization functions takes operational limitations (280 MW) into account
 - With introduction of bidding zone border between AT-DE on 1.10.2018 available CZC has to be considered.
- In a further step TSOs agreed to intensify the cooperation and commonly procure aFRR balancing capacity as of **Q2 2019**.
 - This was a part of the project-plan since 2016, and already then approved by ENTSO-E
 - Based on a harmonization of aFRR balancing capacity & energy markets in AT and DE
 - In accordance with the requirements from EBGL.
- The necessary CZC needs to be allocated to ensure access to balancing capacity procured abroad.
 - Allocation is a requirement arising from EBGL

2) Common procurement of balancing capacity

- Common procurement of balancing capacity is no requirement from EBGL but a regional voluntary initiative of two or more TSOs.
 - Regional consultation for common procurement is stipulated by EBGL.
 - Proposal needs to be submitted to NRAs of the concerned region.
- Common procurement of aFRR capacity will be based on a **TSO-TSO model**.
 - Collection of bids remain in the responsibility of the respective connecting TSOs.
 - Bids will be submitted to a central procurement optimization function.
- According to EBGL TSOs that commonly procure balancing capacity need to ensure the availability of CZC for the exchange.

3) Allocation of CZC for exchange of balancing capacity (Cost-Benefit Analysis)

- Allocation of CZC will be based on monthly Cost-Benefit Analysis (CBA) comparing the day-ahead energy market with the balancing market.
 - Determination of CZC for balancing purposes before monthly capacity auctions based outcome of CBAs
 - CZC valued for, and hence allocated to the balancing-market, will not be allocated in the monthly CZC auctions



Inputs to the Cost-Benefit Analysis

- CBA will be based on a comparison of market values for CZC on the day-ahead and aFRR balancing market.
 - CBA performs an optimization of both market values to allocate CZC to the timeframe, where they generate the highest welfare
- Currently envisaged is a determination of CZC on a monthly basis.
 - Both market values need to be approximated based on historical data of past month (e.g. comparison of each 4h-timeslot)
 - Based on compared 4h-timeslots determination of one monthly value allocated for balancing

Inputs to the CBA	
Forecast Day-Ahead Market	Forecast aFRR balancing market
Time-Series model: <ul style="list-style-type: none"> – Basis: historical Day-Ahead prices (e.g. values of previous month) 	Forecasted MOLs for aFRR balancing capacity and energy: <ul style="list-style-type: none"> – Historical tender results for Balancing Capacity – Probability of activation for the aFRR energy MOL.

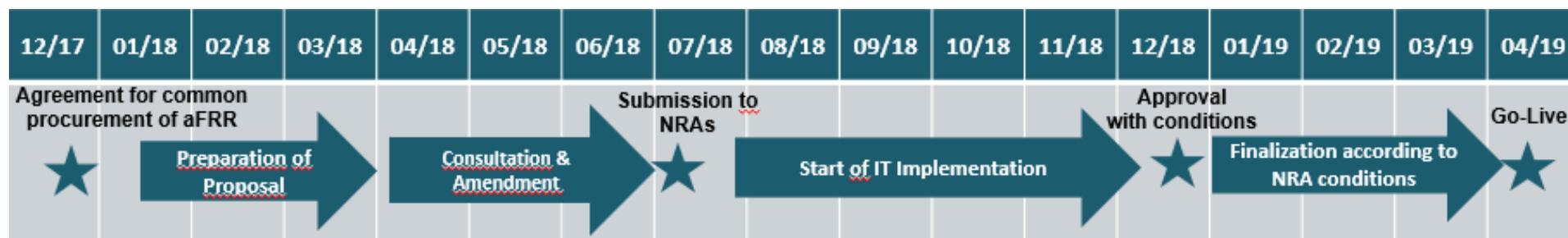
Cost-Benefit Analysis: relation to EBGL

- Calculation of market values is based on methods proposed by EBGL but on a monthly basis.
- However, proposals for allocation of CZC need to/can be developed on all TSO (co-optimised allocation process) and CCR level (market-based and economic efficiency analysis allocation process) 2 years after EIF of EBGL.
- **Currently foreseen approach can be seen as a pragmatic pilot project for future efforts on European level:**
 - Gather operational experiences
 - Investigate interactions with other processes (flow-based market coupling) and time-frames (long-term, day-ahead).
 - As the possible allocated volume for balancing is extremely limited in this pilot phase (max. 80 MW of 4.900 MW), there will be no further processes in regards to DA-MC. If it proves to be necessary, CZC allocated for balancing will be secured with operational measures, rather than impacting DA-MC.

aFRR	automatic Frequency Restoration Reserve
CBA	Cost-Benefit Analysis
CCR	Capacity Calculation Region
CZC	Cross-Zonal Capacity
EBGL	Guideline on Electricity Balancing

4) Timeplan and Outlook

- In accordance with requirements from EBGL a public consultation has been performed in Q1/2018.
- Based on stakeholder feedback the proposal has been amended and submitted to NRAs in AT and DE for approval **end of June 2018**.
- The proposal was approved with some conditions by the AT and DE NRAs.
- DE-AT balancing experts are currently preparing the necessary IT-implementations and finalize the CBA methodology.
 - Outlines of CBA methodology has been presented in BCG and to stakeholders and a **market information document** with details on the CBA was distributed. – CBA currently in finalization.



Appendix

Appendix 1

1. CZCA allocation restrictions

CZC allocation restrictions for balancing from EB GL

EB GL restriction:

- Cross-zonal capacity allocated on a market-based process shall be limited to 10 % of the available capacity for the exchange of energy of the previous relevant calendar year between the respective bidding zones or, in case of new interconnectors, 10% of the total installed technical capacity of those new interconnectors. This volume limitation may not apply where the contracting is done not more than two days in advance of the provision of the balancing capacity or for bidding zone borders connected through DC interconnectors until the co-optimised allocation process is harmonised at Union level pursuant to Article 38(3).
- The allocation of cross-zonal capacity based on an economic efficiency analysis shall be limited to 5 % of the available capacity for the exchange of energy of the previous relevant calendar year between the respective bidding zones or, in case of new interconnectors, 10 % of the total installed technical capacity of those new interconnectors. This volume limitation may not apply for bidding zone borders connected through DC interconnectors until the application of the co-optimised or market-based allocation processes is harmonised at Union level pursuant to Article 38(3).
- Art. 39.6: Where the contracting is done not more than two days in advance of the provision of the balancing capacity, the relevant regulatory authorities may, following this review, set a limit other than that specified in Article 41(2)

CZC allocation restrictions for balancing from CEP

CEP restriction:

- Article 5, paragraph 9: The procurement of upward balancing capacity and downward balancing capacity shall be carried out separately, unless the national regulatory authority approves an exemption from this principle on the basis of the transmission system operator demonstrating that this would result in higher economic efficiency. The contracting of balancing capacity shall be performed for not longer than one day before the provision of the balancing capacity and the contracting period shall have a maximum of one day, unless and to the extent the national regulatory authority has approved earlier contracting and/or longer contracting periods to ensure security of supply or improve economic efficiency. At least for a minimum of 40 % of the standard products and a minimum of 30 % of all products used for balancing capacity, the contracting of the balancing capacity shall be performed for not longer than one day before the provision of the balancing capacity and the contracting period shall have a maximum of one day. The contracting of the remaining part of the balancing capacity shall be performed for a maximum of one month in advance of the provision of balancing capacity and the contracting period of the remaining part of balancing capacity shall have a maximum period of one month.
- 9a) On the request of the transmission system operator the regulatory authority may extend the contracting period of the remaining part of balancing capacity referred to in paragraph 9 to a maximum period of twelve months provided that such decision will be limited in time, and the positive effects in terms of lowering of costs for consumers will exceed the negative impacts on the market. After 31 December 2025, contracting periods shall not extend to periods longer than six months. The request shall include:
 - (a) specification of the time period during which the exemption would apply;
 - (b) specification of the volume of balancing capacity for which the exemption would apply;
 - (c) analysis of the impact of such an exemption on the participation of balancing resources; and
 - (d) justification for the exemption demonstrating that such an exemption would lead to lower costs for consumers.
- 9b. By 1 January 2028, national regulatory authorities shall report to the Agency and the Commission on the share of contract durations and procurement periods longer than one day

Additional CZC allocation restrictions for balancing

Additional restrictions if locally required:

- financial balancing capacity forecast margin [$-\Delta\text{EUR}/\text{MW}$] (to be more conservative for balancing gains)
- financial trading forecast margin [$-\Delta\text{EUR}/\text{MW}$] (to be more conservative for trading losses)
- technical limits to e.g. respect local availability of reserves

Voluntary analysis of forecast versus actual values of prices and market value calculation could be used for implementing allocation restrictions on top of obligatory restrictions from GL EB.

Inaccuracies due to:

- Imperfect forecast of prices
- Generation Shift Key for balancing: translation of allocation of CZC for balancing capacity to actual balancing power flows when balancing energy is activated

Appendix 2

Definitions

- **allocation CZC** means firm CZC assigned to a certain market that has been run
- **awarding CZC** means CZC assigned to a certain market to perform the auction
- **pre-coupling** means converting submitted bids to supply and demand orders to be used by the day-ahead market coupling operator
- Euphemia is an algorithm developed by several European NEMOs to solve the problem associated with the coupling of day-ahead energy markets in the Price Coupling Region

Appendix 3

1. EB GL codes

GLEB article 38

Article 38 General requirements

1. Two or more TSOs may at their initiative or at the request of their relevant regulatory authorities in accordance with Article 37 of Directive 2009/72/EC set up a proposal for the application of one of the following processes:

- (a) co-optimised allocation process pursuant to Article 40;
- (b) market-based allocation process pursuant to Article 41;
- (c) allocation process based on economic efficiency analysis pursuant to Article 42.

Cross-zonal capacity allocated for the exchange of balancing capacity or sharing of reserves before the entry into force of this Regulation may continue to be used for that purpose until the expiry of the contracting period.

Article 38.1 informs that two or more TSOs are allowed to reserve (a part) of cross-zonal capacity for the use of balancing timeframes based on three different allocation methodologies, or based on a valid contract signed before the entry into force of GL EB. Such contract keeps valid until its termination condition is fulfilled. The allocation is only valid for exchange of balancing capacity (procurement of balancing reserves), and sharing of reserves (reduced procurement of two or more balancing areas due to a reserve sharing agreement). The allocation for balancing energy is not regulated explicitly.

2. The proposal for the application of the allocation process shall include:

- (a) the bidding zone borders, the market timeframe, the duration of application and the methodology to be applied;
- (b) in case of allocation process based on economic efficiency analysis, the volume of allocated cross zonal capacity and the actual economic efficiency analysis justifying the efficiency of such allocation.

Article 38.2 lists the information of which any CZC allocation proposal should consist of.

3. By five years after entry into force of this Regulation, all TSOs shall develop a proposal to harmonise the methodology for the allocation process of cross-zonal capacity for the exchange of balancing capacity or sharing of reserves per timeframe pursuant to Article 40 and, where relevant, pursuant to Articles 41 and 42.

Article 38.3 requires the needs to harmonise the different proposal per methodology after 5 years of GL EB entry into force. However, all TSOs concluded within the Working Group Ancillary Service to develop one single proposal per CZC allocation methodology. This prevents the need to harmonise different methodologies until entry into force + 5 years.

GLEB article 38

Article 38 General requirements

4. Cross-zonal capacity allocated for the exchange of balancing capacity or sharing of reserves shall be used exclusively for frequency restoration reserves with manual activation, for frequency restoration reserves with automatic activation and for replacement reserves. The reliability margin calculated pursuant to Commission Regulation (EU) 2015/1222 shall be used for operating and exchanging frequency containment reserves, except on Direct Current ('DC') interconnectors for which cross-zonal capacity for operating and exchanging frequency containment reserves may also be allocated in accordance with paragraph 1.

Article 38.4 mentions that allocation of cross-zonal capacity is only allowed for the standard products of mFRR, aFRR and RR for both AC and DC connection. The reliability margin of AC connections should not be used for the exchange of balancing capacity or sharing of reserves. On DC connections, cross-zonal capacity may also be allocated for FCR, in addition to mFRR, aFRR, and RR.

5. TSOs may allocate cross-zonal capacity for the exchange of balancing capacity or sharing of reserves only if cross-zonal capacity is calculated in accordance with the capacity calculation methodologies developed pursuant to Commission Regulation (EU) 2015/1222 and pursuant to Commission Regulation (EU) 2016/1719.

Article 38.5 restricts cross-zonal capacity allocation when capacity calculation is not performed according to capacity calculation methodologies developed pursuant to Commission Regulation (EU) 2015/1222 and pursuant to Commission Regulation (EU) 2016/1719.

6. TSOs shall include cross-zonal capacity allocated for the exchange of balancing capacity or sharing of reserves as already allocated cross-zonal capacity in the calculations of cross-zonal capacity.

7. If physical transmission right holders use cross-zonal capacity for the exchange of balancing capacity, the capacity shall be considered as nominated solely for the purpose of excluding it from the application of the use-it-or-sell-it ('UIOSI') principle.

GLEB article 38

Article 38 General requirements

8. All TSOs exchanging balancing capacity or sharing of reserves shall regularly assess whether the cross-zonal capacity allocated for the exchange of balancing capacity or sharing of reserves is still needed for that purpose. Where the allocation process based on economic efficiency analysis is applied, this assessment shall be done at least every year. When cross-zonal capacity allocated for the exchange of balancing capacity or sharing of reserves is no longer needed, it shall be released as soon as possible and returned in the subsequent capacity allocation timeframes. Such cross-zonal capacity shall no longer be included as already allocated cross-zonal capacity in the calculations of cross-zonal capacity.

Article 38.8 consists of two requirements. Firstly, on a regular basis it shall be assessed whether the allocated cross-zonal capacity is needed for the purpose of balancing. Secondly, when assessments reveal that the capacity is not needed for the purpose of balancing, it shall be released as soon as possible and returned in the subsequent capacity allocation timeframes. This means that the capacity may be used for trading and if proven to be beneficial for other balancing processes.

9. When cross-zonal capacity allocated for the exchange of balancing capacity or sharing of reserves has not been used for the associated exchange of balancing energy, it shall be released for the exchange of balancing energy with shorter activation times or for operating the imbalance netting process.

Article 38.9 mentions that cross-zonal capacity should be released when RR, mFRR and aFRR (the latter makes it only available for imbalance netting) have not been activated, meaning that the CZC “has not been used for the associated exchange of balancing energy”. It is still open for interpretation whether CZC shall be released when local non-contracted bids (free bids) fulfil the local dimensioning criteria and the LFC Area/Block is not dependent any more on cross-zonal capacity for a certain balancing product.

GLEB article 39

Article 39 Calculation of market value of cross-zonal capacity

1. The market value of cross-zonal capacity for the exchange of energy and for the exchange of balancing capacity or sharing of reserves used in a co-optimised or market-based allocation process shall be based on the actual or forecasted market values of cross-zonal capacity.

Article 39.1 states that the market value of cross-zonal capacity is determined (depending on the methodology) based on actual and forecast market values of cross-zonal capacity. This value is calculated based on actual and forecasted bids from trading markets, and from balancing capacity auctions.

2. The actual market value of cross-zonal capacity for the exchange of energy shall be calculated based on the bids of market participants in the day-ahead markets, and take into account, where relevant and possible, expected bids of market participants in the intraday markets.

Article 39.2 says that the value of cross-zonal capacity determined by the exchange of energy is calculated based on trading bids from the DA and based on expected bids from ID market.

3. The actual market value of cross-zonal capacity for the exchange of balancing capacity used in a co-optimised or a market-based allocation process shall be calculated based on balancing capacity bids submitted to the capacity procurement optimisation function pursuant to Article 33(3).

Article 39.3 says that the value of cross-zonal capacity determined by the exchange of balancing capacity for methodologies co-optimisation and market-based allocation is calculated based on balancing capacity bids submitted to the European Platform.

4. The actual market value of cross-zonal capacity for the sharing of reserves used in a co-optimised or a market-based allocation process shall be calculated based on the avoided costs of procuring balancing capacity.

Article 39.4 says that the value of cross-zonal capacity determined by sharing of reserves for co-optimisation and market-based allocation is calculated based on the avoided costs of procuring balancing capacity. We expect that the avoided costs are based on the prices of balancing capacity bids submitted to the respective European Platform.

GLEB article 39

Article 39 Calculation of market value of cross-zonal capacity

5. The forecasted market value of cross-zonal capacity shall be based on one of the following alternative principles:

- (a) the use of transparent market indicators that disclose the market value of cross-zonal capacity; or
- (b) the use of a forecasting methodology enabling the accurate and reliable assessment of the market value of cross-zonal capacity.

The forecasted market value of cross-zonal capacity for the exchange of energy between bidding zones shall be calculated based on the expected differences in market prices of the day-ahead and, where relevant and possible, intraday markets between bidding zones.

When calculating the forecasted market value, additional relevant factors influencing demand and generation patterns in the different bidding zones shall be taken duly into account.

Article 39.5 allows two different principles (transparent market indicators and use of forecasting methodology) how the forecasted market value of cross-zonal capacity can be determined. It is our understanding that the market indicators and forecast methodologies are not only for the exchange of energy, but also for the exchange of balancing capacity and sharing of reserves.

6. The efficiency of the forecasting methodology pursuant to paragraph 5(b), including a comparison of the forecasted and actual market values of the cross-zonal capacity, may be reviewed by the relevant regulatory authorities. Where the contracting is done not more than two days in advance of the provision of the balancing capacity, the relevant regulatory authorities may, following this review, set a limit other than that specified in Article 41(2).

Article 39.6 gives relevant regulatory authorities the right to review the efficiency of the forecasting methodologies and according to the review, set a capacity allocation limit other than that specified in Article 41(2), a limit being larger or smaller, for the contracting of balancing capacity performed not more than two days in advance of the provision of the balancing capacity.

Appendix 4

Specifications of the 3 allocation methodologies

	Co-optimisation method	Market-based method		Economic efficiency method
		Market-based approach	Inverted market-based approach	
Obligation to develop the methodology?; Who?; When?	Yes (shall) [Art.40]; All TSOs; ≤2 years	No (may) [Art.41]; CCR TSOs; ≤2 years	No (may) [Art.41]; CCR TSOs; ≤2 years	No (may) [Art.42]; CCR TSOs; ≤2 years
Use of bids for market value calculation	actual bids of DA actual bids of BC	forecasted bids of DA actual bids of BC	actual bids of DA forecasted bids of BC	forecasted bids of DA forecasted bids of BC
Optimisation step to allocate CZC for balancing and/or energy	D-1 During DA market auction	≤W-1 and >D-1 During BC auction	D-1 During DA market auction	>W-1 Before DA market and BC auction
Contracting closure time balancing capacity procurement; Required timing	≤D-1; Parallel to DA market auction	≤W-1; Before DA market auction, but not more than one week in advance	<D-1; After DA market auction	>W-1; More than 1 week in advance of the provision of balancing capacity
Contracting period of balancing capacity	≤1day	≤1day	≤1day	>1day
CZCA limit acc. to GLEB	No limitation	Cross-zonal capacity allocated on a market-based process shall be limited to 10 % of the available capacity for the exchange of energy of the previous relevant calendar year between the respective bidding zones or, in case of new interconnectors, 10 % of the total installed technical capacity of those new interconnectors	Cross-zonal capacity allocated on a market-based process shall be limited to 10 % of the available capacity for the exchange of energy of the previous relevant calendar year between the respective bidding zones or, in case of new interconnectors, 10 % of the total installed technical capacity of those new interconnectors	The allocation of cross-zonal capacity based on an economic efficiency analysis shall be limited to 5 % of the available capacity for the exchange of energy of the previous relevant calendar year between the respective bidding zones or, in case of new interconnectors, 10 % of the total installed technical capacity of those new interconnectors
This volume limitation may not apply		where the contracting is done not more than two days in advance of the provision of the balancing capacity or for bidding zone borders connected through DC interconnectors until the co- optimised allocation process is harmonised at Union level pursuant to Article 38(3).	where the contracting is done not more than two days in advance of the provision of the balancing capacity or for bidding zone borders connected through DC interconnectors until the co- optimised allocation process is harmonised at Union level pursuant to Article 38(3).	for bidding zone borders connected through DC interconnectors until the co- optimised or market-based allocation processes are harmonised at Union level pursuant to Article 38(3).

Summary of timing conditions per allocation method

	Co-optimisation	Market based		Economic efficiency
		Market based	Inverted market based	
Adaptation/Interaction with market coupling	Yes	No (limited)	Yes	No
Direct interaction with Capacity calculation	No	Yes for Option A	No	No
		No for Option B		
Re-computation of CZC after allocation for balancing	Yes, implicit within EUPHEMIA	Yes for Option A during cap. calculation	No	No
		Yes for Option B, after cap. calculation		
Upfront market information of exact available CZC for the BSP auction	No, not available	No, not available	Yes, available	Yes, available
Upfront market information of exact available CZC for the DA-MC auction (trading)	No, not available	Yes, available	No, not available	Yes, available
CZC input for CBA available	Yes	No, only forecast for Option A	Yes	No, only forecast
		Yes for Option B		

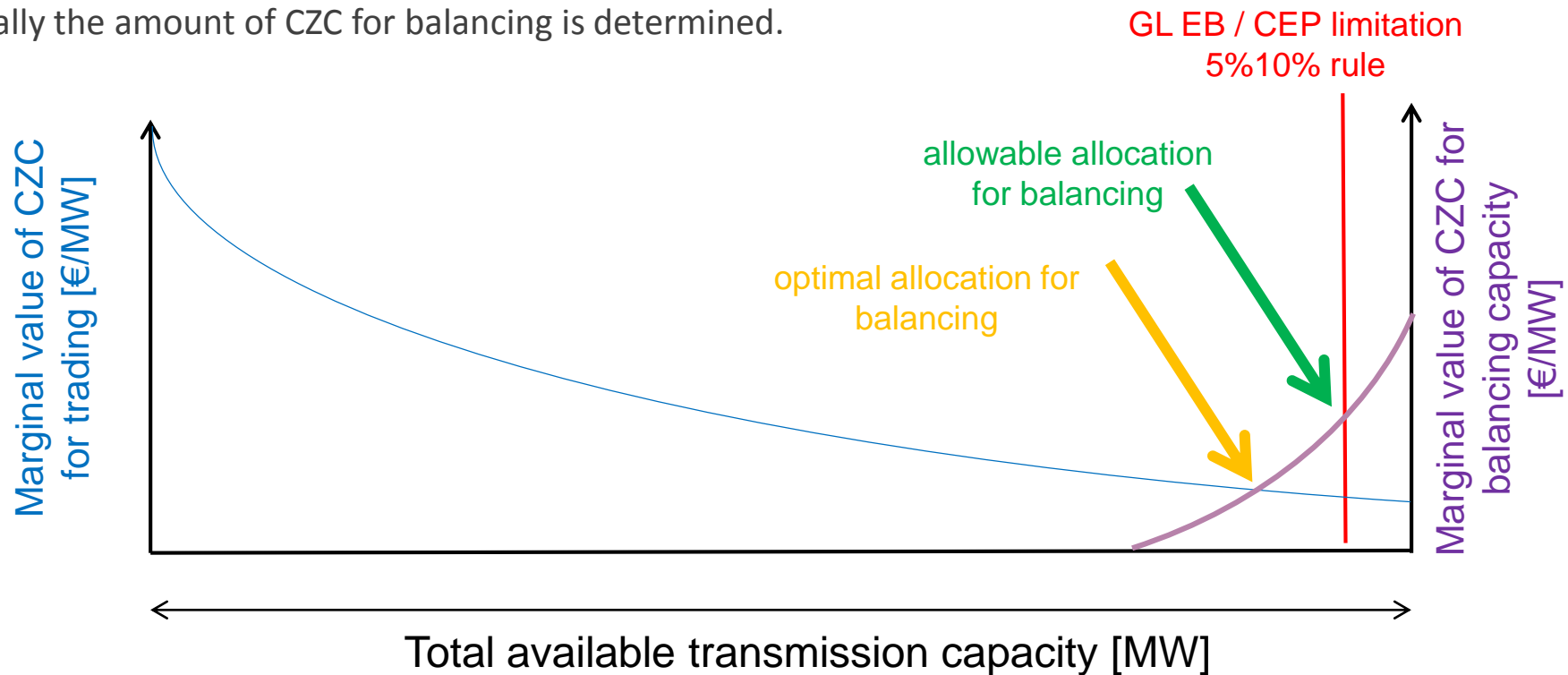
Appendix 4

1. CBA welfare surplus

Outcome of the cost-benefit analysis

CBA approach

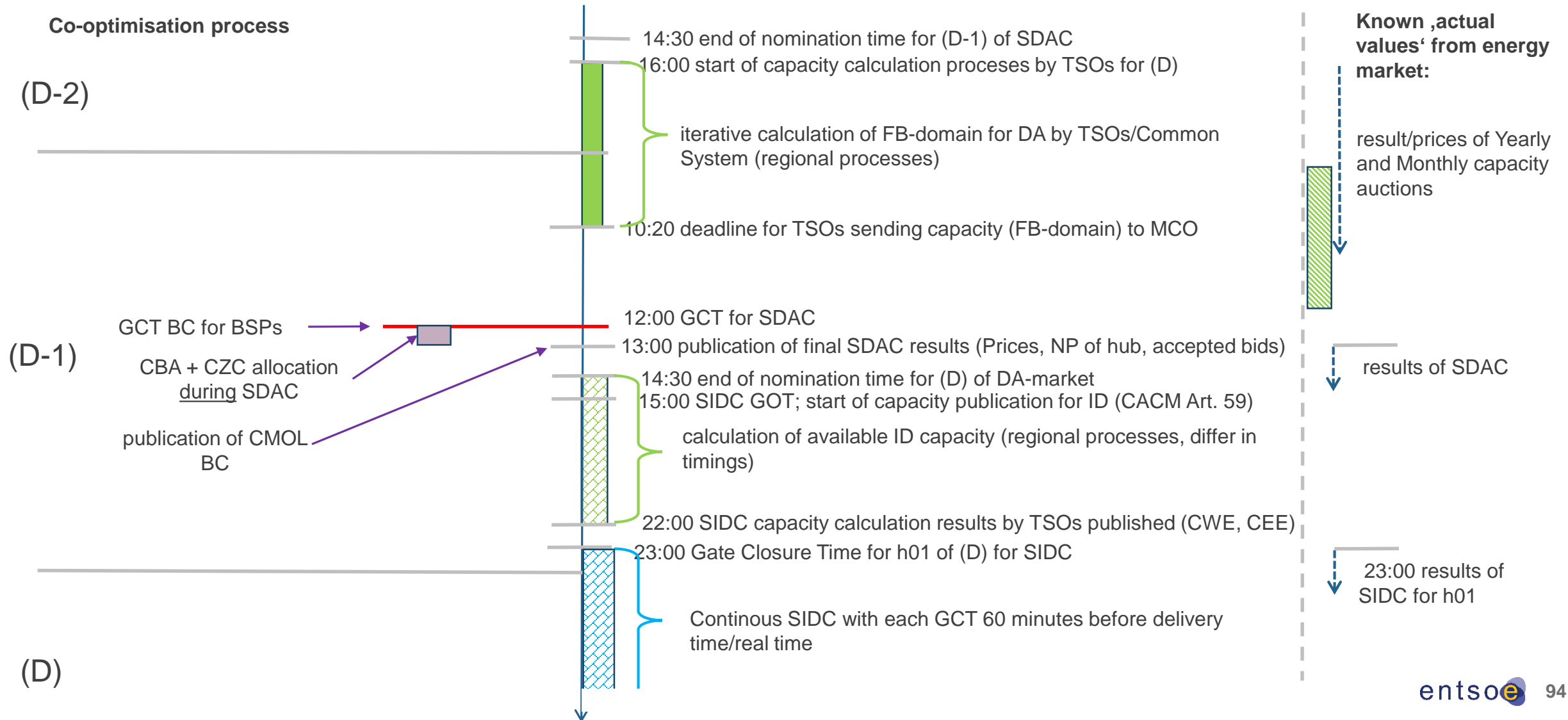
1. The two market value curves are compared,
2. their intersection is determined,
3. restrictions are taken into account and
4. finally the amount of CZC for balancing is determined.



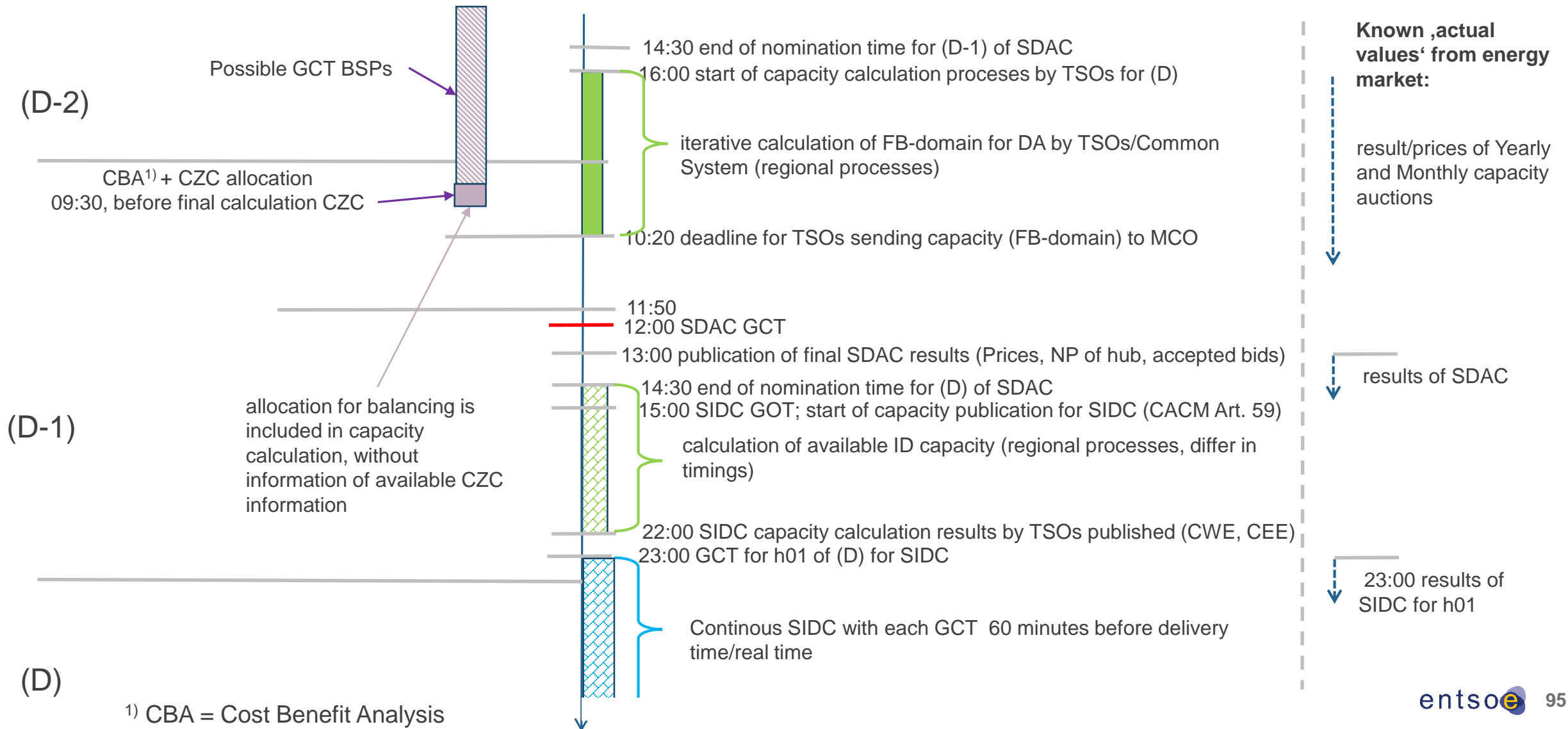
Appendix 4

1. Detailed timings per method

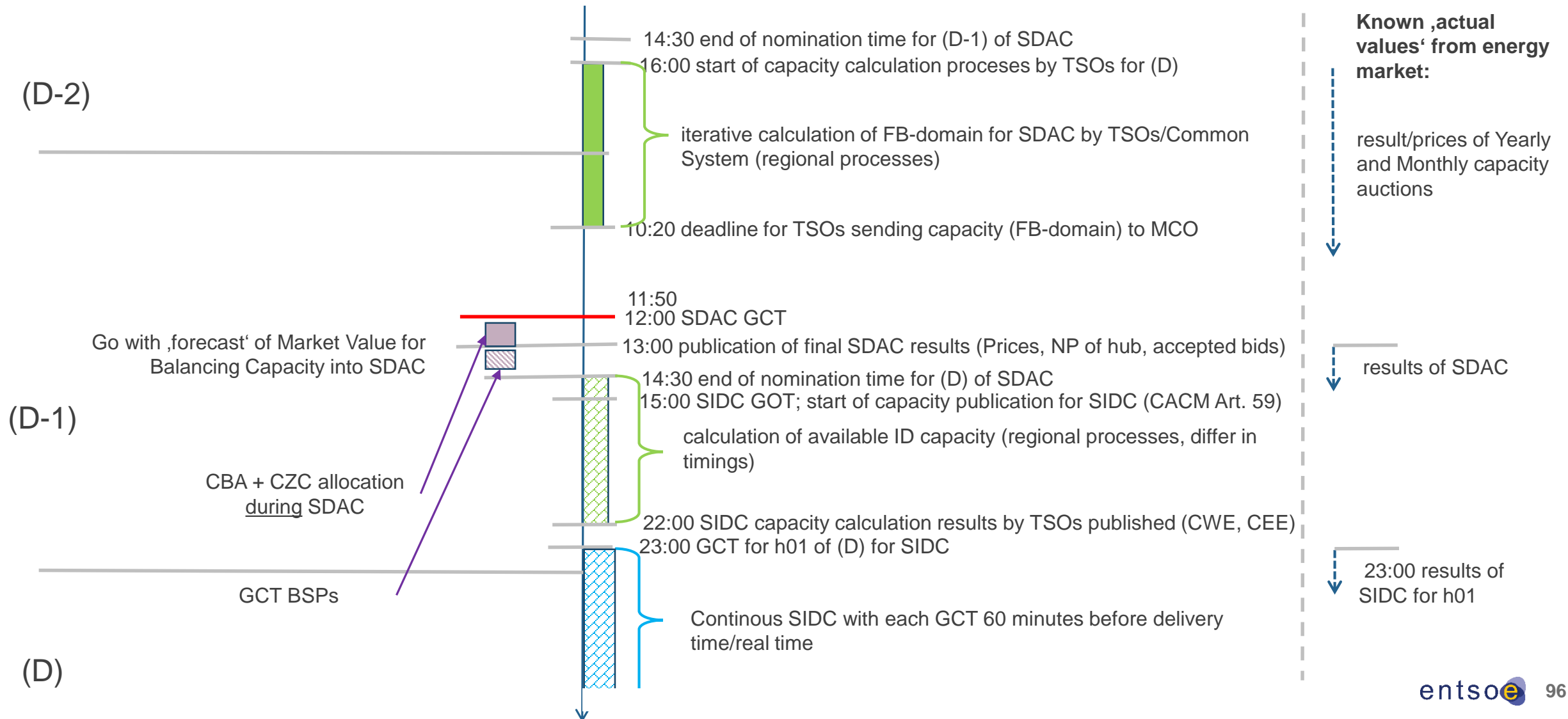
Co-optimisation allocation timeline



Market-based approach timeline



(Inverted) market-based approach timeline



Economic efficiency allocation timeline

